PUBLIC WORKS MEMORANDUM
#11-2021

DATE: March 22, 2021

TO: Honorable Mayor Meredith Leighty and City Council Members

THROUGH: Heather Geyer, City Manager hmg

FROM: Kent Kisselman PE, Director of Public Works KHK

SUBJECT: CR-35 – Water Treatment Plant Solids Handling Improvements Addendum #1

PURPOSE
To consider CR-35, a resolution approving Addendum #1 to the Professional Services Agreement (PSA) with Hazen and Sawyer to complete the final design, permitting and bidding of the Water Treatment Plant (WTP) Solids Handling Improvements Project.

BACKGROUND
The goal of the project is to save water from the WTP, some of which is currently being wasted to the sewer system. When complete, this project offers water savings of 40 to 60 million gallons per year with an estimated value of $4.5 to $5.1M in avoided water rights costs.

On Aug. 10, 2020, Council approved Resolution No. 20-115, entering the City into a PSA with Hazen and Sawyer to perform a high-level evaluation of feasible dewatering technologies and to prepare a Preliminary Engineering Report (PER) summarizing the WTP existing solids handling process and proposing improvements to that process. The above portion of the work was defined as Phase I.

Phase II will complete the final design, permitting, and bidding of the WTP Solids Handling Improvements Project identified by Hazen and Sawyer in the PER. Work will include design of the improvements, obtaining all necessary permits from the Colorado Department of Public Health & Environment, and advertising the project for bids by the end of this year.

BUDGET/TIME IMPLICATIONS
The addendum proposed by Hazen and Sawyer is in the amount of $452,210, which would come out of the Water Fund. The entire project cost estimate is summarized below:

Budget Implications	Amount
PER – Phase I	$72,620
Design and bidding – Phase II	$452,210
Engineer’s construction estimate	$5,130,000
Total Project Cost	$5,654,830

Phase II of the project will be completed by late 2021, with construction anticipated to start in early 2022.

STAFF RECOMMENDATION
Attached is CR-35, a resolution that, if approved, would authorize the Mayor to execute Addendum #1 between the City and Hazen and Sawyer for the Water Treatment Plant Solids Handling Improvements Project in an amount not to exceed $452,210. Staff recommends approval of CR-35.

STAFF REFERENCE
If Council members have any questions, please contact Kent Kisselman, Director of Public Works, at 303.450.4005 or kkisselman@northglenn.org.

ATTACHMENT

1. Preliminary Engineering Report

CR-35 – Water Treatment Plant Solids Handling Improvements Addendum #1
Addendum #1 to Professional Services Agreement

ATTACHMENT 1

Hazen and Sawyer
143 Union Boulevard, Suite 200
Lakewood, CO 80228 • 720.262.4456

Northglenn Water Treatment Facility Solids Handling Improvements

Preliminary Engineering Report
Hazen No. 70052-000
December 2020

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Executive Summary

Background

The City of Northglenn's (City) Water Treatment Plant (WTP) currently sends all clarifier solids and filter backwash waste to the sanitary sewer. As water rights acquisition costs rise in Colorado, the City wishes to evaluate residuals handling alternatives that would achieve the following goals:

- Maximize raw water efficiency by capturing residual flows and recycling them to the head of the plant.
- Minimize impacts to water quality and treatability by removing solids from return flows to prevent increased chemical consumption and up-cycling of organics and metals.
- Right-size facilities to provide an economic solution to residuals handling that justify the capital investment in new facilities through avoidance of greater raw water rights acquisition costs.
- Select process technologies for solids handling that provide maximum operational flexibility and are highly automated to limit the impact of new processes on operations staff.

Key Decisions

Key decisions at every step of the process were discussed and determined through close collaboration with the City. They are as follows:

Recycle Flows: It was critical to determine which potential process streams would be recycled to the head of the plant. The following flows were determined suitable for recycle to the head of the plant: 1) Backwash waste 2) Gravity thickener decant 3) Filter to Waste (Future). These flows are high quality water with low concentrations of solids.

Separation of Residual Flows: It was agreed that backwash waste would go to a separate basin and clarifier solids would be sent to separate solids handling processes. This avoids a second separation step of solids from higher quality water.

Three process alternatives were considered:

1. Maximum Recycle Flows and Minimum Project Costs – Gravity Thickener, Backwash Equalization and Recycle, and Solids to Sewer with no Mechanical Dewatering
2. Mechanical Dewatering with Gravity Thickening – Gravity Thickener, Backwash Equalization and Recycle, Dewatering with pressate to sewer and solids to landfill
3. Mechanical Dewatering without Thickening – Backwash equalization and recycle, Dewatering with pressate to sewer and solids to landfill

To evaluate these alternatives, a mass balance tool was utilized to estimate recycle flows, flows to the sewer, solids to the sewer, and solids to landfill. The mass balance was calibrated with current plant performance and historical trending data. Results of solids mass balance calculations for alternative are shown in

Table 2-6 through **Table 2-8** for comparison. Alternative 1, while minimizing capital, produced the greatest volume of thickened solids to the sewer which could cause sewer backups. Alternative 3 reduced capital costs by excluding a gravity thickener but reduced raw water rights cost avoidance by nearly one million dollars and does not meet sludge storage needs for intermittent processing of solids. Alternative 2 maximized raw water acquisition cost avoidance and maximized operational consistency by including a thickener. For these reasons, the City staff selected Alternative 2 as the preferred option.

Dewatering Technologies

After determining the process alternative, dewatering systems were discussed with the City. Key requirements and assumptions regarding dewatering operations included:

- A full-time operator will not be available to monitor the dewatering equipment
- A maximum equipment run time during normal operating conditions of six hours per day was chosen as a reasonable time that can be accommodated during an 8-hour shift, allowing for 2 hours of start-up, troubleshooting, and shut down.
- The ability to store solids for a three-day holiday weekend without running the dewatering equipment. The gravity thickener was sized to accommodate this request.

The dewatering technology evaluated included:

- Screw press
- Volute Screw Press
- Rotary Fan Press
- Centrifuge
- Belt Filter Press
- Solids Drying Beds

The last three respective technologies were removed from further consideration due to an inability to meet the City's requirements (operator complexity, water recycling goals). The volute screw press and fan press were piloted to further aid the decision. The fan press was ultimately selected due to minimal operation and maintenance requirements, dual channels providing redundancy, and a small footprint.

Economic Evaluation and Recommendations

A feasibility level (Class IV) construction cost estimate was developed for the project. This estimate is expected to be within +50 to -30 percent of the actual construction costs. This total estimate equated to $4.66M - $5.13M.

It is recommended to construct the Solids Handling Improvements Project consisting of four key facilities: backwash equalization pond, waste solids equalization pond to sanitary sewer, gravity thickener and dewatering building. In addition to the offset water rights costs, the 20-year net present worth estimates over $1.2M in wastewater treatment and hauling savings after accounting for dewatering system costs and operations. The additional operations time and complexity at the WTP is worthwhile to alleviate water rights needs and reduce loads at the Northglenn Wastewater Treatment Plant.

1. Project Understanding

The City of Northglenn's (City) Water Treatment Plant (WTP) currently sends all clarifier solids and filter backwash waste to the sanitary sewer. As water rights acquisition costs rise in Colorado, the City wishes to evaluate residuals handling alternatives that would achieve the following goals:

- Maximize raw water efficiency by capturing residual flows and recycling them to the head of the plant.
- Minimize impacts to water quality and treatability by removing solids from return flows to prevent increased chemical consumption and up-cycling of organics and metals.
- Right-size facilities to provide an economic solution to residuals handling that justify the capital investment in new facilities through avoidance of greater raw water rights acquisition costs.
- Select process technologies for solids handling that provide maximum operational flexibility and are highly automated to limit the impact of new processes on operations staff.

The Northglenn WTP is a 14 mgd conventional treatment plant, consisting of rapid mix, flocculation, clarification, and granular media filtration followed by disinfection. An overview of the existing WTP site is shown in **Figure 1-1**.

The existing solids handling process at the WTP consists of two recycle ponds (north and south) and a pump station. Clarifier solids and spent filter backwash water flow by gravity to a splitter box between the ponds. Valving controls direct whether the flows are sent to the north or south ponds. Historically, the north pond is used more frequently. With further valving controls, the contents can then be pumped from either pond to the sanitary sewer system.

Figure 1-1: Northglenn WTP Existing Site Overview

The process flow diagram of the current WTP is shown below in **Figure 1-2**.

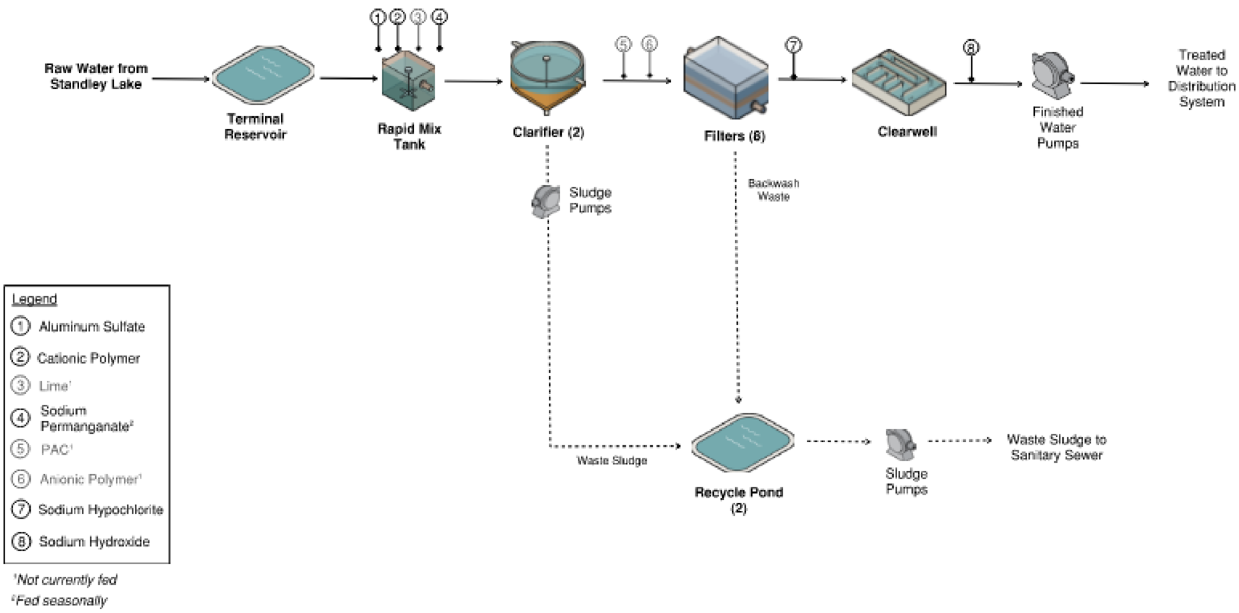


Figure 1-2: Northglenn WTP Process Flow Diagram – Current Design

2. Solids Mass Balance

Solids mass balance calculations were carried out to estimate solids production from the existing plant to establish a baseline against which evaluations of alternative residuals handling alternatives can be made.

The first steps of the mass balance calculations involved analysis of historical plant flows, influent water quality that contributes to solids production, and chemical doses. These data points were then used as the final criteria when running the mass balances.

2.1 Historical Data Trending

Historical plant data was trended to determine the solids and hydraulics loading inputs for each solids mass balance calculation. Three cases were considered for the analysis: 50^{th} percentile, 95^{th} percentile, and maximum value conditions. The 50^{th} percentile case represents average conditions and will be used to account for average annual values. The 95^{th} percentile case acts as a near maximum value while potentially removing any extreme outlier events or data points. The maximum case represented the highest recorded values at the WTP for use in design criteria.

2.1.1 Daily Plant Production

Daily plant production volumes for the Northglenn WTP ranged from approximately 2 to 9 mgd from January 2019 to February 2020, as shown in **Figure 2-1.** These values are well below the maximum rated plant capacity of 14 mgd. As the City is mostly built out, and significant future development is not anticipated at this time, these peak flow values are not expected to change in the coming years. Based on this information and discussions with City staff, it was determined the ideal maximum plant flow value be set at 9 mgd. With the ability to divert additional flows to the existing sewer connection, this diversion would allow for flows above 9 mgd through the WTP without overwhelming the new solids handling facilities. A summary of daily plant production values for each case are provided in **Table 2-1**.

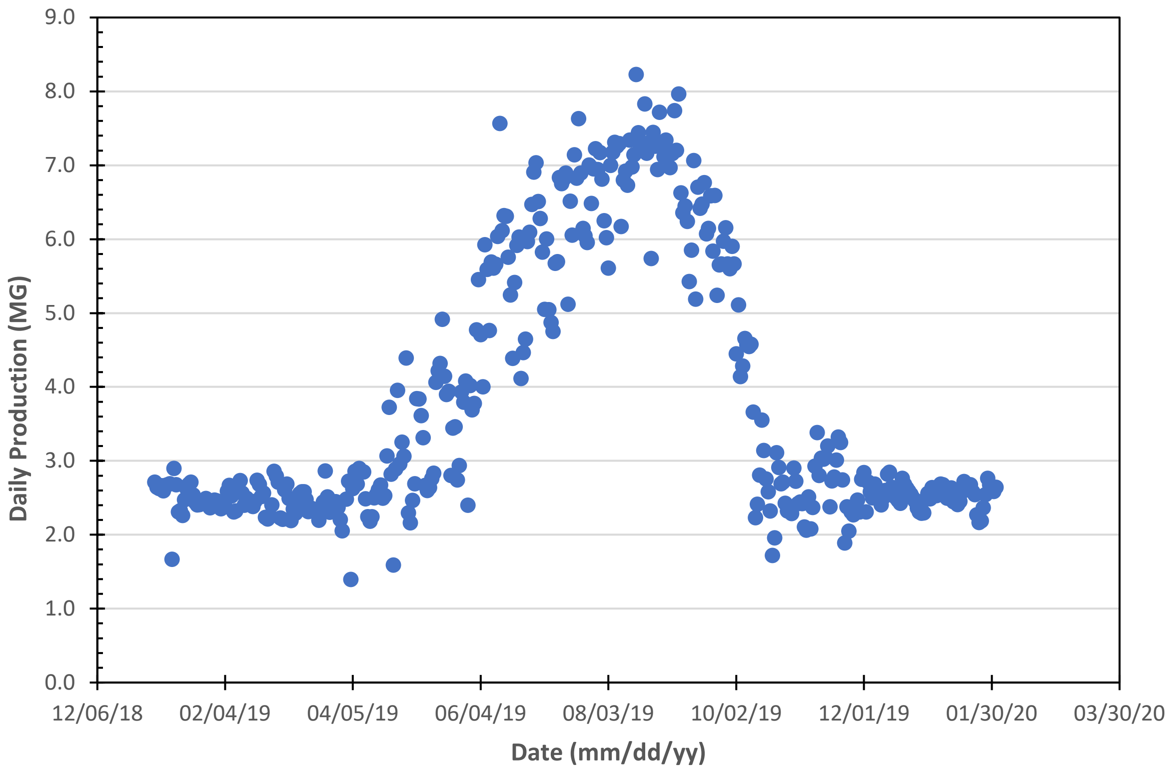


Figure 2-1: Northglenn WTP Daily Production – Jan 2019 to Feb 2020

As expected, winter demands are consistent and range between 2 and 3 mgd. **Table 2-1** summarizes the plant production data to be used in the mass balance scenarios.

Table 2-1: Solids Mass Balance Inputs – Daily Production

Case	Daily Production (MG)
50th percentile	2.7
95th percentile	7.2
Max flow	9.0

2.1.2 Raw Water Turbidity

Raw water turbidities at the Northglenn WTP ranged from approximately 0.5 to 7.0 NTU from January 2019 to September 2020, as shown in **Figure 2-2**. These turbidities are consistently low, with Standley Lake and the terminal reservoir on site providing consistently high-quality water year-round. Though this is only one year of turbidity data, discussions with City staff confirm that these values are consistent with historical raw water quality, and there is not a need to consider additional solids loading conditions beyond this existing data. If turbidities increase beyond these assumed values in the future, the solids handling processes could be run more frequently, or a portion of the solids could be wasted to the sewer to augment the solids handling facilities.

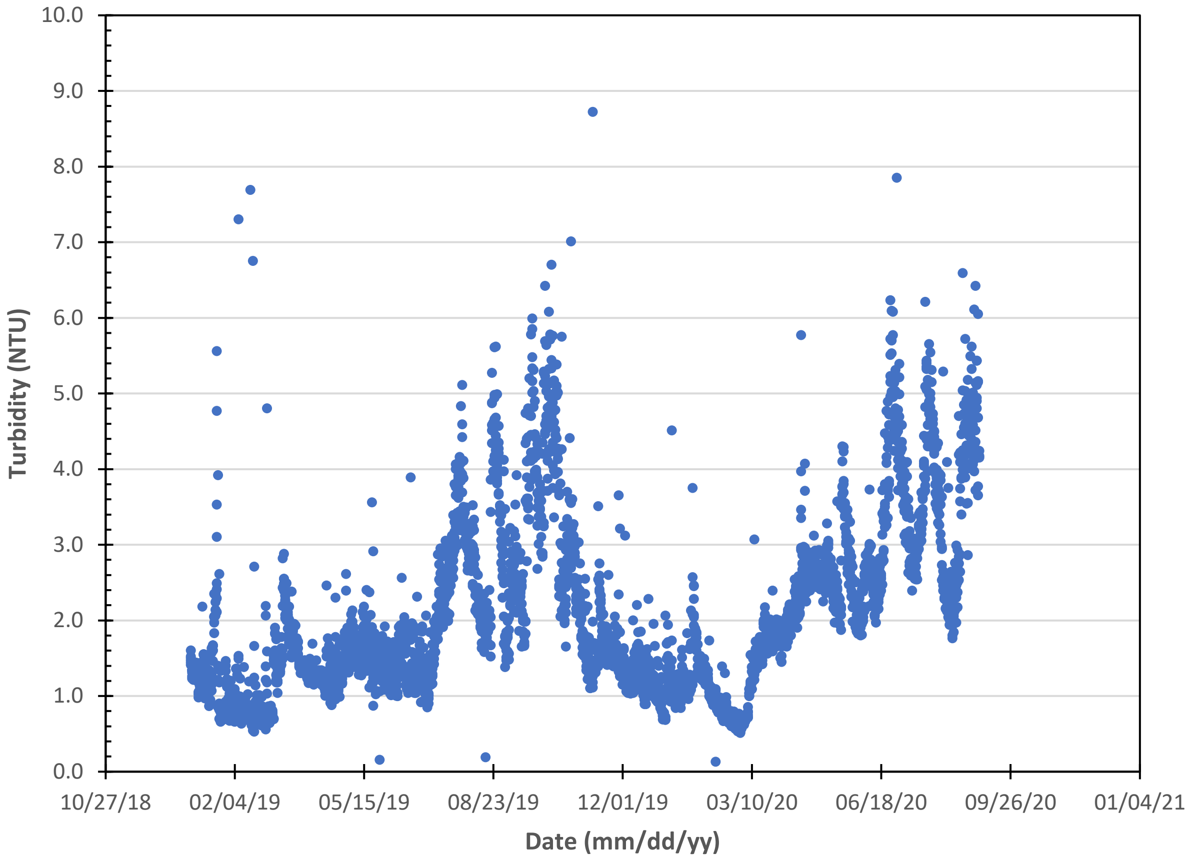


Figure 2-2: Northglenn WTP Raw Water Turbidity – Jan 2019 to Sept 2020

A summary of raw water turbidities for each case is provided in **Table 2-2.**

Table 2-2: Solids Mass Balance Inputs – Raw Water Turbidity

Case	Raw Water Turbidity (NTU)
50th percentile	1.8
95th percentile	4.6
Max flow	8.2

2.1.3 Chemical Dosages

Alum and polymer are added in the rapid mix tank prior to clarification. Alum and polymer dosages were evaluated using operational data for 2019. The alum dose ranged from 12 to 28 mg/L as bulk aluminum sulfate during this time, as shown in **Figure 2-3.**

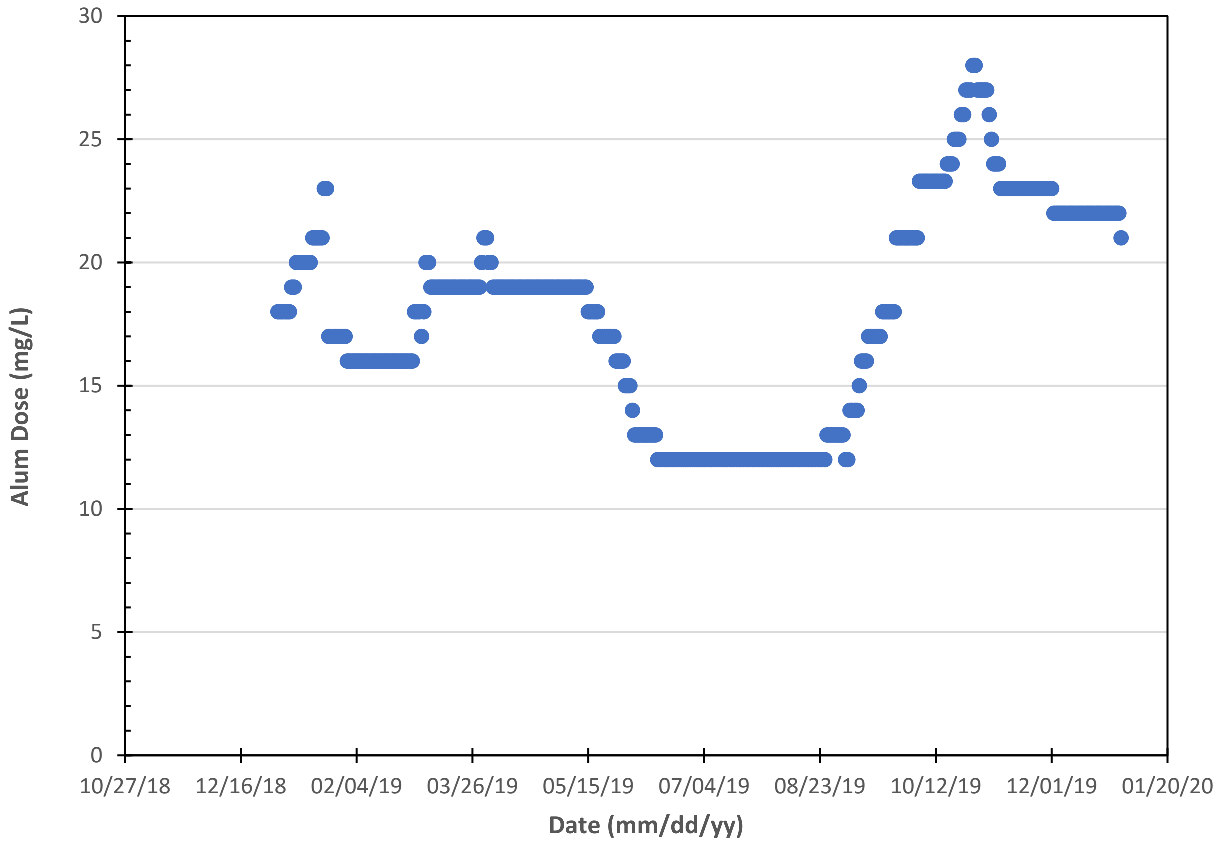


Figure 2-3: Northglenn WTP Alum Dose – 2019

A summary of alum dosages for each case is provided in **Table 2-3**. It is important to note that the alum dose of 24 mg/L as the 95th percentile case was also used in the maximum case. The reason this was chosen is the max alum dose does not correspond to peak solids loading or flows, therefore 95th percentile values were used so as to not overestimate solids production in a maximum condition. For reference, the alum dose compared to the influent TOC and turbidity is displayed in **Figure 2-4.**

Table 2-3: Solids Mass Balance Inputs – Alum Dose

Case	Alum Dose (mg/L)
50th percentile	19
95th percentile	24
Max flow	24

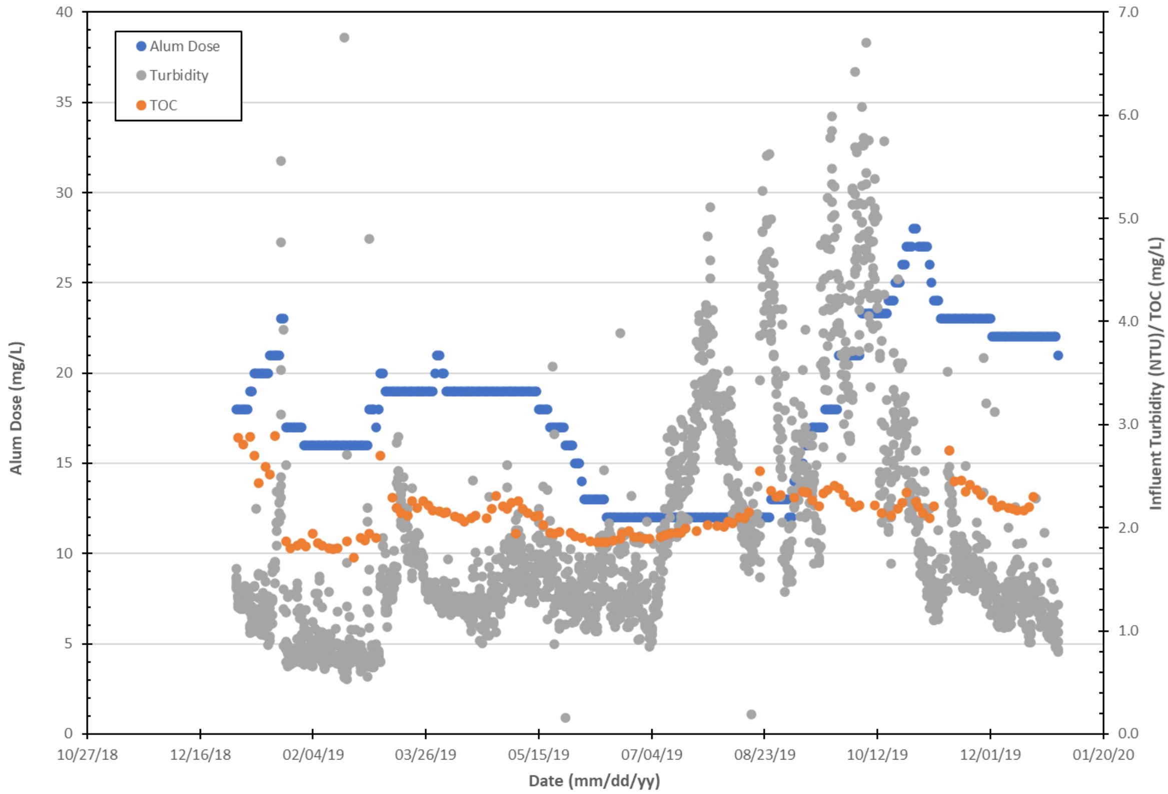


Figure 2-4: Northglenn WTP Alum Dose versus Influent TOC and Turbidity

The polymer dose ranged from 2.5 to 3.3 mg/L; however, remained relatively constant at 2.8 mg/L. As **Figure 2-5** shows, the majority of the year the polymer dose is set at 2.8 mg/L and was therefore the selected polymer dose for all mass balance scenarios to reflect plant operations most accurately.

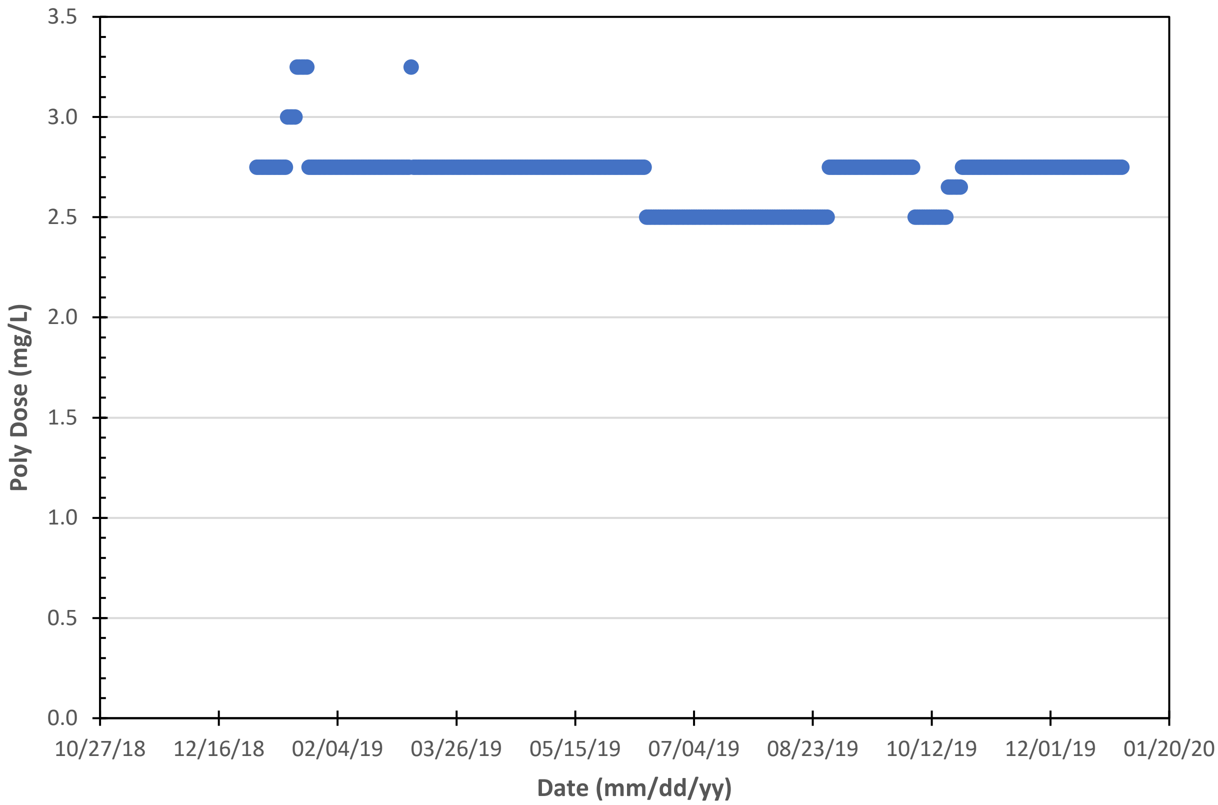


Figure 2-5: Northglenn WTP Polymer Dose – 2019

2.2 Operational Assumptions Affecting Solids Production Estimates

To create a properly calibrated mass balance that mimics current plant performance, assumptions for the operation of each treatment process were made based on historical data. These assumptions and how they apply to the mass balance calculations are discussed below.

Clarifier effluent turbidities from January 2019 to September 2020 ranged from 0.07 to 0.8 NTU, as shown in **Figure 2-6**. Consistently, the clarifiers achieved effluent turbidities between 0.2 and 0.6 NTU across a range of influent flows and turbidities. These values were then used in the mass balance assumptions to calibrate clarifier solids removal to the existing conditions.

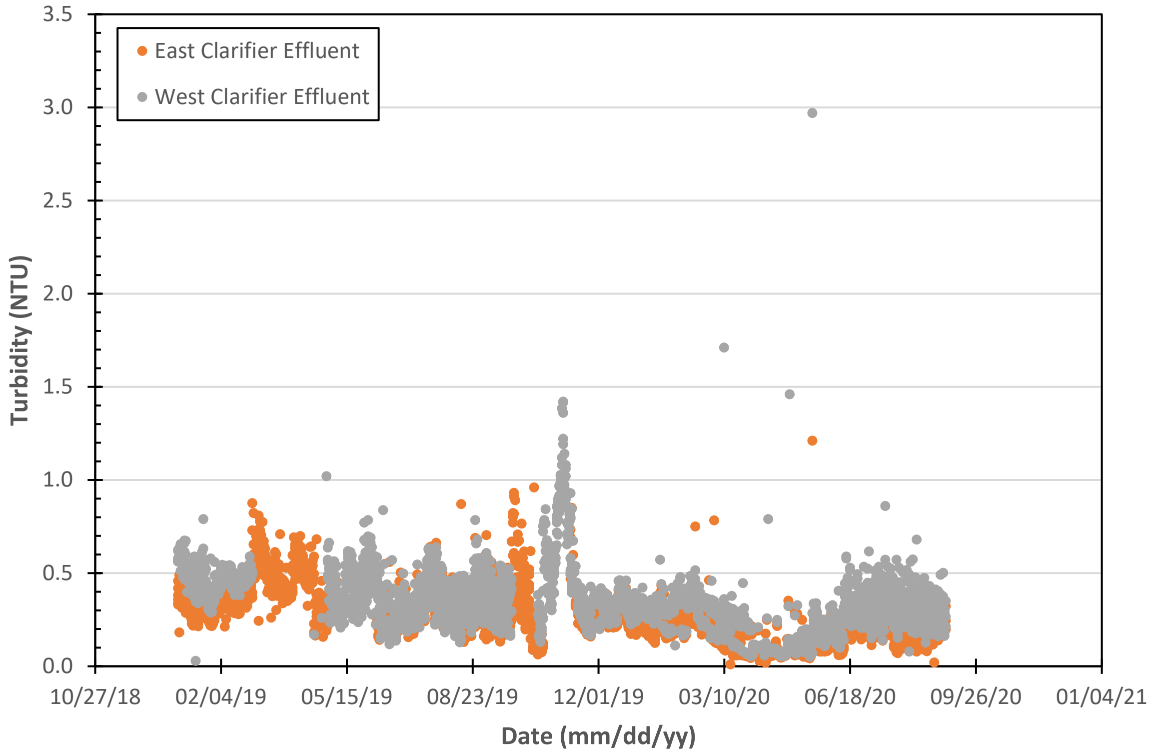


Figure 2-6: Clarifier Effluent Turbidities - 2019 to Sept 2020

Clarifier effluent turbidities shown below were based on the historical performance of the clarifiers. Solids removal was calibrated in the mass balance so the effluent turbidities match what is achieved at the WTP. Dry solids concentrations for the clarifier solids were based on grab samples of solids taken on the west clarifier in July of 2020, which resulted in an average of 0.68% solids for seven samples. The concentrations assumed for clarifier performance in the mass balance calculations are similar to these results, but account for some conservatism at average conditions, while also assuming an increase in solids concentration under increased solids loading at peak conditions. Solids mass balance calculation assumptions for the clarifiers for each case are summarized in **Table 2-4.**

Table 2-4: Solids Mass Balance Assumptions - Clarifiers

Parameter	Case		
	50th Percentile	95th Percentile	Max Flow
Raw water flow (mgd)	2.7	7.2	9.0
Effluent turbidity (NTU)	0.20 - 0.50	0.60	0.40
Dry solids concentration (%)	0.25	1.0	1.0

The dry solids concentrations for the backwash equalization, gravity thickener, and dewatering equipment were based on the conservative end of typical ranges observed in the industry, along with pilot testing performance data. The dry solids concentration assumptions were as follows for each case:

- Backwash equalization and recycle: 0.10%
- Gravity thickener: 3.0%
- Dewatering: 20%

It should be noted that the pilot data for dewatering performance was greater than 20% dry solids, but 20% as an annual value is a reasonable target for initial performance. Increased dewatering performance above 20% dry solids would only reduce hauling costs for solids disposal for the City, while potentially increasing dewatering chemical costs.

Filter effluent turbidites remained constant at 0.02 NTU from 2019 to September 2020, as shown in **Figure 2-7.** Therefore, the filter effluent turbidity was set to 0.02 NTU for each case to replicate filter performance at the WTP.

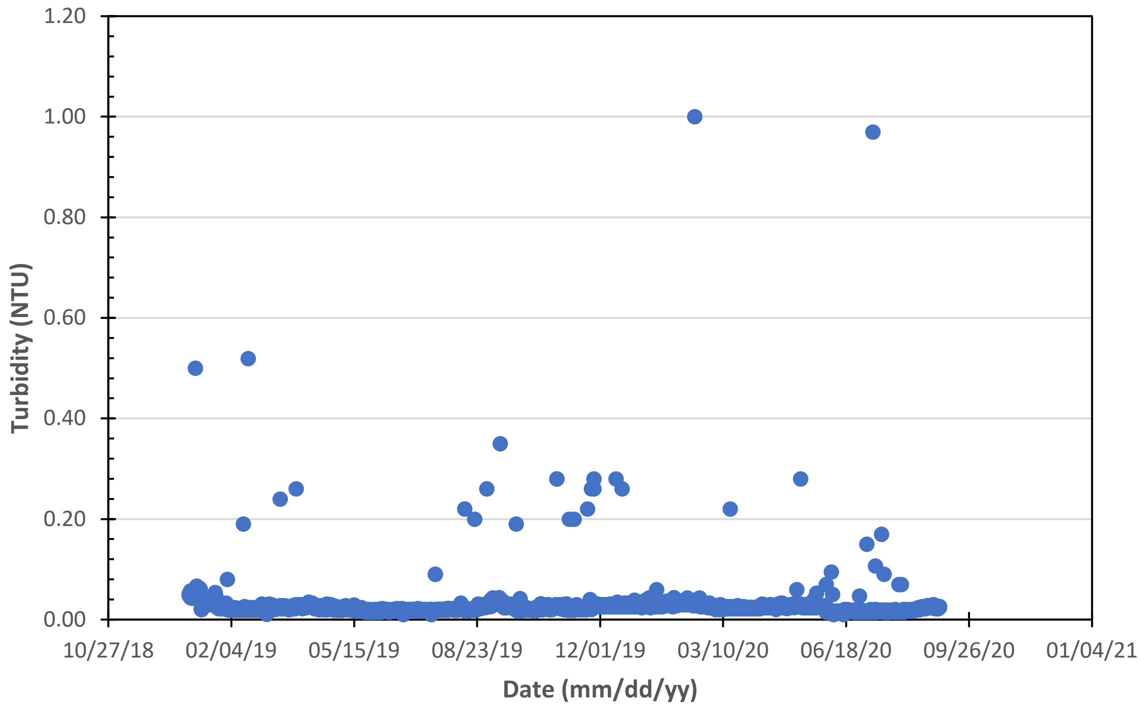


Figure 2-7: Filter Effluent Turbidities - 2019 to Sept 2020

Solids mass balance input assumptions for the filters shown in **Table 2-5** were based on current design and operating conditions. The number of duty filters were selected to match the current operational scheme for the WTP, and the filter loading rate were based on a design filter surface area of 338 ft^2. The filter run time and number of backwashes per filter per day were based on backwash data for 2020. Filter run times ranged from 72 hours in the winter, to 24 hours under peak loading conditions. To be conservative in the calculations, a maximum filter run time under average conditions of 48 hours was selected.

Table 2-5: Solids Mass Balance Assumptions – Filters

Parameter	Case		
	50th Percentile	95th Percentile	Max Flow
Raw water flow (mgd)	2.7	7.2	9.0
Number of duty filters	3	5	7
Number of standby filters	5	3	1
Filter loading rate (gpm/ft^2)	1.9	2.9	2.6
Filter run time (hours)	48	24	24
Number of backwashes per filter per day	0.5	1	1
Filter effluent turbidity (NTU)	0.020	0.020	0.020

2.3 Development of Residuals Handling Alternatives

Before creating the alternatives for further evaluation, a few key decisions needed to be made through collaboration and discussion with City staff. These decisions, along with associated additional considerations, are discussed in the sections below. Process flow diagrams for each alternative are provided in **Appendix A.**

2.3.1 Determining Recycle Flows

The first decision that was made in collaboration with the City was deciding which potential process streams would be recycled to the head of the plant under normal operating conditions. The residuals streams considered and the decision regarding whether or not to recycle those streams are broken down below:

1. Backwash Waste – This is the largest total volume of water and has the lowest concentration of suspended solids. Given the high value of this volume, in all alternatives backwash waste will be fully recycled.

2. Gravity Thickener Decant – This is the second largest volume of water that could be recycled by settling solids out of the clarifier blowdown, and under normal conditions will see decant turbidities similar to raw water turbidity. This is a high quality recycle stream and will be considered for recycle for alternatives that include thickening.

3. Dewatering Pressate/Centrate – This is a very small volume of water with a high concentration of suspended solids. The water savings here would be very minimal, while providing treatment challenges through intermittent spikes of high turbidity recycle events. This stream will also have the highest concentration of organics, iron, and manganese that could be brought back to the head of the plant. This volume is assumed to be wasted to the sewer for all alternatives.

4. Filter to Waste (Future) – If the filter to waste project is implemented, this additional flow will be combined with the backwash waste. Similar to the backwash waste, this is a large volume of flow with a low concentration of suspended solids. This volume will be fully recycled if filter to waste is implemented. An additional alternative, is to optimize the backwash sequence including an extended terminal subfluidization wash (ETSW). This implementation could potentially bring the filters online without implementing filter to waste, resulting in lower recycle flows.

2.3.2 Separation of Residual Flows

The next decision was whether to combine or keep the clarifier blowdown and spent filter backwash residual streams separate prior to recycle. Similar to the discussion regarding recycle flows, the decision involves a high-quality water volume in backwash waste, and a higher solids concentration stream off the clarifiers. To avoid a second separation step of solids from higher quality water, it was recommended and agreed on that the backwash waste would go to a separate basin, and clarifier solids would be sent to separate solids handling processes for the alternatives.

2.3.3 Alternative 1: Maximum Recycle Flows and Minimum Project Costs

Alternative 1 considered the addition of a gravity thickener and backwash equalization pond. This allows backwash flows and the proposed gravity thickener decant to be recycled, with thickened solids sent to the sewer, as shown in **Figure 2-8**. This alternative minimizes capital cost by not including mechanical dewatering, but involves pumping thickened solids a great distance to the WWTP.

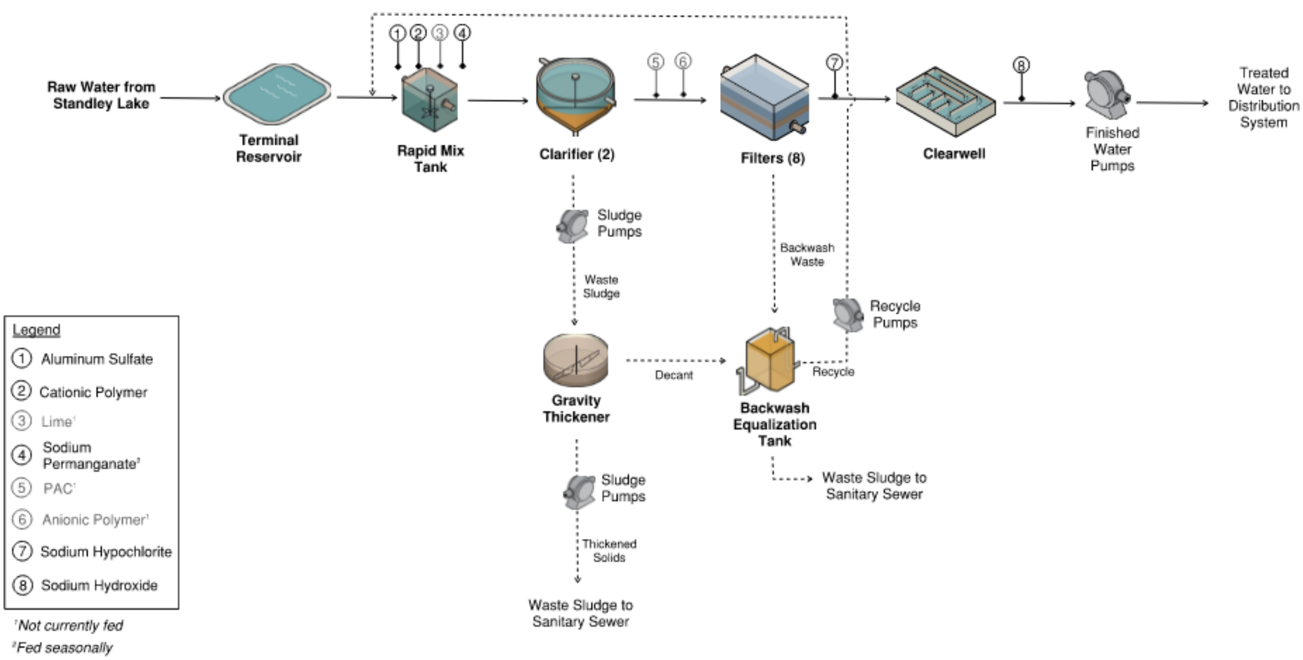


Figure 2-8: Northglenn WTP Process Flow Diagram – Alternative 1

2.3.4 Alternative 2: Mechanical Dewatering with Gravity Thickening

The addition of a dewatering unit was considered for Alternative 2 to reduce waste solids sent the sewer. The gravity thickener provides the benefit of solids storage volume and provides a more consistent thickened solids feed to the dewatering unit. Additionally, this thickening process would be required to produce a 2 to 4% solids feed prior to a screw press, a candidate dewatering technology for the Northglenn WTP. The other technologies considered can handle any solids percentage, but require a consistent feed rate. A process flow diagram of Alternative 2 is shown in **Figure 2-9**.

