65% DESIGN ANALYSIS REPORT
PHASE II

Water Treatment Plant Upgrades, Kongiganak, Alaska

March 2021

Prepared For:

Native Village of Kongiganak,
Kongiganak, Alaska 99545

and

State of Alaska Department of Environmental Conservation Village Safe Water Program
(Project #19-VSW-KKH-014)

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Acronyms and Abbreviations

°	degree
AAC	Alaska Administrative Code
ADA	Americans with Disability Act
ADL	Alaska Division of Lands
ADOL	Alaska Department of Labor and Workforce Development
ANTHC	Alaska Native Tribal Health Consortium
ASSE	American Society of Safety Engineers
ATV	all-terrain vehicle
Bristol	Bristol Engineering Services Company, LLC
CFR	Code of Federal Register
CH	Chloral hydrate
DAR	Design Analysis Report
DBP	disinfection by-products
DCCED	Alaska Department of Commerce, Community and Economic Development
DCRA	Division of Community and Regional Affairs
DEC	Alaska Department of Environmental Conservation
DIC	Dissolved inorganic carbon
DNR	Alaska Department of Natural Resources
DOC	Dissolved organic carbon
DOT&PF	Alaska Department of Transportation and Public Facilities
EPA	U.S. Environmental Protection Agency
F	Fahrenheit
ft	feet
gpcd	gallons per capita per day

gpd	gallons