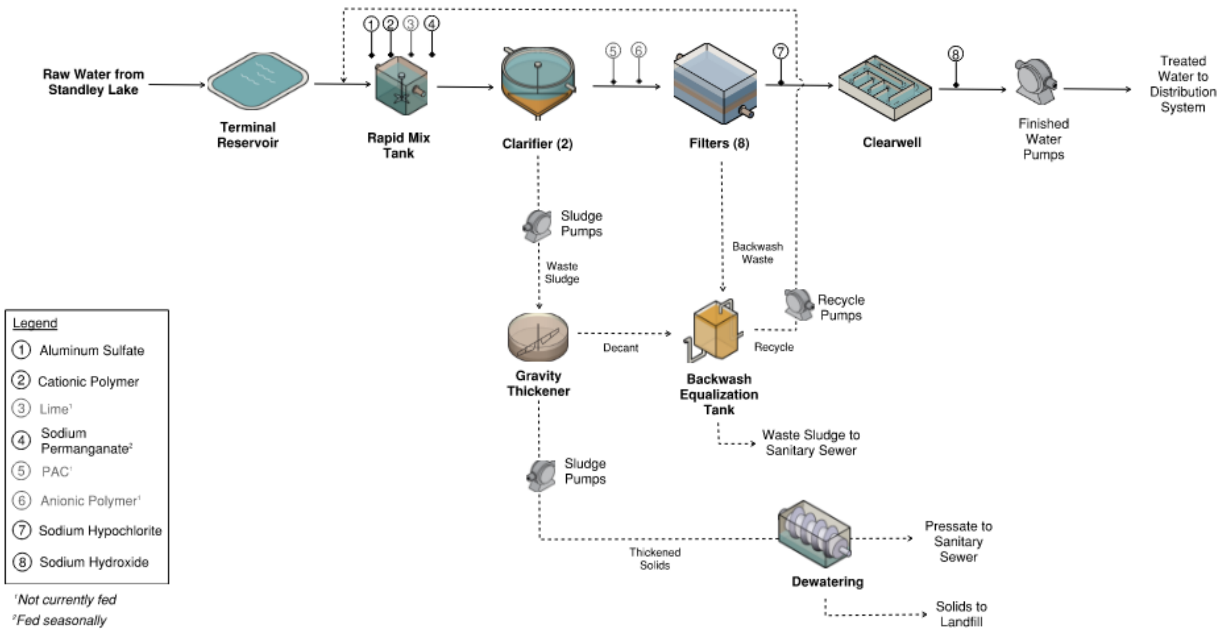


Figure 2-9: Northglenn WTP Process Flow Diagram - Alternative 2

2.3.5 Alternative 3: Mechanical Dewatering without Thickening

The addition of a dewatering unit was also considered for Alternative 3 to reduce waste solids sent the sewer. However, a sludge holding tank was evaluated in Alternative 3 as an alternative to a gravity thickener to eliminate additional mechanical equipment and operational complexity. A process flow diagram of Alternative 3 is shown in **Figure 2-10.**

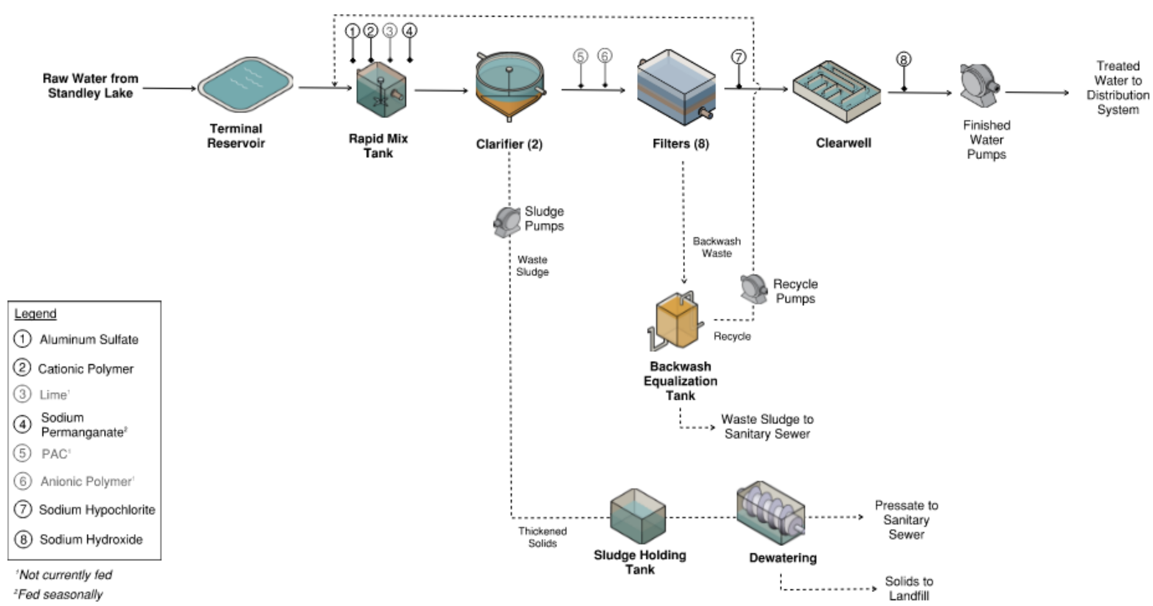


Figure 2-10: Northglenn WTP Process Flow Diagram - Alternative 3

2.4 Solids Production Estimates

Results of solids mass balance calculations for each alternative are shown in **Table 2-6** through **Table 2-8** for comparison. Alternative 3 resulted in the highest reduction of solids to the sewer. The dewatering performance is slightly better for Alternative 2 over Alternative 3 by applying thickened solids to the dewatering units, but the gravity thickener decant and return flows to the backwash equalization basin result in more solids accumulating in the backwash equalization basin that could ultimately go to the sewer or potentially to landfill depending on how thick these solids are. In the Tables below, accumulated solids in the backwash equalization are part of the daily solids to sewer calculation but will only be removed from the basin periodically. These numbers are meant to show the general production and accumulation of solids for comparison. Alternatives 1 and 2 resulted in the greatest total recycle flows and would result in the greatest raw water rights acquisition cost savings. The 95th percentile and max cases do not show annual recycle volumes as these events are not representative of annual volumes, but intended to show daily flows during these shorter peak events. Detailed process flow diagrams which contain detailed mass balance summary tables are shown in **Appendix A** for each alternative and for current conditions for comparison.

Table 2-6: Solids Production for Each Alternative – 50th Percentile

Parameter	Current Design	Alternative 1	Alternative 2	Alternative 3
Recycle flow (acre-ft/yr)	NA	111	111	93
Recycle flow (mgd)	NA	0.099	0.099	0.083
Flow to sewer (mgd)	0.11	0.013	0.013	0.028
Solids to sewer (ppd)	344	353	44	13
Solids to landfill (ppd)	NA	NA	309	341

Table 2-7: Solids Production for Each Alternative – 95th Percentile

Parameter	Current Design	Alternative 1	Alternative 2	Alternative 3
Recycle flow (mgd)	NA	0.33	0.33	0.32
Flow to sewer (mgd)	0.33	0.017	0.016	0.027
Solids to sewer (ppd)	1,321	1,358	189	72
Solids to landfill (ppd)	NA	NA	1,170	1,287

Table 2-8: Solids Production for Each Alternative – Max Flow

Parameter	Current Design	Alternative 1	Alternative 2	Alternative 3
Recycle flow (mgd)	NA	0.48	0.48	0.46
Flow to sewer (mgd)	0.47	0.020	0.019	0.037
Solids to sewer (ppd)	2,156	2,208	276	82
Solids to landfill (ppd)	NA	NA	1,934	2,128

2.5 Raw Water Rights Cost Avoidance and Alternative Selection

Currently, an average of 49 MG or 150AF is wasted to the sewer each year at the WTP. Since water rights acquisition costs continue to rise in Colorado, the City wishes to recover this flow. The City's water resources department noted in a Memo dated July 22nd, 2020 from Sophie Porcelli that water rights acquisition costs range between \$40,000 and \$50,000 per acre/ft. Using this cost range, each of the alternatives was evaluated to determine an equivalent savings, as summarized in **Table 2-9**.

Table 2-9: Avoided Raw Water Rights Acquisition Cost Comparison

Parameter	Current Design	Alternative 1	Alternative 2	Alternative 3
Recycle flow (acre-ft/yr)	NA	111	111	93
Avoided Raw Water Rights Cost ($)	**$0**	**$4.5 – 5.6 M**	**$4.5 – 5.6 M**	**$3.8 – 4.8 M**

With optimization of the gravity thickener and backwash equalization tank, recycle flows will increase, further minimizing wasted flows.

Alternative 1 maximizes the savings of future acquisition costs while minimizing capital facilities, but was ultimately deemed non-viable by City staff. Thickening solids and then pumping those to the sewer would likely result in frequent sewer backups due to accumulated solids, which can periodically occur now with unthickened solids. Therefore, alternative 1 was eliminated from consideration.

Alternative 3 reduces capital costs associated with construction of a gravity thickener, but reduces raw water rights cost avoidance by nearly one million dollars. In addition, the need to keep those solids constantly mixed while being stored, and total volume of solids storage needed would not provide enough cost savings to offset this reduction in recycle flows.

Based on this analysis, along with discussion with City staff, alternative 2 was selected as the preferred alternative to maximize raw water acquisition cost avoidance while maximizing operational consistency by providing a consistent solids feed to the dewatering equipment from a thickener.

3. Dewatering Technologies

3.1 Operational Needs

Operating requirements for the dewatering system were discussed with City staff during a workshop on September 15th, 2020. These requirements consisted of the following:

- A full-time operator will not be available to monitor the dewatering equipment; therefore, the capability for equipment to be automated will be of importance.
- A maximum equipment run time of six hours was chosen as a reasonable time that can be accommodated during an 8-hour shift, allowing for 2 hours of start-up, troubleshooting, and shut down. Initial equipment selections were sized to operate for two 4-hour shifts a week under average conditions. During maximum WTP flows, the dewatering demand must be met in less than 40 hours of run time.
- Plant staff would like the ability to store solids for a three-day holiday weekend without running the dewatering equipment. The gravity thickener was sized to accommodate this request.

3.2 Description of Dewatering Technologies

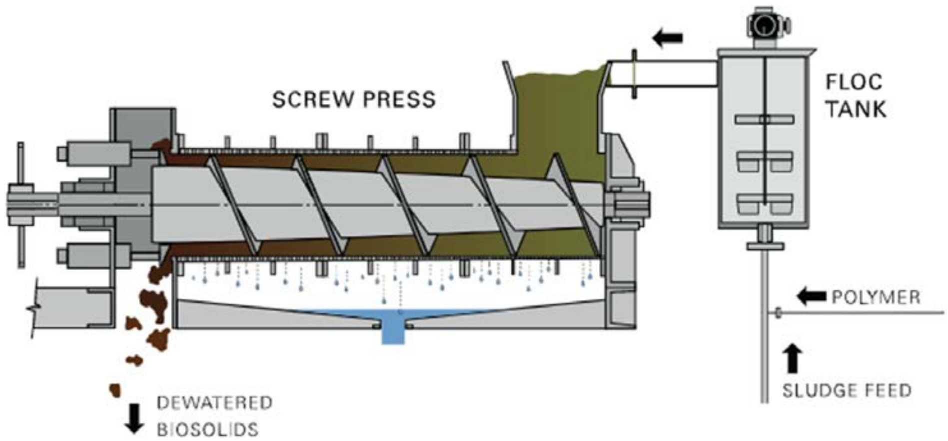
A high-level evaluation of dewatering technologies was performed to identify technologies to consider for further consideration. The dewatering technologies initially evaluated included the screw press, volute screw press, fan press, centrifuge, belt filter press, and drying beds.

The following factors were considered in the initial review of dewatering technologies:

- Equipment layout
- Estimated solids production
- Solids dewaterability analysis (by vendors)
- Reasonably anticipated operational performance
- Performance of dewatering equipment at other plants
- Ease of operations and maintenance
- Level of reliability and redundancy
- Capital and life-cycle cost comparisons
- Building upgrades required (e.g., structural modifications or building code upgrades)
- Lead time on equipment procurement

3.2.1 Screw Press

The screw press uses a large rotating screw to slowly compress and dewater the solids. The screw is surrounded by a perforated screen that allows water to drain out as the solids are compressed. As the solids move down the screw, the screw presses the solids to release moisture and discharges the cake solids at the end of the screw. Screw presses are slow moving with low horsepower motors. A schematic of a screw press is shown in **Figure 3-1** below. Screw presses are pressurized systems with enclosed flocculation tanks and only one screw on a skid. Screw presses can have a large footprint and can be over 18 feet in length. Advantages of screw presses include less operator attention required typically (compared to other technologies), ease of start-up, and average polymer use. However, this remains a newer technology in the water treatment industry.



Typical Sludge Dewatering Process Flow Diagram

Figure 3-1: Typical Screw Press (picture from FKC)

3.2.2 Volute Screw Press

The volute dewatering press is similar to the standard screw press but encompasses a dewatering drum that can achieve both thickening and dewatering of the solids in a single, compact operation. The dewatering drum is made up of fixed and moving rings and does not have a perforated screen like the standard screw press. Tie rods hold spacers and fixed rings in place with moving rings located between the fixed rings. The moving rings are smaller than the outer diameter of the screw and narrower than the spacers. The fine gaps between the moving and fixed rings are cleaned by the constant movement of the rings. The moving rings help prevent clogging and cut into the cake to allow additional release of moisture from the surface area. As the screw moves, the moving rings move in a circular motion mimicking the movement of the screw flight. **Figure 3-2** shows the fixed and moving rings and the zones along the screw press that allow for thickening and dewatering in the same unit.

One skid for the volute dewatering press can include up to three screws side-by-side. Multiple screws on a skid allow for a compact footprint to meet design capacities. Each screw requires a dedicated low horsepower motor for operation. Each skid has a dedicated polymer mixing/flocculation tank that feeds the screws. Advantages of volute screw presses are similar to those outlined above for screw presses; however, this remains a newer technology in the water treatment industry and there is only one volute screw press manufacturer.

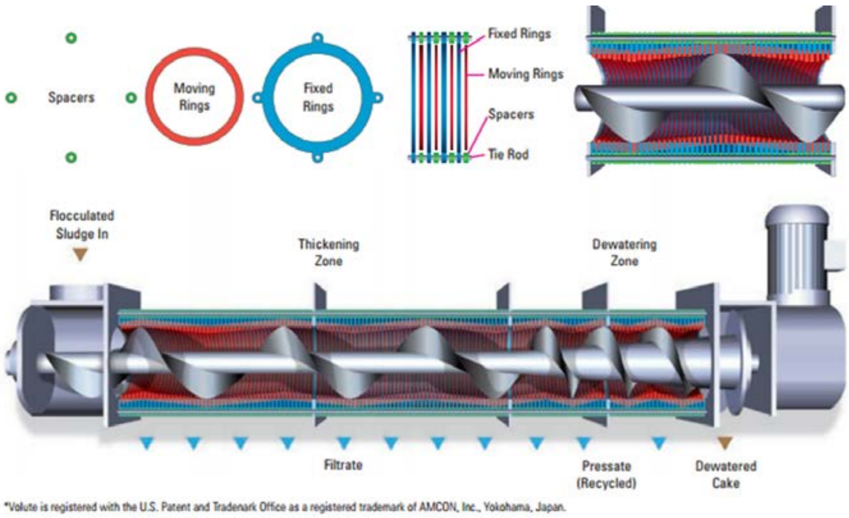


Figure 3-2: Volute Dewatering Press (picture from PW Tech)

3.2.3 Fan Press

The third technology under consideration is the rotary fan press. The fan press has two parallel rotating filters that press the solids as they move through the channel under low pressure in between the parallel filters. The filtrate is drained through the screens as shown in **Figure 3-3**. The solids build up within the channel until enough pressure is generated to move the arm at the outlet. The fan press is compact and slow moving and is completely enclosed. Polymer is mixed by an inline mixing valve located in the piping between the polymer storage tank and the press. Washwater is sprayed intermittently to clean the filters. The rotating filters move at slow speeds and require a dedicated low horsepower motor for each fan. To meet required design capacities, up to two fans can be combined on a single skid. Advantages of the fan press include small footprint requirements, less operator attention, ease of start-up, and average polymer use. However, of the technologies proposed, this is the newest being considered and there is only one US manufacturer.

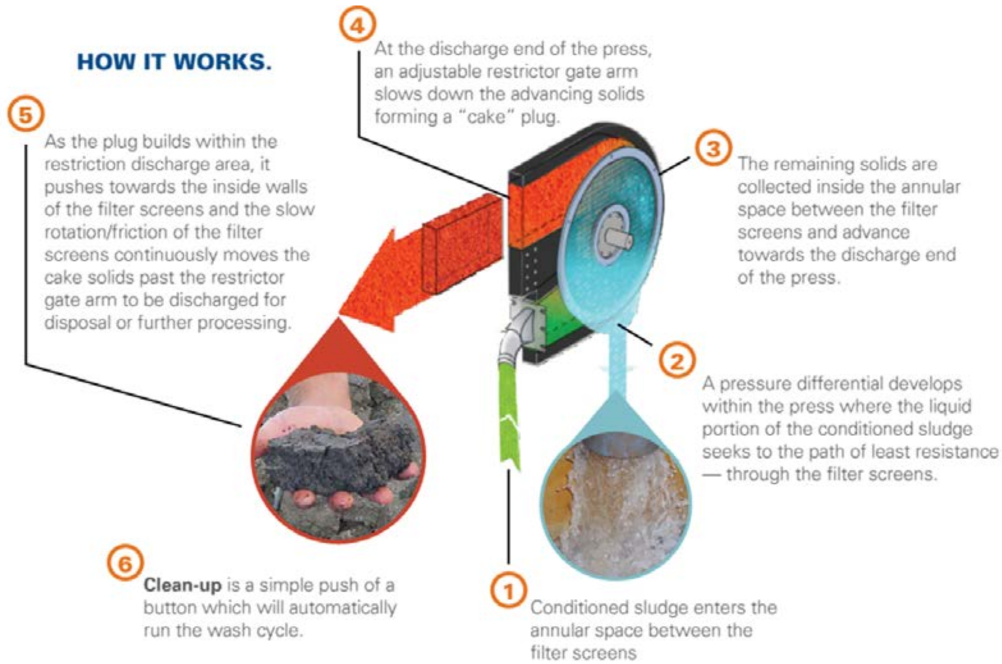


Figure 3-3: Rotary Fan Press Explanation (picture from Prime Solution)

3.2.4 Centrifuge

Centrifuges are proven technologies used to separate solids from sludge. A motor drives the rotational movement of the drum and scroll, upon which the effects of the centrifugal force cause a separation and settling of particles according to density, as shown in **Figure 3-4**. The enclosed equipment provides a cleaner operating space and minimizes messes, but the high rotational speeds can cause significant vibration and noise. Centrifuges require calibration and optimization dependent upon the solids loading. For this reason, centrifuges are sensitive to changing solids concentrations and require polymer dose optimization. They often require more operator attention compared to the other technologies presented. Lastly, balancing, in order to avoid vibration, is often difficult.

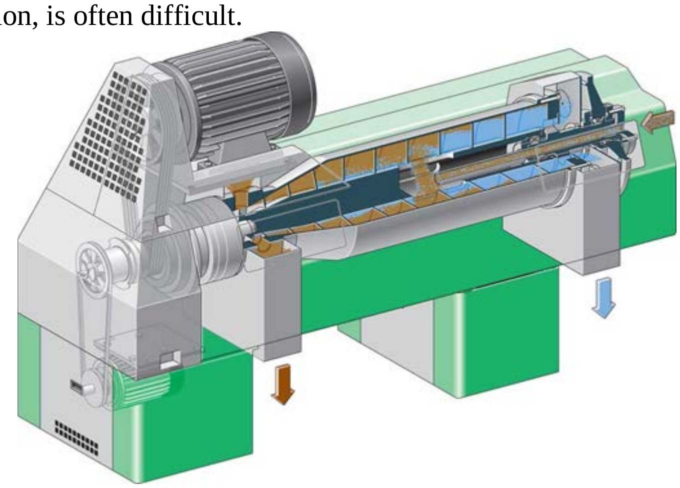


Figure 3-4: Example Centrifuge (picture from GEA Westfalia)

3.2.5 Belt Filter Press

Belt filter presses apply pressure and utilize gravity drainage to dewater sludge along a continuous belt. Multiple rollers are used to compress the sludge (**Figure 3-5**). A significant amount of washwater is required in this process. This technology is frequently and successfully used in similar applications, including historically in the Denver area. However, operator attention is required to ensure max efficiency. Belt filter presses require higher polymer doses than other dewatering technologies. Lastly, the open nature of the equipment is messier than the other alternatives considered.

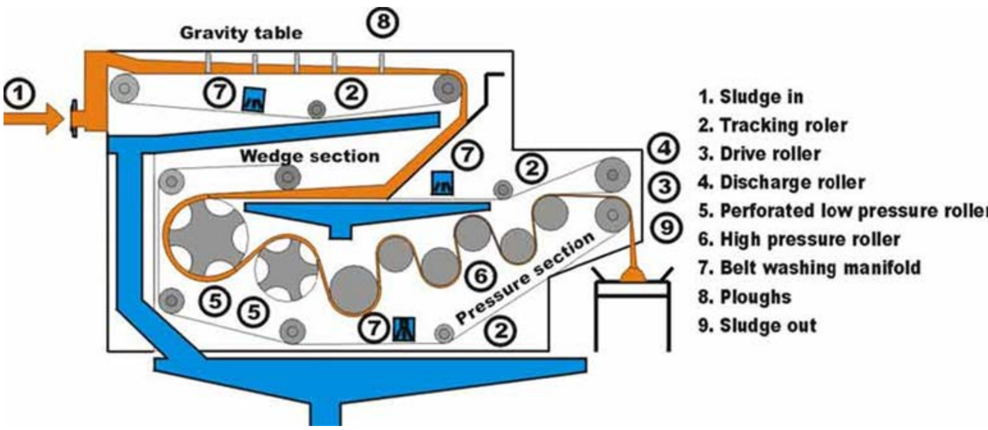


Figure 3-5: Belt Filter Press Schematic (picture from Krofta Engineering)

3.2.6 Drying Beds

Drying beds utilize a large footprint to apply solids across the area at a shallow depth. The base of the bed can be covered with either clay liners, asphalt, or sand. A combination of evaporation and drainage enable the dewatering process. This is a low-cost option that requires minimal operator attention. However, large space requirements are necessary and seasonal variation can impact drying effectiveness. Furthermore, dust generated from the beds can impact neighboring areas.

3.3 Technology Comparisons

The technologies selected for further comparison were the screw press, volute screw press, and fan press. Centrifuges were removed from further consideration due to start-up complexity, vibration concerns, plant staff's previous experience, and operator requirements. Similarly, belt filter presses require more operator attention with start-up/shutdown and are not enclosed which can be messier than other options and thus were eliminated. Lastly, drying beds, while requiring the least operator attention, presented a dust issue that would be challenging for the neighboring area. Additionally, it would not accomplish the City's water recycling goals and was withdrawn from further consideration. The City conducted pilot testing to better inform the final technology selection. Testing was conducted in October 2019 for the volute screw press and in August 2020 for the fan press. A screw press was not piloted due to schedule constraints of this project, but enough testing has been completed in the local industry to anticipate performance.

3.3.1 Pilot Testing

PW Tech piloted the Volute Dewatering Press, model ES-201. During the testing, cake solids averaged 26%, with a max value of 34% solids achieved. These variations resulted from different polymer doses and throughputs tested. Solids capture rates averaged 98.4% when polymer was dosed over 14.7 lbs/ton, with a max capture rate of 99.5% observed. A summary of these ranges is listed in **Table 3-1.** The detailed pilot test results can be found in **Appendix B.**

Prime Solutions piloted the Rotary Fan Press Model #RFP2.0-24S. Cake solids averaged 27.2%, with a max observed value of 30.6% solids. Capture rates averaged 98.6%. A summary of these ranges and a comparison to the volute press are included in **Table 3-1**. The detailed pilot test results can be found in **Appendix B.**

Table 3-1: Technology and Manufacturer Pilot Comparison

	PW Tech (Volute Press)	Prime Solutions (Fan Press)
Feed Solids (%)	0.5 – 3.4	0.79 – 1.11
Cake Solids (%)	20.2 – 34.0	25.1 – 30.6
Capture Rate (%)	71.9 – 99.5	97.0 – 99.8
Source	Pilot test	Pilot test
Solids Loading Rate (lb/hr)	22 – 94	39.5 – 66.7

In reviewing the comparison of the pilot tests, the PW Tech volute press was able to achieve the highest percentage of cake solids (34%). However, on average, Prime Solutions fan press achieved a higher average dry cake solid (27.2% vs 26%) with a lower percentage feed solids (1.1% vs. 3.4%).

3.3.2 Polymer Use

A major component in dewatering equipment costs is the polymer consumption. PW Tech's piloted polymer (Solenis Praestol K111) costs roughly $1.50 per pound. The cost of the polymer Prime Solutions tested was not available for comparison. However, comparison values for typical cationic, NSF approved polymer for dewatering technologies frequently used along the front range, was referenced for the fan press at approximately $1.55 per pound. The volute screw press and fan press were analyzed for annual polymer consumption based on the pilot testing, and the percent active and optimal dose (active lbs/dry ton) are compared in **Table 3-2**. The fan press had a lower optimal active polymer usage compared to the volute screw press (12.1 vs 14.7 lb/ton).

Table 3-2: Polymer Usage by Manufacturer

	PW Tech (Volute)	Prime Solutions (Fan)
Unit Cost ($/lbs of raw polymer)	$1.50	$1.55
% Active	32	40
Optimal Polymer Dose (active lbs/ton)	14.7	12.1
Source of Polymer Usage Value	Pilot Test Average	Pilot Test Average
Total Cost per Dry Ton of Solids	$69.45	$46.90

3.4 Vendor Package Comparison

In comparing dewatering technologies, the following factors, listed in **Table 3-3,** are also critical to consider. Overall, the three technologies (volute, screw, and fan press) are relatively similar in terms of budgetary quotes, but vary in footprint, washwater usage, dry input feed solids, and polymer usage. All received budgetary vendor packages can be found in **Appendix C.**

Table 3-3: Vendor Package Comparison

	Volute Dewatering Press	Rotary Fan Press	Screw Press
Recommended Model	ES-303	48” Dual Channel 2.0	3.0P-600-D
Footprint	13.2’ L x 5.25’ W x 6.2’ H	8.5’ L x 6.0’ W x 8.25’ H	20’ L x 8’ W x 10.5’ H
Lead Time (months)[1]	6	3.5-4.5	5-7.5
Water Demand (gpm)	16	14-20	15-20
Max Dry Input Feed Solids (lb/hr)	1050 (solids > 4%)	222-555	350 (solids > 2%)
Max Hydraulic Throughput (gpm)	105 (solids < 1%)	100	40
Polymer Usage (lb/ton)	14.7	12.1	10-20[3]
Budgetary Quote	$355,000	$380,000	$350,000

1. Lead Time after shop drawing approval
2. Fan Press was solids limited. Prime Solution confirmed the anticipated hydraulic loading can be met.
3. Screw Press was not piloted. Optimal polymer dose requires bench testing.

The vendor quotes each included a full skid unit comprised of polymer feed(s), interconnecting piping, valves, instrumentation, controls. and freight to site. The screw press additionally included a conveyor. Installation and startup site visits as well as unloading at the WTP were not included. Purchasing a fully packaged skid unit is recommended over purchasing each component individually from suppliers. This is because all coordination and communication between components falls under the dewatering equipment manufacturer’s scope and simplifies communications between the owner, contractor and vendor. During detailed design, design and operating criteria will be refined to confirm the selected technology’s model.

3.5 Technology Recommendation and Selection

After the pilot testing and a workshop on October 1, 2020, the City decided to move forward with Prime Solution’s rotary fan press dewatering technology. A main driver in decision making was operation and maintenance requirements. With limited available staff capacity and a dewatering system running intermittently, a technology with simple startup and shutdown procedures was necessary. The fan press met this desired need. Furthermore, the dual channel option of the fan press was an added point of redundancy. Although the cost of the skid unit was the highest of the received budgetary quotes, the small size of the skid will result in a smaller building footprint. The reduced building cost will offset the equipment price.

4. Facilities Pre-Design

4.1 Backwash Equalization Pond

The existing recycle holding ponds are nearing their end of useful life, as the present liners are in poor condition need to be rehabilitated. Furthermore, the current system pumps the waste streams through a series of force mains to the Northglenn Wastewater Treatment Plant (WWTP). Backups occur within the current system in a neighborhood to the southwest of the plant. The two ponds will be reconstructed as a backwash equalization pond and waste solids equalization pond. To minimize excavation and construction costs, the new ponds were preliminarily sized to match the existing geometry resulting in approximately the same storage volume as is currently available. After borings and survey are completed during final design, an analysis will be performed to determine how much additional volume can be gained by further sloping the pond walls. The North pond will be repurposed as the backwash equalization pond and during normal conditions the backwash waste will be sent to this pond through the existing 24-inch concrete line. Decant from the new gravity thickener will also be sent to this pond and recycled to the head of the plant by a recycle pump station.

As solids accumulate, a sludge blanket will accumulate over time. Three handling techniques were discussed – 1) install sludge collector, 2) consistently pump to sewer or bypass pond, or 3) dredge out or pump out periodically. The first two options were eliminated due to the additional cost and required operations and maintenance. Periodic dredging or pumping every few years requires the least operator attention and mechanical equipment. Flows can be bypassed to the waste solids equalization pond and temporarily pumped to the sewer during dredging.

Two new recycle pumps will be installed in the existing pump station that currently houses two waste pumps to the sanitary sewer. To accommodate the new recycle pumps, the out of service decant pump will be removed as it no longer operates. The second pump will require adjustment to the layout of the existing waste pumps or will be a shelf spare. This will be determined during detailed design once models for the recycle pumps have been selected.

A new recycle line will be routed to the head of the plant. Two connection points have been identified for the recycle line tie-in. The preferred location is upstream of the rapid mix and alum injection point in the flocculation control vault. The Colorado Department of Public Health and Environment (CDPHE) approved connecting the recycle downstream of the first chemical injection point which doses sodium permanganate, if it connects before the coagulant addition.

The following design details and assumptions describe the proposed design:

- Existing footprint and original as-built geometry remain constant, as shown in **Figure 4-1,** to minimize excavation and hauling costs. The jersey barricades will be removed
- Max pond water level elevation of 5,357.18 ft – constrained by the elevation of the backwash pipe inlet
- Total storage equates to 202,500 gallons – this provides storage for three backwash events at 64,000 gallons per backwash event, or about 48 hours of storage under average conditions
- Periodic dredging or pumping will be used to remove solids accumulation
- New recycle pumps will be installed in the existing pump station
- Concrete lined construction

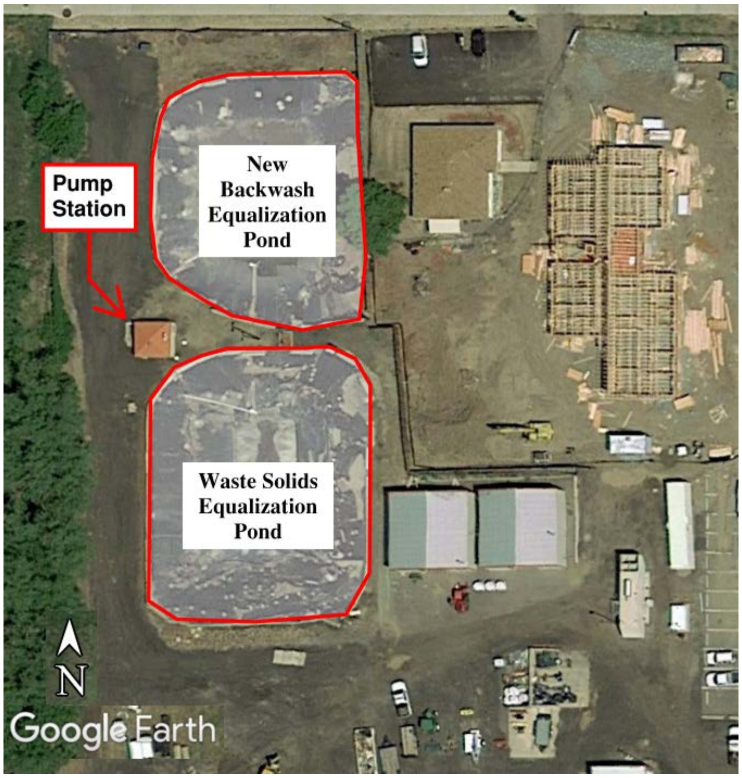


Figure 4-1: Backwash Equalization and Waste Solids Equalization Pond Site Plan

Design of the original ponds set the maximum water surface elevation at 5360.18, which would provide an additional 120,000 gallons of storage in each pond. This elevation matches the Backwash Access Hatch in the Filter Gallery as shown by the Hydraulic Profile in the 2014 Improvements Project, **Figure 4-2.** Surcharging this channel will cause filter performance issues and flood the filter gallery. To prevent this from occurring, the top of the backwash pipe (5,357.18ft) was conservatively chosen for the maximum pond water surface elevation.

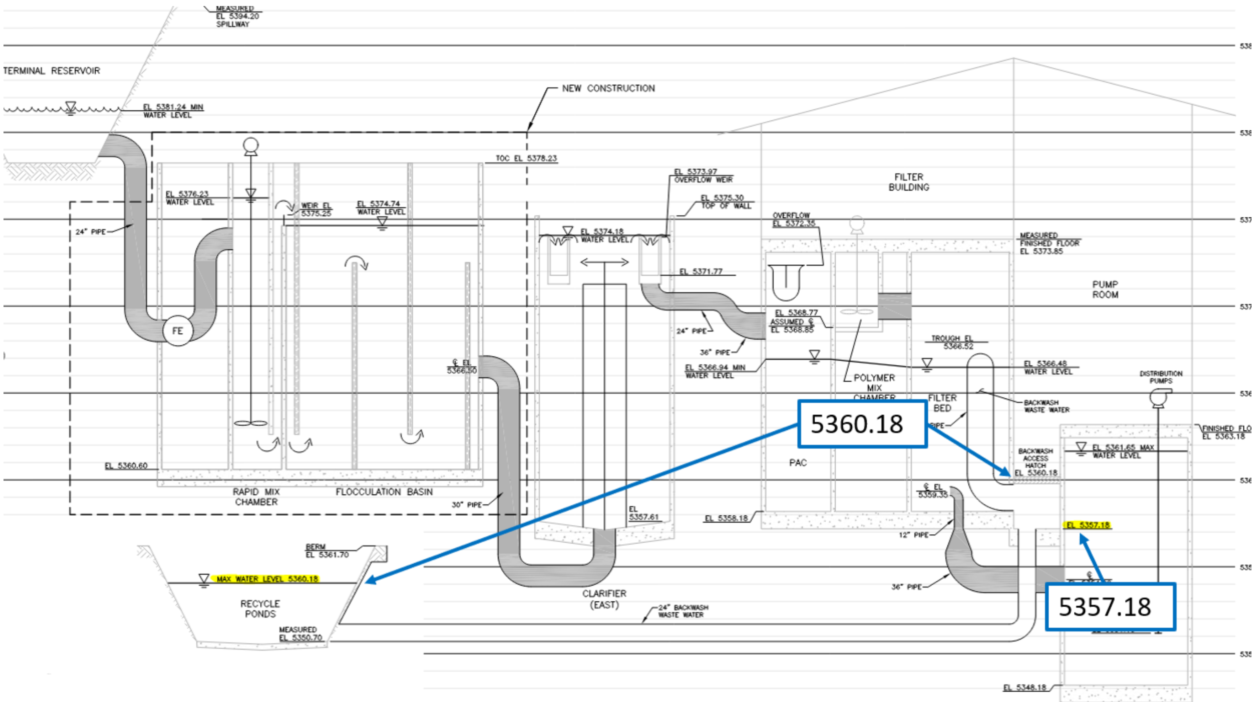


Figure 4-2: Existing Hydraulic Profile

4.2 Waste Solids Equalization Pond

The waste solids equalization pond will continue to function as a holding pond to pump to the sanitary sewer. It will collect the pressate from the new dewatering system, act as a bypass of the new dewatering system, and serve as an overflow for the gravity thickener and backwash equalization basin. The existing waste pumps in the adjacent pump station will pump to the sanitary sewer when needed. The decreased load on the sewer will help prevent the backups that currently occur within the collection system to the WWTP. The south pond was selected as the waste solids equalization pond due to an existing toe drain connection from the reservoir. The average toe drain connection flow is approximately 1 L/min of drainage and will continue to operate the same way after this project is complete.

The following design details and assumptions describe the proposed design:

- Existing footprint and original as-built geometry remain constant to minimize excavation and hauling costs. The jersey barricades will be removed (**Figure 4-1**)
- Max pond water level elevation of 5,357.18 ft – this is constrained by the elevation of the backwash pipe inlet
- Total storage equates to 202,500 gallons – this provides storage for one week of clarifier blowdowns at max flows
- Continued use of the existing waste pumps
- Concrete lined construction

4.3 Gravity Thickener

The gravity thickener will receive the unthickened solids from the clarifiers. Currently, the plant sends these solids via two 4-inch lines to the two holding ponds. A new valve vault will be constructed near the southeast corner of the waste solids equalization pond to direct flow to the new gravity thickener. The thickener will then concentrate those solids into a denser sludge, while allowing for clarified water to be decanted to the backwash equalization pond and recycled.

As discussed in Section 3.1, the operational needs of the dewatering system include intermittent operation during weekdays, and the thickener will have to provide up to three days of solids storage over holiday weekends.

To ensure the thickener is properly sized, 95th percentile conditions were considered as it is very likely that a long weekend in the summer could see these 95th percentile conditions of increased flows and solids loading. These values drive both the solids storage volume needed, and the hydraulic and solids loading rates that will drive the sizing of the thickener.

Using the 95th percentile values, the total loads to the thickener are:

- 16,000 gallons/day of unthickened solids volume
- 1,325 lbs/day total weight of solids

Gravity thickeners are sized to be able to handle both the hydraulic and solids loading from the total volume of solids, as well as the total weight of solids. The next step in sizing the thickener is to determine if hydraulic loading or solids loading drives the thickener diameter. Typical ranges of acceptable loading values are 100-300 gallons/ft^2/day for hydraulic loading, and 2-10 lbs/ ft^2/day for solids loading. Sizing results are below:

- At 200 gallons/ft^2/day maximum hydraulic loading, the minimum thickener diameter is 10 feet
- At 6 lbs/ ft^2/day maximum solids loading, the minimum thickener diameter is 17 feet.

With solids loading driving thickener sizing, a minimum diameter of 17 feet is needed. However, the three days of solids storage at 16,000 gallons/day would add significant depth to the thickener to accommodate these solids. Therefore, the thickener will likely need to be 20-22 feet in diameter to balance footprint and overall depth of the structure. This will be optimized in design depending on groundwater conditions, site elevation constraints, and plant hydraulics.

4.4 Dewatering Building

Sufficient space is available south of the ponds to locate a new dewatering building, see **Figure 4-3**. An initial layout as shown in **Figure 4-4** was drafted around Prime Solution’s 48-inch dual-channel rotary fan press skid. Major components that will be housed in the building include:

- Polymer Storage – two 275 gallon totes on IBC spill containment pallets
- Dewatering skids
- Conveyor – assuming 27 degree angle
- Roll-off bin –20 yd^3
- Electrical Room

To minimize building space, the electrical room was broken off as an additional space, so it would not drive the length or width of the building footprint. For cost savings, a prefabricated metal building was selected. A roll-up door for access to the roll-off bin was sited on the south side of the building as well as a double-door allowing a forklift to easily deliver and remove polymer totes. Final height will be driven by conveyor selection. Prime Solutions can include an OEM shaftless screw conveyor with the fan press skid.

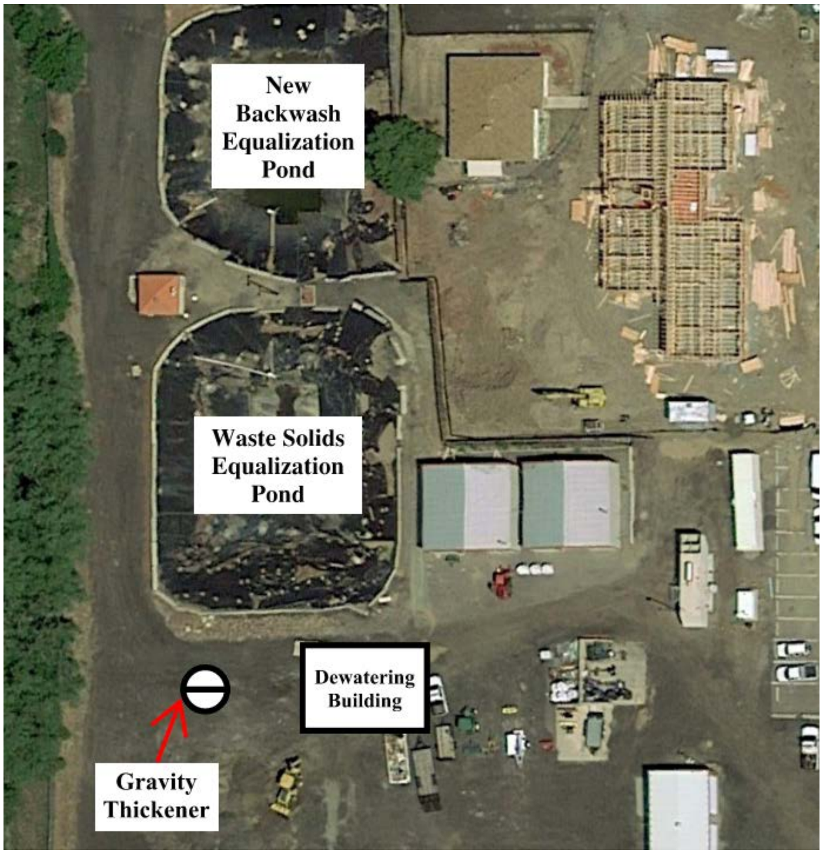


Figure 4-3: Dewatering Building Location

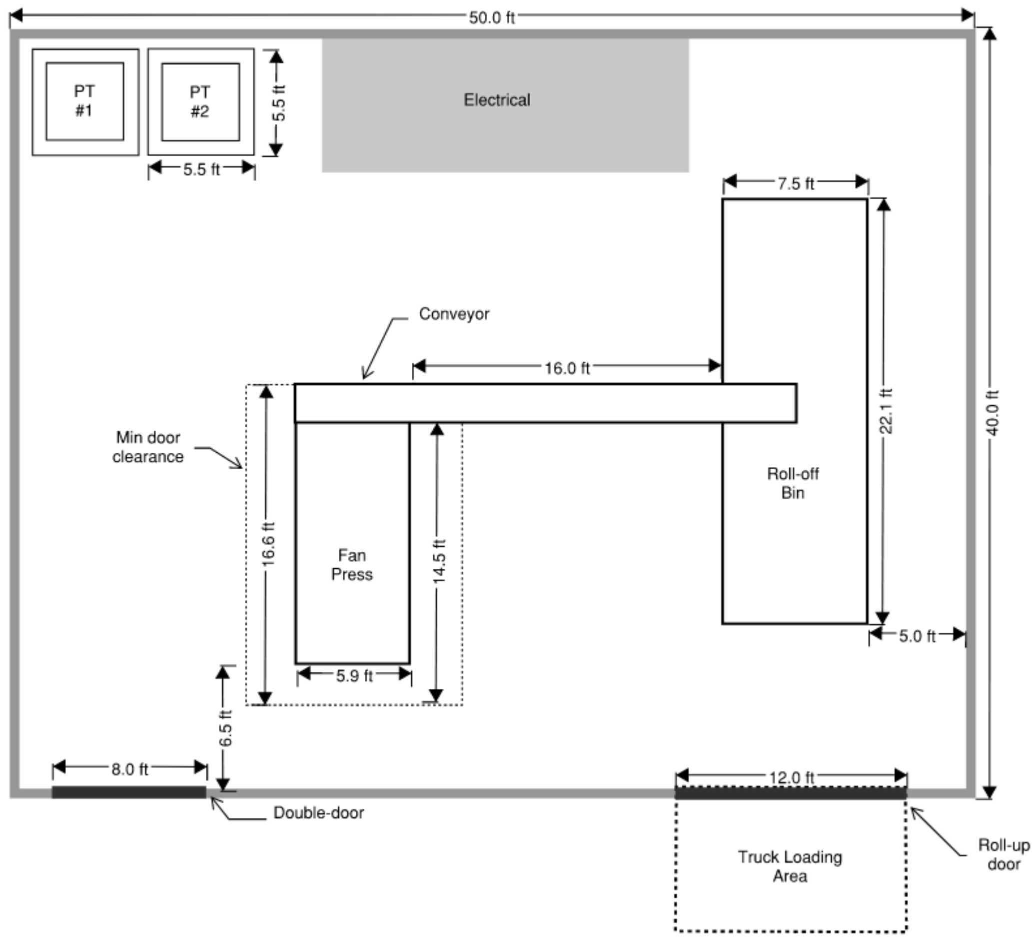


Figure 4-4: Preliminary Dewatering Building Layout
(See Appendix D)

5. Cost Estimate

5.1 Preliminary Construction Cost Estimate

A feasibility level (Class IV) cost estimate was developed for the project and is summarized in **Table 5-1**. This estimate is expected to be within +50 to -30 percent of the actual construction costs. Labor costs were estimated from regional bid tabs of similar sized projects. General Conditions includes mobilization/demobilization, erosion & sediment control, site trailers, submittals, etc. The Construction Notice-to-Proceed (NTP) was assumed to be July 1, 2021 with a total duration of 12 months. The full breakdown is attached in **Appendix E**.

A 30% contingency is recommended for the preliminary phase of the project. As the design progresses and more information is available, this contingency will be reduced. The contingency covers design unknowns and further details that have not been defined during the study phase, such as:

- Geotechnical unknowns
- Utility conflicts
- Yard piping valves, valve boxes/manholes
- Electrical ductbanks, and possible new electrical equipment
- Additional excavation and grading
- Architectural requirements (railings, stairs, etc.)
- Equipment testing & startup, pump balancing, etc.
- Instrumentation, Controls and Integration

Additionally, a 10% bidding environment factor is recommended given the competitive market for construction services in the Denver Metro area. This addition is meant to quantify risk associated with the current workload of contractors and impacts of Covid-19. This risk can be mitigated through early conversations and involvement of contractors prior to requesting bids. Additional construction schedule flexibility can also lower the risk of high bids in the current market conditions.

Table 5-1: Cost Estimate Summary

Description	Total
General Conditions (15%)	$ 354,000
Sitework	$ 285,000
Backwash Equalization Pond	$ 113,000
Waste Solids Equalization Pond	$ 124,000
Recycle Pump Station	$ 300,000
Gravity Thickener	$ 600,000
New Dewatering Building	$ 939,000
Subtotal:	$ 2,715,000
Contractor and Subcontractor Overhead, Profit and Fee	$ 715,000
Subtotal:	$ 3,430,000
Labor Escalation at 3.5% annually	$ 16,000
Material/Equipment Escalation at 5% annually	$ 34,000
Subtotal:	$ 3,480,000
Bonds and Insurance (3.0%)	$ 104,000
Subtotal:	$ 3,585,000
Design Contingency (30%)	$ 1,075,000
Total (Rounded)[1]:	$ 4,660,000

1. Total (Rounded) with 10% Bidding Environment contingency: **$5,130,000**

5.2 Alternative Building Size Estimate

One value engineering option is to reduce the size of the building footprint by locating the roll-off bin outside of the metal building. Reducing the footprint to a 30 feet x 40 feet building saves 800 square feet of building space and an estimated $300,000. The smaller building will require less HVAC and electrical but all servicing of the roll off bin will happen outdoors. An overhang can protect the roll-off from most weather but adds to the complexity of the conveyor from the fan press skid through the building wall. This construction estimate is summarized in **Table 5-2**.

Table 5-2: Modified Building Footprint - Cost Estimate Summary

Description	Total
General Conditions (15%)	$ 354,000
Sitework	$ 285,000
Backwash Equalization Pond	$ 113,000
Waste Solids Equalization Pond	$ 124,000
Recycle Pump Station	$ 300,000
Gravity Thickener	$ 600,000
New Dewatering Building	*$ 750,000*
Subtotal:	$ 2,530,000
Contractor and Subcontractor Overhead, Profit and Fee	$ 660,000
Subtotal:	$ 3,190,000
Labor Escalation at 3.5% annually	$ 14,000
Material/Equipment Escalation at 5% annually	$ 30,000
Subtotal:	$ 3,234,000
Bonds and Insurance (3.0%)	$ 100,000
Subtotal:	$ 3,334,000
Design Contingency (30%)	$ 1,000,000
Total (Rounded)[1]:	$ 4,340,000

1. Total (Rounded) with 10% Bidding Environment contingency: **$4,780,000**

6. Economic Analysis

6.1 20-year Life Cycle Cost

Capital and annual costs were used to estimate the total investment for the 20-year design life of the proposed dewatering equipment. The valuation used an interest rate of 5% to account for the opportunity costs of committing annual funds to the budget. Certain aspects of annual costs such as electricity, chemicals, employee rates, etc., will increase over time with inflation. A material escalation factor of 3% was applied to the annualized costs to account for this inflation. No debt costs were factored into the capital investment. The life cycle costs are included in **Appendix E**.

Additional staffing will be needed for the dewatering building, thickener and recycle system. Most weeks the equipment will only run two days a week requiring 4 to 6 hours of operator attention. During peak periods, the equipment may require operation up to five days a week or 10-15 hours of operator attention. Adding in additional maintenance and operation of the recycle system led to a total of just over 500 O&M hours a year, or the equivalent of a quarter-time operator.

Table 6-1: 20-year Life Cycle Cost Analysis

Estimated O&M for additional .25 FTE staff[1] [A]	$22,850
Estimated Annual Parts[2] ($/yr) [B]	$5,700
Polymer Cost[3] ($/yr) [C]	$3,779
Electrical Cost[4] ($/yr) [D]	$1,271
Hauling Costs[5] ($/yr) [E]	$2,117
Annual Costs [A+B+C+D+E]	$35,717
Annualized Costs (NPW)	$450,000
Annualized Cost w/ Material Cost Escalation (NPW)	$590,000
Total Initial Capital Cost	$4,660,000
20-year Net Present Worth ($)	**$5,300,000**

Notes:

1. Midpoint of the City's operator salary for 0.25 FTE + 50% Overhead
2. Estimated at 1.5% of equipment cost per year
3. Using fan press data and typical polymer rate for the front range
4. Using $0.07 per kWh blended Denver Rate
5. Using $36.50/yd^3 Northglenn rate

6.2 20-year Savings Analysis

Using the same parameters as the life cycle cost analysis, savings were calculated for the 20-year lifespan. Four major components were considered for savings: cost to treat the flows at the wastewater treatment plant, hauling of solids from the wastewater treatment plant, electrical savings for the waste pumps and the avoided water rights acquisition costs. The wastewater treatment and hauling savings were estimated using current costs for the WWTP and estimated electrical savings are for reduced run time of the existing waste pumps. As discussed in Section 2.5, the water right cost avoidance was calculated using values per acre-ft from the City's water resources department. A full breakdown is included in **Appendix E**.

Table 6-2: 20-year Savings Analysis

Estimated Annual Wastewater Treatment Savings[1] [A]	$84,000
Estimated Annual Wastewater Hauling Savings[2] [B]	$23,689
Electrical Savings[3] ($/yr) [C]	$2,556
Annual Savings [A+B+C]	$110,244
Annualized Savings (NPW)	$1,380,000
Water Rights Cost Avoidance	$5,050,000
20-year Net Present Worth ($)	**$6,500,000**

Notes:

1. Using $1.68/1000 gallons
2. Using $421.22/dry ton
3. Using $0.07 per kWh blended Denver Rate

6.3 Cost vs. Savings Analysis and Recommendation

The City analyzed their water supply system in the 2019 IWRP and projects a water supply/demand gap of 751 acre-ft/yr. The Solids Handling Improvements Project offers water savings of 40 to 60 million gallons of water per year which is currently sent to the WWTP. Recycling this volume of water will help to close the water gap without going through the legal process of acquiring new water rights at $40,000 to $50,000 per acre-ft and avoids approximately $300,000 in water court case costs. The initial $4.6M - $5.1M capital cost for the Solids Handling Improvements is immediately offset by the $4.5M - $5.6M in avoided water rights costs.

At an average 50 million gallons per year, the WTP waste flows account for approximately 4 percent of the wastewater treated by the City each year. Reducing this volume results in $75,000 of wastewater treatment and hauling savings each year. As an added bonus, capturing the solids produced in the water treatment process alleviates the flow sent via force main through nearby neighbors to the WWTP. This force main currently causes periodic backups and operational issues affecting households along the force main alignment.

It is recommended to construct the Solids Handling Improvements to save $1.2M over the next 20 years. The additional operations time and complexity at the WTP will see alleviated water rights needs and reduce loads at the WWTP.

7. Summary of Decision Points

The predesign process was conducted in three main stages – 1) complete the mass balance calculations, 2) determine dewatering technology, and 3) decide on the key facility drivers. To complete the mass balance, first the historical data was reviewed and mass balance inputs determined, summarized in **Table 6-1**. Then the clarifier and filter operations were discussed to develop the parameters in **Table 6-2** for each of the processes.

Table 7-1: Summary of Mass Balance Inputs

Case	Daily Production (MG)	Raw Water Turbidity (NTU)	Alum Dose (mg/L)
50th percentile	2.7	1.8	19
95th percentile	7.2	4.6	24
Max flow	9.0	8.2	24

Table 7-2: Summary of Clarifier and Filter Parameters

Clarifier Parameter	Case		
	50th Percentile	95th Percentile	Max Flow
Raw water flow (mgd)	2.7	7.2	9.0
Effluent turbidity (NTU)	0.20 - 0.50	0.60	0.40
Dry solids concentration (%)	0.25	1.0	1.0
Filter Parameter			
Raw water flow (mgd)	2.7	7.2	9.0
Number of duty filters	3	5	7
Number of standby filters	5	3	1
Filter loading rate (gpm/ft^2)	1.9	2.9	2.6
Filter run time (hours)	48	24	24
Number of backwashes per filter per day	0.5	1	1
Filter effluent turbidity (NTU)	0.020	0.020	0.020

From these, three alternatives were analyzed, and Alternative 2 - Mechanical Dewatering with Gravity Thickening was chosen. This alternative's solids production, **Table 6-3**, was used to size and determine the preferred dewatering technology.

Table 7-3: Summary of Solids Production

Parameter	50th Percentile	95th Percentile	Max Flow
Recycle flow (mgd)	0.099	0.33	0.48
Flow to sewer (mgd)	0.013	0.016	0.019
Solids to sewer (mgd)	44	189	276
Solids to landfill (ppd)	309	1,170	1,934

Six dewatering technologies were initially evaluated including the screw press, volute screw press, fan press, centrifuge, belt filter press, and drying beds. Of these, it was determined the screw press, volute screw press and fan press would best fit the City's operational needs. Vendor proposals and pilot testing narrowed these to a rotary fan press as the best option for the City.

Four key facilities will be designed as part of the dewatering system: backwash equalization pond, waste solids equalization pond to sanitary sewer, gravity thickener and dewatering building. The following key criteria were determined to guide initial sizing and cost estimating:

Backwash Equalization Pond

- Existing footprint and geometry remain constant (will be refined during final design)
- Max pond water level elevation of 5,357.18 ft – constrained by the elevation of the backwash pipe inlet
- Total storage equates to 202,500 gallons – this provides storage for three backwash events at 64,000 gallons per backwash event, or about 48 hours of storage under average conditions
- Periodic dredging will be used to remove solids accumulation
- New recycle pumps will be installed in the existing pump station
- Concrete lined

Waste Solids Equalization Pond to Sanitary Sewer

- Existing footprint and geometry remain constant
- Max pond water level elevation of 5,357.18 ft – this is constrained by the elevation of the backwash pipe inlet
- Total storage equates to 202,500 gallons – this provides storage for one week of clarifier blowdowns at max flows
- Continued use of the existing waste pumps
- Concrete lined construction

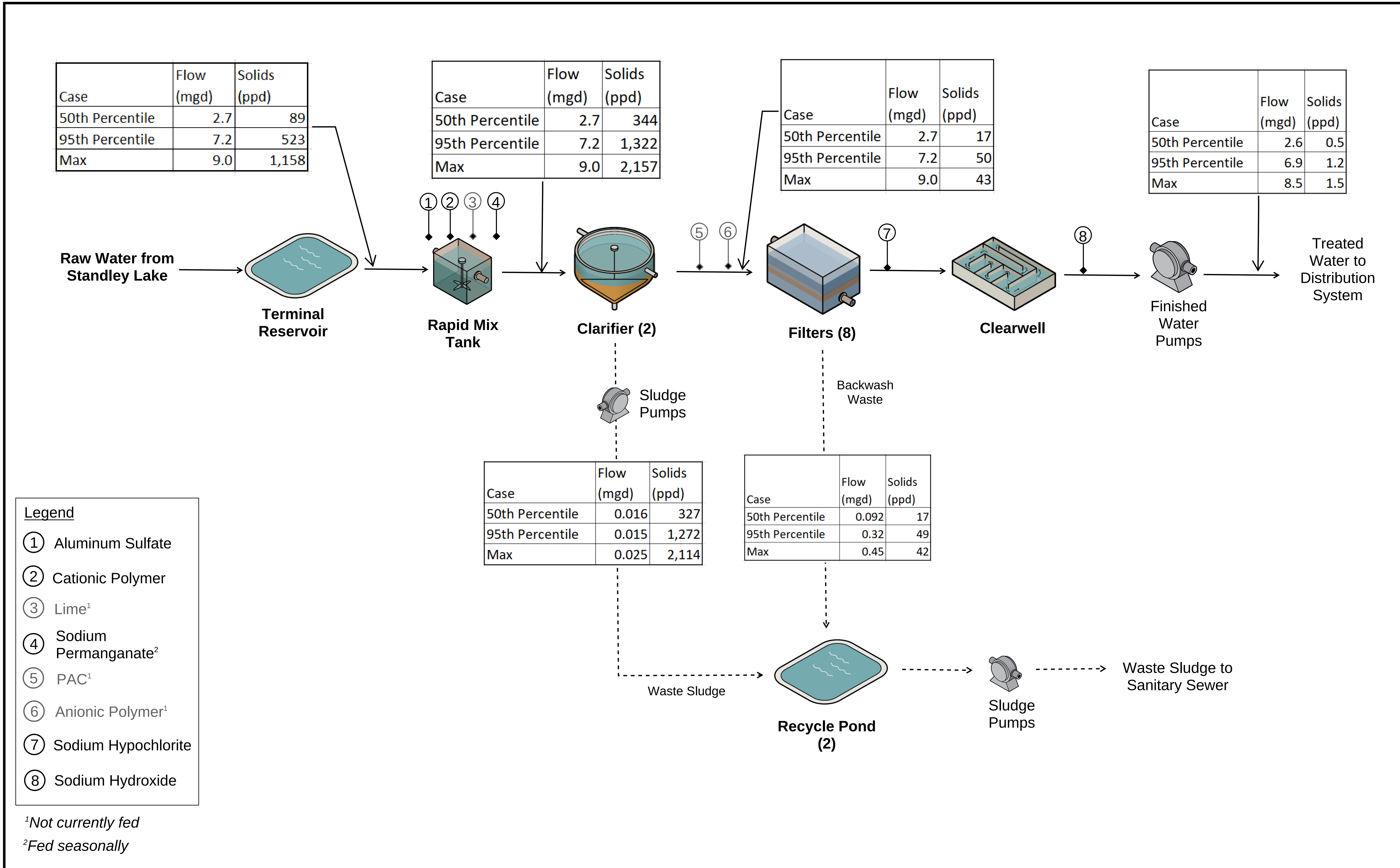
Gravity Thickener

- A gravity thickener will be constructed instead of a sludge holding tank
- The thickener will be sized using 95^{th} percentile values, resulting in the following loads:
  - 16,000 gallons/day of unthickened solids volume
  - 1,325 lbs/day total weight of solids

Dewatering Building will include:

- Polymer Storage – two 275 gallon totes on IBC spill containment pallets
- Conveyor – assuming 27 degree angle
- Roll-off bin –20 yd^3
- Electrical Room
- Prefabricated Metal Building

Appendix A: Process Flow Diagrams



Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	89
95th Percentile	7.2	523
Max	9.0	1,158

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	344
95th Percentile	7.2	1,322
Max	9.0	2,157

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	17
95th Percentile	7.2	50
Max	9.0	43

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.6	0.5
95th Percentile	6.9	1.2
Max	8.5	1.5

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.016	327
95th Percentile	0.015	1,272
Max	0.025	2,114

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.092	17
95th Percentile	0.32	49
Max	0.45	42

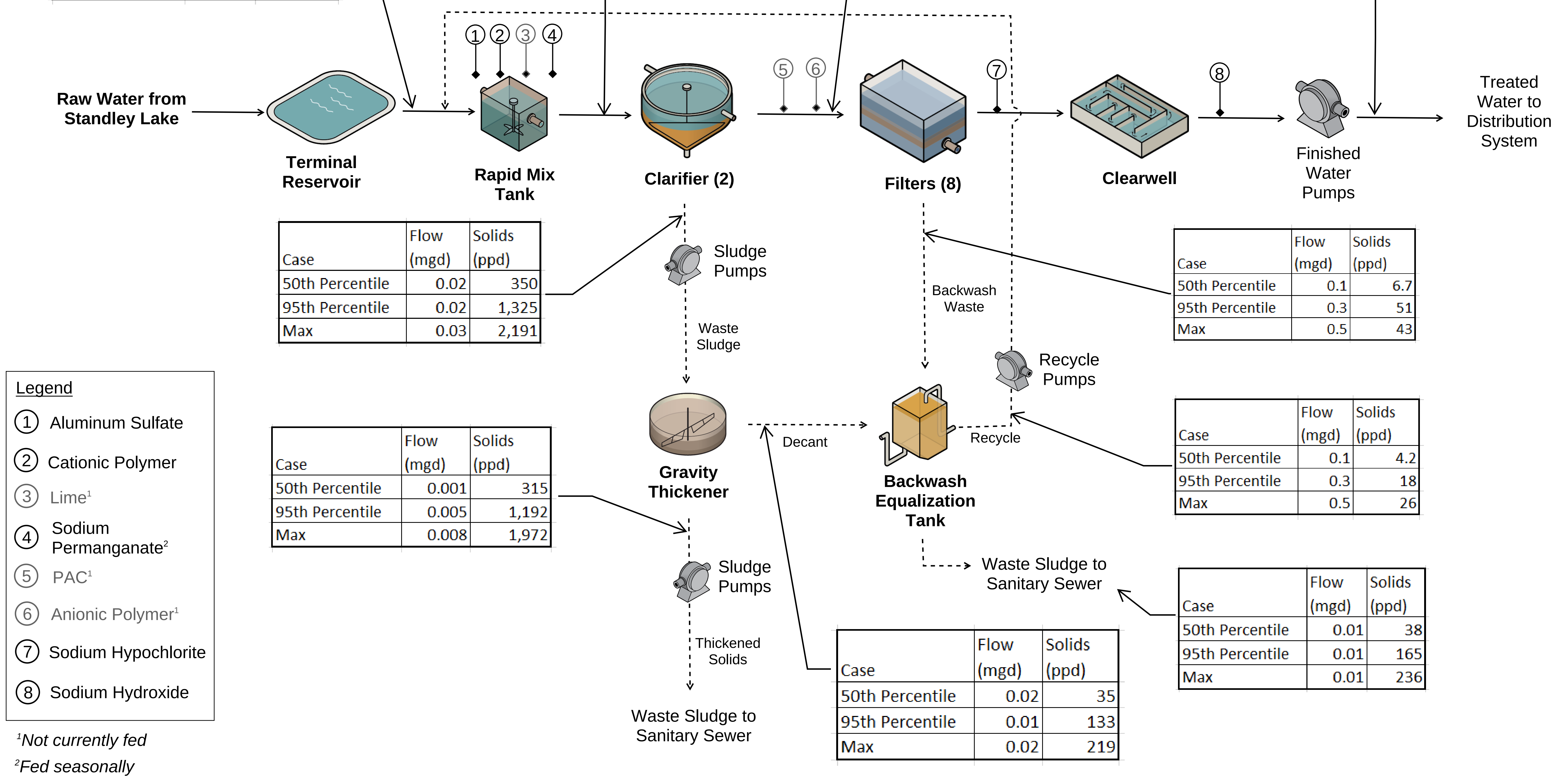
[1]Not currently fed

[2]Fed seasonally

City of Northglenn Water Treatment Plant - Process Flow Diagram

Current Design

Hazen



Raw water to Terminal Reservoir / Rapid Mix Tank:

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	89
95th Percentile	7.2	523
Max	9.0	1,158

Clarifier (2) influent:

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.8	357
95th Percentile	7.5	1,378
Max	9.5	2,236

Filters (8) influent:

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.8	7.2
95th Percentile	7.5	52
Max	9.4	45

Treated Water to Distribution System:

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	0.5
95th Percentile	7.2	1.3
Max	9.0	1.6

Waste Sludge from Clarifier:

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.02	350
95th Percentile	0.02	1,325
Max	0.03	2,191

Backwash Waste:

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.1	6.7
95th Percentile	0.3	51
Max	0.5	43

Recycle:

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.1	4.2
95th Percentile	0.3	18
Max	0.5	26

Thickened Solids:

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.001	315
95th Percentile	0.005	1,192
Max	0.008	1,972

Decant:

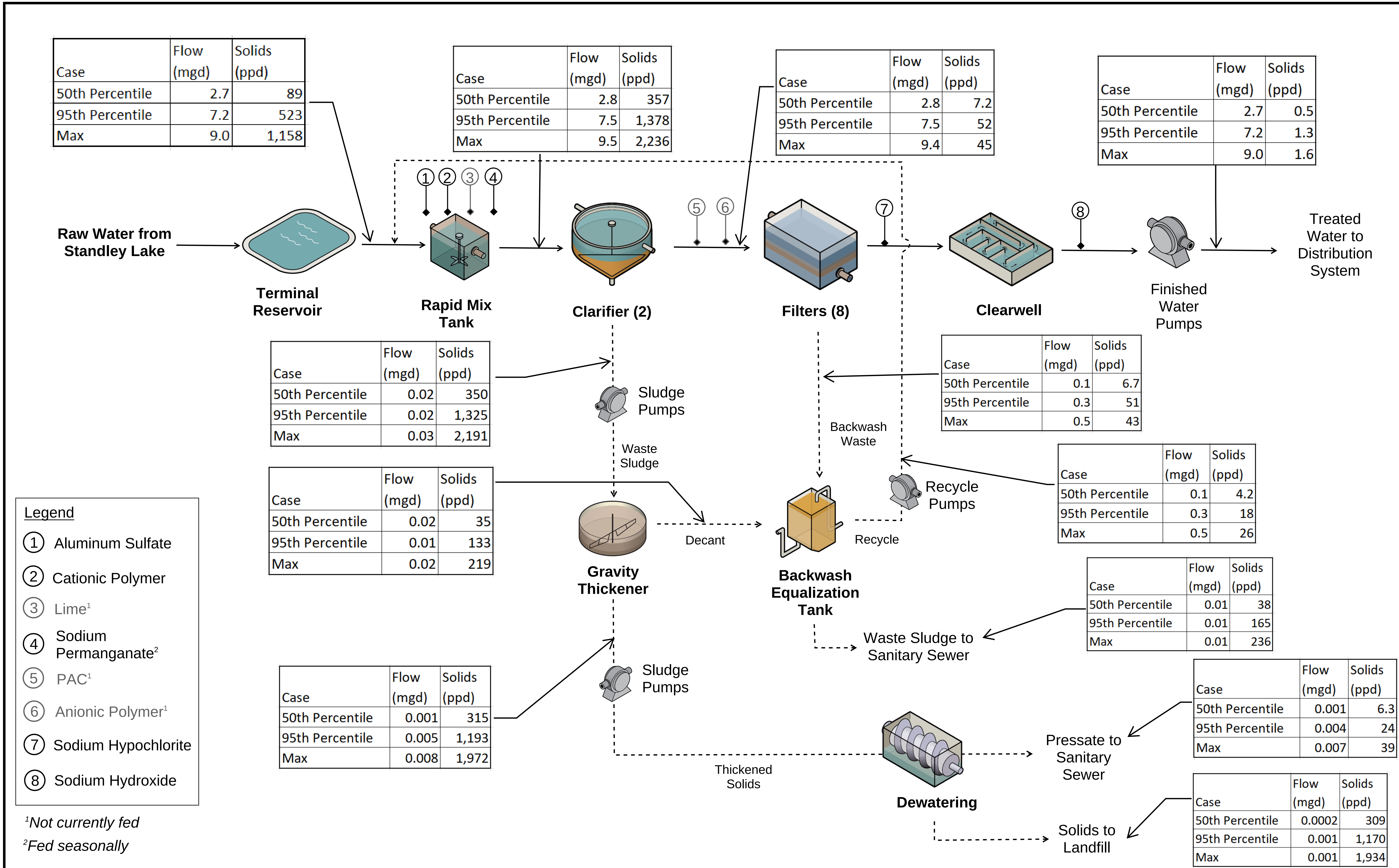
Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.02	35
95th Percentile	0.01	133
Max	0.02	219

Waste Sludge to Sanitary Sewer (Backwash Equalization Tank):

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.01	38
95th Percentile	0.01	165
Max	0.01	236

City of Northglenn Water Treatment Plant - Process Flow Diagram
Alternative 1 - *Gravity thickener, backwash equalization and recycle, solids to sewer*
Alternative 1 was not selected for further design/construction consideration

Hazen



Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	89
95th Percentile	7.2	523
Max	9.0	1,158

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.8	357
95th Percentile	7.5	1,378
Max	9.5	2,236

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.8	7.2
95th Percentile	7.5	52
Max	9.4	45

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	0.5
95th Percentile	7.2	1.3
Max	9.0	1.6

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.02	350
95th Percentile	0.02	1,325
Max	0.03	2,191

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.1	6.7
95th Percentile	0.3	51
Max	0.5	43

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.02	35
95th Percentile	0.01	133
Max	0.02	219

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.1	4.2
95th Percentile	0.3	18
Max	0.5	26

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.01	38
95th Percentile	0.01	165
Max	0.01	236

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.001	315
95th Percentile	0.005	1,193
Max	0.008	1,972

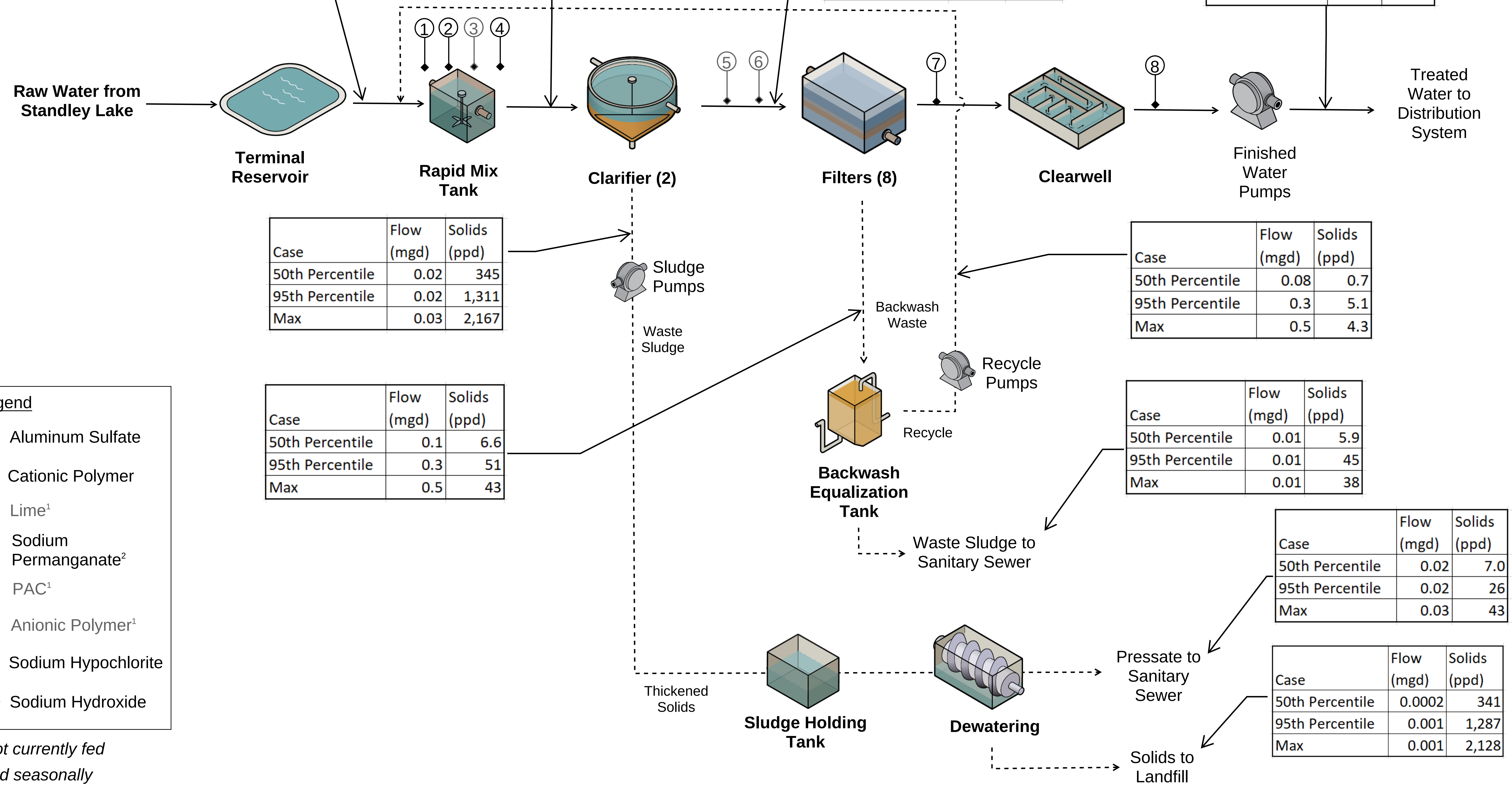
Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.001	6.3
95th Percentile	0.004	24
Max	0.007	39

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.0002	309
95th Percentile	0.001	1,170
Max	0.001	1,934

City of Northglenn Water Treatment Plant - Process Flow Diagram

Alternative 2 - *Gravity thickener, backwash equalization and recycle, dewatering (pressate to sewer, solids to landfill)*

Hazen



Raw Water from Standley Lake / Terminal Reservoir to Rapid Mix Tank

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	89
95th Percentile	7.2	523
Max	9.0	1,158

Rapid Mix Tank to Clarifier

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.8	352
95th Percentile	7.5	1,363
Max	9.5	2,211

Clarifier to Filters

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.8	7.1
95th Percentile	7.5	52
Max	9.4	44

Treated Water to Distribution System

Case	Flow (mgd)	Solids (ppd)
50th Percentile	2.7	0.5
95th Percentile	7.2	1.3
Max	9.0	1.6

Waste Sludge (Sludge Pumps)

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.02	345
95th Percentile	0.02	1,311
Max	0.03	2,167

Recycle

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.08	0.7
95th Percentile	0.3	5.1
Max	0.5	4.3

Backwash Waste

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.1	6.6
95th Percentile	0.3	51
Max	0.5	43

Waste Sludge to Sanitary Sewer

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.01	5.9
95th Percentile	0.01	45
Max	0.01	38

Pressate to Sanitary Sewer

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.02	7.0
95th Percentile	0.02	26
Max	0.03	43

Solids to Landfill

Case	Flow (mgd)	Solids (ppd)
50th Percentile	0.0002	341
95th Percentile	0.001	1,287
Max	0.001	2,128

Legend

1. Aluminum Sulfate
2. Cationic Polymer
3. Lime[1]
4. Sodium Permanganate[2]
5. PAC[1]
6. Anionic Polymer[1]
7. Sodium Hypochlorite
8. Sodium Hydroxide

[1]Not currently fed

[2]Fed seasonally

City of Northglenn Water Treatment Plant - Process Flow Diagram

Alternative 3 - *Backwash equalization and recycle, dewatering (pressate to sewer, solids to landfill)*

Alternative 3 was not selected for further design/construction consideration

Hazen

Appendix B: Pilot Testing

Report on Piloting of the PWTech Volute Dewatering Press at the Northglenn WTF in Colorado

October 14th – 18th, 2019

PWTech
PROCESS WASTEWATER TECHNOLOGIES LLC
Process Wastewater Technologies, LLC.
9004 Yellow Brick Road, Suite D, Rosedale, MD21237
Phone: 410-238-7977, Fax: 410-238-7559

Pilot Operator: Nathan Hovorka
Report Prepared by: Nathan Hovorka
Manufacturer's Representative: Sean Lynch, Ambiente H20 Inc.

Summary

- The Volute Dewatering Press, model ES-201, was piloted on alum sludge from a lagoon
- Cake solids as high as 34.0% were achieved.
- Solids capture rates averaged 98.4% for runs dosing >14.7 lbs/ton
- Dewatering power use averaged 12.0 kWh/DT

Contents

1. Introduction

PWTech piloted the Volute Dewatering Press, model ES-201, on alum sludge at the Northglenn Water Treatment Facility (WTF) in Colorado.

The North Glenn WTF treats an average of 3.5 MGD during the winter (up to 10 MGD in the summer) and uses a conventional treatment process. Water from a nearby reservoir enters a flocculation tank where coagulants are added and rapidly mixed prior to clarification. Clarified water is then chlorinated and filtered before storage and distribution. **Figure 1** outlines the treatment process at Northglenn with the location of the pilot unit.

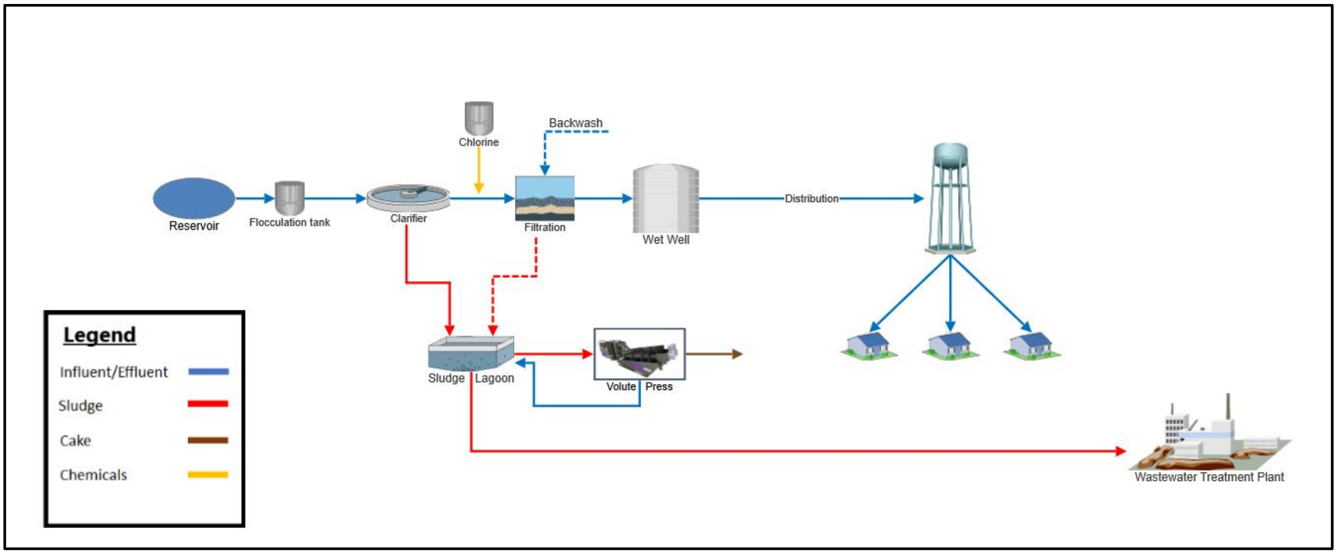


Figure 1: Water treatment process with pilot unit location

Sludge from the clarifiers and backwash from the filters is stored in a lagoon before being pumped over 9 miles to the WWTP where it can be dewatered. This increases the maintenance required for lift stations and creates other issues for the WTF when they discharge sludge to the WWTP. The plant is looking at onsite dewatering options to eliminate these issues

The clarifier wastes approximately 15,600 gallons per day (100-130 GPM wasted for 10 min. every 120 min.), and a total of 60 million gallons of sludge were discharged to the WWTP last year.

PWTech conducted pilot testing in order to demonstrate the operations and performance of the Volute Press. Several parameters were tested in order to determine the best method of operation and examine the feasibility of onsite dewatering. This report details the methods of testing used and the results achieved during the pilot study.

2. Objective

The objectives of this pilot were to demonstrate the operation of the Volute Press and determine the best method of operation.

3. Pilot Set-Up

The trailer mounted Volute, model ES-201, was parked next to one of the lagoons. A submersible pump was placed in the lagoon in order to fill a small tank with sludge. Inside the tank, one pump was used to mix the sludge and another was used to supply sludge to the pilot unit. This setup (shown in **Figure 2**) created a well-mixed tank that could be used to accurately determine polymer doses and throughput. Pressate (also referred to as filtrate) was discharged back into the lagoon, and cake was discharged into an empty chemical tote. 480V power and wash water were provided by the plant via nearby connections.

Figure 2: Sludge mixing tank setup

The ES-201 has a single 8-inch diameter drum, and a maximum solids throughput capacity of 80 dry lbs/hour for thick sludge (>3% solids) and the hydraulic throughput capacity is 15 GPM for thin sludge (<1% solids).

4. Testing and Sample Analysis

Following the start-up of the unit, different variables were isolated and altered in order to find the most cost effective and efficient methods of dewatering. The controlled variables were:

- Feed sludge flow rate (and the resulting screw speed)
- Polymer type
- Polymer dose (units of active lbs / dry ton of solids)

In order to determine the effectiveness of the unit, samples were taken once every hour. Types of samples taken include:

- Cake solids- measured as total residual solids (TS) in weight percent
- Feed solids- measured as total residual solids (TS) in weight percent
- Pressate solids- – measured as total suspended solids (TSS) in mg/L

Feed and cake solids were measured using a moisture analyzer made by Sartorius, which is accurate up to 0.1%. The machine works by recording the initial weight of the sample and heating it at 105 ˚C until the weight of the sample changes less than 1 mg per minute. The total residual solids are calculated as a percent using the equation below:

$$Total\ \%\ Solids = 100 * \left(\frac{A}{B}\right)$$

Where A is the weight of the dry sample and B is the weight of the wet sample.

Pressate samples (also referred to as filtrate) were collected from the end of the pressate hose, and a TSS analysis was conducted at a nearby lab. This procedure is best performed in a lab instead of a trailer because vibrations, wind, and other factors affect the accuracy of the test.

The polymer system in the trailer was fed the liquid polymer, which was then activated by introducing water. After mixing appropriately, the activated polymer was introduced to the influent sludge inside the mixing tank in order to achieve flocculation.

The polymer tested was:

- Solenis Praestol K111

Current and voltage readings from each motor on the pilot unit were recorded every hour. These were used to calculate the power use directly related to dewatering, as well as the overall power use of the pilot unit.

5. Results and Discussion

10 sets of samples, also called “runs”, were tested during the pilot study. **Figure 3** below shows the influent sludge compared to the cake solids and pressate produced during the initial startup of the pilot unit.

Figure 3: Influent sludge (Left) compared to the cake solids (Bottom Right) and pressate (Top Right).

A comprehensive set of parameters and sample results is tabulated in the appendix of this report. The following sections discuss specific parameters and the results achieved for the pilot study.

5.1. Influent Solids

Initially, sludge was pumped into an empty chemical tote and mixed while the pilot unit was running. The tote could not hold a large enough volume to account for a full hour of running, so a larger tank was used after run #3 to ensure the influent solids did not change in the middle of a run. For each run following, the sludge tank was filled, mixed, and sampled prior to operating the pilot unit. By knowing the influent solids concentration before operating, the pilot unit could run at the desired settings without any unexpected changes in solids concentration. **Figure 1** displays the influent solids concentrations for each run.

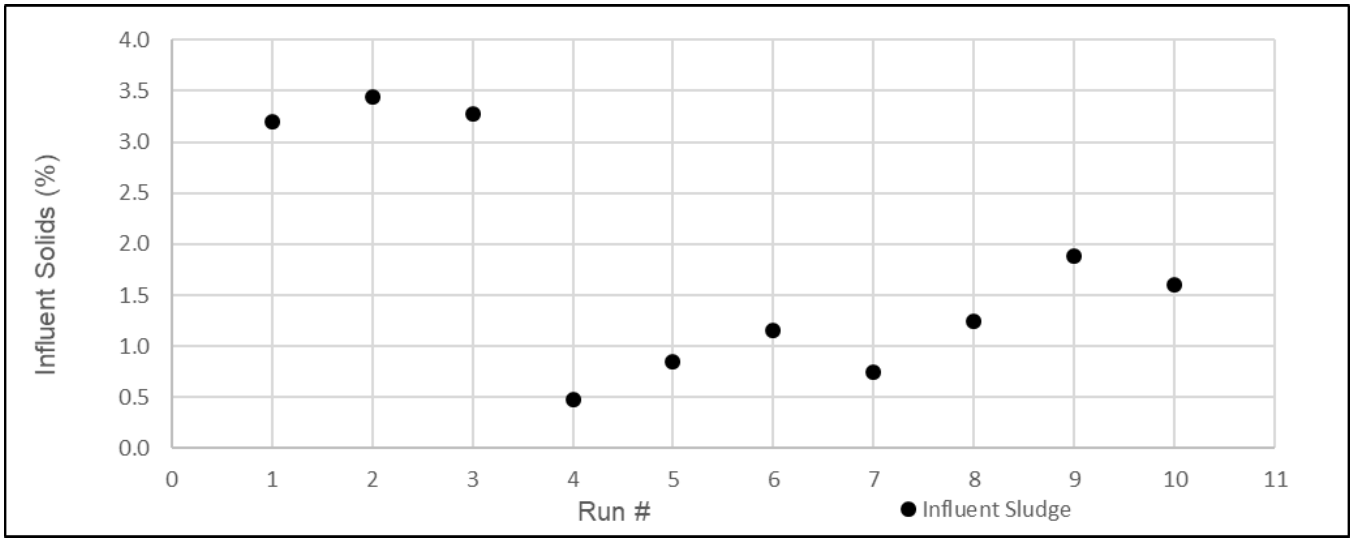


Figure 3: Influent solids concentrations for each run

Changes in influent solids affect the polymer dose and operating throughput, and having a well-mixed tank is important for pilot testing because of the various polymer doses and throughputs that are tested. The large variation in solids concentration after run #3 can be attributed to excess water present in the lagoon after clarifier wasting, which was decanted into the second lagoon for the remainder of the week.

5.2. Cake Solids Overview

Cake solids as high as 34.0% solids were achieved, and averaged 26.1% solids. **Figure 4** displays the cake solids produced during each run. Variations in cake solids resulted from different polymer doses and throughputs, which are discussed in the following sections.

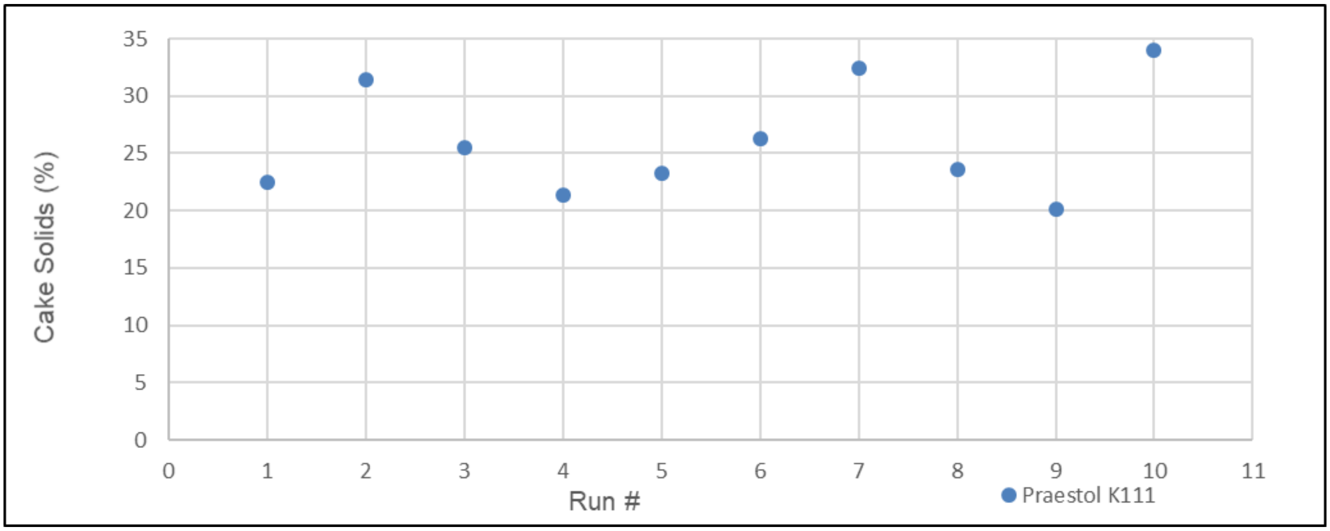


Figure 4: Cake solids produced during each run

5.3. Polymer Selection and Dosing

Solenis Praestol K111 was the polymer provided by PWTech and used for each run. This polymer was tested across a range of doses in order to determine the best method of operation. **Figure 5** displays the cake solids produced relative to different polymer doses. Each sample was taken while the pilot unit was operating between 60-86% of the rated throughput.

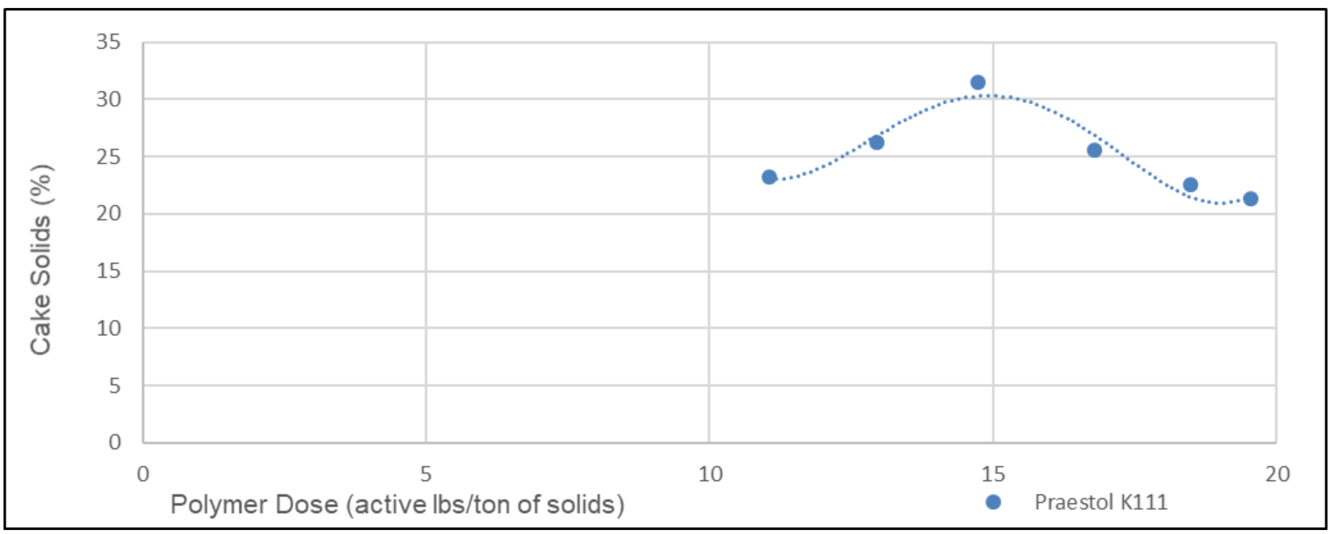


Figure 5: Cake solids vs. polymer dose

During this test, the highest cake solids (31.4% solids) were produced at 14.7 lbs/ton. Above this dose, cake solids decreased and excess polymer was present in the filtrate. Below this dose, both cake solids and solids capture rates decreased due to a weak floc. Solids capture rates for these runs can be seen in **Figure 6** below.

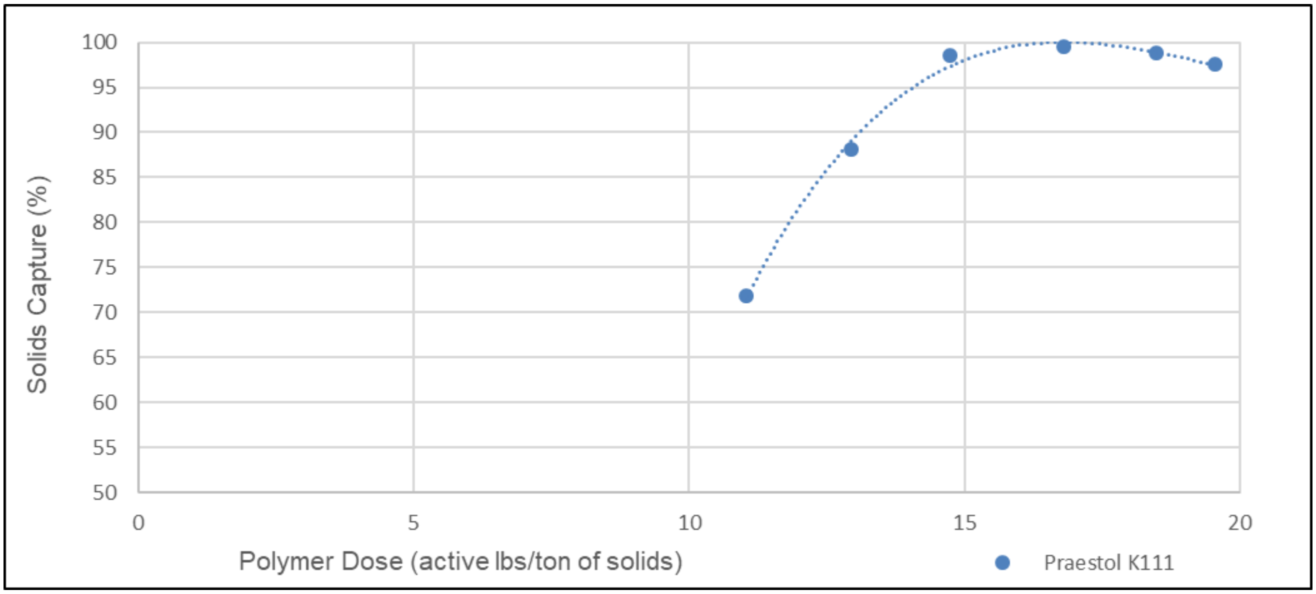


Figure 6: Solids capture rates vs. polymer dose

Solids capture rates >97% were produced for each run with a dose >14.7 lbs/ton. Below this dose, only a small floc was produced, and more solids were able to pass into the pressate.

5.4. Solids Throughput

After the optimal polymer dose was determined, several runs were conducted at different throughputs while maintaining a polymer dose of ~15 lbs/ton. The results for these runs are shown in **Figure 7**. The dashed line at 80 dry lbs/hour represents the rated maximum throughput capacity for the pilot unit.

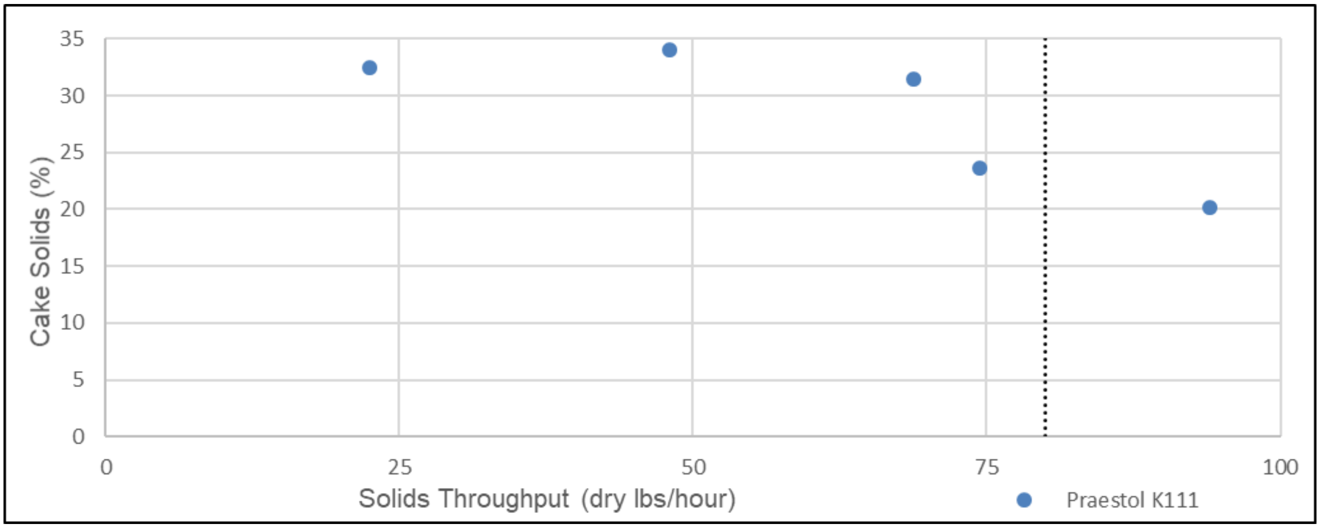


Figure 7: Cake solids vs. throughput

Cake solids >31% were produced until the pilot unit operated beyond 69 dry lbs/hour (86% of max capacity). While operating above this throughput, cake solids decreased because of the increased speed of the augers inside the drums. This reduces the amount of time that sludge spends under pressure, which explains the decrease in cake solids at higher throughputs. Once the unit began operating at 74 dry lbs/hour (93% of max capacity), cake solids decreased to 23.6%.

5.5. Solids Capture Performance

Solids capture rates as high as 99.5% were recorded, and averaged 98.4% for all runs dosed >14.7 lbs/ton. **Figure 8** displays the solids capture rates for each run. The lower results for runs 5 and 6 were the result of underdosing polymer.

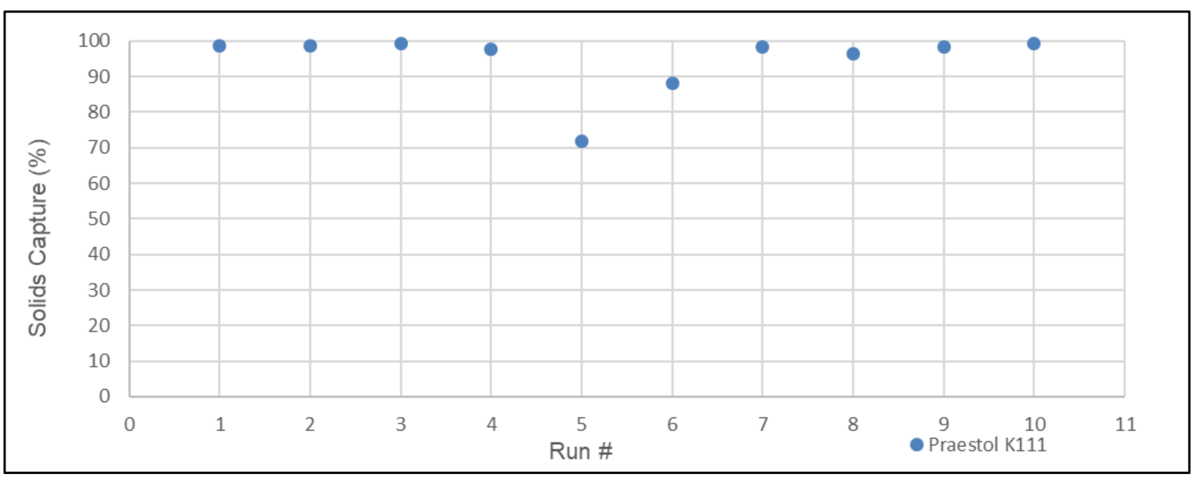


Figure 8: Solids capture rates for each run

5.6. Power Consumption Analysis

During the pilot, the Volute power use required to dewater solids was monitored using current and voltage readings from motor VFD's within the control panel. Two power uses were recorded: the average power used by the dewatering drums (dewatering power use) and the average power used by all components of the Volute (dewatering drums, tank mixers, and feed pump) referred to as total power use, which can be found in the appendix. Power use is made scalable to larger Volutes as it is related to the dry tons of solids processed within a run (kWh/DT). **Figure 8** displays the dewatering power use relative to the solids throughput capacity.

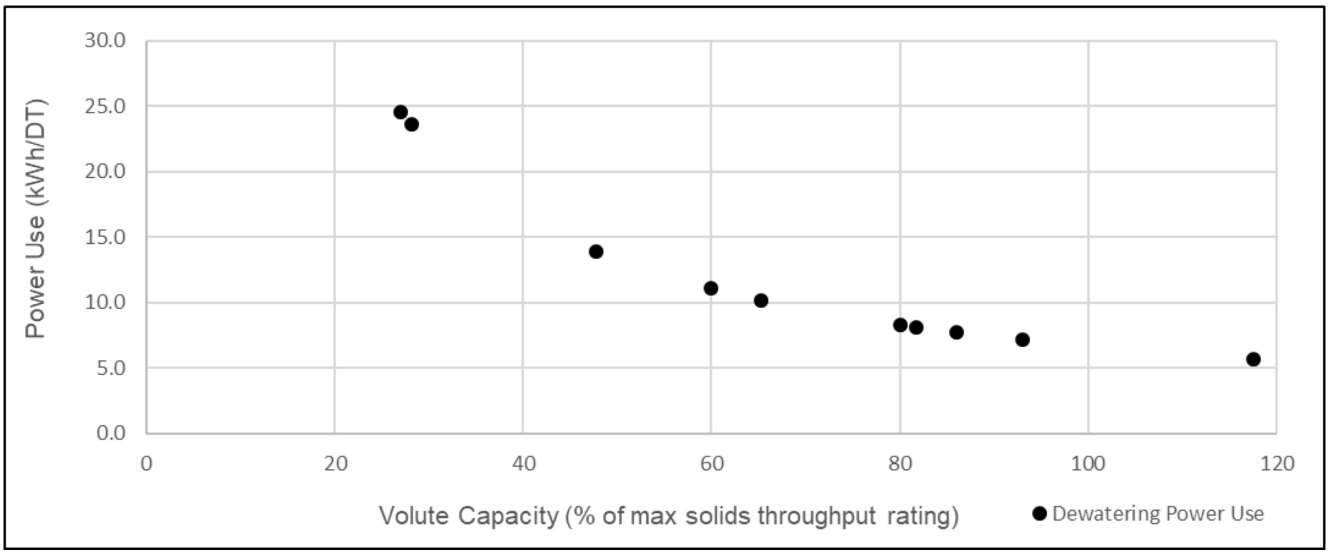


Figure 8: Power use vs. solids throughput

Power use does not increase proportionally as throughput is increased; therefore, higher throughput results in lower power use per dry ton of solids processed. Over the duration of the pilot, dewatering power use averaged 12.0 kWh/DT.

6. Conclusion

The Volute Press is designed to be a low wash water, low energy dewatering press with minimal maintenance and simple operation. Cake solids as high as 34% were produced during the pilot at Northglenn, and solids capture rates up to 99.5% were recorded. Cake solids >31% were consistently produced at different throughputs, and solids capture rates averaged 98.4% for runs dosed at 14.7 lbs/ton or greater. Dewatering power use averaged 12.0 kWh/DT.

7. Acknowledgements

PWTech would like to thank the Chief Plant Operator, Shaun Hollstrom, and the rest of the plant staff for expressing interest in the Volute Dewatering Press and providing all of the utilities needed for piloting.

Appendix- All Results

Run		1	2	3	4	5	6	7	8	9	10
Date		10/15/19	10/15/19	10/15/19	10/15/19	10/15/19	10/15/19	10/16/19	10/16/19	10/16/19	10/16/19
Unit Parameters											
Endplate Gap	[mm]	20	20	20	20	20	20	20	20	20	20
Drum Screw Speed	[RPM]	3.0	3.0	2.5	2.5	2.5	2.5	2.0	3.5	4.0	3.0
Flocculation Mixer Speed	[RPM]	32	32	32	32	32	32	32	32	32	32
Flow	[gpm]	4	4	4	9	9	9	6	12	10	6
Chemical Dosing											
Polymer		Praestol K111									
Raw Polymer Flow	[mL/min]	14	12	13	5	5	8	4	13	17	9
Percent Active	[%]	32	32	32	32	32	32	32	32	32	32
Cost Per pound	[$]	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Active Polymer Dose Rate	[ppm]	237	203	220	42	42	68	48	85	131	109
Solids Concentration											
Influent Solids	[%]	3.2	3.4	3.3	0.5	0.9	1.2	0.8	1.2	1.9	1.6
Cake Solids	[%]	22.5	31.5	25.5	21.3	23.2	26.2	32.4	23.6	20.2	34.0
Pressate Solids	[mg/L]	379	512	176	115	2392	1372	132	438	315	94
Calculated Parameters											
Solids Throughput	[#/hour]	64	69	65	22	38	52	23	74	94	48
Solids Capture	[%]	98.8	98.5	99.5	97.6	71.9	88.2	98.2	96.5	98.3	99.4
Active Polymer Use	[lbs/ton]	18.5	14.7	16.8	19.6	11.0	12.9	15.0	14.8	15.3	15.8
Dewatering Energy Use	[kWh/ton]	8.3	7.7	8.1	24.6	13.9	10.2	23.6	7.1	5.6	11.1
Total Energy Use	[kWh/ton]	58.4	54.3	57.2	173.1	97.7	71.6	166.1	50.2	39.8	77.9
Polymer Cost											
Total Cost per Ton	[$]	87	69	79	92	52	61	70	69	72	74

Table 2: All results from pilot testing

Appendix- Table 2 Calculations expanded

Active Polymer Use relates polymer used to solids generated. It is the ratio of active polymer used to solids throughput and is commonly calculated as pounds of active polymer per dry ton of solids. In order to show this calculation, solids throughput and active polymer flowrate are calculated first. Sludge is assumed to have a specific gravity of 1.

Solids Throughput: calculated for one hour.

$$Sludge\ Flowrate\ (gpm) * 60\ \frac{min}{hour} * 8.35\ \frac{lb}{gallon} = pounds\ of\ sludge\ per\ hour$$

$$\frac{influent\ solids\ \%}{100} * \frac{lbs\ of\ sludge}{hour} = lbs\ of\ solids\ per\ hour$$

Active Polymer Flow for one hour is calculated from Raw Polymer Flow:

$$\frac{mLs\ of\ raw\ polymer}{minute} * 60\ \frac{min}{hr} * \frac{\%\ active}{100} * .0022\ \frac{lbs}{mL} = lbs\ of\ active\ polymer\ per\ hour$$

Active Polymer Use is the ratio of Active Polymer Flow to Solids Throughput:

$$\frac{lbs\ of\ active\ polymer\ per\ hour}{lbs\ of\ solids\ per\ hour} * 2000\frac{lbs}{ton} = lbs\ of\ active\ polymer\ per\ dry\ ton\ of\ solids$$

Polymer Cost per Ton of Solids is calculated from Active Polymer Use and Solids Throughput:

$$\frac{lbs\ of\ active\ polymer}{dry\ ton\ of\ solids} * \frac{100}{\%\ active} = lbs\ of\ raw\ polymer\ per\ dry\ ton\ of\ solids$$

$$\frac{lbs\ of\ raw\ polymer}{dry\ ton\ of\ solids} * \frac{\$}{lbs\ of\ raw\ polymer} = \$\ per\ dry\ ton\ of\ solids$$

The total and dewatering energy consumption in kilowatt-hours (kWh) of the Volute pilot unit can be calculated using the current and voltage obtained from the drum, flash tank mixer, and flocculation tank mixer motor VFDs within the Volute control panel. Amperage and Voltage readings are obtained during each hour-long run. The energy consumption can be scaled to larger production models by relating this value to the calculated solids throughput (dry lbs/hour) the unit was operating at.

Power use of each component (drum motors, flash tank mixer motor, flocculation tank mixer motor, feed pump) of the Volute:

$$Motor\ Amperage\ (A) \times Motor\ Voltage\ (V) \times \frac{1\ kW}{1000\ W} = Motor\ Power\ Usage\ (kW)$$

Total Energy Consumption (kW) is obtained by adding all Volute component motor power usages:

$$Total\ kW = [Feed\ Pump\ Motor\ Power\ (kW) + Drum\ Motors\ Power\ (kW) + Flash\ Mixer\ Motor\ Power\ (kW) + Floc\ Mixer\ Motor\ Power\ (kW)]$$

Total Energy Use (kWh/dry ton) is obtained by dividing the total power by the Solids Throughput per hour:

$$\frac{kWh}{ton} = [Total\ kW/(\frac{lbs\ of\ solids}{hour} \times \frac{1\ ton}{2000\ lbs})]$$

The Dewatering Energy Use is similarly calculated using the Drum Power:

$$\frac{kWh}{ton} = [Total\ Drums\ kW/(\frac{lbs\ of\ solids}{hour} \times \frac{1\ ton}{2000\ lbs})]$$

Example calculations for Run # 4:

Note: Numbers in the spreadsheet are rounded to the nearest tenth place and nearest integer to keep it neat and easily readable. Numbers may vary slightly from the example calculations below.

Solids throughput:

$$4\ gpm\ *\ 60\ \frac{min}{hr}\ *\ 8.35\ \frac{lb}{gallon} = 2{,}004\ \ lbs\ of\ sludge\ per\ hour$$

$$\frac{3.44\%}{100} * \frac{2{,}004\ lbs}{hour}\ = 68.9\ lbs\ of\ solids\ per\ hour$$

Active Polymer Flow for one hour is calculated from Raw Polymer Flow:

$$\frac{12\ mL}{minute}\ *\ 60\ \frac{min}{hr}\ *\ \frac{32\%}{100}\ *\ .0022\ \frac{lbs}{mL}\ = 0.51\ lbs\ per\ hour$$

Active Polymer Use is the ratio of Active Polymer Flow to Solids Throughput:

$$\frac{0.51\ lbs\ polymer}{68.9\ lbs\ solids} *\ 2000\frac{lbs}{ton} = 14.8\ lbs\ of\ active\ polymer\ per\ dry\ ton\ of\ solids$$

Polymer Cost per Ton of Solids is calculated from Active Polymer Use and Solids Throughput:

$$\frac{14.8\ lbs}{dry\ ton\ of\ solids} * \frac{100}{32\%} = 46.3\ lbs\ of\ raw\ polymer\ per\ dry\ ton\ of\ solids$$

$$\frac{46.3\ lbs\ of\ raw\ polymer}{dry\ ton\ of\ solids}\ *\ \frac{\$\ 1.5}{lbs\ of\ raw\ polymer} = \$69.45\ per\ dry\ ton\ of\ solids$$

Power use of each component (drum motors, flash tank mixer motor, flocculation tank mixer motor, feed pump) of the Volute:

$$Drum\ 1\ Motor\ Power\ = 1.1A * 241.4V * \frac{1kW}{1000W} = 0.27\ kW$$

$$Floc\ Tank\ Mixer\ Motor\ Power\ = 0.8A * 242.0V * \frac{1kW}{1000W} = 0.19\ kW$$

$$Flash\ Tank\ Mixer\ Motor\ Power\ = 0.7A * 246.7V * \frac{1kW}{1000W} = 0.17\ kW$$

$$Feed\ Pump\ Motor\ Power\ = 5.1A * 242.6V * \frac{1kW}{1000W} = 1.2\ kW$$

Total Power Consumption (kW) is obtained by adding all Volute component motor power usages:

$$Total\ Energy\ Consumption\ (kW) = 0.27\ kW + \ 0.19\ kW + 0.17\ kW + 1.2\ kW = \ 1.83\ kW$$

Total Power Use (kWh/dry ton) is obtained by dividing the Total Power Consumption by the Solids Throughput per hour:

$$\frac{1.83\ kW}{\left(\frac{68.9\ dry\ lbs}{hour} * \frac{1\ ton}{2000\ lbs}\right)} = \frac{53.1\ kWh}{dry\ ton}$$

Dewatering Energy use (kWh/dry ton) is obtained by dividing the Total Drum Power by the Solids Throughput per hour:

$$\frac{0.27\ kW}{\left(\frac{68.9\ dry\ lbs}{hour} * \frac{1\ ton}{2000\ lbs}\right)} = \frac{7.8\ kWh}{dry\ ton}$$

PRIME SOLUTION ROTARY FAN PRESS® PILOT TESTING REPORT FOR SLUDGE DEWATERING

North Glenn WTF

(North Glenn, CO)

Testing Date(s): August 10th – 11th, 2020

DEWATERING PERFORMANCE SIMPLIFIED

Prime Solution, Inc.
610 S. Platt Street
Otsego, MI 49078
(269) 694-6666
www.psirotary.com

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Key Information:

Plant Site:	North Glenn WTF 2350 W. 112^{th} Ave. North Glenn, CO 80234
Plant Contact:	Mr. Shaun Hollstrom 720-717-0895 shollstrom@northglenn.org
Prime Solution Sales Representative:	Falcon Environmental Mr. Jared Keating 303-720-2790 jared@fecal.us
Testing Date(s):	August 10^{th} – 11^{th}, 2020
Prime Solution Pilot Equipment:	RFP2.0-24S Rotary Fan Press 2.0
Application Type:	Municipal
Sludge Type:	Primary
Process Type:	WTF Residuals
Sludge Conditioning:	ALUM
Sludge Age:	~1 - 3 Days
Feed Solids Ranged:	0.79 - 1.11% TS
Volatile Solids Ranged:	26.7 – 27.8% TVS
Dry Cake Solids Ranged:	**25.1 – 30.6% TS**
Averaged Dry Cake Solids:	**27.2% TS**
Averaged Capture Rate:	98.6% TSS
Averaged Active Polymer Usage:	18.59 lbs/dry ton
Optimal Polymer Usage:	12.1 lbs/dry ton
Averaged Press Energy Usage:	0.49 kW
Lab(s):	Prime Solution, Inc.
Prime Solution Regional Sales Manager:	Mr. Joe Dendel (616) 540-0500 Joe@psirotary.com
Report Prepared By:	Mrs. Randi Yeaman (269) 694-6666 ryeaman@psirotary.com
Report #:	PR200818-1

Pilot Summary:

On-site pilot testing was performed by Prime Solution, Inc. on August 10th – August 11th, 2020 for the North Glenn WTF in North Glenn, CO. The purpose of the pilot test was to determine the dewaterability of the Municipal ALUM Primary Sludge that is produced at the Plant. The results listed in this report confirm that the Rotary Fan Press 2.0 can effectively dewater the sludge produced at the Plant.

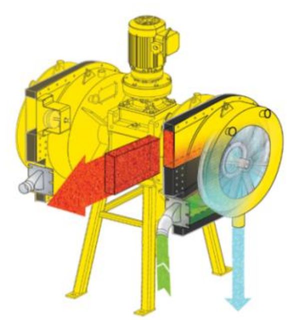
The Rotary Fan Press operated consistently over the two (2) day trial period with a total number of ten (10) samples pulled at various sludge flow rates. All samples were collected and tested by Prime Solution. The cake solids ranged in dryness from 25.1 – 30.6% TS during the testing period with excellent capture rates averaging 98.6% TSS.

Piloting Equipment Description:

The mobile pilot unit that was used for the testing is a full-scale Prime Rotary Fan Press® Model #RFP2.0-24S including all of the necessary equipment to condition the sludge/slurry, pump the filtrate back to the plant and transfer the dewatered cake solids for disposal.

➢ RFP2.0-24S Rotary Fan Press (2.0)	➢ In-Line Grinder
➢ PrimeBlend Emulsion Polymer System	➢ Flocculator Assembly
➢ Rotary Lobe Sludge Feed Pump	➢ Folding Sludge Cake Conveyor
➢ Wash Water Booster Pump	➢ Central Operator Control Panel
➢ Filtrate Pump w/ Float Control	➢ Chemical Feed System

The Prime Rotary Fan Press® operates using the low differential pressure between the incoming conditioned sludge and the outgoing sludge cake combined with the very slow (<1 rpm) rotational motion of the two (2) filter screens to advance the sludge through the press. As the conditioned sludge enters the annular space between the filter screens a pressure differential develops within the press where the liquid portion of the conditioned sludge seeks to the path of least resistance through the filter screens. The remaining solids are collected inside the annular space between the filter screens which advance towards the discharge end of the press. At the discharge end of the press, an adjustable restrictor gate arm slows down the advancing solids forming a "cake" plug. As the plug builds within the restriction discharge area, it pushes towards the inside walls of the filter screens and the slow rotation/friction of the filter screens continuously moves the cake solids past the restrictor gate arm to be discharged for disposal or further processing. Operation of the Prime Rotary Fan Press® can either be continuous or intermittent depending on your application. Clean-up is a simple push of a button which will automatically run the wash cycle.



Pilot Testing Results:

The Rotary Fan Press was on-site North Glenn WTF for two days (August 10th – August 11th, 2020) and operated at varying flow rates, polymer types and polymer dosages. Day one, August 10th, was used as set up. The next day several samples were taken of the sludge cake/filtrate and split with the plant for analysis. Using different polymers at different concentrations showed varying results, which was noted on the last day the mixing energy used to blend the polymer with the sludge had an equal effect on the cake solid dryness.

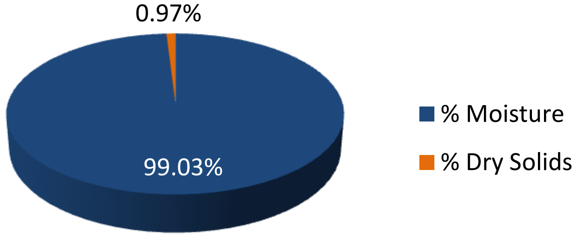
Results Overview:
Sludge flow ranged 1.90 – 2.86 gpm/ft², Averaged Feed solids were 0.97% TS, Solids loading ranged 9.40 – 15.88 lbs/hr/ft², Averaged cake solids were 27.2% TS, Capture rates averaged 98.6% TSS, Averaged press energy was 0.49 kW & pH Level was 7 for the testing period.

Polymer Consumption:
Drawing the sludge into the Rotary Fan Press system and at the suction side of the pump, the diluted/blended polymer was added to the incoming sludge where it was mixed in-line to form a stable floc before entering the dewatering channel(s) of the Rotary Fan Press. The averaged polymer dosage for the pilot testing was 18.59 active lbs/dry ton, with the optimal polymer dosage being 12.1 active lbs/dry ton.

The Table On The Following Page Details The Following:
Date and time of sample collection, Rotary Fan Press operating parameters: press speed %, energy usage (press kW), inlet and gate pressures, polymer results, sludge processing flow (gpm/ft²), feed solid concentration (% TS), solids loading (lbs/hr/ft²), cake solids (%TS) and capture rate (mg/L & %TSS).

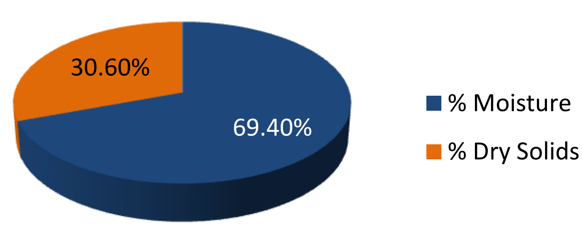
Averaged Feed Solids

% Moisture vs. % Dry Solids



Maximum Cake Solids

% Moisture vs. % Dry Solids



Pilot Testing Results Continued:

Plant: North Glenn WTF

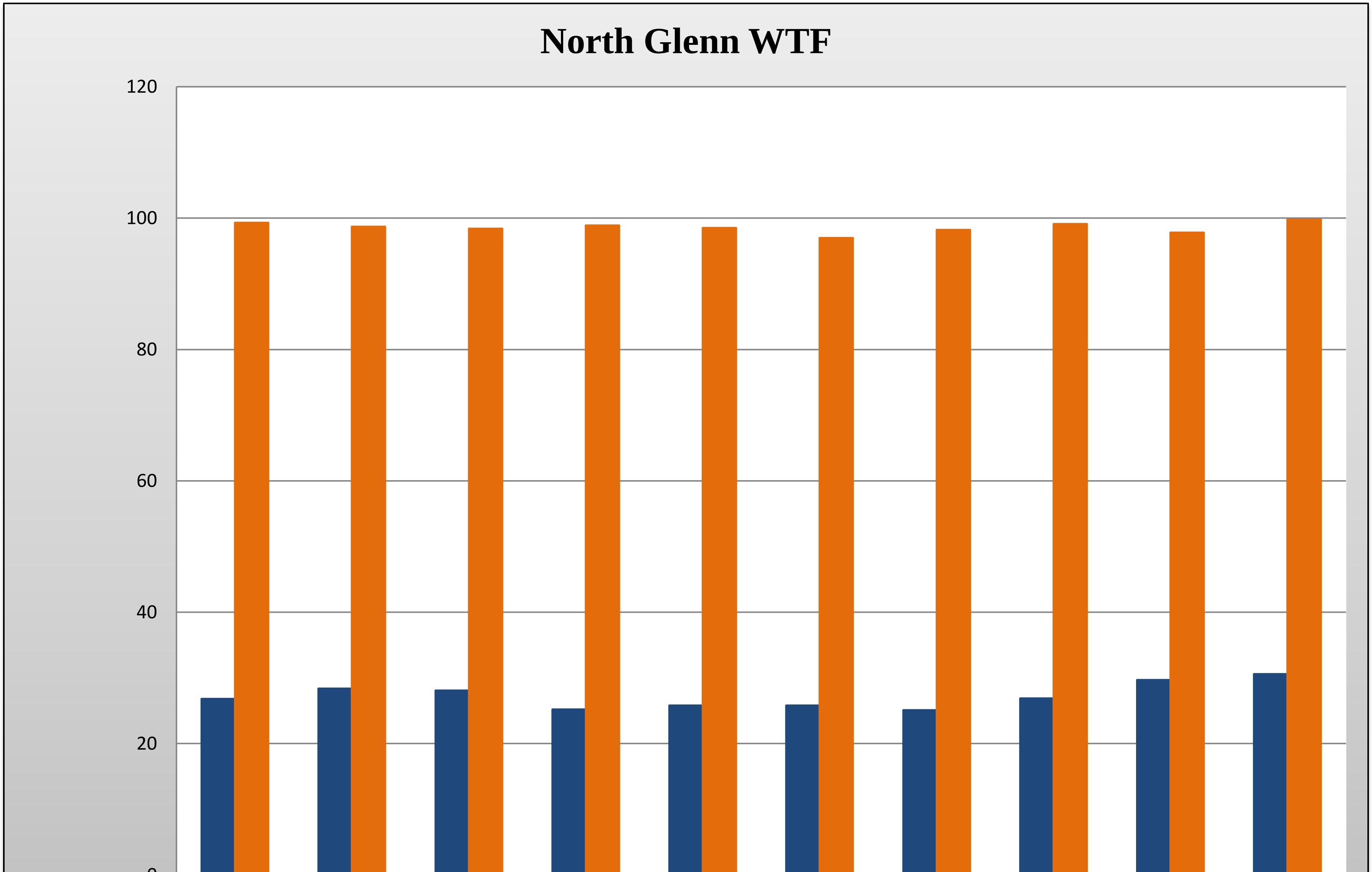
Sludge Type: Municipal

Process: Primary / ALUM

Base Model Pilot Equipment: RFP2.0-24S – Rotary Fan Press (2.0)

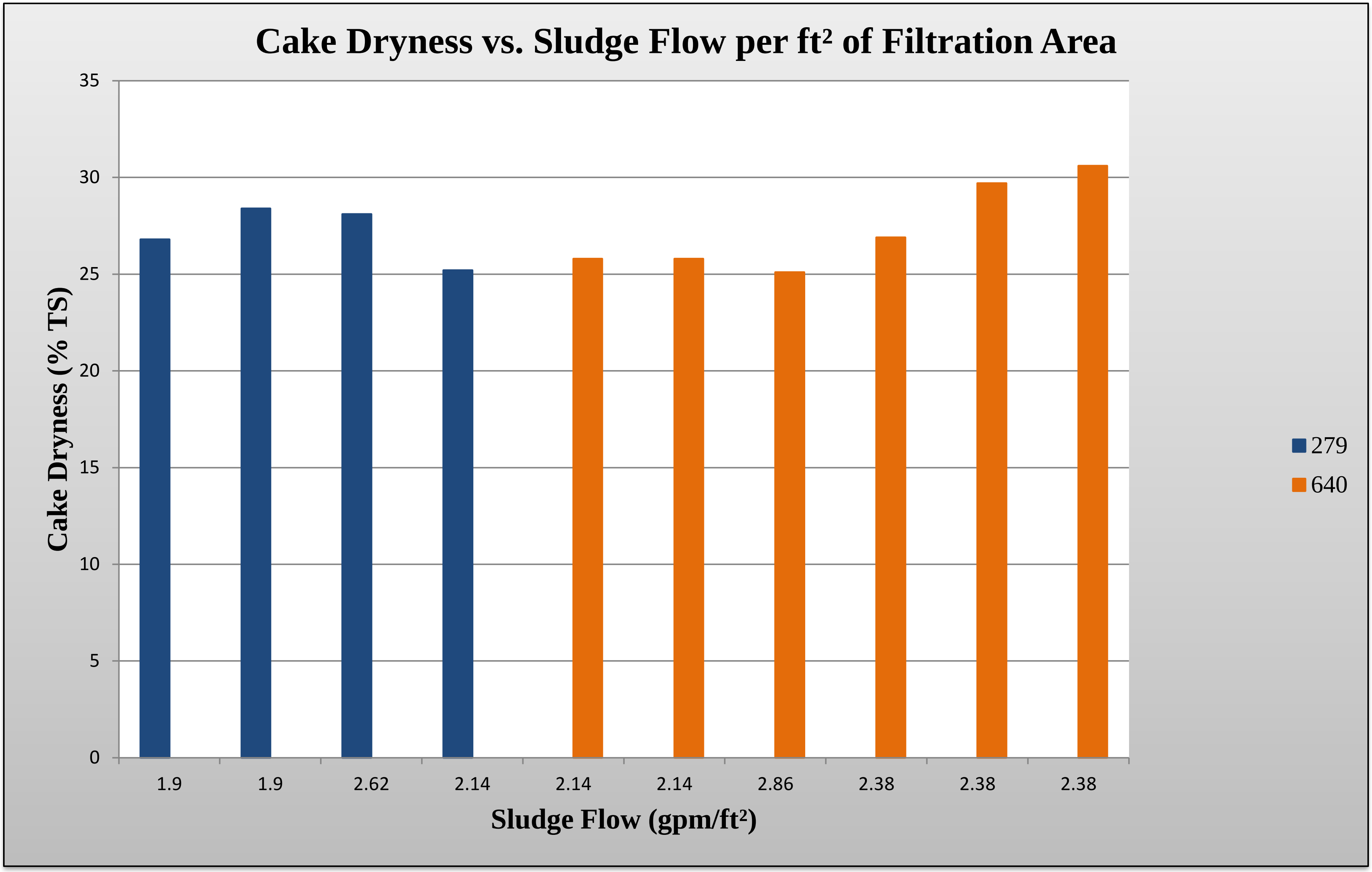
Sampling			Rotary Fan Press						Polymer						Results					
Run #	Date	Time	Model Type	Filt. Area ft²	Press Speed %	Press Energy kW	Inlet PSI	Gate PSI	Type	Neat Flow gph	Dil. Water gpm	Conc. %	Act. %	Active lbs/d.t.	Sludge Flow gpm/ft²	Feed Solids %TS	Solids Loading lbs/hr/ft²	**Cake Solids %TS**	Capture Rate mg/L	Capture Rate %TSS
1	8/11	8:48	RFP2.0 -24S	4.2	35	0.50	2.50	15	279	0.138	1	0.23	40	24.0	1.90	1.00	9.52	**26.8**	68	99.3
2	8/11	9:00	RFP2.0 -24S	4.2	35	0.50	2.38	15	279	0.138	1	0.23	40	24.0	1.90	1.00	9.52	**28.4**	128	98.7
3	8/11	9:10	RFP2.0 -24S	4.2	35	0.50	2.26	15	279	0.138	1	0.23	40	17.4	2.62	1.00	13.10	**28.1**	160	98.4
4	8/11	10:20	RFP2.0 -24S	4.2	35	0.50	2.21	15	279	0.138	1	0.23	40	19.2	2.14	1.11	11.90	**25.2**	124	98.9
5	8/11	10:40	RFP2.0 -24S	4.2	35	0.50	2.54	15	640	0.138	1	0.23	40	19.2	2.14	1.11	11.90	**25.8**	164	98.5
6	8/11	10:55	RFP2.0 -24S	4.2	35	0.50	2.54	15	640	0.138	1	0.23	40	19.2	2.14	1.11	11.90	**25.8**	328	97.0
7	8/11	11:15	RFP2.0 -24S	4.2	35	0.50	2.55	15	640	0.138	1	0.23	40	14.4	2.86	1.11	15.88	**25.1**	204	98.2
8	8/11	11:44	RFP2.0 -24S	4.2	35	0.50	2.75	15	640	0.138	1	0.23	40	24.3	2.38	0.79	9.40	**26.9**	84	99.1
9	8/11	12:05	RFP2.0 -24S	4.2	35	0.46	2.79	15	640	0.069	1	0.11	40	12.1	2.38	0.79	9.40	**29.7**	218	97.8
10	8/11	12:15	RFP2.0 -24S	4.2	35	0.46	3.20	15	640	0.069	1	0.11	40	12.1	2.38	0.79	9.40	**30.6**	20	99.8

Pilot Testing Results Continued:

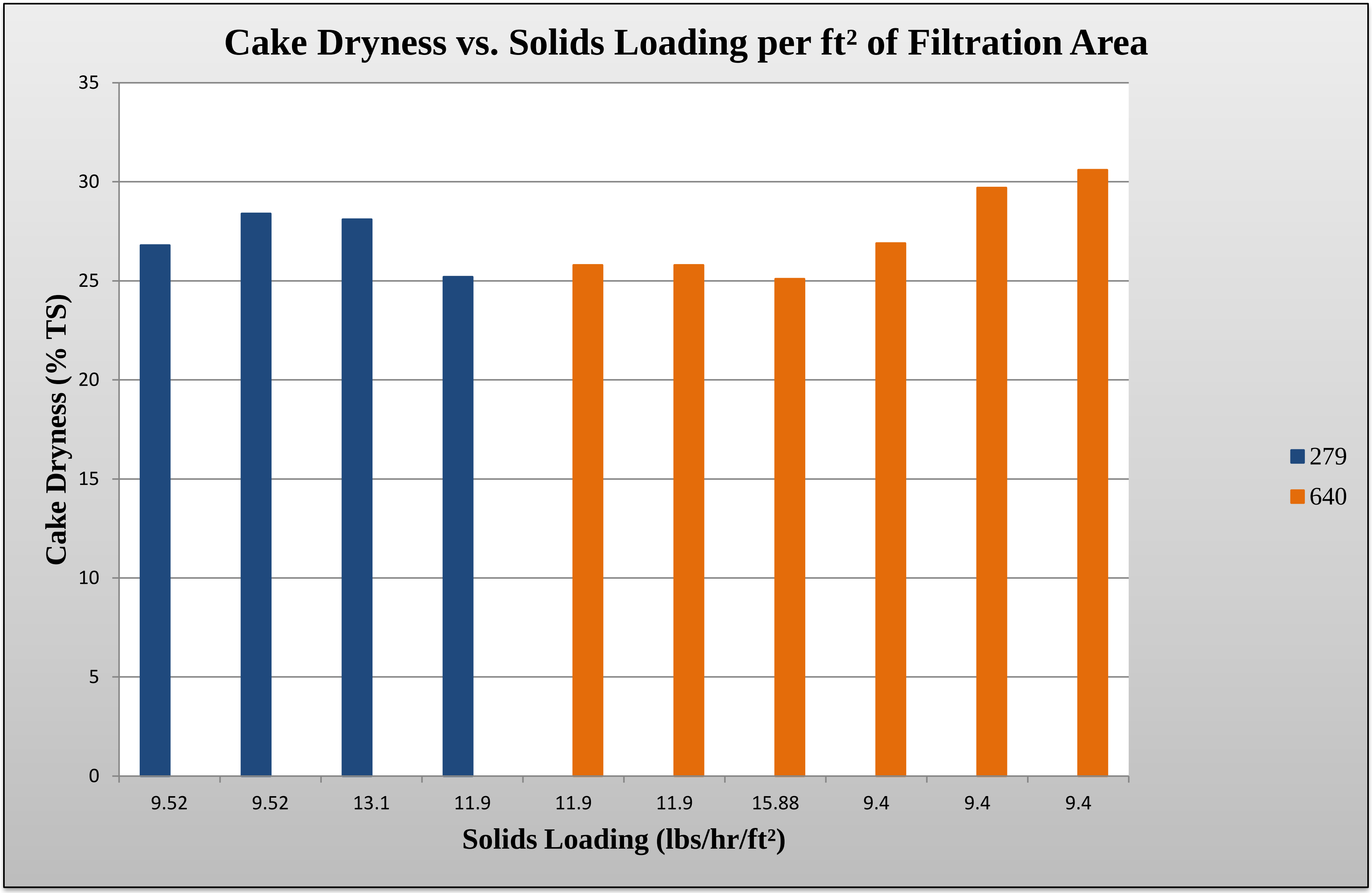


	1	2	3	4	5	6	7	8	9	10
Cake Solids	26.8	28.4	28.1	25.2	25.8	25.8	25.1	26.9	29.7	30.6
Capture Rate	99.3	98.7	98.4	98.9	98.5	97	98.2	99.1	97.8	99.8

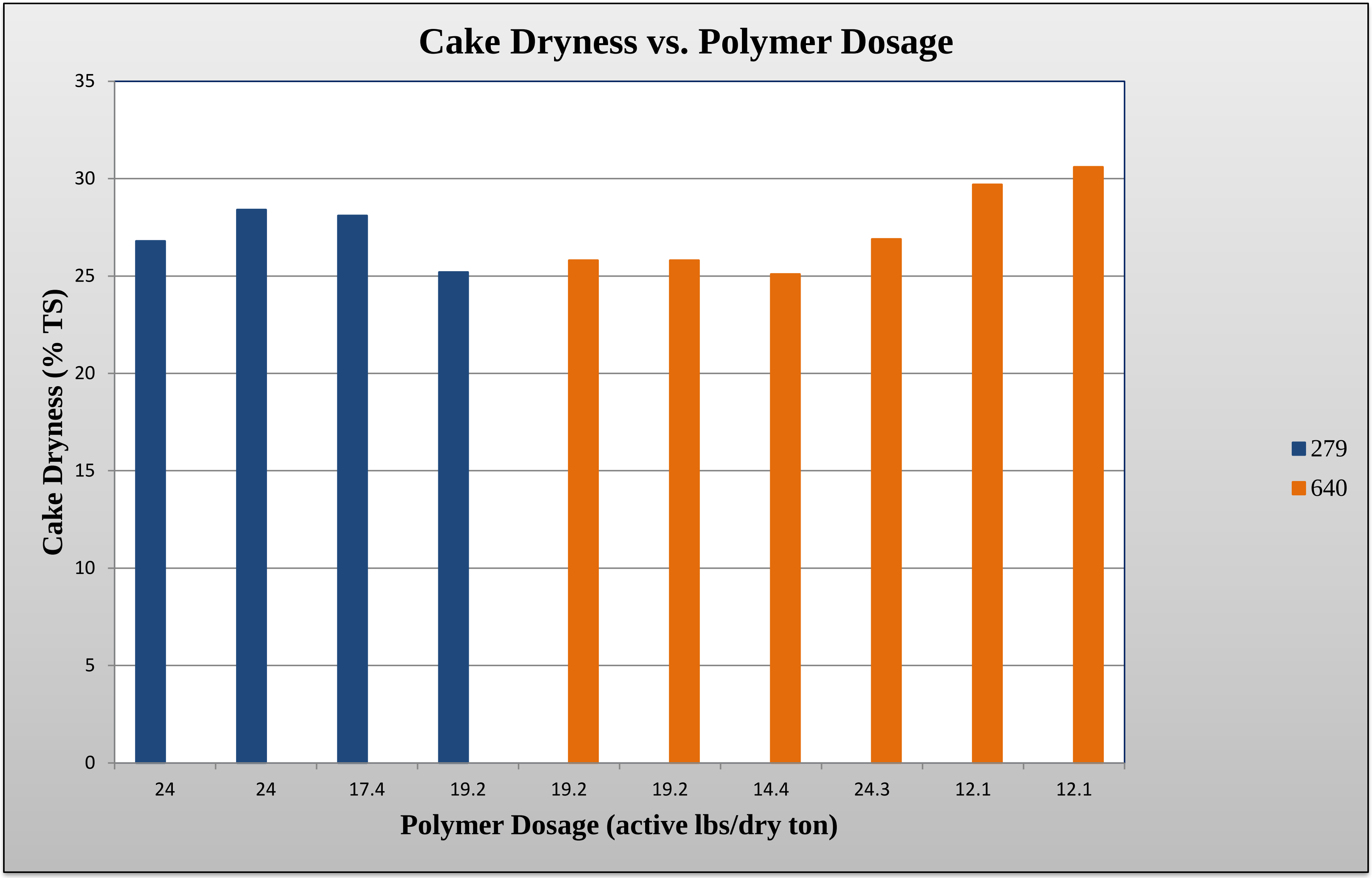
Pilot Testing Results Continued:



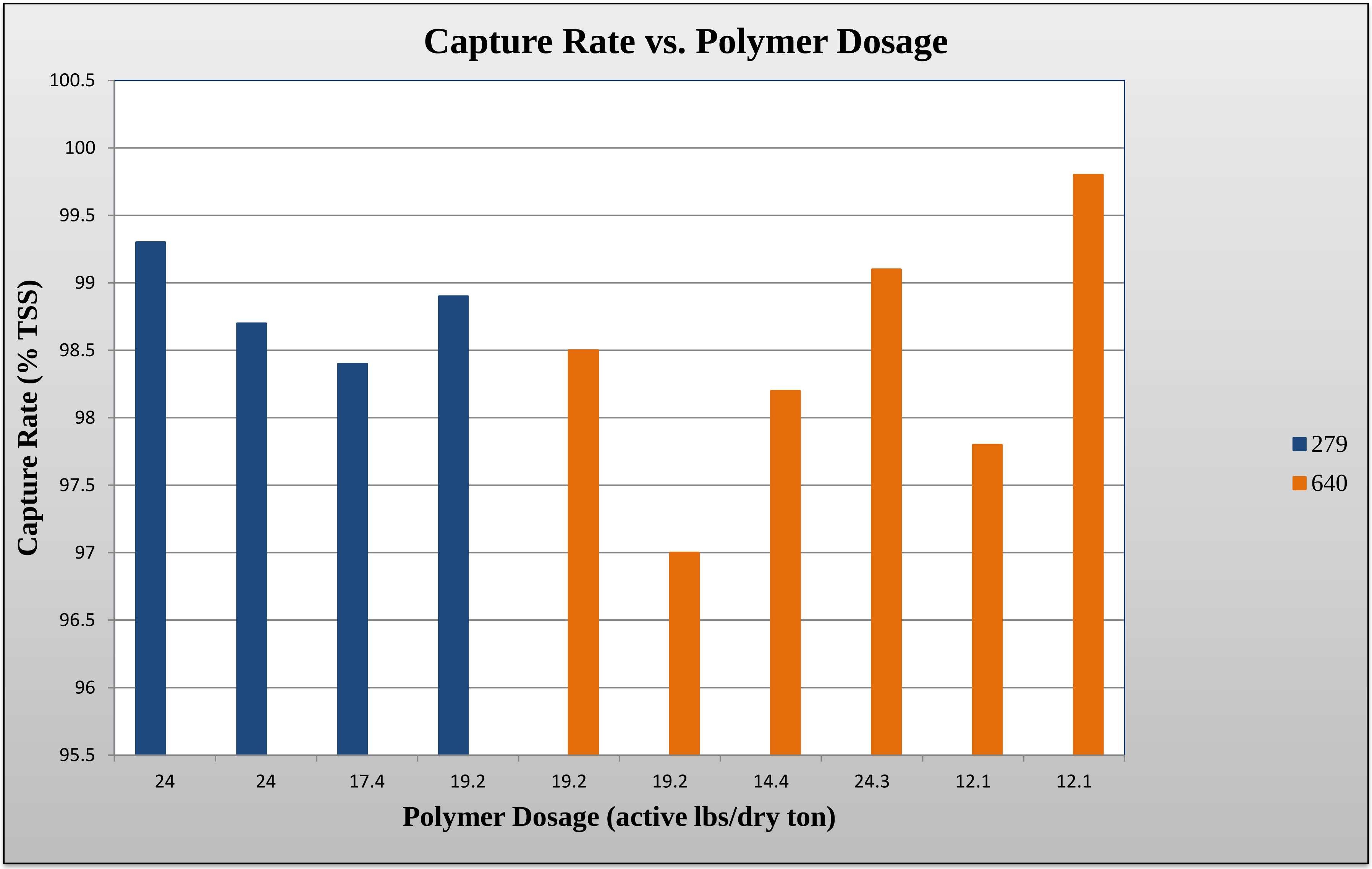
Pilot Testing Results Continued:



Pilot Testing Results Continued:



Pilot Testing Results Continued:



On-Site Pictures:

Pilot Conclusion:

This demonstration successfully illustrated the simplicity, ease-of-use and semi-automatic operation of the Rotary Fan Press, along with its ability to consistently produce dry cake solids — while using low energy and wash water. The totally enclosed design of the Rotary Fan Press provided a clean and safe work environment that virtually eliminated odors and airborne contaminants. This environment promotes prolonged equipment and building life.

Along with ease-of-operation, low maintenance requirements were demonstrated and discussed with plant operators and engineers — as well as, the RFP's ease of installation into existing facilities. Due to its small footprint, it does not require special building modifications.

Prime Solution, Inc. and Falcon Environmental would like to express their gratitude to the North Glenn WTF in North Glenn, CO, and everyone involved, for the opportunity and support that made this pilot possible. We look forward to providing equipment that will suit the needs of the Plant.

Mr. Joe Dendel
Regional Sales Manager
Phone: (616) 540-0500
E-Mail: Joe@psirotary.com
Web: www.psirotary.com

Appendix C: Vendor Information

Screw Press

FKC CO., LTD.
2708 West 18th Street
Port Angeles, WA 98363
(360) 452-9472
FAX (360) 452-6880

September 28, 2020

Caitlin Kodweis, PE
Hazen and Sawyer
Lakewood, Colorado

RE: Screw Press Proposal for Northglenn WTP

Caitlin,

Attached is a proposal for the Northglenn WTP. The equipment outlined is FKC's Skid System with the BHX 700 x 4000 screw press, which will process 350 Dry Lbs. / HR of alum-based water treatment plant residuals. Based on the information provided, this equipment package will operate 7 Hrs. / Week at 50th percentile, 26 Hrs. / Week at the 95th Percentile and 43 Hrs. / Week in the max case.

This system proposed is our fully assembled and pre-engineered dewatering skid system. The skid includes a screw press, dual-flocculation tanks, two (2) polymer systems, control panel, sludge pump, conveyor and all required field equipment. The skid is assembled, piped and wired at the FKC Factory in Port Angeles, WA. It will be factory tested prior to shipment.

Please note that these prices only include the equipment listed. It also does not include any consumable items such as polymer totes, polymer hoses, disposal bin, etc. The conveyor quoted is also 25 feet in length. The conveyor is custom manufactured and can be made to any desired length. Adder / deduct pricing for the conveyor length is outlined in the attached proposal.

I'm looking forward to working with you on this project. Please let me know if you need any additional information.

Best Regards,

Wesley Bond
FKC Co., Ltd.

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A. Proposed Equipment

Qty.	Description	FOB City of Northglenn, CO
1	FKC Screw Press Model BHX-700x4000L	US $348,000.00
	Material:	Alum WTP Residuals
	Capacity:	350 Dry Lbs. per hour., not to exceed 40 GPM
	Inlet Consistency:	2.0 or greater
	Outlet consistency:	15% TS w / polymer use or higher
	Anionic Polymer:	Not to Exceed 10 Lbs. / DT Active
	Cationic Polymer:	Not to Exceed 20 Lbs. / DT Active
	Capture Rate:	95% or Higher
	Materials of construction:	SS-304 wetted parts Other Carbon Steel
	Speed reducer:	Sumitomo Cyclo Reducer
	Motor requirements:	3.0 HP, 1800 rpm, NEMA B Motors included
	Other:	(1) One set standard tools (1) One set insulated drum covers w/ side shields (1) One motor coupling (4) Four spare screens
	Delivery:	Delivery within 7.5 months after approval of submittal and release for fabrication.

A. Proposed Equipment (con't)

2. Ancillary Equipment Skid

Qty.	Description	Unit Price
1	Ancillary Equipment mounted on Skid	Included in Screw Press Pricing
2	w/ FKC Polymer Makedown System Model #: 3.0P-600-D Mechanical Polymer Activation 2-point In-line polymer / sludge injection system	
1	w/ PLC based Control Panel NEMA 4X Enclosure Stainless Steel 60H"x48W"x18D" Allen Bradley Compact Logix 1769-L24ER with Ethernet Connection Maple System 9.7" OIT 200 BTU ISC air conditioner TVSS & 480/120 VAC Transformer Uninterruptible Power Supply Screw Press VFD AB-Powerflex 525 with line reactor & Ethernet Connection HOA, Running Lights & Potentiometer Sludge Pump VFD AB-Powerflex 525 with line reactor & Ethernet Connection HOA, Running Lights & Potentiometer Flocculation Tank VFD AB-Powerflex 525 with line reactor & Ethernet Connection HOA, Running Lights & Potentiometer Conveyor Motor Starter, 3 HP HOA, Running Lights / Rail Lights Polymer System Controls Screw Press Wash Water Controls Screw Press Headbox Level Transmitter Headbox Hi-Hi Level Probe	
1	w/ Dual - Flocculation Tank 150gl w/ SEW Eurodrive Gearmotor 460V/3ph/1.0HP	
1	w/ Netzsch Sludge Pump NM045BY01L07V	

A. Proposed Equipment (con't)

2. Ancillary Equipment Skid

1 w/ 9" FKC Conveyor - 25 Feet Long
Includes:
- SEW Eurodrive Gearmotor; 460V/3ph/3.0HP
- 304SS Transition Chute
- 304SS Trough Body and convers
- 304 SS Supports and Legs, as required
- UHMW Trough Liners
- 8620 Steel Spiral Flighting, 9" Diameter
- One (1) Zero Speed Switch
- One (1) Safety E- Stop

1 Increase / Decrease Conveyor length ± $950.00 per foot

1 w/ Ship Ladder & Access Platform

1 w/ Marine Grade Aluminum Skid
96"W x 24' w/ channel & treadplate

1 Skid Mounted, Factory Assembled and Tested

B. Miscellaneous

1. Delivery

The dewatering equipment will be ready to ship within six (6) months after receipt of written purchase order and release for Fabrication of Equipment. Deliver within seven (7) months.

2. Shipping Arrangements

The FKC dewatering system will be shipped best way overland from Port Angeles, Washington to Northglenn WTP.

Offloading all equipment is at owner's expense.

3. Effective Period

This proposal shall remain valid **60** days from the date of the proposal.

4. Payment Terms

90% with Delivery
10% with performance or within 6 months of delivery if the equipment has yet to start-up due to the schedule of the customer, whichever occurs first.

Net 30 days

5. Installation

The screw press skid is shipped ready for installation. The flocculation tank and agitator will require some assembly for installation. Installation drawings are provided.

The Dewatering Screw Press Skid includes interconnecting piping and wiring between components mounted on skid. It does not include any piping or wiring to or from the skid.

This scope of supply does not include conduits, wiring or piping to any controls or equipment not integrally mounted on the dewatering skid.

The scope of supply does not include any other field equipment or controls not listed in the proposed equipment list.

Installation and erection assistance are not included in the price of the equipment and generally are not required. However, the service is available for our standard service rates (see the enclosed rate sheet).

6. Operator Training and Start Up

Operator and maintenance training and start up services are included in the price of the equipment.

Operator and maintenance training can be accomplished in approximately two hours per group. Ideal training sessions include both classroom and on-site (at the screw press) sessions.

Generally speaking training and start up can be accomplished in a three day period.

A follow-up/performance testing visit of a two day duration is also included in the price of the equipment.

Erection assistance and a separate trip for training are not included in the price of the equipment. Additional engineering service days are billed at the rates on the enclosed rate sheet.

7. Utility Requirements

A. Screw Press - Intermittent shower water 15 - 20 GPM at 30-40 psi

8. Warranty

FKC's mechanical warranty covers material and workmanship for a period of 10 years from start-up or 10.5 years from delivery whichever occurs first.

The warranty will cover all the fixed, rotating, and wearing parts on the screw press. The following mechanical items on the screw press will be covered by the warranty:

1. All screw shaft bearings and seals
2. Screens and drums on the screw press.
3. The screw shaft, shell, and flights
4. The Sumitomo Cyclo drive reducer
5. Screw Base, inlet stand, and discharge box.

This extended warranty requires that the WWTP staff document that the equipment is lubricated according to the Manufacturer recommendations as follows.

1. The screw shaft bearings will be lubricated per the FKC supplied O&M manual.
2. The Sumitomo Cyclo drive reducer will have the recommended oil and the oil will be changed as specified in the Sumitomo maintenance manual.

This extended warranty does not cover the other skid components:

All other items will have a standard warranty, which covers material and workmanship for a period of 12 months from start-up or 18 months from delivery whichever occurs first.

9. Performance Guarantee

The performance figures and conditions denoted in section A of this proposal constitute FKC Co., Ltd.'s performance guarantee and the conditions required to meet the guarantee. All of the consistency figures are based on total solids (TS) not total suspended solids (TSS).

In the event that performance is not met, FKC will provide all parts, engineering, and labor associated with the work necessary to bring the equipment into conformance with the performance guarantee. FKC is not responsible for any consequential damages that may occur with the purchase of this equipment package.

10. Documentation Schedule

A. Approval Drawings - within 3 weeks after receipt of purchase order
B. Certified Drawings - within 2 weeks after return of approval drawings
C. Operation and Maintenance Manuals - 14-16 weeks after receipt of order

11. Spare Parts List

No spare parts are required for the first 1-2 year period of operation.
A list of long term spare parts is available upon request.

12. Service Rates

The following are rates and terms for professional and technical services furnished by FKC:

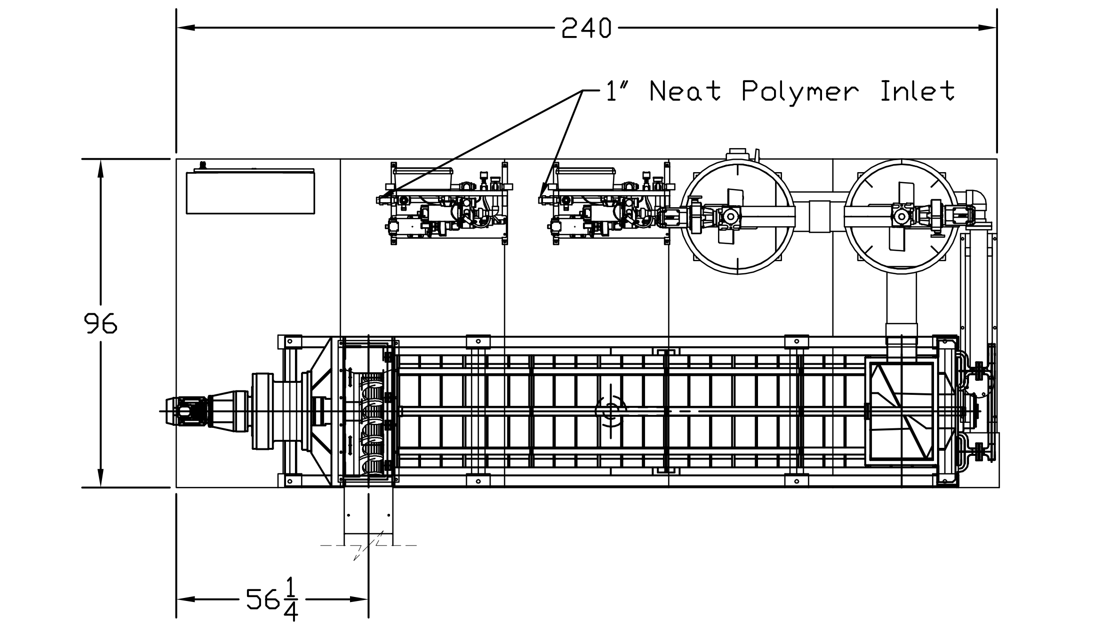
Weekdays
$800.00 - Per eight (8) hour day on weekdays plus, lodging, and rental car expenses.
$150.00 - Per hour for all hours exceeding eight (8) hour workday on weekdays.
$90.00 - Per hour for office engineering services and telephone consultations.

Saturdays, Sundays and Holidays
$1,200.00 - Per eight (8) hour day plus lodging and rental car expenses.
$225.00 - Per hour for all hours exceeding eight (8) hour workday.

Travel Time - Weekdays
$75.00 - Per hour travel time. (Not to exceed $600/day)

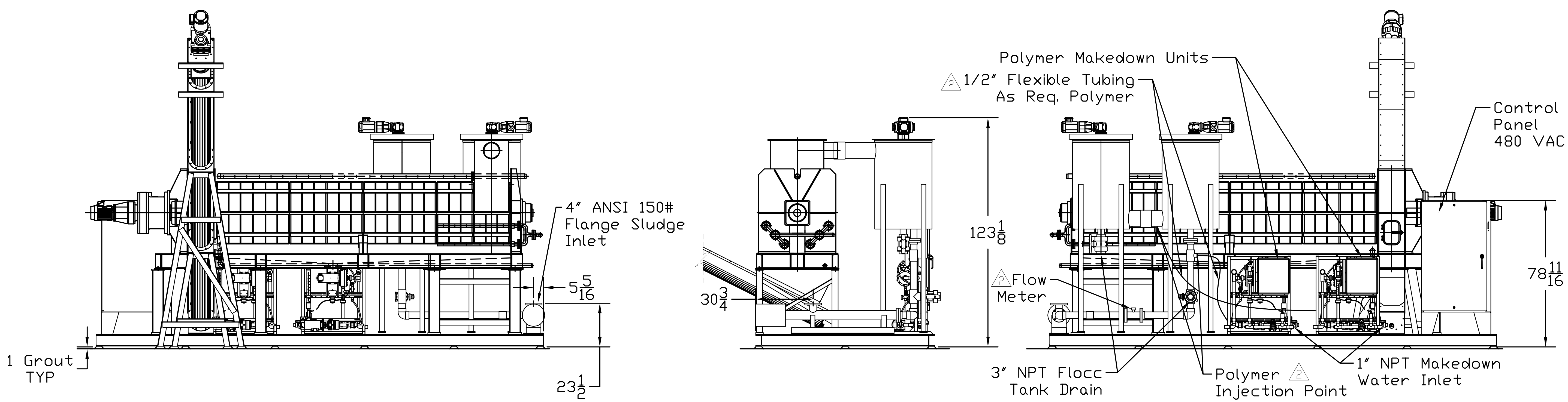
Travel Time – Weekends and US Holidays
$120.00 - Per hour travel time (Not to exceed $900.00/day)

The above rates are US$.
Payment terms: Net 30 days.



Note:

- Skid Weight:
- Operating Weight:
- Conveyor to me installed on skid after equipment has been installed and properly anchored.
- All sludge line piping on skid to be CPVC.
- Solenoid valves to be provided on shower header connection. Shower water feed lines by others.
- Piping to screw press filtrate flange by others.



Job No. Skid-311	Customer Folsom WTP Folsom, CA		Wt. Lbs.
Drawing No. A311-900	Title BHX-700x4000L Skid Assembly Details		Quantity 1
			Date 8/6/14
FKC	FKC CO. LTD 2708 W 18th St. Port Angeles, WA 98363 (360) 452-9472 Fax (360) 452-6880		Drawn By RTB
	Revision		SHEET 1 OF 1

No.	Alteration	Date	Sign
3	Issued as Certified	1/8/15	RTB
2	General Revisions	12/11/14	RTB
1	Issued for Approval	8/6/14	RTB

FKC Screw Press On-Site Trials

On-Site Trial Requirements

1. Power: 460 or 575 volt, three-phase power is required to the test trailer power connection. The total amp requirement will be < 20 amps.

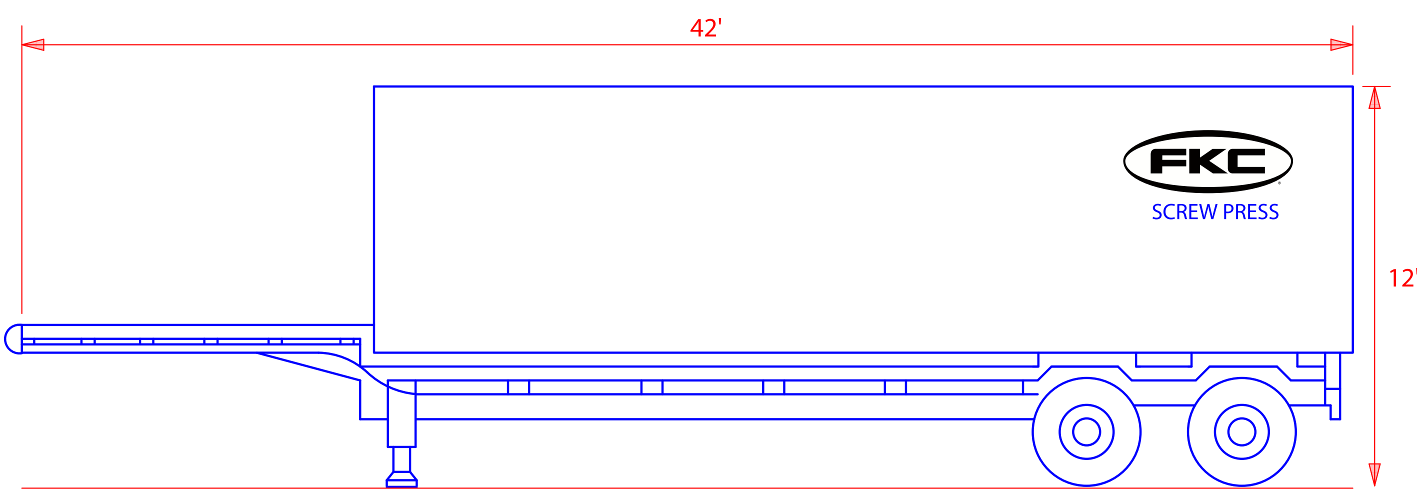
2. Water: One ¾" water hose to the trial unit for polymer make-down, steam generation, rotary screen thickener shower water, and wash-down is required.

3. Sludge Supply: A sludge line to the sludge feed tank inlet valve located at the rear of the trailer is necessary. If there are 2 or more materials to be mixed for dewatering, separate lines are required for each sludge. Each trailer carries a portable poly tank which can be used to mix sludges.

4. Kerosene: Five gallons of kerosene should be provided to power the boiler for steam generation if steam use testing is to be done.

5. Other: A bin place next to the trailer for cake disposal is helpful. Usually 100–200 lbs./hr of dewatered material will be produced. 100" of 2½" hose is carried on the trailer for sludge supply and filtrate drainage.

6. Cost: The cost for an on-site test is the cost of one-way trailer transportation plus airfare for two FKC technicians to the airport nearest the work site.



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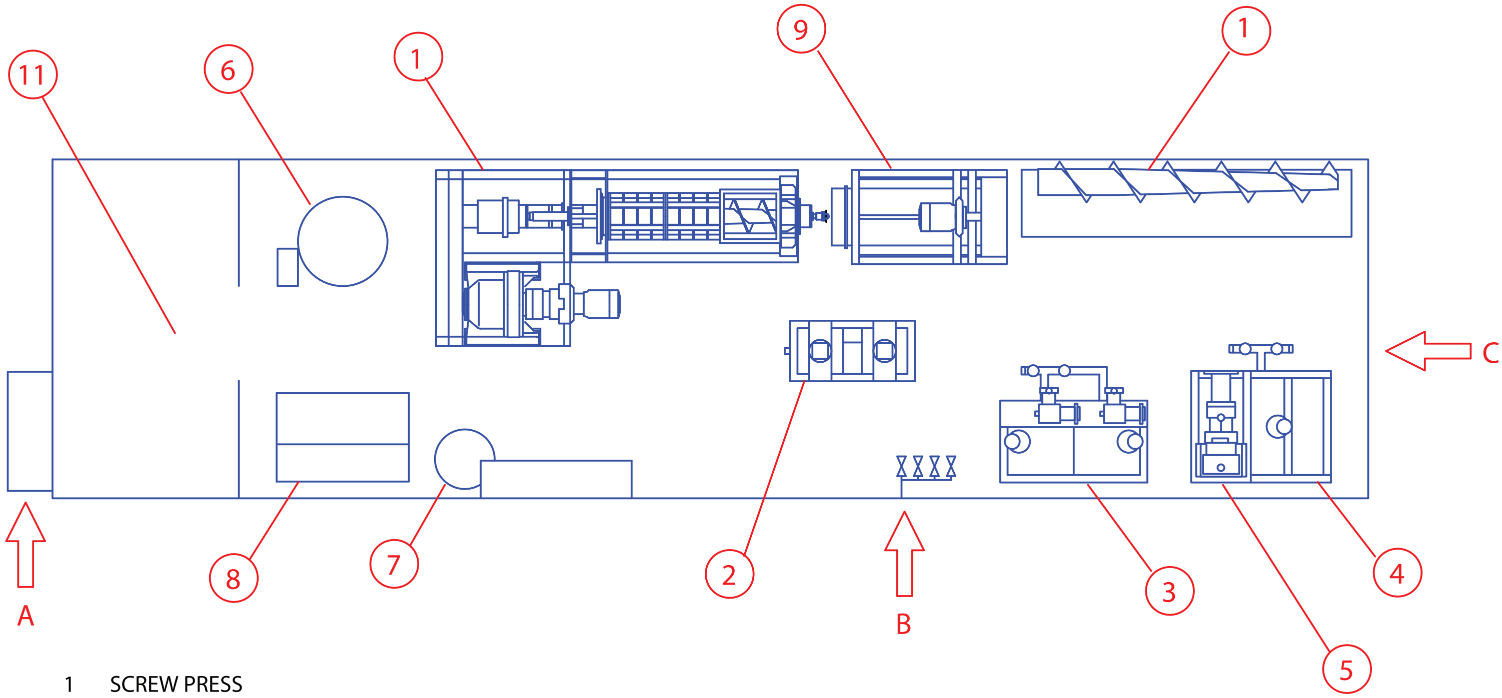
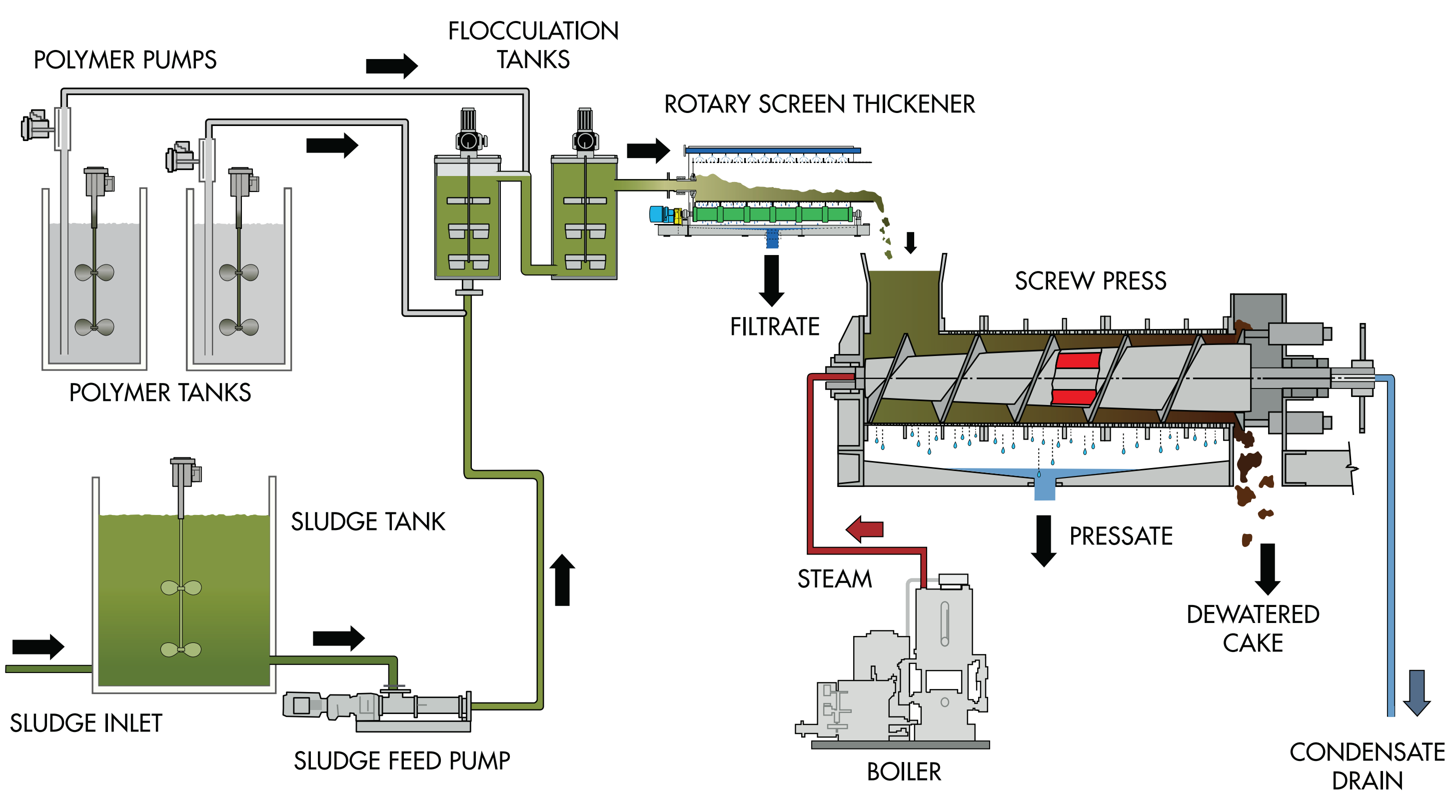
e-mail:mail@fkcscrewpress.com



1 SCREW PRESS
2 FLOCCULATION TANKS W/ AGITATORS
3 POLYMER TANKS W/ AGITATORS
4 SLUDGE TANK W/ AGITATOR
5 SLUDGE FEED PUMP
6 BOILER
7 BOILER FUEL TANK
8 CONTROL PANEL
9 ROTARY SCREEN THICKNER
10 SPARE SCREWS SHELVING
11 LAB

A ELECTRICAL CONNECTION
575V or 480V / 3 PH
B WATER CONNECTION
3/4" NPT
C SLUDGE CONNECTION
2 1/2" FEMALE CAMLOCK



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CONTACT LIST FOR BIOLOGICAL SLUDGE DEWATERING APPLICATIONS UTILIZING FKC SCREW PRESSES

Screw Press Location:	City of Victoriaville, Quebec
Screw Press Model #:	SHX-1000x7000L (2 each) [3 HP]
RST Model Number	RST-S630x2000L (2 each - installed 2003) [1 HP]
Type of Bio Sludge:	Municipal Aerobically Digested WAS, 10.5 mgd
Year Started:	1997
Contact Name #1:	Mr. Martin Blanchette – Head WWTP Operator Tel: (819) 758-3158 Fax: (819) 758-8900 martin.blanchette@ville.victoriaville.qc.ca
Contact Name #2:	Mr. Serge Cyr – Utilities Manager Tel: (819) 752-2480 Fax: (819)752-7409
Typical performance:	33 gpm each, 2.5% Inlet, 16~17% outlet

Screw Press Location:	City of Mirabel, Quebec
Screw Press Model #:	SHX-1100x7000L [3 HP]
RST Model Number:	RST-S630x2000L [1 HP]
Type of Bio Sludge:	Municipal Blend of WAS and Raw Primary, 4.2 mgd
Year Started:	2001
Contact Name #1:	Mr. Francois Lizotte - Plant Foreman Tel: 450 475-2077 Fax: (450) 436-9447 f.lizotte@ville.mirabel.qc.ca
Typical performance:	87 gpm, 1.0% Inlet, 23% outlet

Screw Press Location:	City of Sequim, WA
Screw Press Model #:	SHX-600x5000L for Class A Biosolids [3 HP]
RST Model Number	RST-S480x2000L [0.75 HP]
Type of Bio Sludge:	Municipal WAS / Using FKC's Class A Process, 2.0 mgd
Year Started:	2003
Contact Name #1:	Mr. Al Chrisman, Head WWTP Operator Tel: (360) 683-3883 Fax: (360) 681-0552 achrisman@ci.sequim.wa.us
Contact Name #2:	Mr. Nathan Gaul, WWTP Operator Tel: (360) 683-3883 Fax: (360) 681-0552
Typical performance	30 gpm, 1.8% Inlet, 35-45% outlet

Screw Press Location:	City of Forks, WA
Screw Press Model #:	SHX-300x2000L for Class A Biosolids [1 HP]
RST Model Number	RST-S300x1000L [0.25 HP]
Type of Bio Sludge:	Municipal WAS/ Using FKC's Class A Process, .5 mgd
Year Started:	2003
Contact Name#1:	Dan Wahlgren – WWTP Operator Tel: (360) 374-3124 Fax: (360) 374-9430 dwah.forks@centurytel.net
Typical performance:	6.0 gpm, 1.6% Inlet, 25-30% outlet

Screw Press Location:	City of Lake Wales, FL
Screw Press Model #:	SHX-1050x8000L [3 HP]
RST Model Number	RST-S775x3600L
Type of Bio Sludge:	Municipal WAS, Extended aeration, 2.2 MGD
Year Started:	2003
Contact Name #1:	Mr. Ted Long – Wastewater Division Manager Tel: (863) 678-4114 Fax: (863) 678-4181 tlong@cityoflakewales.com
Contact Name #2:	Mr. Chris Jackson – WWTP Operator Tel: (863) 678-4114 Fax: (863) 678-4052 cjackson@cityoflakewales.com
Typical performance:	75-100 gpm, 0.8% Inlet, 17% outlet

Screw Press Location:	City of Anson-Madison, ME
Screw Press Model #:	SHX-650x4500L [15 HP]
RST Model Number	RST-S630x3000L
Type of Bio Sludge:	80-100% Primary Sludge ; 0-20% Secondary Sludge, 5.0 MGD
Year Started:	2003
Contact Name #1:	Dale Clark – (207) 696-3246 or (207) 696-5211
Typical performance:	66-125 gpm, 2-3% Inlet, 45-50% outlet

Screw Press Location:	California American Water Company – Las Palmas Facility in Salinas, CA
Screw Press Model #:	SHX-400x3500L [2 HP]
Type of Bio Sludge:	Trickling Filter WAS + Headworks Screenings
RST Model Number	none
Year Started:	2004
Contact Name:	Jim Bricker - Cell (831) 236-2635, james.bricker@amwater.com
Typical performance:	10 gpm, 1.2% Inlet, 18% outlet

Screw Press Location:	Marin Sanitation District #5 – Tiburon, California
Screw Press Model #:	SHX-400x3000L [1 HP]
Type of Bio Sludge:	Anaerobically Digested Sludge
RST Model Number	none
Year Started:	April 2007
Contact Name:	Tony Rubio – Tel: 415 716-7224
Typical performance:	15 gpm, 1.1% Inlet, 21-23% outlet

Screw Press Location:	California American Water Company – Pasadera Facility by Monterey, CA
Screw Press Model #:	SHX-300x2500L [1 HP]
Type of Bio Sludge:	Trickling Filter WAS
RST Model Number	none
Year Started:	2005
Contact Name:	Jim Bricker - Cell (831) 236-2635, james.bricker@amwater.com
Typical performance:	3.5 gpm, 1.2% Inlet, 16% outlet

Screw Press Location:	California American Water Company – Carmel Valley Ranch by Carmel, CA
Screw Press Model #:	SHX-300x2500L [1 HP]
Type of Bio Sludge:	Rotating Biological Contactor (RBC) WAS
RST Model Number	none
Year Started:	2005
Contact Name:	Jim Bricker - Cell (831) 236-2635, james.bricker@amwater.com
Typical performance:	3.5 gpm, 1.2% Inlet, 16% outlet

Screw Press Location:	City of St. Cloud, FL
Screw Press Model #:	SHX-900x7500L [3 HP]
RST Model Number	RST-S630x2000L [1 HP]
Type of Bio Sludge:	Municipal Aerobically Digested WAS from Extended Aeration Process 2MGD
Year Started:	June 2005
Contact Name:	Mr. Howard Miller – Treatment Plant Superintendent Tel: (407) 957-7340 Fax: (407) 892-3776 hmiller@stcloud.org
Typical performance:	44 gpm, 1.5% Inlet, 18% outlet

Screw Press Location:	City of Aberdeen, WA
Screw Press Model #:	SHX-900x6000L [3 HP]
RST Model Number	RST-S630x2000L [1 HP]
Type of Bio Sludge:	Municipal Anaerobically Digested Blend of Raw and WAS, 13 MGD
Year Started:	December 2005
Contact Name #1:	Mr. Kyle Scott– Treatment Plant Superintendent, Tel: (360) 537-3285,
Typical performance:	43 gpm, 2.0% Inlet, 22% outlet

Screw Press Location:	Monterey Regional Water Pollution Control Authority / Monterey, CA
Screw Press Model #:	SHX-1250x9000L (2 each) [7.5 HP]
RST Model Number	RST-S630x2000L (2 each) [1.5 HP]
Type of Bio Sludge:	Municipal Anaerobically Digested Blend of Raw and WAS, 20 MGD
Year Started:	November 2007
Contact Name #1:	Mr. Richard Gilliam – Supervising Wastewater Treatment Plant Operator Tel: (831) 883-1118
Expected performance:	41.3~82.5 gpm, 2.0~4.0% Inlet, 25% outlet

Screw Press Location:	City of Cambria, CA
Screw Press Model #:	SHX-900x7000L for Class A Biosolids [3 HP]
RST Model Number	RST-S630x2000L [1 HP]
Type of Bio Sludge:	Municipal WAS
Year Started:	June 2008
Contact Name #1:	Ben Easton, Lead Operator, Tel (805) 927-6254
Contact Name #2:	Antonio Artho, Operator, Tel (805) 801-3933
Expected performance:	25 gpm, 2.0% Inlet, 17% outlet

Screw Press Location:	City of Petaluma, CA
Screw Press Model #:	SHX-1250x9000L [7.5 HP]
RST Model Number	RST-S630x2000L [1.5 HP]
Type of Bio Sludge:	Municipal Anaerobically Digested WAS, 6.7 MGD
Year Started:	Startup completed in 2009
Contact Name	Matthew Pierce, Operations Supervisor, Tel: (707) 776-3777
Expected performance:	50 gpm, 2.5% ~ 3.5% Inlet, 18% outlet

Screw Press Location:	City of Hampstead, MD
Screw Press Model #:	SHX-800x5000L [3 HP]
Type of Bio Sludge:	Municipal WAS
Year Started:	July 2008
Contact Name:	Wendy Armstrong, Tel: (410) 374-6180
Typical performance:	100 gpm, 0.8% Inlet, 16% outlet

Screw Press Location:	California American Water Company – Fillmore WRF, CA
Screw Press Model #:	SHX-900x6000L Biosolids [3 HP]
Type of Bio Sludge:	Municipal MBR WAS
Year Started:	August 2009
Contact Name:	Mr. Matt Petersen, Tel: (805) 524-2599 Cell: (805) 223-9625
Typical performance:	65 gpm, 1.0% Inlet, 16~18% outlet

Screw Press Location:	City of Yachats, OR
Screw Press Model #:	SHX-300x2500L for Class A Biosolids [1 HP]
Type of Bio Sludge:	Municipal Sequential Batch Reactor (SBR) WAS
Year Started:	Startup Completed 2/09
Contact Name:	Dave Buckwald, WWTP Operator, Tel: (541) 547-3243
Typical performance:	7.5 gpm, 1.0% Inlet, 15~17% outlet

Screw Press Location:	City of Enterprise, OR
Screw Press Model #:	HX 400 x 3000L Skid system, [1 HP]
Type of Bio Sludge:	Aerobically digested WAS
Year Started:	Startup completed in 2009
Contact Name:	Dave Wilke, Chief Operator, Tel: (514) 398-2400
Typical performance:	13.2 gpm, 1.0% Inlet, 16% outlet

Screw Press Location:	City of Bainbridge Island, WA
Screw Press Model #:	SHX-900x6000L [3 HP], Class “A” Capable
Type of Bio Sludge:	Municipal WAS
Year Started:	Startup completed in 2009
Contact Name:	Steve Pyke, Tel: (360) 780-3592
Typical performance:	55.6 gpm, 1.0% Inlet, >15% outlet

Screw Press Location:	City of Toppenish, WA
Screw Press Model #:	SHX-650x4000L [3 HP]
Type of Bio Sludge:	Anaerobically Digested
Year Started:	Startup completed in 2009
Contact Name:	Eric Bakker, WWTP Operator, Tel: (509) 865-4089
Typical performance:	18 gpm, 2.0% Inlet, 20% outlet

Screw Press Location:	City of Sausalito, CA
Screw Press Model #:	SHX-900x5000L [2 HP]
Type of Bio Sludge:	Anaerobically Digested
Year Started:	Startup completed in 2009
Contact Name:	Kevin Rahman, WWTO Engineer, Tel: (415) 331-4714
Typical performance:	40 gpm, 2.0% Inlet, 24% outlet

Screw Press Location:	City of Fairfield, CA
Screw Press Model #:	SHX-1250x8000L [7.5 HP]
Type of Bio Sludge:	Anaerobically Digested, 14.8 MGD
Year Started:	Startup completed in 2009
Contact Name:	Ron Hipkiss, (707) 429-8930
Typical performance:	55 gpm, 2.5% Inlet, 23% outlet

Screw Press Location:	City Live Oak, FL
Screw Press Model #:	SHX-600x4000L [3 HP]
Type of Bio Sludge:	Aerobically Digested Biosolids, Class “A” Capable system
Year Started:	Startup completed in 2010
Contact Name:	William Brandon, Utilities Plant Manager, Tel: (386) 364-3749
Typical performance:	17 gpm, 2.0% Inlet, >15% outlet

Screw Press Location:	Sun n’ Lake, Sebring, FL
Screw Press Model #:	BHX-600x4000L [2 HP]
Type of Bio Sludge:	Municipal WAS
Year Started:	Startup completed in 2010
Contact Name #1:	Mr. Don Gavoni – Supervising Wastewater Treatment Plant Operator Tel: (863) 381-2376
Contact Name #2:	Mr. Rob Dingle - Lead Operator - Tel: (863) 381-2368
Typical performance:	40 gpm, 1.0% Inlet, 15~18% outlet

Screw Press Location:	City of Hamilton, MT
Screw Press Model #:	BHX-400x2500L [1 HP]
Type of Bio Sludge:	Waste Activated Sludge
Year Started:	Startup completed in 2010
Contact Name:	Keith Smith, Public Works Director, Tel: (406) 363-6732
Performance:	10-11 gpm, 2.4% Inlet, 17-19% outlet

Screw Press Location:	Oroville, WA
Screw Press Model #:	SHX-350x3000L
Type of Bio Sludge:	Municipal WAS / Operating with FKC’s Patented Class “A” Process
Year Started:	Startup completed in 2010
Contact Name:	Steve Thompson, Public Works Director, Tel: (509) 476-2345 Robert Marcel, WWTP Operator, Tel: (509) 476-3432
Typical performance:	6-8 gpm, 1.4% Inlet, >27% for Class “A” operation

Screw Press Location:	City of Kerman, CA
Screw Press Model #:	SHX-1000x8000L
Type of Bio Sludge:	Aerobically Digested Municipal Sludge, Class “A” Capable system
Year Started:	2010
Contact Name:	Doug Hearld, WWTP Manager, Tel: (559) 846-3998
Typical performance:	88 gpm, .8% Inlet, >15% outlet, >25% for Class “A” operation

Screw Press Location:	City of Umatilla, FL
Screw Press Model #:	SHX-800x6500L
Type of Bio Sludge:	Secondary Sludge, Class “A” Capable system
Year Started:	2010
Contact Name:	Vaughn Nilson, City of Umatilla Operator, Tel (352) 602-9269
Typical performance:	55 gpm, 1% Inlet, >16% outlet, >25% for Class “A” operation

Screw Press Location:	City of Erie, Co
Screw Press Model #:	SHX-800x6500L
Type of Bio Sludge:	Municipal WAS / Operating with FKC’s Patented Class “A” Process
Year Started:	2011
Contact Name #1:	Jon Mays, Chief Plant Operator, Tel: (303) 926-2895
Typical performance:	50 gpm, 1% Inlet, >25% for Class “A” operation

Screw Press Location:	City of Merrimack, NH
Screw Press Model #:	BHX-1100x6000L
Type of Bio Sludge:	40%Pri:60%Sec Municipal Sludge, 11.5 MGD
Year Started:	2011
Contact Name:	Leo Gaudette, Town of Merrimack, Lead Operator, Tel: (603) 420 - 1621
Performance:	95 gpm, 3.5% Inlet, 18-25% outlet

Screw Press Location:	City of Lapwai, ID
Screw Press Model #:	SHX-400x3500L
Type of Bio Sludge:	Municipal MBR Sec. / Operating with FKC's Patented Class "A" Process
Year Started:	2012
Contact Name:	Jason Vangen, Tel: (208) 843-7368 x 3898
Typical performance:	8-10 gpm, 1.8% Inlet, >25% for Class "A" operation

Screw Press Location:	Waikoloa, HI / Hawaii Water Service Co.
Screw Press Model #:	SHX-900x7000L, [5HP] Class "A" Capable
Type of Bio Sludge:	Municipal Membrane Bioreactor (MBR) WAS
Year Started:	2012
Contact Name:	Ron Hay Tel: (808) 282-9867
Typical performance:	52 gpm, 1.5% Inlet, >15% outlet

Screw Press Location:	City of Avon Park, FL #1
Screw Press Model #:	BHX-700x4000L [2 HP]
Type of Bio Sludge:	Municipal WAS
Year Started:	2012
Contact Name:	Jonathon, Lead Operator, Tel: (863) 214-5115
Typical performance:	50 gpm, 1.0% Inlet, 16~18% outlet

Screw Press Location:	City Skagway, AK
Screw Press Model #:	HX-350x2000L [2 HP]
Type of Bio Sludge:	Municipal Primary Sludge 50/50 Pri/Sec Mix
Year Started:	2012
Contact Name:	Tim Gladden, Operator, Tel: (907) 983-2071
Typical performance:	20 gpm, 2% inlet, 35% outlet

Screw Press Location:	City of Pendleton, OR
Screw Press Model #:	BHX-1050x5500L [5 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge, 5.5 MGD
Year Started:	2012
Contact Name:	Mark Milne, Wastewater Treatment Superintendent, Tel: 541-276-3372
Typical performance:	100 gpm, 2% inlet, 16% outlet

Screw Press Location:	City Raymond/South Bend, WA
Screw Press Model #:	SHX-500x4000L [3 HP]
Type of Bio Sludge:	Municipal WAS / Will Operate with FKC's Patented Class "A" Process
Year Started:	2013
Contact Name:	Jeff Smith, Operator, Tel: (360) 942 - 4125
Typical performance:	24 gpm, 1% inlet, 25%-30% outlet

Screw Press Location:	City of Brookings, OR
Screw Press Model #:	BHX-800 x 4500L [2 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2012
Contact Name:	Ray Page, Tel: (541) 412-0424, ex. 3181
Typical performance:	77 gpm, 1% inlet, 22% outlet

Screw Press Location:	City of Guadalupe, CA
Screw Press Model #:	BHX-500 x 3000L [2 HP]
Type of Bio Sludge:	Municipal Waste Activated Sludge
Year Started:	2012
Contact Name:	Charlie Vasquez, Tel: (805) 343-1340
Typical performance:	30 gpm, 1% inlet, 16% outlet

Screw Press Location:	City of Tehachapi, CA
Screw Press Model #:	BHX-550 x 4000L [2 HP]
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	2013
Contact Name:	Wyatt Misiura, Tel: (661) 972-1768
Typical performance:	24 gpm, 1% inlet, 15% outlet

Screw Press Location:	City of Gold Beach, OR
Screw Press Model #:	BHX-500 x 3000L [2 HP]
Type of Bio Sludge:	Municipal Sequential Batch Reactor (SBR) WAS
Year Started:	April 2013
Contact Name:	Will Newdall, Tel: (541) 247-7029
Typical performance:	44 gpm, 0.8% inlet, 17% outlet

Screw Press Location:	Polk County, FL
Screw Press Model #:	BHX-900 x 5000L (2 each) [3 HP]
Type of Bio Sludge:	Aerobically Digested Municipal Sludge, 6 MGD
Year Started:	2012
Contact Name:	Jeff Goolsby, Tel: 863-221-1213
Typical performance:	94 gpm, 0.8% inlet, 17% outlet

Screw Press Location:	City of Waterloo, WI
Screw Press Model #:	BHX-1000x5000L [3 HP]
Type of Bio Sludge:	Municipal WAS
Year Started:	2012
Contact Name:	Dennis Hotmar, dhotmar@hotmail.com, Tel: (920) 478-2720
Typical performance:	105 gpm, 1% inlet, 18% outlet

Screw Press Location:	Mackinac Island, MI
Screw Press Model #:	SHX-700x5000L [5 HP] Class “A” Capable
Type of Bio Sludge:	Co-Settled Primary and WAS, Municipal Sludge
Year Started:	Scheduled for 2013
Contact Name:	Will Fisher, Tel: (906) 847-3278
Typical performance:	37 gpm, 4% inlet, 20% outlet

Screw Press Location:	Fort Meade, MD
Screw Press Model #:	BHX-600x4000L
Type of Bio Sludge:	Municipal Primary Sludge 50/50 Pri/Sec Mix
Year Started:	2012
Contact Name:	Douglas Smith, Operations Supervisor, Tel: (443) 591-7218
Typical performance:	37 gpm, 4% inlet, 20% outlet

Screw Press Location:	North of the River Sanitation District - Shafter, CA
Screw Press Model #:	SHX-1100x8500L
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	June 2013
Contact Name:	Ramon Arredondo, WWTP Supervisor 661-746-4230
Typical performance:	125 gpm, 1% inlet, 18% outlet

Screw Press Location:	City of Graceville, FL
Screw Press Model #:	SHX-600x5000L [3 HP] Class “A” Capable
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	2013
Contact Name:	Bill Austin, Tel: 850-326-0837
Typical performance:	35 gpm, 1% inlet, 17% outlet

Screw Press Location:	City of Tacoma, WA
Screw Press Model #:	BHX-1100x6000L (3 each) [5HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2014
Contact Name:	Norman Cook, Operations Division, Tel: 253-405-1175
Typical performance:	133 gpm, 1.5% inlet, 22% outlet

Screw Press Location:	Oceanside Wastewater Treatment Plant - San Francisco, CA
Screw Press Model #:	BHX-1100x6000L (2 each) [5 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	August 2013
Contact Name:	Jeff Yee, Tel: 415-713-3913

Screw Press Location:	City of Mt Sterling, OH
Screw Press Model #:	SHX-600x5000L
Type of Bio Sludge:	Municipal WAS + Septage, Will Operate with FKC’s Patented Class “A” Process
Year Started:	February 2014
Contact Name:	Dusty Parker, Tel: (740) 837-0424
Typical performance:	33 gpm, 1% inlet, 35% outlet

Screw Press Location:	City of Bridgeport, WA
Screw Press Model #:	BHX-450x2500L [1HP]
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	2014
Contact Name #1:	Bruce Plimpton, Tel: (509) 686-5653
Typical performance:	27 gpm, 1% inlet, 17% outlet

Screw Press Location:	City of Roseburg, OR
Screw Press Model #:	BHX-1000x5500L
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	April 2014
Contact Name #1:	Jim Baird, Operations Manager, (541) 672-1551
Typical performance:	63 gpm, 2% inlet, 20% outlet

Screw Press Location:	Sonoma, CA
Screw Press Model #:	SHX-1250x9000L [7.5 HP]
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	2014
Contact Name #1:	John Albrecht, 707-547-1073
Typical performance:	80 GPM, 1.5% inlet, 19% outlet

Screw Press Location:	Quincy, FL
Screw Press Model #:	BHX-500x3000L Skid [3 HP]
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	2014
Contact Name #1:	Terry Presnal, 850-627-1879
Typical performance:	30 gpm, 1% inlet, 18% outlet

Screw Press Location:	Hualalai, HI
Screw Press Model #:	BHX-700x4000L [3 HP]
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	2014
Contact Name #1:	Charles Dawrs, Utility Manager, 808-325-8179
Typical performance:	50 gpm, 1% inlet, 17% outlet

Screw Press Location:	Berlin NH
Screw Press Model #:	BHX-1100X6000L [5 HP]
Type of Bio Sludge:	Municipal Primary / Secondary Blend
Year Started:	2014
Contact Name #1:	City of Berlin, WWTP Supervisor, 603-752-8563
Typical performance:	115 gpm, 3% inlet, 26% outlet

Screw Press Location:	Bay City MI
Screw Press Model #:	BHX-700X4000L (2 each) [5 HP]
Type of Bio Sludge:	Municipal Primary / Secondary Blend
Year Started:	2014
Contact Name #1:	Paul Goergen, Tel: (810) 869-2338
Typical performance:	32 gpm, 4.5% inlet, 35% outlet

Screw Press Location:	Los Osos, CA
Screw Press Model #:	BHX-1100X6000L (2 each) [5 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	2016
Contact Name #1:	Brenden Clemens, Chief Plant Operator, 805-528-3010
Typical performance:	70 gpm, 2% inlet, 15% outlet

Screw Press Location:	Visalia, CA
Screw Press Model #:	BHX-1200X6600L (2 each) [5 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2016
Contact Name #1:	Jason Rodriques, Lead Operator, ph# 559-713-4671
Typical performance:	110 gpm, 2.0% inlet, 20% outlet

Screw Press Location:	San Luis Obispo CA
Screw Press Model #:	BHX-1000x5500L [5 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2015
Contact Name #1:	Chris Leeman, Interim Deputy Supervisor, ph: 805-781-7240
Typical performance:	66 gpm, 2% inlet, 20% outlet

Screw Press Location:	Stonegate CO
Screw Press Model #:	BHX-600X4000L
Type of Bio Sludge:	Municipal Membrane Bioreactor (MBR) WAS
Year Started:	2016
Contact Name #1:	Ger Whelam, Lead Operator, ph: 303-912-1126
Typical performance:	25 GPM, 1.0% inlet, 16% outlet

Screw Press Location:	Monroe MI
Screw Press Model #:	BHX-1000x5500L (3 each) [5 HP]
Type of Bio Sludge:	Municipal Primary / Secondary Blend
Year Started:	2015
Contact Name #1:	Davis Hileman, Tel: (734) 241-5926
Typical performance:	140 gpm, 2% inlet, 25% outlet

Screw Press Location:	Galt, CA
Screw Press Model #:	BHX-900x5000L [3 HP]
Type of Bio Sludge:	Waste Activated (Oxidation Ditch) Municipal Sludge
Year Started:	2016
Contact Name #1:	Alex Fastro, (209) 400-4914
Typical performance:	45 to 95 gpm, 0.8 to 4% inlet, 18 to 20% outlet

Screw Press Location:	Lynnwood WA
Screw Press Model #:	BHX-800x4500L [5 HP]
Type of Bio Sludge:	Municipal Primary / Secondary Blend
Year Started:	2015
Contact Name #1:	John Ewell, Tel: (425) 670-6272
Typical performance:	45 gpm, 2% inlet, 24% outlet

Screw Press Location:	Puyallup WA
Screw Press Model #:	BHX-1000x5500L [3 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2016
Contact Name #1:	Cecil Harper, Tel: (253) 435-3658
Typical performance:	65 GPM, 2.0% inlet, 23%

Screw Press Location:	Paris Illinois
Screw Press Model #:	BHX-600x3500 [3 HP]
Type of Bio Sludge:	Lightly Aerated Municipal Primary / Secondary Blend
Year Started:	2015
Contact Name #1:	Aaron Shanks, Tel; (217) 264-3750, Cell: (217) 264-9488
Typical performance:	40 gpm, 2% inlet, 22% outlet

Screw Press Location:	Davis CA
Screw Press Model #:	BHX-1000x5500 (2 each) [5 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2016
Contact Name #1:	John Alexander; 530-632-8799; JAlexander@cityofdavis.org
Typical performance:	65 GPM, 2.0% inlet, 23% outlet

Screw Press Location:	Holland MI
Screw Press Model #:	BHX-1250x7000 (4 each) [7.5 HP]
Type of Bio Sludge:	Municipal Primary / Secondary Blend
Year Started:	2015
Contact Name #1:	**Joel Davenport, PE,** Superintendent, Water Reclamation Facility 616.355.1252 office, 616.745.1629 cell
Typical performance:	125 GPM, 3.0% inlet, 25% outlet

Screw Press Location:	Hill Canyon WWTP, Thousand Oaks CA
Screw Press Model #:	BHX-1100x6000 (2 each) [5 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2015
Contact Name #1:	John Minkel, Utilities Superintendent, 805-491-8121
Typical performance:	75 GPM, 2.0% inlet, 24% outlet

Screw Press Location:	Lewiston ME
Screw Press Model #:	BHX-900x5000 (2 each) [3 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2016
Contact Name #1:	Travis Peaslee, Assistant Superintendent, 207-782-0917 tpleaslee@lawpca.org
Typical performance:	40 GPM, 2.2-2.5% inlet, 23% outlet

Screw Press Location:	Myrtle Point OR
Screw Press Model #:	SHX-400x3500 [2 HP]
Type of Bio Sludge:	Municipal WAS / Will Operate with FKC's Patented Class "A" Process
Year Started:	To be started in 2016
Contact Name #1:	To be determined
Typical performance:	To be determined

Screw Press Location:	Middleborough MA
Screw Press Model #:	BHX-700x4000 (2 each) [5 HP]
Type of Bio Sludge:	Municipal Primary / Secondary Blend
Year Started:	To be started in 2016
Contact Name #1:	Todd Goldman – Wastewater Superintendent 508-946-2485 tgldmn@middleborough.com
Typical performance:	45-60 GPM, 2-3% inlet, 18-20% outlet

Screw Press Location:	Fredericksburg, TX
Screw Press Model #:	BHX-900x4000 [2 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	March 2016
Contact Name #1:	Lyle Drust, (803) 889-5842
Typical performance:	70 gpm, 1% inlet, 17% outlet

Screw Press Location:	Carmel CA
Screw Press Model #:	BHX-900x4500 [2 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2016
Contact Name #1:	Ed Waggoner; Lead Operator: waggoner@cawd.org
Typical performance:	80 GPM, 1.5% inlet, 20% outlet

Screw Press Location:	Hartsville TN
Screw Press Model #:	BHX-700x4000 [2 HP]
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	2017
Contact Name #1:	Penny Sutherland, Wastewater Superintendent, Tel: 615-374-2681, hartwater@hotmail.com
Typical performance:	45 gpm @ 1% inlet, 18-20% outlet

Screw Press Location:	Miller Creek Treatment Plant, SSSD, Normandy Park WA
Screw Press Model #:	BHX-800x4500L [2 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2016
Contact Name:	Tim Berge, Tel: 206-432-3518
Typical performance:	30 gpm @ 2% inlet, 22-24% outlet

Screw Press Location:	Keene NH WWTP
Screw Press Model #:	(2) BHX-1000x5500L (5 HP)
Type of Bio Sludge:	Primary / Secondary
Year Started:	2017
Contact Name:	Aaron Costa – Operations Manager 603-357-9836x6507 acosta@ci.keene.nh.us
Typical performance:	60-65 gpm @ 2.5% inlet, 34-36% outlet

Screw Press Location:	Ocala, FL American Pipe & Tank
Screw Press Model #:	BHX-1250x7000 [7.5 HP]
Type of Bio Sludge:	WAS / Septage Blend
Year Started:	2017
Contact Name #1:	George Conomos President, 352-687-4281, americanpipeandtank@embarqmail.com
Typical performance:	150 gpm @ 1.3% inlet, 19% outlet

Screw Press Location:	Central Davis Sewer Dist., Kaysville UT
Screw Press Model #:	BHX 1100 x 6000L
Type of Bio Sludge:	WAS
Year Started:	2016
Contact Name:	David Hatch, Engineering Manager 801-451-2190 dhatch@cdsewer.org
Typical performance:	120 GPM @ 1.0% inlet, 16% outlet

Screw Press Location:	Palmyra, MO
Screw Press Model #:	BHX-400x2500L [1 HP]
Type of Bio Sludge:	Waste Activated (Oxidation Ditch) Municipal Sludge
Year Started:	2017
Contact Name #1:	John Selleck, Tel: 573-231-9720
Typical performance:	10 to 16 gpm, 0.8 to 1.0% inlet, 16 to 19% outlet

Screw Press Location:	Talbot County MD
Screw Press Model #:	Two each BHX-500x3000L [3 HP] Skid Systems
Type of Bio Sludge:	Septage / Grease Trap Waste
Year Started:	2017
Contact Name:	Ryan Ebling, Tel: 410-507-1413
Typical performance:	50 gpm, 1.2% inlet, 25% outlet

Screw Press Location:	City of Avon Park, FL #1
Screw Press Model #:	BHX-700x4000L [2 HP]
Type of Bio Sludge:	Municipal WAS
Year Started:	2018
Contact Name:	Jonathan, 863-443-1806
Typical performance:	50 gpm, 1.0% Inlet, 16~18% outlet

Screw Press Location:	Bass Lake CA WWTP
Screw Press Model #:	BHX-450x2500L [1 HP] Skid System
Type of Bio Sludge:	Aerobically Digested Sludge
Year Started:	Scheduled for 2018
Contact Name:	TBD
Typical performance:	20 gpm, 1% inlet, 15% outlet

Screw Press Location:	Benton IL WWTP
Screw Press Model #:	BHX 600x3500L
Type of Bio Sludge:	Municipal 100% WAS
Year Started:	August 2018
Contact Name:	Kevin, Cell: 618.790.4351
Typical performance:	30 gpm, 1% inlet, 16% outlet

Screw Press Location:	Sydney Water Corp, Sydney Australia
Screw Press Model #:	BHX-1250x7000 [7.5 HP]
Type of Bio Sludge:	Municipal WAS from lagoon
Year Started:	June 2018
Contact Name:	TBD
Typical performance:	100 ~ 110 gpm, >1.4% inlet, 20% outlet

Screw Press Location:	Sunnyside WA WWTP
Screw Press Model #:	BHX 800x4500L
Type of Bio Sludge:	Aerobically Digested Sludge
Year Started:	January 2018
Contact Name:	Raul Sanchez, O:509-836-6566, Rsanchez@sunnyside-wa.gov
Typical performance:	30 ~ 45 gpm, 2.5% inlet, 18% outlet

Screw Press Location:	West Sound Utility District WWTP, Port Orchard WA
Screw Press Model #:	BHX-700x4000L [2 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2018
Contact Name:	Marty Grabill, Tel: 360-895-6926
Typical performance:	31 gpm @ 1.8% inlet, 20% outlet

Screw Press Location:	Port Angeles WA WWTP
Screw Press Model #:	BHX-800x4500L [2 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2018
Contact Name:	Gary Richmond, Tel: 360-417-4893
Typical performance:	50 gpm @ 1.22% inlet, 26% outlet

Screw Press Location:	Woodland WA WWTP
Screw Press Model #:	BHX-500x3000L [2 HP] Skid System
Type of Bio Sludge:	Aerobically Digested Sludge
Year Started:	2018
Contact Name:	Derrek Amburgey, Tel: 360-225-7007
Typical performance:	13.5 gpm, 1.9% inlet, 16% outlet

Screw Press Location:	Mount Vernon WA WWTP
Screw Press Model #:	BHX-1050x5500L [3HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2017
Contact Name:	Chad Tesarik, Tel: 360-336-6219 ext. 2303
Typical performance:	62.4 gpm @ 2.5% inlet, 18.5% outlet

Screw Press Location:	Pleasant Hills PA WWTP
Screw Press Model #:	BHX-1050x5500L [3HP]
Type of Bio Sludge:	Anaerobic Municipal Sludge
Year Started:	To be started up 2019
Contact Name:	TBD
Typical performance:	80 gpm, 2.0% inlet, 22% outlet

Screw Press Location:	City of Coulee Dam WA WWTP
Screw Press Model #:	BHX-500x3000L [2 HP] Skid System
Type of Bio Sludge:	Aerobically Digested Sludge
Year Started:	Scheduled for 2019
Contact Name:	TBD
Typical performance:	21 gpm, 1.2% inlet, 17% outlet

Screw Press Location:	Lyon County NV WWTP
Screw Press Model #:	BHX-800x4500L [2 HP] Skid System
Type of Bio Sludge:	Waste Activated Sludge
Year Started:	2018
Contact Name:	Jason Dukek, Tel: 775-246-6220
Typical performance:	60 gpm, 1% inlet, 16% outlet

Screw Press Location:	Hermiston OR WWTP
Screw Press Model #:	BHX-800x4500L [2 HP] Skid System
Type of Bio Sludge:	Anaerobically Digested Sludge
Year Started:	To be delivered 2018
Contact Name:	Bill Schmittle, 541-667-5076, wschmittle@hermiston.or.us
Typical performance:	63 gpm, 1.5% inlet, 17% outlet

Screw Press Location:	Salmon Creek Treatment Plant, SSSD, Burien WA
Screw Press Model #:	BHX800x4500L (2 HP)
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	To be started 2019
Contact Name:	Tim Berge, Tel: 206-432-3518
Typical performance:	30 gpm @2 %, 22-24% outlet

Screw Press Location:	Harrisonburg WWTP
Screw Press Model #:	BHX-1100x6000L [3 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	November 2018
Contact Name:	???
Typical performance:	80 gpm, 2.5% inlet, 18% outlet

Screw Press Location:	Santaquin WWTP
Screw Press Model #:	BHX-800x4000L [2 HP]
Type of Bio Sludge:	Municipal Membrane Bioreactor (MBR) WAS
Year Started:	To be started 2019
Contact Name:	TBD
Typical performance:	86 gpm, 0.7% TS inlet, 16% TS outlet

Screw Press Location:	Tesuque Casino WWTP, Santa Fe NM
Screw Press Model #:	BHX-350x2000L [1 HP] Skid System
Type of Bio Sludge:	Membrane Bio-Reactor Waste Activated Sludge
Year Started:	To be started 2018
Contact Name:	To be determined
Typical performance:	12 gpm, 0.75% inlet, 15% outlet

Screw Press Location:	Evansville WI WWTP
Screw Press Model #:	BHX-1000x5500L [3HP}
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	2019
Contact Name:	Dale Roberts, Tel: 608-882-2271
Typical performance:	70 gpm, 1.5% inlet, 16% outlet

Screw Press Location:	Epping NH WWTP
Screw Press Model #:	BHX-700x4000L [5 HP]
Type of Bio Sludge:	Septage/MBR WAS Municipal Blend
Year Started:	2019
Contact Name:	Jim Pouliot, Tel: 603-679-5441, eppingwwtf@townofepping.com
Typical performance:	115 gpm, 1.2% inlet, 20% outlet

Screw Press Location:	Depoe Bay WWTP
Screw Press Model #:	SHX-500x4000L [2 HP]
Type of Bio Sludge:	Waste Activated, Aerobically Digested Sludge
Year Started:	Scheduled for 2018
Contact Name:	Gary Walls, Tel: (541) 765-2364, wwtp@cityofdepoebay.org
Typical performance:	17-18 gpm, 1.7% inlet, 15-18% outlet

Screw Press Location:	Sutherlin OR WWTP
Screw Press Model #:	BHX-900x5000L [3 HP]
Type of Bio Sludge:	Waste Activated Sludge
Year Started:	To be started up in 2019
Contact Name:	TBD
Typical performance:	54 gpm, 1.5% inlet, 17% outlet

Screw Press Location:	Cayucos CA WWTP
Screw Press Model #:	BHX-600x3500L [3 HP]
Type of Bio Sludge:	MBR WAS Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	32 gpm, 1.2% inlet, 17% outlet

Screw Press Location:	Hall County, Spout Springs GA WWTP
Screw Press Model #:	BHX-600x3500L [2 HP]
Type of Bio Sludge:	Aerobically Digested Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	32 gpm, 1.6% inlet, 16% outlet

Screw Press Location:	Hawaii American Water, Hawaii Kai, HI
Screw Press Model #:	BHX-700x4000L (2 each) [2 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	2019
Contact Name:	Lee Mansfield, Tel: 808-394-1285, Plant Manager
Typical performance:	25 gpm, 3% inlet, 19% outlet

Screw Press Location:	Torrington CT WWTP
Screw Press Model #:	BHX-500x3000L [3 HP]
Type of Bio Sludge:	Primary/Secondary/Tertiary Municipal Blend
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	37 gpm, 2% inlet, 25% outlet

Screw Press Location:	Andover KS WWTP
Screw Press Model #:	BHX-900x5000L [3 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	60 gpm, 1.0% inlet, 16% outlet

Screw Press Location:	Hardrock Fire Mtn Casino, Wheatland CA
Screw Press Model #:	BHX-500x2500L [2 HP]
Type of Bio Sludge:	Municipal Membrane Bioreactor (MBR) WAS
Year Started:	2019
Contact Name:	Josh Brown, Tel: 916-420-1966, jbrown@aquality.com
Typical performance:	24 gpm, 1.2% inlet, 15% outlet

Screw Press Location:	Silverton OR WWTP
Screw Press Model #:	BHX-900x4500L [2 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	73 gpm, 2.0% inlet, 17% outlet

Screw Press Location:	Long Beach WA WWTP
Screw Press Model #:	BHX-800x00L [HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	70 gpm, 1.0% inlet, 15% outlet

Screw Press Location:	East Lansing WWTP
Screw Press Model #:	BHX-1250x7000L (3 each) [7.5 HP]
Type of Bio Sludge:	Anaerobically Digested Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	110 gpm, 2.0% inlet, 22% outlet

Screw Press Location:	Canyonville WWTP
Screw Press Model #:	BHX-600x3500L [2 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	42 gpm, 1.0% inlet, 16% outlet

Screw Press Location:	Pahrump WWTP
Screw Press Model #:	BHX-1100x6000L [3 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	138 gpm, 1.0% inlet, 15% outlet

Screw Press Location:	Hillsborough County FL, NW WWTP
Screw Press Model #:	BHX-1250x7000L (4 each) [5 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	150 gpm, 1.0% inlet, 17% outlet

Screw Press Location:	Rock Island WA WWTP
Screw Press Model #:	BHX-600x3500L [2 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	2020
Contact Name:	Wyatt Long, Tel: (509) 884-1261, publicworks@rockislandwa.gov
Typical performance:	31 gpm, 1.25% inlet, 17% outlet

Screw Press Location:	Ahousaht BC CA WWTP
Screw Press Model #:	BHX-450x2500L [1 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	12 gpm, 1.3% inlet, 18% outlet

Screw Press Location:	Highland IL WWTP
Screw Press Model #:	BHX-1100x6000L [3 HP]
Type of Bio Sludge:	Waste Activated Municipal Sludge
Year Started:	To be started up in 2020
Contact Name:	TBD
Typical performance:	100 gpm, 1.2% inlet, 17% outlet

Screw Press Location:	
Screw Press Model #:	
Type of Bio Sludge:	
Year Started:	
Contact Name:	
Typical performance:	

Screw Press Location:	
Screw Press Model #:	
Type of Bio Sludge:	
Year Started:	
Contact Name:	
Typical performance:	

Screw Press Location:	
Screw Press Model #:	
Type of Bio Sludge:	
Year Started:	
Contact Name:	
Typical performance:	

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Port Angeles, WA 98363
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CONTACT LIST FOR WATER TREATMENT PLANT RESIDUALS DEWATERING APPLICATIONS UTILIZING FKC SCREW PRESSES

Screw Press Location:	Cal American Water - Begonia Iron Removal Facility (BIRP)
Screw Press Model #:	SHX-550x4000L [3 HP]
Type of Residuals:	WTP Iron Precipitation Residuals
Year Started:	2011
Contact Name #1:	Mr. Anthony Lindstrom.– Operations Supervisor Tel: 831 646-3258 Fax: 831 375-4367 anthony.lindstrom@amwater.com
Typical performance:	19-20 gpm, 1.0% Inlet, 18~21% outlet

Screw Press Location:	Highlands Water Utility District – Highlands, CA
Screw Press Model #:	SHX-400x3500L [2 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2008
Contact Name #1:	Mr. Jeff Davis - Plant Supervisor Tel: 707 994-8676 Fax: 707 994-1308 jdavis@highlandswater.com
Typical performance:	11-12 gpm, 1.0% Inlet, 18% outlet

Screw Press Location:	American Water Co. - City of Lucerne, CA
Screw Press Model #:	SHX-500x4000L [2 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2008
Contact Name #1:	Mr. Donny Breedlove – Superintendent II Tel: 707-495-5541 Fax: 707-274-2612 dbreedlove@calwater.com
Typical performance:	18 gpm, 1.0% Inlet, 16-20% outlet

Screw Press Location:	Green River Filtration Facility – Ravensdale, WA **135 MGD**
Screw Press Model #:	(2 each) BHX-1000x5500L [5 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2015
Contact Name #1:	Mr. Gary Fox – Lead Operator Tel: 253-502-8214 or 253-377-1138 Gary.Fox@ci.tacoma.wa.us
Typical performance:	1,000 dry lbs. per hour / 80 gpm (each), 2.5% Inlet, 25% outlet

Screw Press Location:	Lake Oswego Tigard WTP – West Linn, OR **75 MGD**
Screw Press Model #:	(2 each) BHX-700x4000L [3 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2015
Contact Name #1:	Kari Duncan Tel: 503-635-0393 kduncan@ci.oswego.or.us
Typical performance:	5.7 T/D (475 dry lbs per hour) each, 20 gpm (each), 4.5% Inlet, 38.5% outlet, 99% capture

Screw Press Location:	Lynden WTP – Lynden WA **8 MGD**
Screw Press Model #:	BHX-900x5000L [3 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2015
Contact Name #1:	Tamara Adams Tel: 360-255-5470 Adamst@LYNDENWA.ORG
Typical performance:	6.9 T/D (575 dry lbs per hour), 52 gpm, 2.2% Inlet, 37% outlet

Screw Press Location:	Montague CA WTP **1 MGD**
Screw Press Model #:	BHX-250x1500L [1 HP]
Type of Residuals:	WTP Alum / ACH / PAC Residuals
Year Started:	2013
Contact Name #1:	Don Kincade – Montague Public Works Tel: 530-459-5204 pubwks.ci.montague.ca.us@gmail.com
Typical performance:	0.2 T/D (25 dry lbs per hour), 5 gpm, 1.3% Inlet, 20% outlet

Screw Press Location:	Folsom WTP – Folsom, CA **50 MGD**
Screw Press Model #:	BHX-700x4000L [3 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2015
Contact Name #1:	Eric Loughlin Tel: 360-255-5470 eloughlin@folsom.ca.us
Typical performance:	4.4 T/D (370 dry lbs. per hour), 37 gpm, 2.0% Inlet, 24% outlet

Screw Press Location:	Columbus Water Works – Columbus GA **90 MGD**
Screw Press Model #:	BHX-1000x5500L (2 each) [5 HP]
Type of Bio Sludge:	Alum / PAC WTP Sludge
Year Started:	2018
Contact Name #1:	Mr. John Otto – Water Treatment Superintendent Tel: 706-649-3402 or 706-304-6035 jotto@cwwga.org
Typical performance:	1,000 dry lbs. per hour / 40 gpm (each), 5% Inlet, 26-29% outlet

Screw Press Location:	Bernalillo WTP, Albuquerque NM **90 MGD**
Screw Press Model #:	BHX-1250x7000L (2 each) [10 HP]
Type of Bio Sludge:	Ferric WTP Sludge
Year Started:	#1 started 2019, #2 to be started 2020
Contact Name #1:	Mr. Kris Johnson, P.E., Tel: (505) 289-3374
Typical performance:	1,350 dry lbs. per hour / 135 gpm (each), 2.0% Inlet, 27% outlet

INDUSTRIAL APPLICATIONS UTILIZING FKC SCREW PRESSES FOR BIOLOGICAL SLUDGES

Screw Press Location:	DAK America (Formerly: Carolina Eastman Company, & Voridan) Columbia, SC
Screw Press Model #:	HX-1050x6000L [3 HP] and HX-1200x7000L [5 HP]
RST Model Number:	RST-S630x3000L (2 each) [1 HP]
Type of Bio Sludge:	Biological Sludge / aerobically digested WAS from PETE/plastic bead production wastewater treatment process
Year Started:	1989
Contact Name #1:	DJ (Bud) Roland, 803-963-4046 droland@dakamericas.com
Contact Name #2:	Tel: (803) 926-5011
Typical performance:	90~100 gpm each, 0.7% Inlet, 16~19% outlet

Screw Press Location:	Tropicana Products Inc., Bradenton, FL
Screw Press Model #:	SHX-1200x8000L (2 each) [5 HP]
RST Model Number:	RST-S630x3000L (2 each) [1 HP]
Type of Bio Sludge:	Biological Sludge (WAS from orange juice production wastewater treatment plus a small percentage of raw primary)
Year Started:	2002
Contact Name #1:	Margorie Drake – Wastewater Systems Superintendent Tel: (941) 742-3464 Margorie.Drake@pepsico.com
Contact Name #2:	Mr. Tony Ahnberg - Environmental Manager Tel: (941) 742-2753
Typical performance:	75 gpm each, 2.0% Inlet, 15~20% outlet

Screw Press Location:	Port of Sunnyside, WA
Screw Press Model #:	BHX-1000x5500L [3 HP]
Type of Bio Sludge:	SBR, Waste Activated Sludge
Year Started:	Startup completed in 2009
Contact Name:	Bob Ferrell, WWTP Engineer, Tel: (509) 839-3187
Performance:	96 gpm, 1.0% Inlet, 15-17% outlet

Screw Press Location:	Washington Beef, Toppenish, WA
Screw Press Model #:	BHX-1000x5500L [3 HP]
Type of Bio Sludge:	Anaerobically Digested Sludge
Year Started:	Startup completed in 2012
Contact Name:	Sheri Byers
Performance:	72 gpm, 2.5% Inlet, >22% outlet

Screw Press Location:	Tahoe Reno Industrial Park
Screw Press Model #:	BHX-700x4000L [2 HP]
Type of Bio Sludge:	Industrial Waste Activated Sludge
Year Started:	2015
Contact Name:	Daniel Peterson, 775-329-7757
Performance:	50 GPM, 1.0 % Inlet, 18% outlet

FKC CO., LTD.
2708 West 18th Street
Port Angeles, WA 98363
(360) 452-9472
FAX (360) 452-6880

CONTACT LIST FOR WATER TREATMENT PLANT RESIDUALS DEWATERING APPLICATIONS UTILIZING FKC SCREW PRESSES

Screw Press Location:	Cal American Water - Begonia Iron Removal Facility (BIRP)
Screw Press Model #:	SHX-550x4000L [3 HP]
Type of Residuals:	WTP Iron Precipitation Residuals
Year Started:	2011
Contact Name:	Mr. Anthony Lindstrom.– Operations Supervisor Tel: 831 646-3258 Fax: 831 375-4367 anthony.lindstrom@amwater.com
Typical performance:	19-20 gpm, 1.0% Inlet, 18~21% Outlet

Screw Press Location:	Highlands Water Utility District – Highlands, CA
Screw Press Model #:	SHX-400x3500L [2 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2008
Contact Name:	Mr. Jeff Davis - Plant Supervisor Tel: 707 994-8676 Fax: 707 994-1308 jdavis@highlandswater.com
Typical performance:	11-12 gpm, 1.0% Inlet, 18% Outlet

Screw Press Location:	American Water Co. - City of Lucerne, CA
Screw Press Model #:	SHX-500x4000L [2 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2008
Contact Name:	Mr. Donny Breedlove – Superintendent II Tel: 707-495-5541 Fax: 707-274-2612 dbreedlove@calwater.com
Typical performance:	18 gpm, 1.0% Inlet, 16-20% Outlet

Screw Press Location:	T-3 Water Storage and Treatment Plant, Fresno CA
Screw Press Model #:	BHX-700x5000L [3 HP]
Type of Bio Sludge:	Alum WTP Sludge
Year Started:	2012
Contact Name:	??? (plant has been converted from treatment to distribution so dewatering equipment is currently not in operation)
Typical performance:	184 dry lbs. per hour / 25 gpm @ 1.5% Inlet, 16% outlet

Screw Press Location:	Green River Filtration Facility – Ravensdale, WA 135 MGD
Screw Press Model #:	(2 each) BHX-1000x5500L [5 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2015
Contact Name:	Mr. Jeffrey Bolam – Operations Manager Office: 253-396-3191 Cell: 253-954-6949 jbolam@ci.tacoma.wa.us
Typical performance:	1,000 dry lbs. per hour / 80 gpm (each), 2.5% Inlet, 25% Outlet

Screw Press Location:	Lake Oswego Tigard WTP – West Linn, OR 75 MGD
Screw Press Model #:	(2 each) BHX-700x4000L [3 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2015
Contact Name:	Kari Duncan, Plant Manager Tel: 503-635-0393 kduncan@ci.oswego.or.us
Typical performance:	5.7 T/D (475 dry lbs per hour) each, 20 gpm (each), 4.5% Inlet, 38.5% Outlet, 99% capture

Screw Press Location:	Lynden WTP – Lynden, WA 8 MGD
Screw Press Model #:	BHX-900x5000L [3 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2015
Contact Name:	Mike Kim, Plant Superintendent Tel: 360-603-6913 kimm@lyndenwa.org
Typical performance:	6.9 T/D (575 dry lbs per hour), 52 gpm, 2.2% Inlet, 37% Outlet

Screw Press Location:	Montague, CA 1 MGD
Screw Press Model #:	BHX-250x1500L [1 HP]
Type of Residuals:	WTP Alum / ACH / PAC Residuals
Year Started:	2013
Contact Name:	Don Kincade – Montague Public Works Tel: 530-459-5204 pubwks.ci.montague.ca.us@gmail.com
Typical performance:	0.2 T/D (25 dry lbs per hour), 5 gpm, 1.3% Inlet, 20% Outlet

Screw Press Location:	Folsom WTP – Folsom, CA, WA 50 MGD
Screw Press Model #:	BHX-700x4000L [3 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2015
Contact Name:	Bryson Pearson – WTP Operator / Screw Press Lead Office: 9164616191-255-5470 Cell: 503-363-8044 bpearson@folsom.ca.us
Typical performance:	4.4 T/D (370 dry lbs. per hour), 37 gpm, 2.0% Inlet, 24% Outlet

Screw Press Location:	Montevina WTP – San Jose, CA, WA
Screw Press Model #:	(2 each) BHX-1100x6000L [5 HP]
Type of Residuals:	WTP Alum / PAC Residuals
Year Started:	2017
Contact Name:	Joshua Karpel - Water Treatment Plant Supervisor Tel: 408-309-6906 joshua.karpel@sjwater.com
Typical performance:	1,000 dry lbs. per hour / 100 gpm (each), 2% Inlet, 20% Outlet

Screw Press Location:	Columbus Water Works – Columbus, GA 90 MGD
Screw Press Model #:	(2) BHX-1000x5500L [5 HP]
Type of Bio Sludge:	Alum / PAC WTP Sludge
Year Started:	2018
Contact Name #1:	Mr. John Otto – Water Treatment Superintendent Tel: 706-649-3402 or 706-304-6035 jotto@cwwga.org
Typical performance:	1,000 dry lbs. per hour / 40 gpm (each), 5% Inlet, 26-29% Outlet

Screw Press Location:	Bernalillo WTP, Albuquerque NM 90 MGD
Screw Press Model #:	BHX-1250x7000L (2 each) [10 HP]
Type of Bio Sludge:	Ferric WTP Sludge
Year Started:	#1 started 2019, #2 to be started 2020
Contact Name #1:	Mr. Kris Johnson, P.E., Tel: (505) 289-3374
Typical performance:	1,350 dry lbs. per hour / 135 gpm (each), 2.0% Inlet, 27% outlet

Screw Press Location:	West Morgan – East Lawrence W&SA, Hillsboro AL
Screw Press Model #:	BHX-1200x6500L [7.5 HP]
Type of Bio Sludge:	Alum WTP Sludge with Carbon
Year Started:	To be started 2021
Contact Name #1:	TBD
Typical performance:	1,250 dry lbs. per hour / 100 gpm, 2.5% Inlet, 20% outlet

Screw Press Location:	Tualatin Valley Water District, Hillsboro OR 120 MGD
Screw Press Model #:	BHX-1250x7000L (2 each) [10 HP]
Type of Bio Sludge:	Alum WTP Sludge
Year Started:	To be started 2026
Contact Name #1:	TBD
Typical performance:	1,300 dry lbs. per hour / 173 gpm (each), 1.5% Inlet, 20% outlet

Volute Press

PROPOSAL

PROCESS WASTEWATER TECHNOLOGIES, LLC. | 9004 Yellow Brick Rd, Suite. D, Rosedale, MD, 21237
Phone: 410 238 7977 | **Facsimile:** 410 238 7559 | **Email:** volute@PWTech.us | **Web:** www.PWTech.us

PROJECT / REF:	City of Northglenn WTF, CO		
TO:	Matt Ridens, P.E.	**DATE:**	28 September 2020
		PWTech #:	VDPCO19234
COMPANY:	Hazen and Sawyer	**REV:**	0
ADDRESS:		**REP:**	Steve Hansen
		FIRM:	Ambiente H2O
		CONTACT:	303-638-1608 cell shansen@ambienteh2o.com
SUBJECT:	Budget Price and Scope for Volute* Dewatering Press – PWTech® model ES-303 and appurtenances for City of Northglenn WTF, CO		
SIZING:	Sized to dewater 1272 ppd of Alum Solids from sludge 0.5-3%. ~30 hours of operation per week. ES-303 selected will work provided solids are >0.75%		
NOTES:			

Scope of supply:

- One (1) Volute* Dewatering Press – PWTech® Model ES-303 unit
- One (1) Polymer Preparation System - VeloDyne Model VeloBlend VM-5P-600-X0D
- One (1) Influent Sludge flowmeter - Rosemount™ Model 8750W with 3" ANSI Flange connections.
- One (1) Control system for the above
- Documentation (Submittals and O&M Manuals)
- Start-up and commissioning services
- Delivery to site

*Volute is registered with the U.S. Patent and Trademark Office as a registered trademark of AMCON, Inc., Yokohama, Japan

Notes on Volute*Dewatering Press, PWTech Model ES-303

Base unit supply

- The unit to be supplied will be an ES-303 with a capacity of about 100 GPM of thin sludge (<1%) or 1050 dry pounds per hour for heavier sludge (>3%).
- The Dewatering Press consists of:
  - Flash mixing tank including mixer with gear motor.
  - Flocculation tank including mixer with gear motor.
  - Three (3) x 300 Series Dewatering Drum with a drive motor,
  - Filtrate collection pan and support frame.
  - Integrated, pre-wired control panel for the unit and appurtenances mounted on the flocculation tank. (may be provided mounted separately if requested).
- Connections are:
  - Inlet: DN 3" ANSI B16.5 Class 150
  - Filtrate outlet: DN 6" ANSI B16.5 Class 150
  - Washwater Water inlet: ¾" FNPT

Construction

- The unit is all stainless steel. No carbon steel is used in the manufacture of the press.
- Unit is manufactured and assembled in the USA. All components are sourced from the USA or Japan.
- Electrical components are manufactured and tested prior to shipment to site in the United States.
- Gear Drives are Nissei GTR gear motors utilizing heloid gear reduction. They are one piece construction and are sealed for life.

Supplied spare parts

- No spare parts are included in this scope.

Additional Press information is appended to this scope.

Notes on Polymer Prep. System - VeloDyne Model VeloBlend VM-5P-600-X0D

Polymer preparation system consists of the following components:

Polymer Mixing Chamber

- A high energy, multi-zoned, hydro-mechanical mixing device designed to effectively activate, dilute and mix polymer and dilution water utilizing an impeller designed to produce variable intensity, back-flow mixing action to optimize polymer performance without damage to the polymer's molecular structure.
- Mixer Motor: ½ HP, 90 VDC, 1750 RPM, Wash-Down Duty with keyless shaft and left hand impeller mounting screw
- Mechanical Mixer Shaft Seal and Seal Flushing Assembly with ON/OFF Valve
- Velo-Check© neat polymer poppet style check valve specifically designed to isolate neat polymer and dilution water. The check valve shall be held in place by a quick release pin for easy assembly and disassembly
- Materials of construction are PVC and Lexan (Body), Viton, SS304 and ceramic (Seals) and SS304
- Pressure Rating: 100 psi

Neat Polymer Metering Pump

- A 5GPH stainless steel & Viton progressive cavity metering pump shall be provided

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- ½ HP, 2500 RPM, 90 VDC, TEFC Motor with 10:1 Gear Reducer
- Thermal type loss of polymer flow sensor
- Metering pump calibration assembly with isolation valves: (500 ml)

Dilution Water Inlet and Solution Outlet Assembly

- Primary 60-600 GPH controllable dilution water flow
- 1" FNPT water inlet connection with Dilution Water ON/OFF Solenoid Valve
- Low differential pressure alarm switch
- 0-160 psi inlet water pressure gauge (stainless steel, liquid filled)
- Swing type PVC and Viton check valve

Construction

- Frame and fasteners are 304 stainless steel. Frame is open design for access to all components and is designed for bolt-down installation.

Notes on Magnetic flowmeter, Rosemount™ Model 8750W

- 3 inch ANSI 150# flange connections.
- Coated Carbon Steel construction with a polyurethane, ceramic, neoprene, or Teflon liner as required by the application.
- All metallic wetted parts are stainless steel type 316
- Suitable for direct burial and constant flooding (IP 68).
- Includes grounding rings
- Flowmeter out-puts analogue signal (4-20 mA) to Volute* Press Control panel

Notes on Electrical and Control

The Volute* unit is supplied with a pre-mounted, pre-wired control panel designed to control all aspects of the thickening/dewatering operation unless otherwise specified and noted.

- Panel is fed by a single 208, 240, or 480VAC, 3-phase, 60 Hz, power supply (client specified)
- Control panel is NEMA 4X rated manufactured in Stainless Steel type 304
- Control Panel is manufactured in a UL accredited facility and is UL Listed
- Panel includes HMI and PLC control modules. Unless specified otherwise, PLC/HMI is a single Unitronics Unistream unit.
- All manual switching operations are undertaken via switches on the HMI
- Unit includes complete control system for unit and ancillary equipment including operation of the polymer preparation system and VFD control for feed pump.
- Control system may utilize a system flow meter (not included in this proposal unless specifically noted in the scope) and PID loop to allow operator to set the system flow.
- System may include interlocks for Conveyor start-up, shut down and E-stop if required
- Control panel includes system running and system fault outputs to plant PLC and the ability to connect via Ethernet (ModBus TCP/IP) to external controls.
- A junction box on the polymer preparation skid is pre-wired to the polymer preparation components and designed for easy on-site connection to the main Volute* system control panel.
- Junction box is NEMA 4X FRP and includes numbered terminal block & wires with terminal block legend.

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General Notes

Documentation:

Scope includes:

- Submittals (hard copy and electronic) and
- O&M Manuals (hard copy and electronic).
- PLC/HMI Program (but not software)

Start-up services:

Scope includes the following start-up services -

- On-site start-up and training services for four (4) consecutive days (8 hours per day, Monday-Friday) by a PWTECH field service engineer and/or manufacturer's representative
- Services include:
    - Installation inspection
    - Commissioning of Volute* unit and Controls
    - Start-up of Ancillary equipment included in this Scope
    - Functional testing and calibration of equipment
    - Training on all equipment
- Phone consultation regarding installation will also be provided.
- Should additional services be deemed necessary by the PURCHASER, the additional services can be procured from PWTech on a per diem basis. The current rate is $1000 per day plus travel.

Items not included in this proposal

- Taxes, permits and bonding
- Any civil works including, but not limited to, any building works, construction of suitable foundations, and access structures.
- Installation including, but not limited to, mechanical, plumbing, and electrical hook-ups
- Unloading on site and storage
- PLC/HMI Programming software unless specified elsewhere.

Delivery and Freight

- Submittals issued approximately six (6) weeks from receipt of written Purchase Order
- Delivery is approx. eighteen (18) weeks from receipt of written acceptance of Submittal documents
- Deliver to site for all components **is INCLUDED in this scope.**

Governing Terms and Conditions and Warranty

- This scope is subject to Process Wastewater Technologies, LLC. Standard Terms and Conditions and Standard Warranty as attached with the exception of the following:
    - No Exceptions

PRICE

Total price for One (1) Volute Press and appurtenances as per this proposal: **$355,000.00**

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Volute Dewatering Press Data Sheet - ES-303

Please note - All information here is generic and for preliminary reference only. Detailed dimensions, and other data is very project specific and this sheet has not been altered to reflect that. Project specific data would be available from PWTech at the appropriate time.

General Data		Over All Dimensions:		158" x 63" x 74" (L x W x H)
		Optimal Space requirement of installation:		218" x 146" (L x W)
		Minimum Opening dimensions for installation:		65" x 60"
		Weight	Empty:	4100 lbs
			Operating:	6650 lbs
		MAX Solids throughput (Solids >4%):		1050 Dry pounds per hour
		MAX Hydraulic throughput (Solids <1%):		105 GPM
		Power use:		3.9 HP
		Washwater use:		16 GPM intermittent, 48 GPH total

Dewatering Drum	General	Dimension:		12" diameter x 61" long
		Quantity:		3
			Rings, Tierods, spacers:	Type 304 Stainless Steel
			Screw:	304 Stainless Steel with CoCr coating
	Drive info	Gear Motor Supplier:		Nissei Corporation
		Model:		FSW-55-750-T040-WEX
		Motor Power:		0.4 kW (0.54HP) 4-Pole
		Insulation:		TEFC / IP65
		Gear Reduction:		750 : 1

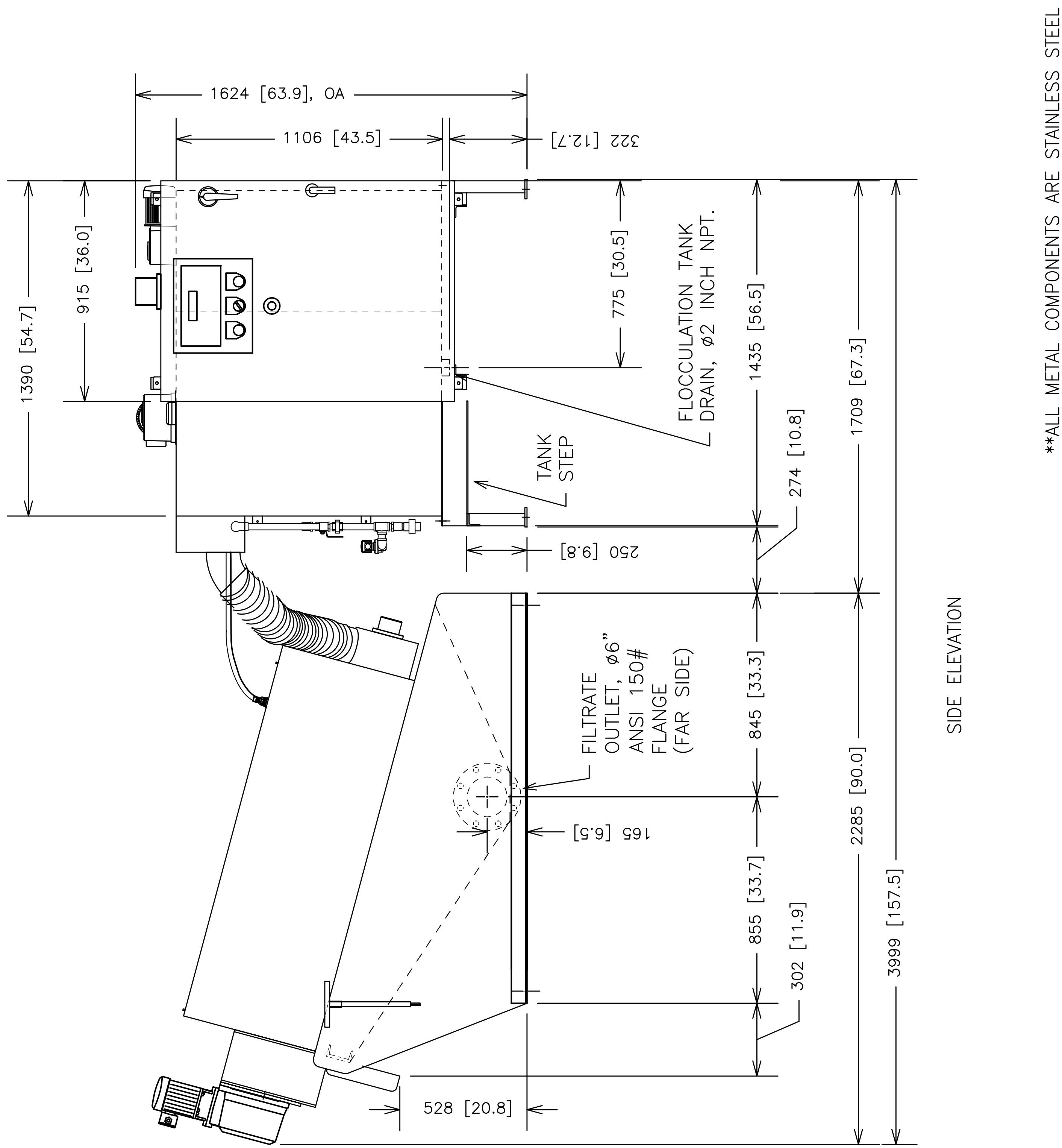
Flash mixing tanks	General	Dimensions:	20" x 33" x 43" (L x W x H)
		Volume	112.3 Gallons
		Working Volume:	98.2 Gallons
		Material	Type 304 Stainless Steel
	Drive Info	Gear Motor Supplier:	Nissei Corporation
		Model:	FSW-30-15-T020 WA
		Motor Power:	0.2 kW 4-Pole
		Motor Insulation:	TEFC / IP65
		Gear Reduction:	15 : 1

Flocculation tank	General	Dimensions:	33" x 33" x 43" (L x W x H)
		Volume	190.9 Gallons
		Working Volume:	167.0 Gallons
		Material	Type 304 Stainless Steel
	Drive Info	Gear Motor Supplier:	Nissei Corporation
		Model:	FSW-45-60-075 WEX
		Motor Power:	0.75 kW (1.0HP) 4-Pole
		Motor Insulation:	TEFC / IP65
		Gear Reduction:	60 : 1

Electrical	General	Supply Voltage:	208/240/440/480 VAC
		Service:	3-Phase, 3-Wire (No Neutral)
		Control Voltage:	Dual - 24VDC & 115VAC
		Minimum Required Breaker Size:*	12 Amps * 480 VAC
	Panel	Standard Panel Size:	36"(w) x 48"(h) x 12"(d)
		Panel Material:	Type 304 Stainless Steel
		Panel Rating:	Nema 4X
		Standard Control Module:	Unitronics Unistream 10 PLC

Polymer System	Supplier:	Velocity Dynamics, Inc.
	Model:	VM-5P-600-X0D
	Mixing Type:	Variable - Mechanical & Hydraulic
	Feed Pump Type:	Progressive Cavity
	Polymer Feed Capacity:	0.25 - 5 Gallons per hour
	Water Use:	60 - 600 Gallons per hour
	Dimensions:	24" x 34" x 42" (L x W x H)
	Weight:	~200 lbs

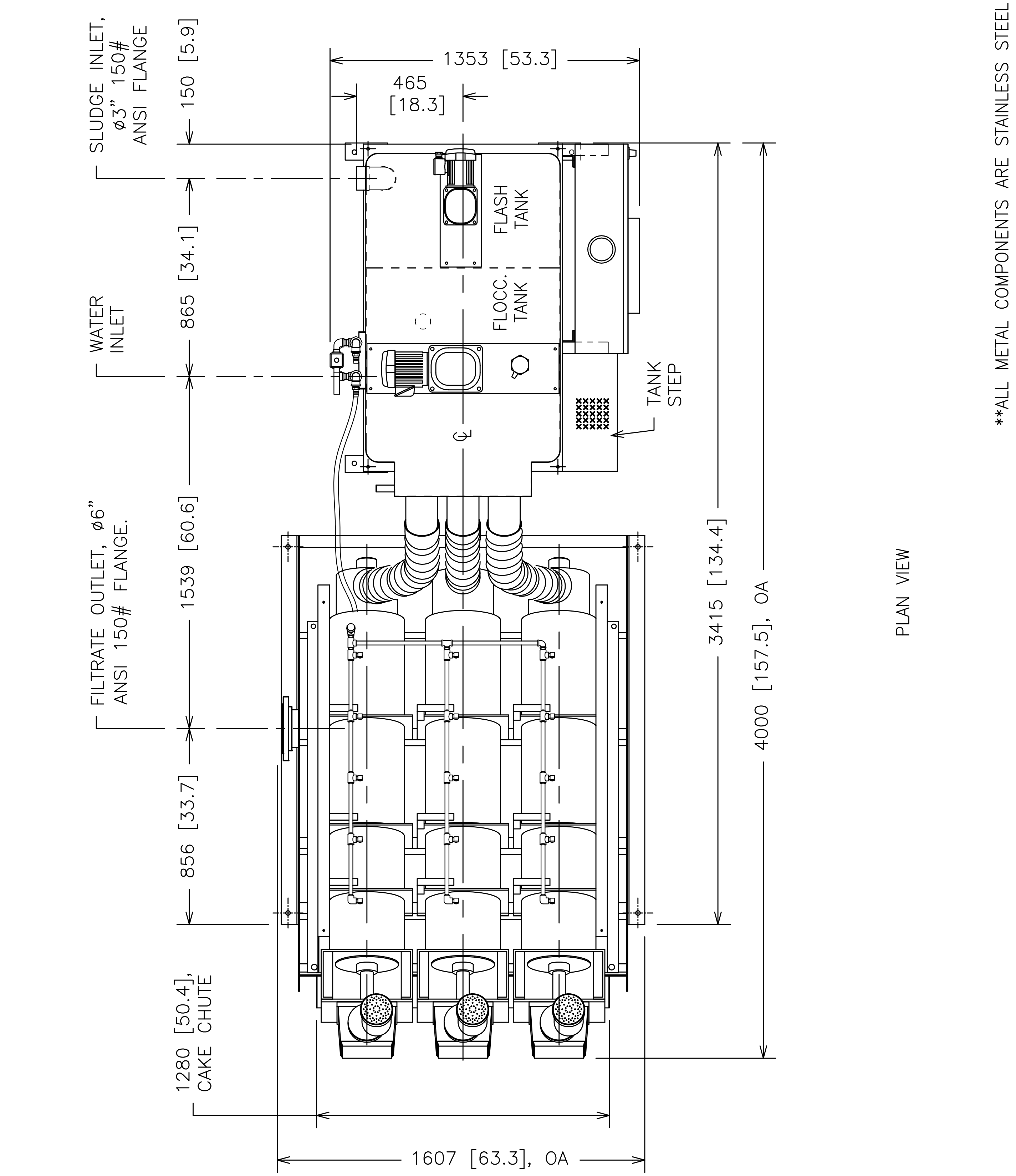
Connections	Feed Sludge:	3" ANSI 150# Flange
	Filtrate:	6" ANSI 150# Flange
	Drain:	2" FNPT Coupling
	Water:	3/4" FNPT Coupling
	Polymer Water Inlet:	1" FNPT
	Polymer Solutions Outlet.	1"FNPT
	Raw Polymer Feed Inlet:	1"FNPT



DIMENSIONS: MM [INCHES]

PWTech PROCESS WASTEWATER TECHNOLOGIES	VOLUTE DEWATERING PRESS ES-303 GA ELEVATION	JOB# PWT VDP ES-303 GA	SCALE NTS
		DATE JAN. 2015	
		DRAWN PWTech Inc.	SHEET 1 OF 4
		APPROV. ALEX DAVEY	

9004 YELLOW BRICK ROAD, SUITE D, ROSEDALE, MD 21237 PHONE: 410 238 7977 WEB: www.PWTech.us



DIMENSIONS: MM [INCHES]

PWTech
PROCESS WASTEWATER TECHNOLOGIES

VOLUTE DEWATERING PRESS
ES-303 GA
PLAN

JOB# PWT VDP ES-303 GA	SCALE	NTS
DATE JAN. 2015		
DRAWN PWTech Inc.	SHEET	2 OF 4
APPROV. ALEX DAVEY		

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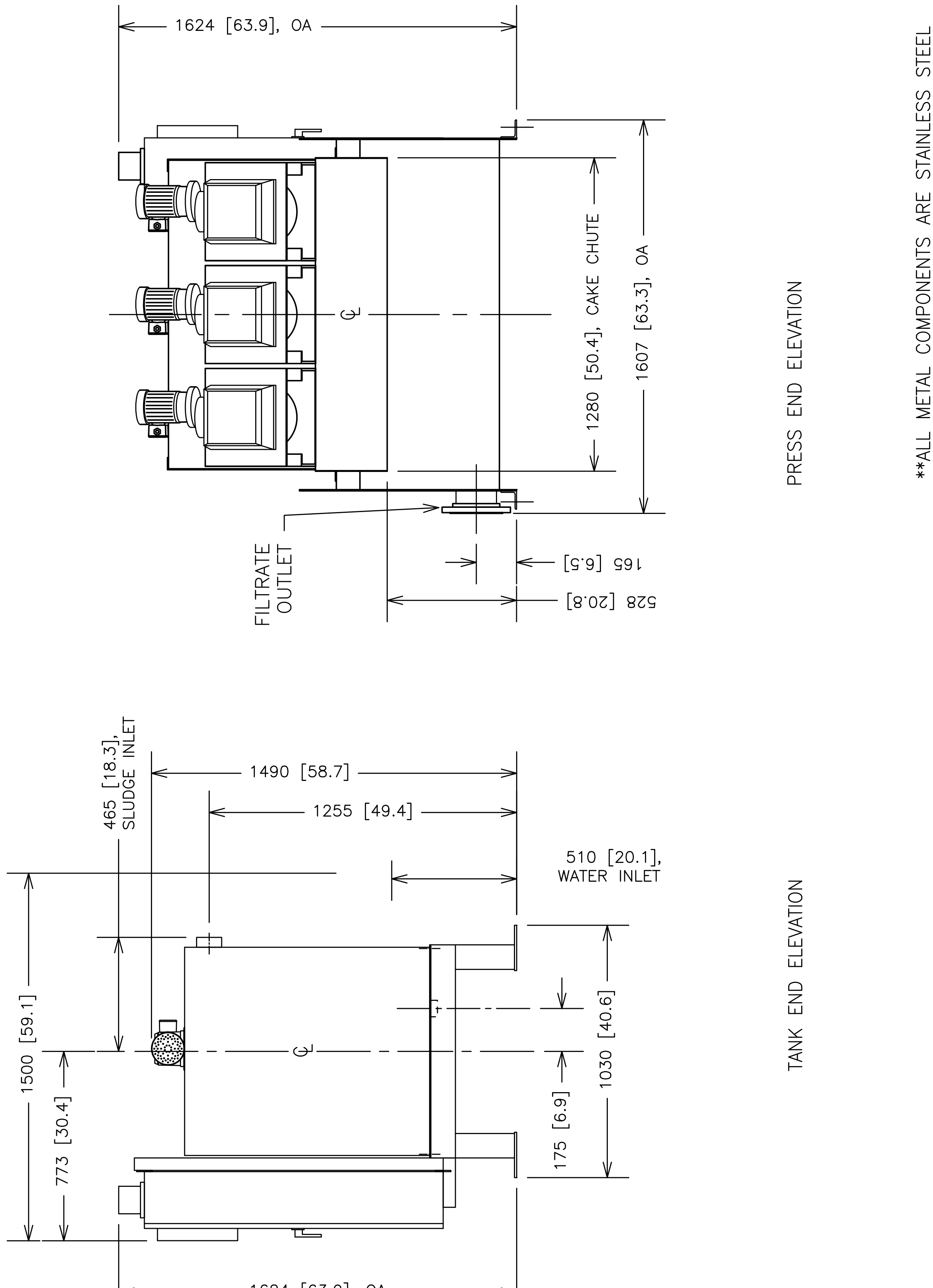
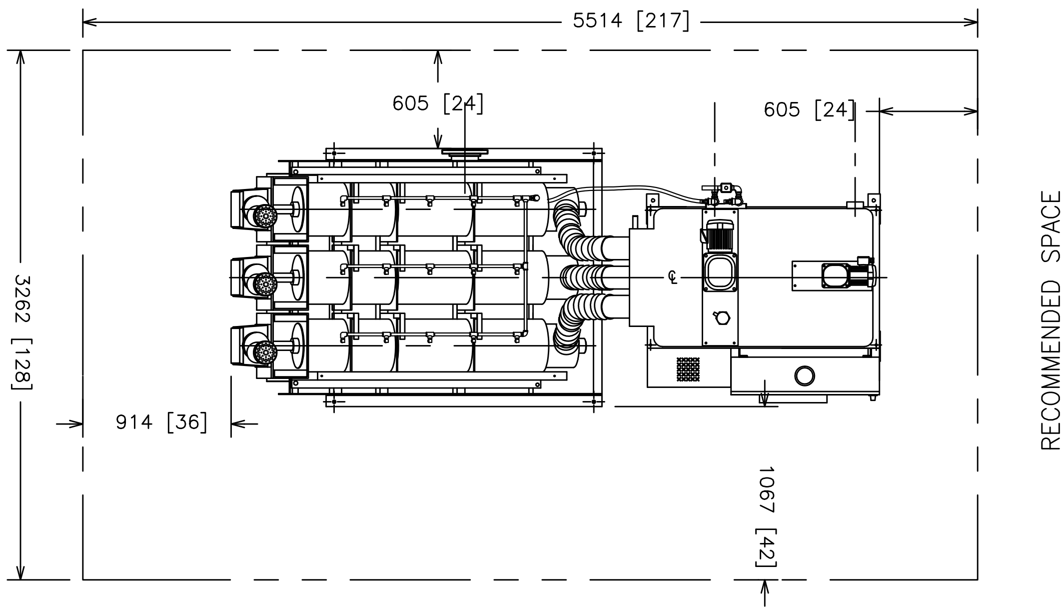


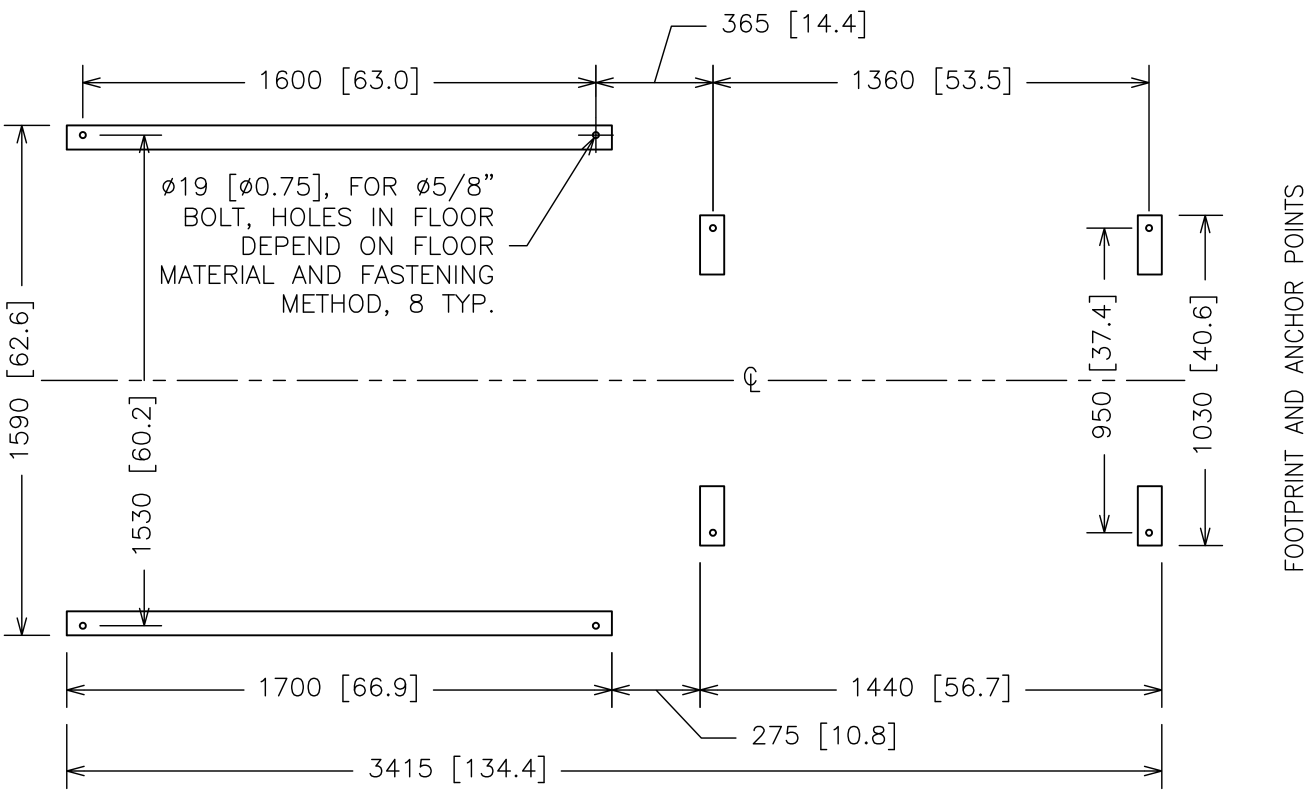
DIMENSIONS: MM [INCHES]

PWTech PROCESS WASTEWATER TECHNOLOGIES	VOLUTE DEWATERING PRESS ES303 GA PRESS AND TANK END ELEV.	JOB# PWT VDP ES303 GA	SCALE NTS
		DATE JAN. 2015	
		DRAWN PWTech Inc.	SHEET 3 OF 4
		APPROV. ALEX DAVEY	

9004 YELLOW BRICK ROAD, SUITE D, ROSEDALE, MD 21237 PHONE: 410 238 7977 WEB: www.PWTech.us



**ALL METAL COMPONENTS ARE STAINLESS STEEL



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PWTech PROCESS WASTEWATER TECHNOLOGIES	VOLUTE DEWATERING PRESS ES303 GA REC. SPACE & ANCHOR PTS.	JOB# PWT VDP ES303 GA	SCALE NTS
		DATE JAN. 2015	
		DRAWN PWTech Inc.	SHEET 4 OF 4
		APPROV. ALEX DAVEY	

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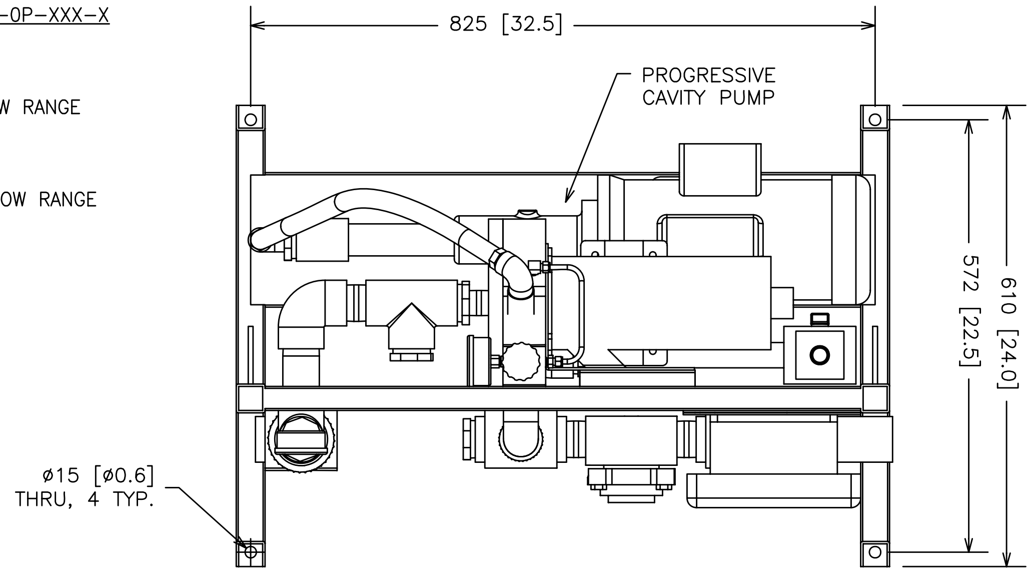
VELOBLEND MODEL: VM-0P-XXX-X

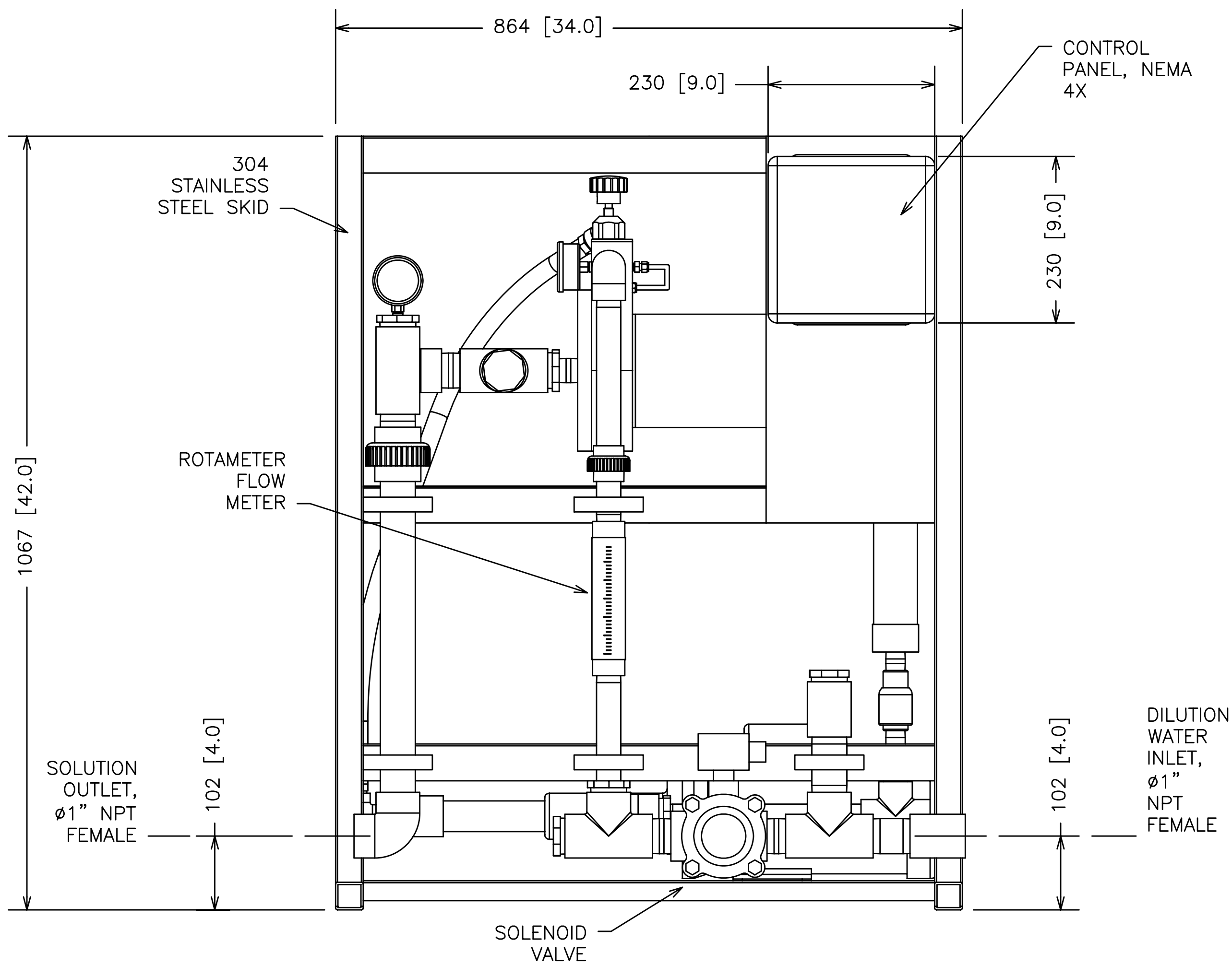
DILUTION WATER:
1. ø1" FNPT INLET
2. X TO XX GPM FLOW RANGE

POLYMER:
1. ø1" FNPT INLET
2. X.XX TO X GPH FLOW RANGE

SOLUTION:
1. ø1" FNPT OUTLET



PLAN



ELEVATION

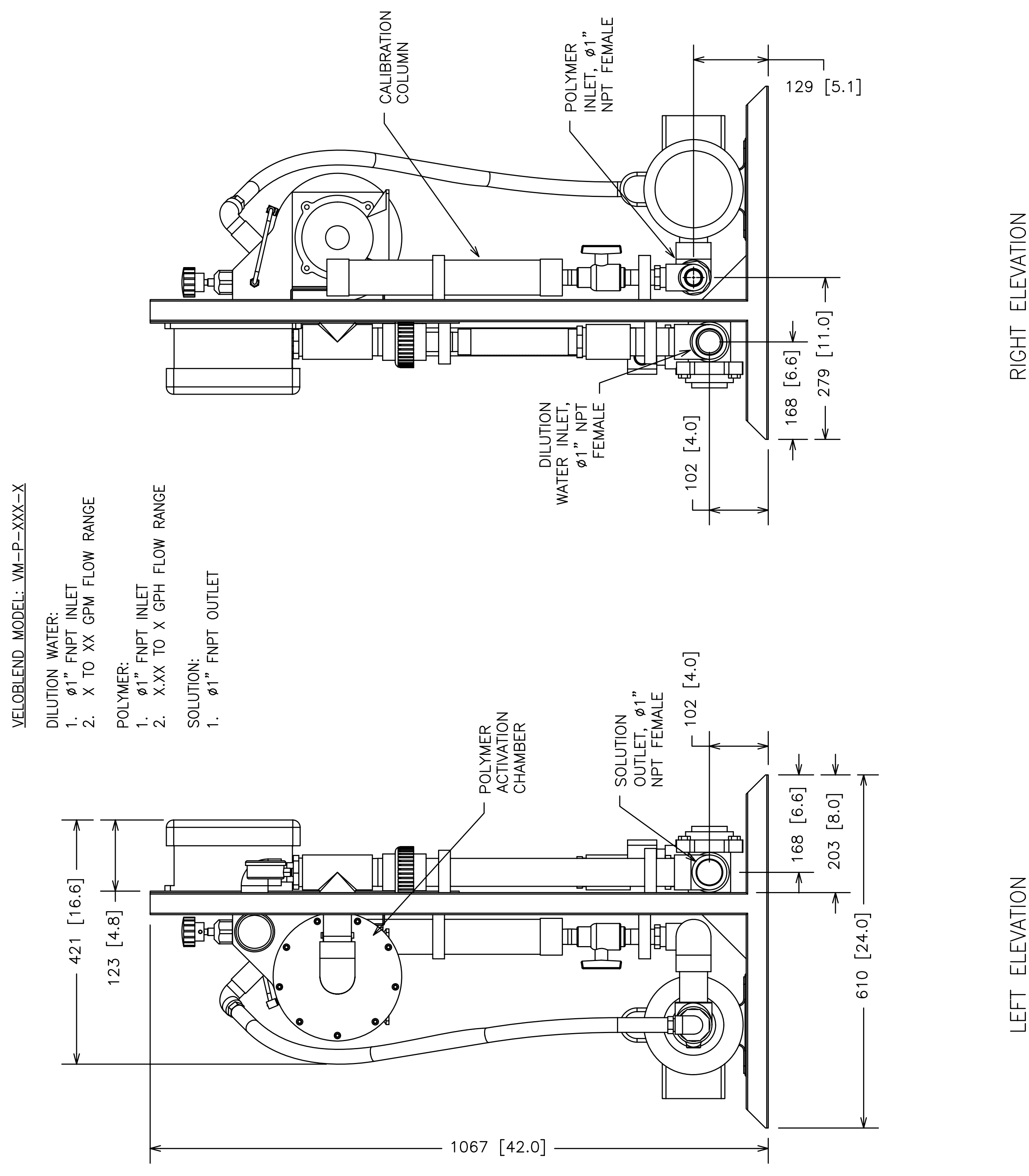
DIMENSIONS: MM [INCHES]

PWTech
PROCESS WASTEWATER TECHNOLOGIES

VELODYNE POLYMER PUMP
VM-P-XXX-X GA DRAWING
FRONT ELEVATION & PLAN

JOB# PWT VM-P-XXX-X	SCALE NTS
DATE 23 MAR 2009	
DRAWN PWTech Inc.	SHEET
APPROV. ALEX DAVEY	1 OF 2

9003 YELLOW BRICK ROAD, SUITE S, ROSEDALE, MD 21237 PHONE: 410 238 7977 WEB: www.PWTech.us



DIMENSIONS: MM [INCHES]

PWTech PROCESS WASTEWATER TECHNOLOGIES	VELODYNE POLYMER PUMP VM-P-XXX-X GA DRAWING RIGHT & LEFT ELEVATION	JOB# PWT VM-P-XXX-X	SCALE NTS
		DATE 23 MAR 2009	
		DRAWN PWTech Inc.	SHEET 2 OF 2
		APPROV. ALEX DAVEY	

9003 YELLOW BRICK ROAD, SUITE S, ROSEDALE, MD 21237 PHONE: 410 238 7977 WEB: www.PWTech.us

Process Wastewater Technologies, LLC. Standard Terms and Conditions (Muni.)

These below terms and conditions shall exclusively govern the sale of all goods and related services by Process Wastewater Technologies, LLC. ("PWT") to Buyer.

Item 1. ACCEPTANCE

Buyer may accept the preceding offer by noting acceptance in the space provided on the preceding offer sheet, if such space is provided, or by written purchase order. No oral acceptance shall be effective. This writing is intended by the parties as a final expression of their agreement and, in conjunction with the accompanying signed offer or purchase order and the PWT Standard Limited Warranty ("PWT Standard Limited Warranty"), is intended as a complete and exclusive statement of the terms of their agreement. Acceptance or acquiescence in a course of performance rendered under this agreement shall not be relevant to determine the meaning of this agreement even though the accepting or acquiescing party has knowledge of the nature of the performance and opportunity for objection. No agent, employee or representative of PWT has any authority to bind the Seller to any affirmation, representation or warranty concerning the equipment, components or related services sold under this agreement, and unless an affirmation, representation or warranty made by an agent, employee or representative is specifically included within this written agreement, it has not formed a part of the basis of this agreement and shall not in any way be enforceable.

Item 2. CANCELLATION

Upon acceptance of the preceding offer, Buyer shall have no right to cancel this agreement or any part thereof, except under the conditions specified in this provision or otherwise agreed to in writing by both parties. Any cancellation by Buyer of this agreement must be in writing and shall be deemed effective upon receipt by PWT. In the event of cancellation by Buyer prior to the commencement of production of the goods specified under this agreement, Buyer shall pay PWT a cancellation charge equal to all of the costs incurred by PWT under this agreement up to the time of cancellation, plus fifteen percent (15%) of the full order amount. In the event that production of the goods under this agreement has commenced prior to cancellation, Buyer shall pay a cancellation charge equal to all of the costs incurred by PWT under this agreement up to the time of cancellation, plus an amount equal to the greater of: the value of the goods already completed under the agreement; or fifteen percent (15%) of the full order amount.

Item 3. PRICES

Unless otherwise stated in this offering, prices are F.O.B. the PWT manufacturing facility in Cincinnati, Ohio Charges for on-site technical assistance performed by a factory technical representative are not included unless indicated.

Item 4. VALIDITY

Unless otherwise specified, the preceding offer is valid for acceptance for (30) thirty days and is subject to review thereafter. Prices may be extended beyond thirty (30) days only if confirmed in writing by PWT.

Item 5. PAYMENT TERMS

Ten percent (10%) of the purchase price under this agreement shall be invoiced net thirty (30) days upon approval of submittals and shop drawings; Eighty percent (80%) of the purchase price under this agreement shall be invoiced net thirty (30) days upon shipping, or upon PWT's offer to ship. Five percent (5%) of the purchase price under this agreement to be invoiced net thirty (30) days upon delivery of O&M Manuals and the remaining five percent (5%) will be invoiced net thirty (30) days upon completion and/or performance of all related services under this agreement. Interest will be charged on the unpaid invoiced balance at the rate of one and a half percent (1½%) per month for any amount received after thirty (30) days from the date of invoice. Any collection costs and/or attorney fees incurred by PWT in order to collect payment due will be invoiced to the Buyer, and Buyer agrees to pay said costs.

Item 6. FEES AND TAXES

Buyer shall pay directly or reimburse PWT for payment of any and all applicable customs, sales, use, excise or other fees and taxes associated with the production and delivery of goods under this agreement. Buyer is responsible for and bears the risk of establishing, if applicable, a valid exemption from any tax, and shall indemnify, defend and hold PWT harmless for any loss, cost or expense relating to any such exemption.

Item 7. DELAYED SHIPPING

If Buyer specifies a shipping date more than one (1) year from the date of acceptance of the preceding offer, the price stated in the preceding offer for the same goods shall be increased by a figure of six percent (6%).

Item 8. FINANCIAL RESPONSIBILITY OF BUYER

If at any time before shipment, Buyer's financial ability to pay becomes impaired or unsatisfactory, PWT shall have the right to require Buyer to make payment in full before shipment. In addition, if at any time before shipment, any proceeding is brought by or against Buyer under the bankruptcy or insolvency laws, PWT shall have the right to cancel this contract and Buyer shall pay PWT a cancellation charge equal to all of the costs incurred by PWT up to the time of termination, plus fifteen percent (15%) of the purchase order amount.

Item 9. SHIPPING

Unless otherwise specified, all equipment and components will be shipped in one lot by the lowest cost method at the discretion of PWT. Any additional shipping requests by Buyer may be subject to additional shipping and handling charges. All shipments shall be F.O.B. the PWT manufacturing facility in Cincinnati, Ohio. Delivery to the carrier shall constitute delivery to Buyer for purpose of transfer of risk of loss or damage in transit, and any delivery deadlines specified in this agreement. Buyer is responsible for obtaining any desired cargo insurance and shall pursue any loss or damage claims solely with the carrier.

Item 10. DELIVERY SCHEDULE

Unless otherwise specified, delivery dates under this agreement are approximate, and failure to meet an exact delivery date shall not constitute a breach of this agreement unless delivery is not effected within a reasonable time after the specified delivery date.

Item 11. INSPECTION

Inspection by Buyer or Buyer's representative of the goods specified under this agreement will be permitted prior to shipment at the PWT manufacturing facility in Cincinnati, Ohio, at a time mutually agreeable to both parties. Inspection will be allowed only inasmuch as such inspection does not unreasonably interfere with PWT's production work flow. Complete details of any requested inspection must be submitted to PWT in writing, at least two weeks in advance of the requested inspection date. Any inspection under this provision must be completed prior to shipment of any goods under this agreement.

Item 12. OFFER BASIS

This agreement is exclusively based upon drawings and specifications in the possession of PWT at the time of this agreement. PWT expressly reserves the right to modify the price and other terms of this agreement as reasonable, should additional drawings, documents, or other addenda be required to produce or deliver the goods and/or services provided under this agreement.

Item 13. LIMITED WARRANTY

PWT's warranty liability under this agreement is limited to the terms listed in the PWT Standard Limited Warranty that accompanies these Terms and Conditions, and is incorporated herein by reference. No other warranty, express of implied, is made with respect to the goods and/or services provided under this agreement.

Item 14. MEET AND CONFER

The parties shall amicably work together to negotiate and resolve any controversy or dispute arising out of, or in connection with this agreement or its interpretation, performance or nonperformance or breach thereof. In particular, in the event of a disagreement, the parties shall meet and confer and attempt in good faith to resolve their differences. At the request of the aggrieved party, a face-to-face meeting between decision-makers of the parties shall be arranged at the offices of the non-aggrieved party. Such a meeting shall occur with fourteen days of the delivery of the written request of the aggrieved party, unless otherwise agreed by the parties.

Item 15. ARBITRATION

If, after meeting and conferring as provided under this agreement, the parties are unable to resolve their differences, any disputes shall be settled by binding arbitration in accordance with the following procedures:

(a) The Arbitration shall be conducted in accordance with the Commercial Arbitration Rules of the American Arbitration Association ("AAA") in effect at the time of the arbitration, except as may be modified herein or by mutual agreement of the parties. The location of the arbitration shall be Baltimore, Maryland or Towson, Maryland.

(b) The arbitration shall be conducted by one arbitrator jointly selected by the parties. If the parties are unable to agree upon an arbitrator after thirty (30) days, the arbitrator shall be selected under AAA rules.

(c) The award shall be in writing and shall state the reasons for the award and shall be final and binding on the parties. The award may also include an award of costs, including reasonable attorneys' fees and disbursements. Judgment upon the award may be entered by any court having competent jurisdiction over the parties or their assets.

Item 16. GOVERNING LAW

All disputes and matters arising under, in connection with, or incidental to this contract shall be litigated, if at all, in and before the Circuit Court of Baltimore County, Maryland, USA to the exclusion of other courts of other states, the United States or other countries and to the exclusion of other venues. The parties expressly consent to the exclusive jurisdiction of this court and agree that this venue is convenient and not to seek a change of venue or to dismiss this action on the grounds of *forum non conveniens*, and not to remove any litigation from that court to a federal court. This Agreement shall be construed in accordance with and governed by the substantive laws of the State of Maryland, to the extent state law applies. An action for breach of this agreement must be commenced within two (2) years after the cause of action has accrued.

Item 17. WAIVER AND MODIFICATION

No waiver by either party of any breach, default or violation of any term, warranty, representation, agreement, covenant, condition or provision of this agreement shall constitute a waiver of any subsequent breach, default, or violation of the same or other term, warranty, representation, agreement, covenant, condition or provision. No modification, amendment, extension, renewal, rescission, termination or waiver of any of the provisions contained in this agreement, or any future representation, promise or condition in connection with the subject matter of this agreement, shall be binding upon either party unless in writing and signed by both parties.

Item 18. SEVERABILITY

Any provision of this agreement which is invalid, prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective solely to the extent of such invalidity, prohibition or unenforceability without invalidating the remaining provisions hereof, and any such invalidity, prohibition or unenforceability in any such jurisdiction shall not invalidate or render unenforceable such provision in any other jurisdiction.

Item 19. ASSIGNMENT AND DELEGATION

Neither party to this agreement shall have the right to assign or delegate its interest in or obligations under this Agreement without the prior written consent of the other party, which shall not be unreasonably withheld. The merger, acquisition, reorganization or other restructuring of PWT shall not constitute an assignment under the terms of this agreement provided the surviving entity has assumed all of the obligations of PWT under this agreement. The transfer of any rights under this agreement from PWT to any entity controlled by or affiliated with PWT shall not constitute an assignment under the terms of this agreement provided PWT retains all of its obligations under this agreement. The rights and obligations of the parties to this Agreement shall be binding upon, and enforceable by their respective heirs, successors and permitted assigns.

PWT LLC Standard Limited Warranty

Item 1. LIMITATION OF LIABILITY

The only warranty which PWT LLC ("PWT") makes is that warranty which is set forth in the preceding agreement and which is further detailed below:

THE GOODS SPECIFIED UNDER AGREEMENT WITH PWT ARE PROVIDED "AS IS" AND PWT DOES NOT MAKE ANY OTHER EXPRESS WARRANTIES OR ANY IMPLIED WARRANTIES WITH RESPECT TO THESE GOODS AND/OR RELATED SERVICES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR USE.

In addition, PWT does not assume and expressly disclaims any liability for (i) any SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES which anyone may suffer as a result of the sale, delivery, service, use, or loss of use, of any goods and/or services provided by PWT, or (ii) any charges or expenses of any nature which are incurred without the express written consent of PWT. In particular, PWT does not warrant that any goods provided are free from any claim of any third person by way of infringement or the like, and PWT expressly disclaims any liability for any claim of infringement or the like that may result from the sale, delivery, service, use, or loss of use of any goods and/or services provided by PWT.

PWT's obligation under this warranty is expressly limited to the repair or replacement of any part or parts that are proved to the satisfaction of PWT to have failed prematurely or because of a fault in workmanship or materials.

PWT's total liability under this warranty or in connection with any claim involving any goods or services is expressly limited to the purchase price of the goods and/or services in respect of which damages are claimed.

Item 2. DEFECTS WARRANTY

PWT warrants that the goods manufactured by PWT shall be free from defects in material and workmanship for the shorter period of: (i) twelve (12) months from the date of start-up; or (ii) eighteen (18) months from the delivery of the specified goods.

PWT's liability under this warranty or in connection with any other claim relating to goods manufactured and delivered by PWT is limited to the repair, or at our option, the replacement or refund of the purchase price, of any products or parts or components which are returned to PWT freight prepaid, and which PWT determines, in its discretion, are defective in material and workmanship. Products or parts or components thereof which are repaired or replaced by PWT will be returned to the buyer freight collect.

Item 3. PRODUCTS OF OTHER MANUFACTURERS

PWT makes no warranty with regard to any products not manufactured by PWT, including but not limited to electrical components or equipment and other prime movers.

Item 4. TYPES OF DAMAGES AND CLAIMS FOR WHICH PWT LLC IS NOT RESPONSIBLE

The following non-exclusive list of items are specifically not covered by the PWT Standard Limited Warranty and, in the event of their occurrence, will render the PWT Defects Warranty null and void:

- defects which are caused by improper installation, improper or abnormal use or operation, or improper storage or handling;
- defects caused by the failure of the buyer or user to perform and log normal preventative maintenance;
- defects caused by the use of replacement parts not approved in writing by PWT;
- defects caused by repairs by persons not authorized in writing by PWT;
- defects caused by modifications or alterations made by the buyer or user;
- any damage to our any product occurring while it is in the possession of the buyer or user.

Item 5. EQUIPMENT SAFETY PARAMETERS:

With respect to operation of the equipment, it is the responsibility of the buyer to define and provide any safety device(s) or associated safety device(s) (other than that which is ordinarily furnished by PWT) which may be necessary and/or required, and to establish safety procedures and operational instructions to safeguard the operator(s) during maintenance, cleaning, or any use of the equipment whatsoever, and to subsequently ensure that the equipment is operated in conformance with all applicable safety procedures, laws, regulations and instructions.

It is also the responsibility of the buyer to enforce all safety regulations and operational instructions and to maintain the equipment in a safe condition (*e.g.*, guards in place; warning, caution and/or important labels affixed; electrical boxes secure; interlocks operational; etc.). In particular, all warning, caution and/or important labels must be maintained in a readable condition, and if necessary, replaced with new labels.

Additionally, as the nature of the equipment does not always make it possible to fully prevent operator access from rotating components, maintenance or cleaning of any nature must not be performed on the equipment without first disconnecting all power.

Item 6. OPERATOR SAFETY COMPLIANCE:

Buyer warrants and agrees that because it has sole control over the equipment, it shall be solely responsible for safety compliance. Operator access and use of equipment, and full compliance with all provisions of the Operator Safety section of PWT Instruction Manuals are essential and the user's responsibility; the provisions of that section being expressly incorporated herein.

Fan Press

ONE (1) 48" DUAL CHANNEL 2.0 ROTARY FAN PRESS SKID SYSTEM PROPOSAL FOR:

NORTH GLENN WTP

(North Glenn, CO)

PRIME SOLUTION, INC.
610 S. PLATT STREET
OTSEGO, MI 49078 USA
(269) 694-6666
www.psirotary.com

Prime Solution Regional Sales Manager: Mrs. Kelley Dendel / PH: (269) 355-3793 / Kelley@psirotary.com

PROPOSAL
#P-200917KD1
Date: September 17, 2020

To: North Glenn WTP
2350 W. 112th Ave.
North Glenn, CO 80234

Contact: Mike Roman
Phone: 308-750-4203
E-Mail: mroman@northglenn.org

Rep Firm: Falcon Environmental
Rep: Adam Pelican
Phone: 308-750-4203
E-Mail: adam@fecal.us

PROJECT DETAILS	
Project Name:	North Glenn-001-FAL
Application:	Municipal
Plant MGD:	0.20 – 0.50 MGD
Sludge Type:	WTP
Sludge Process:	Clarifier Blow Down & Filter Backwash
Solids Loading:	1322 – 2157 d.s. lbs/day / 6 hrs/day = 222 – 555 d.s. lbs/hr
Sludge Age:	~1 – 3 Days
Feed Solids:	1.11% TS (Pilot Max)
Dewatering Flow Rate:	40 – 100 GPM
Capture Rate:	~98.6% TSS (per Pilot)
Hours of Operation/Day:	6 hrs/day for 5 days/wk
Volatile Solids:	~27.8% TVS (per Pilot)

We hereby submit specifications and estimates for: One (1) 48" Dual Channel 2.0 Rotary Fan Press Skid System as listed below in this Scope of Supply. All equipment listed below in Scope of Supply is factory tested, pre-plumbed/wired and ready for field installation and integration by others. Sludge type, feed solids, volatile solids, pretreatment, polymer selection, desired cake solids and process variations will affect performance of the equipment. Installation, system integration, utility and piping connections not included unless listed below in this Scope of Supply shall be provided by others.

All items manufactured by Prime Solution, Inc. meet all American Iron and Steel (ASI) requirements.

ROTARY FAN PRESS PRESS-ONLY EQUIPMENT SCOPE OF SUPPLY

a) One (1) RFP2.0-48D– 48" dual channel 2.0 rotary fan press, Nord 5.0 hp direct gear drive system Model: SK9092.1/52AXZ-132SP/4 CUS TW, epoxy coated carbon steel housings and base, all 304 stainless steel/hard chromed tapered slotted filter screens with stainless steel support wheels.
b) Two (2) Dewatering channel mixing elements, Nord 0.25 hp gearbox/channel Model: SK02040.1AXZBH-63L/4 CUS RD.
c) Two (2) Onyx Valve Inlet pressure sensor Model: 160-0300-13-06-16 IFM PN2696.
d) One (1) Wash manifold assembly with electronic solenoid valves.
e) Two (2) Stainless steel cake discharge chutes.
f) One (1) Enclosed press drive Allen Bradley VFD Model: 25A-D013N104 & Interconnections of Press junctions/box to main control panel.
g) One (1) Pneumatic gate control, plant air supplied by others.
h) Two (2) Hardcopies & one (1) electronic copy of operational/maintenance manual.
i) One (1) Standard limited 12/18 workmanship warranty.

Press Only Price: $278,761.00

ROTARY FAN PRESS SKID EQUIPMENT SCOPE OF SUPPLY

All Items Listed Above in Press Only Plus:

j) One (1) RFP skid platform, epoxy coated carbon steel welded construction. Anchor bolts to be provided by Others.
k) One (1) In-line static mixers with injection rings.
l) One (1) PVC Sch. 80 sludge retention manifold with clear site tube cleanout and sludge sampler.
m) One (1) PVC Sch. 80 filtrate collection piping assembly.
n) One (1) Pneumatic sludge by-pass control valve.
o) One (1) Endress & Hauser Sludge feed magnetic flow meter Model: Promag W 400, 5W4C1H-2LF4/0, 3”.
p) One (1) Boerger Sludge feed pump (rotary lobe) Model: PL200 with VFD gear drive direct coupled on common base.
q) One (1) PrimeBlend Emulsion polymer feed/blend system, with integrated controls.
r) One (1) Process control package (semi-unattended operation) for system as listed in this proposal.
s) One (1) Hoffman 304 SS Central operator panel Model: CSD483612SSR, with touch screen controls, Allen Bradley Panelview Plus 7 HMI Model: 2711P-T1QC21D8S ten inch (10") display, Allen Bradley Micro Logix 1400 PLC Model: 1766-L32BWA , lamps and main disconnect power. System to include operation of associated dewatering equipment as listed in this scope of supply, 480 volt/3 phase/60 hertz (unless specified otherwise), NEMA 4X rated enclosure.
t) One (1) Integration of system with Central Control Panel, utilities and others.

Skid System/Ancillaries: $87,434.00

ADDITIONAL INCLUSIONS TO SCOPE OF SUPPLY

u) One (1) On-site start-up/commissioning/training for a total of twenty-four (24) man-hours.
v) One (1) Estimated Shipment to job –site.

Additional Inclusions: $14,270.00

We Propose to furnish material as stated, FOB North Glenn WTP, North Glenn, CO, freight allowed to job site (offloading by others), complete and in accordance with the above specifications for the sum of:

Skid System Total U.S. Dollars: $380,465.00

Process & Services packages are available for quotation upon request.

All fees and bonding are the full responsibility of the Purchaser/Customer and not included as part of this proposal. Any non-payment amounts, fines, fees, expenses caused thereof shall be the full payment responsibility of the Purchaser/Customer to any and all parties and/or authorities as the case may be.

Please reference this proposal number on the purchase order.

Completion: 10 - 14 weeks from receipt of firm purchase order, receipt of down payment and approval of submittal(s) (one time shipment only).

Submittals: 20 working days from receipt of purchase order with complete project information supplied by Purchaser/Customer.

Terms: (20%) due upon approved submittals, (70%) due net 30 days from shipment date, balance (10%) due net 30 days after approved start-up not to exceed 60 days from shipment.

Terms listed in this proposal only apply with approved credit application.

Terms different than those stated above must be approved in writing prior to submission of submittals.

Clarifications, Exceptions & Recommendations:

Payment terms may not be changed without the written authorization of Prime Solution, Inc. Any shipments delayed by Purchaser/Customer, Prime Solution, Inc. reserves the right to invoice and when full payment is received, pass title to the Purchaser/Customer; Purchaser/Customer agrees to remit the amount due at the times stated, as if equipment had shipped. Any and all costs of storage shall be at the Purchaser's/Customer's expense.

Unauthorized retention of payment by Purchaser/Customer for any reason shall be subjected to a service charge of 2% compounded per month and any collection expenses will be added to total amount due by the Purchaser/Customer. Any system integration, ancillary equipment, services, access platforms, stairs and/or handrails, etc. not listed in this Scope of Supply shall not be part of this proposal and shall be provided by others if required.

Any presses, conveyors, equipment, etc. made with any steel that may have increases in price, a surcharge may be added to the price listed in this proposal to cover these price increases. Any system integration, ancillary equipment, services, access platforms, stairs and/or handrails, etc. not listed in this Scope of Supply shall not be part of this proposal and shall be provided by others if required.

All equipment offloading, site storage, installation and interconnecting wiring and piping between all equipment listed and other ancillary equipment or sources shall be by others as selected or retained by the Purchaser/Customer. Any and all required chemistry (pretreatments/polymers, etc.), testing fees, etc. not listed as included in the Prime Solution, Inc. Equipment Scope of Supply shall be provided and/or paid for by others. The original Purchaser understands and agrees that the type of sludge, pretreatment process, pretreatment chemistry, polymer selection, feed solids, volatile solids, sludge age, any/all changes (temperature, pH, etc.) to the sludge/slurry characteristic(s) not clearly defined in any written documentation will affect the sludge's/slurry's ability to be dewatered and performance/capacity of the equipment. The original Purchaser shall be responsible to provide all suitable pretreatment chemistry for obtaining a suitable and stable flocculated sludge/slurry for mechanical dewatering to achieve any performance requirements. Prime Solution, Inc. can only estimate production performance based upon information supplied by the Purchaser and does not take any responsibility for final equipment performance. Any changes and/or omissions in any way to the type of sludge/slurry listed in any specifications that affects dewaterability of the sludge/slurry shall release Prime Solution, Inc. of any/all responsibility.

Prime Solution, Inc. is furnishing the dewatering equipment as listed in the Scope of Supply only and is only subject to the Limited Workmanship Warranty terms. All equipment, material and components manufactured by others used in the design of the dewatering system shall have the same warranty afforded to Prime Solution, Inc. and is subject to and stipulated by the respective manufacturer's warranty provided that the required maintenance has been performed. Prime Solution, Inc. does not provide any guarantee or warranty of the process, chemistry or other parts and products purchased/supplied by others whatsoever, whether expressed, implied or statutory, including but not limited to, any warranty of merchantability or fitness for a particular purpose or any warranty that the contents of those parts and products will be suitable and error free. Any damages to the Prime Solution, Inc. equipment caused by parts, products or services provided by others will not be covered by the Limited Workmanship Warranty.

In no respect shall Prime Solution, Inc. incur any liability for any damages, direct, indirect, special, or consequential arising out of, resulting from, or any way connected to the use of those parts or products provided by others, whether or not based upon warranty, contract, tort, or otherwise; whether or not injury was sustained by persons or property or otherwise; and whether or not loss was sustained from, or arose out of, the results of parts and products or any services provided by others.

If there are any delays in shipment by the Purchaser, the Purchaser agrees to pay storage charges equal to 0.5% of the total project order per month the order is held by Prime Solution, Inc. for shipment along with full payment is due with terms in this proposal using the completion date as the ship date for payment purposes.

Should any additional service trips, equipment, supplies and/or labor be required by Prime Solution, Inc. to assist the Purchaser/Customer beyond what is listed in this Scope of Supply, these charges shall be in addition to the price listed in this Scope of Supply. On-site service after installation and start-up will be subject to additional charges and is not included in the Limited Workmanship Warranty.

All orders shall be considered final and the Purchaser/Customer shall be responsible for payments as listed above. Should the Purchaser/Customer wish to cancel this order at any time, the Purchaser/Customer shall be responsible to reimburse/pay Prime Solution, Inc. within fifteen (15) days of the cancellation notice for all costs Prime Solution, Inc. has associated with this order. The Purchaser/Customer also recognizes that ownership for this order does not pass to the Purchaser/Customer until payment in full is received by Prime Solution, Inc. Prime Solution, Inc. reserves the right to take back the possession of any/all items delivered to the Purchaser/Customer that full and final payment is not received within thirty (30) days of the terms as outlined above. Any and all costs, including but not limited to actual attorney fees associated with the recovery of items and for non-payment, or to obtain payment, shall be the responsibility of the Purchaser/Customer.

This Proposal is the complete agreement between Prime Solution, Inc. and the Purchaser/Customer, and supersedes any prior discussions, negotiations, representations or understanding of the parties. No other agreements, representations, or understandings not specifically contained herein shall be binding upon the Parties to this Proposal.

All material is guaranteed to be as specified in this Scope of Supply. All work is to be completed in a professional manner according to standard practices. Any alteration or deviation from the above specifications which involve extra costs will be made only upon receipt of an authorized written change order and will be shown on subsequent invoices as amounts over above the original estimate. It is understood that Prime Solution, Inc. will not be penalized for delays caused by change orders, strikes, accidents, war or rebellion, acts of terrorism or delays caused by acts of nature. Our workers are covered by Worker's Compensation Insurance.

Purchaser/Customer agrees to furnish all other appropriate and necessary insurance's coverage's. It is the intent of the Parties that this proposal be non-modifiable unless such modification or variation is agreed to in writing. Given this specific intent, this Proposal may not be varied or modified in any manner whatsoever, except in subsequent writing that is executed and signed by an authorized representative of both Parties.

Any controversy or claim between or among the Parties, including but not limited to those arising out of or relating to this Agreement, including any claim based on or arising from an alleged tort, shall be determined by and through binding arbitration. The arbitration shall be commenced and conducted in accordance with the Commercial Arbitration Rules of the American Arbitration Association. The arbitration shall be conducted before one (1) arbitrator selected either by the parties, or, if the Parties cannot agree, by an arbitrator selected by the American Arbitration Association. This Proposal shall be governed and controlled in all respects by the laws of the State of Michigan, USA, and any arbitration shall resort only to the laws of the State of Michigan, USA. The Arbitrator shall give effect to statutes of limitation in determining any claim. Any controversy concerning whether an issue is subject to arbitration will be determined by the arbitrator. The arbitration shall be conducted in the County of Allegan, State of Michigan, USA. Any arbitration award may be entered in any Court having jurisdiction. Jurisdiction and venue of any proceeding to enter the arbitration award or to otherwise enforce the arbitration award shall lie in Allegan County, Michigan, USA, and shall be binding on the Purchaser/Customer no matter the location of the Purchaser/Customer. Receipt of a purchase order relating in any way to this Proposal from the Purchaser/Customer is deemed the same as signing this Acceptance of Proposal, agreeing to all terms and limitations included herein.

NOTE: This Proposal Is Valid For Sixty (60) Days. Pricing is valid for delivery of equipment on site for 1 year.

Acceptance of Proposal: - The above prices, specifications and conditions are satisfactory and are accepted. You are authorized to do the work as specified and payments will be made as outlined above.

Signature: ____________________________ Date of Acceptance: ______________________

Print: _______________________________ Title: ___________________________________

Regards,

Mrs. Kelley Dendel
Regional Sales Manager
PH: (269) 355-3793
Kelley@psirotary.com

PRIME SOLUTION, INC. PROPOSAL REQUEST FORM

Please fill out form as completely as possible and submit with Proposal Request

Date:	9/15/2020
PSI Rep Firm / Contact:	Adam Pelican/Falcon Environmental
Phone / E-Mail:	
Engineering Firm:	Hazen and Sawyer
Address:	143 Union Blvd, Suite 200
City / State / Zip:	Lakewood, CO 80228
Contact / Title:	Caitlin Kodweis/Principal Engineer
Phone / E-Mail:	720-616-5594
Project / Plant Name:	City of Northglenn/Northglenn Water Treatment Plant
Address:	2350 W 112th Av, Northglenn
City / State / Zip:	Northglenn, CO 80234
Contact / Title:	Mike Roman/mroman@northglenn.org
Phone / E-Mail:	
Project Details / Current Dewatering Situation / Etc:	Currently no thickening or dewatering at the facility.
Project Information:	**Details:**
Application Description: (Municipal or Industrial)	Municipal
Proposal Type: (Budgetary or Firm)	Budgetary
RFP Size for Proposal:	
Machine Type: (Full Skid or Free Standing)	Interested in both options
Estimated Purchase/Bid Date:	January 2021
Desired Hydraulic Flow Rate (gpm)**:**	0.20 - 0.50 MGD
Sludge Type: (primary, secondary, mineral)	Water Treatment Plant, Clarifier Blow Down and Filter Backwash
Estimated Hours for Dewatering: (per day)	6 hours, 5 days a week
Estimated Solids Loading: (d.s lbs. / hr)	a) 50th Percentile/average: 345 ppd B) 95th Percentile/typical max: 1322 ppd C. Max Case: 2157 ppd
Feed Solid (TS%)**:**	
Was A Lab Sample Processed: (Y / N - if Yes is information still the same)	
Was Pilot Testing Performed: (Y / N - if Yes is information still the same)	Y, information is still the same
Ancillary Equipment / Equipment Services Requested:	We will want to discuss polymer and conveyors after initial sizing.
Additional Details:	Open to multiple configurations. If the Max case significantly increases equipment size and cost, we may decide to only use the 95th percentile.

PRIME SOLUTION

LIFE CYCLE COST

EQUIPMENT

Model No.:	RFP2.0-48D
Dewatering Channel:	2
Screen Diameter:	48"
System Dimensions:	103" L x 75" W x 98" H
System Weight:	8,500 Lbs. (approximate)
Rotary Fan Press Drive:	5 HP / 3.1 kW / 6.50 FLA @ 480/3/60
2.0 Mixing Element Drive:	0.50 HP / 0.72 kW / 2.24 FLA @ 480/3/60 (total)

OPERATION

Operator Start-Up/Shutdown:	0.5 Hours Total
Yearly Routine General Maintenance:	5 Hours Total
Pneumatic Retention Gates:	.3 CFM @ 60 psi
Standard Wash Water Intermittent Requirements:	Outer Wash: 14 GPM & Inner Wash: 20 GPM - Wash Water Intermittent Requirements are set and controlled by Operator / Facility once Press is installed. Re-Use water that is Filtered to 200 microns or less may be used.

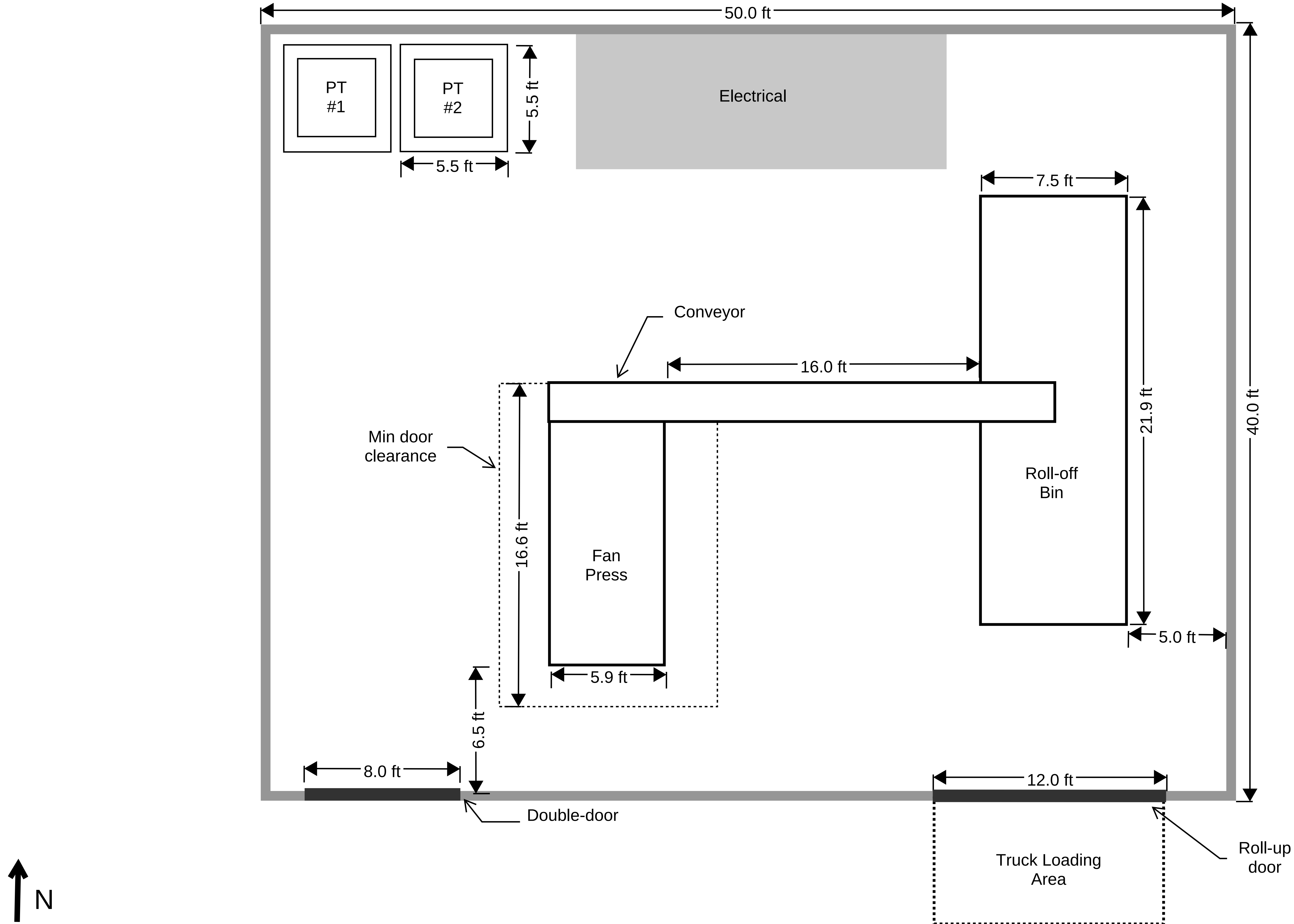
PARTS & SERVICE

Brass Scrapers	Service Life:	5,000 – 10,000 Hours
	Current Cost:	$500.00
	Lead Time:	1 – 2 Weeks
	Labor Hours:	1 – 2 Hours
Gearbox Oil Change	Service Life:	10,000 Hours or 2 Years
	Current Cost:	Market Price
	Lead Time:	>1 Week
	Labor Hours:	1 – 2 Hours
Parts & Service Location		Prime Solution, Inc. 610 S. Platt Street Otsego, MI 49078 Ph: (269) 694-6666

*The Parts/Pricing Listed Above Covers The Two (2) Dewatering Channels of The RFP2.0-48D.

*Service life hours are estimates only as many factors will influence the wear/life of the parts listed above (type of sludge, process variations, feed solids concentration, temperature, chemical selection, desired results, etc.) and in no way is the listed information a guarantee of performance. Pricing is subject to change without notice, please contact Prime Solution for the most current pricing.

Appendix D: Dewatering Building Layout



Hazen

Northglenn WTP
Dewatering Building Layout

Appendix E: Cost Estimate

Hazen

City of Northglenn, WTP Solids Handling Facility

70052-000

Class IV

Date: 10/16/2020

#	Description					Total	
1a	*General Conditions*	*15.0%*	*on*	*$*	*2,361,054*	*$*	*354,158*
1b	*Special Conditions*						
2	*Sitework*					*$*	*284,904*
3	*Bypass Pond*					*$*	*112,989*
4	*Backwash Equalization Pond*					*$*	*124,288*
5	*Recycle Pump Station*					*$*	*300,000*
6	*Gravity Thickener*					*$*	*600,000*
7	*New Dewatering Building*					*$*	*938,874*
	Subtotal:					**$**	**2,715,212**
	Value of Subcontracted Work			*$*	*889,252*		
	Subcontractor Overhead, Profit & Fee	*20.0%*	*on*	*$*	*889,252*	*$*	*177,850*
	Subtotal:					**$**	**2,893,062**
	Prime Contractor Overhead	*15.0%*	*on*	*$*	*1,825,960*	*$*	*273,894*
	Subtotal:					**$**	**3,166,956**
	Prime Contractor Profit	*10.0%*	*on*	*$*	*2,099,854*	*$*	*209,985*
	Subtotal:					**$**	**3,376,942**
	GC Profit on Subcontracted Work	*5.0%*	*on*	*$*	*1,067,103*	*$*	*53,355*
	Subtotal:					**$**	**3,430,297**
	Labor Escalation at 3.5% annually	*4.4%*	*on*	*$*	*357,150*	*$*	*15,693*
	Material/Equip Escalation at 5% annually	*6.3%*	*on*	*$*	*545,661*	*$*	*34,314*
	Subtotal:					**$**	**3,480,304**
	Bond and Insurance	*3.0%*				*$*	*104,409*
	Subtotal:					**$**	**3,584,713**
	Design Contingency	*30.0%*				*$*	*1,075,414*
	Subtotal:					**$**	**4,660,127**
	Bidding Environment	*10.0%*				*$*	*466,013*
	Subtotal:					**$**	**5,126,140**
	Total (rounded):					**$**	**5,126,000**

City of Northglenn
Northglenn Water Treatment Facility Solids Handling Improvements
Costs

Input Values and Assumptions	
Interest Rate:	5.0%
Time Period (yrs):	20
Operation Staff Rate per year	$22,850
Sludge % Solids Input:	1.0%
Maintenance Hours per year:	20
Average Solid Production (DT / Day)	0.15
Power Factor	0.85
Electricity Cost (per kWh):	$0.07
Polymer cost (per lb):	$4.80
Hauling & Disposal Costs ($/yd^3):	$36.50
Sludge Density (lb/gal)	9.60
Density of Water (lb/ft3)	62.40
Material Cost Escalation	3%

System Characteristics	Number of Units	1
	Hours of Operation per Week	8
	Equipment Solids Loading Rate (lb/hour)	500
	Sludge % Solids Output	23%
	Firm Capacity (dry tons per shift)	1.0
	Effective Sludge Density (lb / ft^3)	50.3
	SG of Sludge	5.24
	Capture Rate (%)	95%
	Average Cake Production (cubic yards / week)	1.12
	Active Polymer use (lb / dry ton)	14
	Active Polymer use (lb / week)	15.1
	Fan Press Horsepower (HP)	21
	Thickened Sludge Pumps (HP)	10
	Recycle Sludge Pumps (HP)	5
	Fan Press per week (kWh/week)	19
	Thickened Sludge Pumps per week (kWh/week)	60
	Recycle Sludge Pumps per week (kWh/week)	149
	HVAC and Lighting per week (kWh/week)	68
	Power use (kWh/week)	297
Hours of Op.	Equipment Run-Time (hours operated / day)	4
	Shifts per Week	2
Annual Costs	Estimated O&M for additional .25 FTE staff [A]	$22,850
	Estimated Annual Parts ($/yr) [B]	$5,700
	Polymer Cost ($/yr) [C]	$3,779
	Electrical Cost ($/yr) [D]	$1,271
	Hauling Costs ($/yr) [E]	$2,117
	Annual Costs [A+B+C+D+E]	$35,717
NPW	Annualized Costs (NPW)	$450,000
	Annualized Cost w/ Material Cost Escalation (NPW)	$590,000
	Total Initial Capital Cost	$4,660,000
	20-year Net Present Worth ($)	**$5,300,000**

City of Northglenn
Northglenn Water Treatment Facility Solids Handling Improvements
Savings

Input Values and Assumptions	
Interest Rate:	5.0%
Time Period (yrs):	20
Operation Staff Rate ($/hr):	$22,850.00
Sludge % Solids Input:	1.0%
Maintenance Hours per year:	20
Average Solid Production (DT / Day)	0.15
Power Factor	0.85
Electricity Cost (per kWh):	$0.07
Polymer cost (per lb):	$4.80
Hauling Costs ($/yd^3):	$36.50
Sludge Density (lb/ft3)	10
Density of Water (lb/ft3)	62.40
Material Cost Escalation	3%

System Characteristics	Pumped Volume per Year (MG)	50
	Wastewater Cost to Treat/1000 gal	$1.68
	Average Dry Tons (dry tons / week)	1.1
	Wastewater Cost to Haul ($/ton)	$421.22
	Total Pump Horsepower (HP)	20
	Pump Running Hours per Week (hours)	40
	Power use (kWh/week)	597
Annual Savings	Estimated Annual Wastewater Treatment Savings [A]	$84,000
	Estimated Annual Wastewater Hauling Savings [B]	$23,689
	Electrical Savings ($/yr) [C]	$2,556
	Annual Savings [A+B+C]	$110,244
NPW	Annualized Savings (NPW)	$1,380,000
	Water Rights Cost Avoidance	$5,050,000
	20-year Net Present Worth ($)	**$6,500,000**

SPONSORED BY: MAYOR LEIGHTY

COUNCILMAN'S RESOLUTION | RESOLUTION NO.

No.__________CR-35__________ | __________________________

Series of 2021 | Series of 2021

A RESOLUTION APPROVING ADDENDUM NO. 1 TO THE PROFESSIONAL SERVICES AGREEMENT BETWEEN THE CITY OF NORTHGLENN AND HAZEN AND SAWYER FOR FINAL DESIGN, PERMITTING, AND BIDDING SERVICES FOR THE WATER TREATMENT PLANT SOLIDS HANDLING IMPROVEMENTS PROJECT

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF NORTHGLENN, COLORADO, THAT:

Section 1. Addendum No. 1 to the Professional Services Agreement between the City of Northglenn and Hazen and Sawyer, attached hereto, in an amount not to exceed $452,210.00 for final design, permitting, and bidding services for the Water Treatment Plant Solids Handling Improvements Project is hereby approved and the Mayor is authorized to execute same on behalf of the City of Northglenn.

DATED, at Northglenn, Colorado, this _______day of ______________________, 2021.

____
MEREDITH LEIGHTY
Mayor

ATTEST:

____
JOHANNA SMALL, CMC
City Clerk

APPROVED AS TO FORM:

____
COREY Y. HOFFMANN
City Attorney

ADDENDUM #1 TO AGREEMENT FOR PROFESSIONAL SERVICES

THIS FIRST ADDENDUM TO AGREEMENT FOR PROFESSIONAL SERVICES is made and entered into this _____ day of ____________________, 2021, by and between the CITY OF NORTHGLENN, State of Colorado (hereinafter referred to as the "City") and Hazen and Sawyer (hereinafter referred to as "Consultant").

RECITALS:

A. On August 10, 2020 the City and Consultant entered into an Agreement for Professional Services for Preliminary Engineering services (the "Agreement").

B. The parties desire to supplement the Agreement with this Addendum #1 to allow for an additional scope of services for:

Exhibit A Solids Handling Improvements Project-Design, Permitting and Bid Phase Services

AGREEMENT

NOW, THEREFORE, it is hereby agreed that for the consideration hereinafter set forth, that Consultant shall provide to the City, professional engineering services as needed in the manner provided in the Agreement.

1. The Scope of Services in the Agreement is hereby supplemented to include the scope of services for design, permitting and bid phase services attached hereto as **Exhibit A**, and incorporated herein by this reference (the "Additional Scope of Services"). Consultant shall commence work on the Additional Scope of Services within ten (10) days of the issuance of a Notice to Proceed.

2. Subparagraph A. of Article IV entitled "Compensation" is hereby amended to provide as follows:

A. Compensation shall not exceed four hundred fifty-two thousand two hundred ten dollars ($452,210) for the work described in **Exhibit B** to this Addendum #1.

3. The original Agreement is in full force and effect and is hereby ratified by the City and the Consultant. The original Agreement and this Addendum constitute all of the agreements between the City and the Consultant.

IN WITNESS WHEREOF, the parties hereto each herewith subscribe to the same in duplicate.

CITY OF NORTHGLENN, COLORADO

By: ______________________________

Meredith Leighty
Print Name
Mayor
Title Date

ATTEST:

____
Johanna Small, CMC, City Clerk

APPROVED AS TO FORM:

____
Corey Y. Hoffmann, City Attorney

CONSULTANT

By: ______________________________

VP / REGIONAL MANAGER 3/8/21
Title Date

ATTEST:

____

ASSOCIATE 3/8/21
Title Date

3/4/21

Hazen

Exhibit A

Scope of Work for the City of Northglenn's Solids Handling Improvements Project – Design, Permitting and Bid Phase Services

Project Understanding

This phase of the overall project is to complete the design documents and assist during the bidding phase of the project to install solids dewatering equipment at the City of Northglenn's (City) Water Treatment Plant (WTP). Currently, the City conveys diluted solids via the wastewater collection system to the City's wastewater treatment plant. This project allows the City to dewater the alum solids at the WTP while recycling backwash decant. This new recycling step helps the City close the long-term water supply gap projected by the City's staff.

This scope of work describes the tasks needed to complete the design of rehabilitated ponds, a new gravity thickener and dewatering building with a rotary fan press skid. In addition, Hazen will assist the City with permits and the bid phase of the project.

Scope of Work – Design, Permitting and Bid Phase Services

Task 1 - 60% Design

Hazen will develop design documents for the recommended alternative consisting of detailed plans and specifications suitable for bidding the project. A list of anticipated drawings is included as Attachment A to this scope of work. Hazen will develop major drawings to be reviewed at the 60 percent stage and review this set during a workshop with City staff. Hazen will also consider all City comments and provide a comment-resolution table.

Technical specifications will be developed using CSI 50 Division format. Front-end contract documents will be developed using the City's master documents. For the 60% design, major equipment specifications and associated technical specifications will be developed, along with a draft of the front-end general specification sections.

Hazen will perform the appropriate level of internal QA/QC for the design phases.

Updates to the opinion of probable construction cost (OPCC) will be made at 60% (AACE Class 3).

Meetings:

- Kickoff Meeting: Up to three (3) Hazen staff are expected to attend this meeting in person. Prior to this workshop, a meeting agenda and any items that require City review or input will be provided. Summary meeting notes will also be provided within a week of the workshop to document decisions, outcomes, and other comments.

- Status updates: A 30 minute bi-weekly call will be held to provide an update on the project status. This will include ongoing activities that need coordination and provide updates to the design schedule and budget as needed.

- 30% Concept Workshop with City Staff: Up to three (3) Hazen staff are expected to attend this meeting via phone/Teams call. Prior to this workshop, a meeting agenda and any items that require City review or input will be provided. Summary meeting notes will also be provided within a week of the workshop to document decisions, outcomes, and other comments.

- 60% Workshop with City staff: Up to three (3) Hazen staff are expected to attend this meeting in person. Prior to this workshop, a meeting agenda and any items that require City review or input will be provided. Summary meeting notes will also be provided within a week of the workshop to document decisions, outcomes, and other comments.

Deliverables:

- Hazen will provide an electronic copy of the 60% milestone drawings and applicable specifications.

- Hazen will also provide the detailed breakdown of the OPCC.

- Olsson will provide an electronic copy of the Report of Geotechnical Exploration

- Olsson shall use a subconsultant to perform potholing. Up to 15 potholes shall be done with the depths of found pipe/utilities recorded and provided to the client.

Geotechnical and Survey:

Olsson shall perform a geotechnical exploration with a total drilling footage up to 90 linear feet. Sampling will be completed, at a minimum of every 5 feet and at apparent material transitions.

- Olsson proposes to use a truck-mounted drill rig to complete four (4) soil test borings to an approximate depth of 10 to 40 feet below the existing ground surface.

- The soil borings will be completed to the depths proposed, or to refusal, whichever is shallower. This proposal is based on a total drilling footage of 90 linear feet. Sampling will be completed, at a minimum of every 5 feet and at apparent material transitions, in general accordance with ASTM D3550, ASTM D-1586 and/or ASTM D-1587. If bedrock is encountered at shallow depths and cannot be sampled with conventional barrel sampling methods, coring will be used to obtain bedrock samples. Coring, if necessary, will be extended to proposed foundation bearing elevation or a minimum of an additional ten feet via rock coring, whichever is shallower.

- Olsson understands that all boring locations will be readily accessible by our truck mounted drilling equipment and support vehicles. This proposal is based on completing the field activities during favorable weather conditions.
- The drill crew will locate the borings at the site by using a hand-held GPS device. Borings will also be located by dimension from existing structures by providing at least a minimum of two dimensions to well defined corners for each boring.
- The borings will be logged by a qualified Olsson representative.
- Olsson will contact the Colorado Utility Locator (CO811) for location of utilities in public easements. Private utilities are not part of CO811 and should be identified and marked in the field by others prior to drilling mobilization. Olsson can subcontract and coordinate the services of a private utility locate company for this project, if requested. Expenses related to the private utility locate services will be in addition to the lump sum fee of this proposal.
- Olsson requests that the Client provides right of entry for all properties to conduct the exploration.
- Split barrel, thin walled tubes, and/or ring samplers will be used to obtain samples of the subsurface soils.
- Where encountered, Olsson will obtain groundwater measurements in the test borings at the time of drilling and immediately after completing the drilling operations.
- Some damages to the adjacent ground may occur as a result of the soil boring operations or along access pathways required for the drilling equipment to travel to or from the boring locations. Olsson will attempt to minimize such damage, but no restoration other than backfilling the soil test borings and patching the surface with like materials is included in this scope of services.
- Olsson assumes that borings will be backfilled with drill cuttings and any excess drill cuttings will be removed from the property.

Olsson shall perform and prepare a topographic survey on a portion of the Northglenn Water Treatment Plant on West 112th Avenue. The approximate area to be surveyed is 4.0 acres. Scope further defined below:

- Olsson will provide three (3) horizontal control points tied to Colorado State Plane Coordinate System (NAD 83), and two (2) vertical benchmarks tied to NAVD88 elevation. Should another system be required, the client shall notify Olsson prior to the commencement of survey.
- The survey shall depict topographic features including showing contours at a 1' vertical interval, all physical improvements including buildings, roads, driveways, parking, fencing, general

vegetation, the nearest fire hydrant, and visible utilities, as well as underground utilities as located by the Colorado One-Call system.

- Utility companies will be contacted through the Colorado One Call system and any utilities marked will be shown on the topography survey. Any maps of private utilities which are typically not located thru the one call system that are provided will also be plotted in accordance with above ground structures.

> **NOTE:** Utility location and mapping is for horizontal location of above ground and underground utilities only. Other than sanitary and storm inverts, utility depths will not be obtained or indicated on the survey. Survey of utilities will be based on tracing and marking by One Call utility locate and provided or available maps. By signing this contract, the client understands and acknowledges that utility mapping is not exact and it is possible that not all utility lines will be located. Olsson is not responsible for miss-marked or unmarked utilities.

Task 2 - 90% and Final Design

Hazen will develop drawings to be reviewed at the 90 percent and final design stage and review these sets during a workshop with City staff at each of the two milestones. Attachment A lists the drawings that are anticipated for this project, and all drawings will be included in this phase. Hazen will also consider all City comments and provide a comment-resolution table.

All required technical specifications will be developed using CSI 50 Division format. Front-end contract documents will be developed using the City's master documents.

Hazen will perform the appropriate level of internal QA/QC for the design phases.

Updates to the opinion of probable construction cost (OPCC) will be made at 90% (AACE Class 2) and Final Design (AACE Class 1).

Meetings:

- Status updates: A 30 minute bi-weekly call will be held to provide an update on the project status. This will include ongoing activities that need coordination and provide updates to the design schedule and budget as needed.
- 90% Workshop with City staff: Up to three (3) Hazen staff are expected to attend this meeting in person. Prior to this workshop, a meeting agenda and any items that require City review or input will be provided. Summary meeting notes will also be provided within a week of the workshop to document decisions, outcomes, and other comments.

Deliverables:

- Hazen will provide an electronic copy of the 90% milestone drawings and applicable specifications.

- Hazen will provide an electronic copy of the Final for Bid milestone drawings and applicable specifications.

- Hazen will also provide the detailed breakdown of each OPCC.

Task 3 - Permitting and Bid Phase Services

As water will be recycled back to the raw water system, this project affects the treatment process and requires a formal review and approval from the Colorado Department of Public Health (CDPHE). Hazen will assist the City in providing a design set of drawings to be reviewed. As required, Hazen will prepare a set of plans for permitting through the City of Northglenn Building Department.

Hazen will perform the following during the bid phase of the project.

- Review the Advertisement for Bids prepared by the City.
- Assist in the responses to Contractor questions and issue addenda if needed.
- Attend and assist the City in conducting a Pre-Bid Conference.
- Attend bid opening and prepare a tabulation of bids received and recommendation letter to for award. The deliverable for this item is the recommendation letter.
- Deliver conformed plans and specifications based on any addenda issued during the bid phase.

Meetings:

- Pre-Bid Conference: Up to two (2) Hazen staff are expected to attend this meeting in person. Hazen will assist the City in conducting the meeting.

Deliverables:

- Hazen will issue up to two addenda if needed.
- Hazen will deliver a letter of recommendation after bid opening.
- Hazen will deliver an electronic copy of conformed plans and specifications based on any addenda issued during the bid phase to the City.
- Hazen will deliver a copy of the CAD files for the conformed plans to the City.
- Hazen will deliver an electronic copy of conformed plans and specifications based on any addenda issued during the bid phase to the Contractor.

Assumptions for Task 1, 2 and 3:

- City will assist with utility location and review all pothole and boring locations prior to work.
- City to pay for all permits and reviews

- Pre-qualification of bidders is not required.
- City reviews will be completed in ten business days.
- The project will be bid once and as a single construction contract.
- The City will advertise, sell and distribute contract documents via Bidnet and the City's website.

Schedule

The following lists estimated milestones. Hazen will coordinate with Northglenn's Project Manager to maintain progress on this project.

- Notice to Proceed: March 8, 2021
- Detailed Design 60% Complete: May/June 2021
- Detailed Design 90% Complete: August/September 2021
- Final Design/Ready for Bid Advertisement: September 2021
- Bid Opening: October 2021
- Construction NTP: December 2021
- Construction Complete: December 2022

Exhibit B - Amount of Compensation
City of Northglenn
Solids Handling Improvements
DESIGN ENGINEERING SERVICES

		SPC	SA	A	SPE	PE	AE	Tech	Total	Fee		
Task	Description	$ 270	$ 230	$ 190	$ 165	$ 140	$ 120	$ 110	Hrs	Labor	Exp	Total
1	Task 1 - 60% Design	36	40	96	194	172	240	300	1078	$ 155,050	$ 500	$ 155,550
2	Task 2 - 90% and Final Design	32	60	150	252	264	352	400	1510	$ 215,720	$ 300	$ 216,020
3	Task 3 - Permitting and Bidding	8	0	14	110	124	28	80	364	$ 52,490	$ 150	$ 52,640
	Subconsultant											$ 28,000
	Total	76	100	260	556	560	620	780	2952	$ 423,260	$ 950	$ 452,210

Labor Classifications	Rate
SPC - Sr Principal Consultant	$ 270
SA - Senior Associate	$ 230
A - Associate	$ 190
SPE - Senior Principal Engineer	$ 165
PE - Project Engineer	$ 140
AE - Assistant Engineer	$ 120
Tech - Technician / Designer / Admin	$ 110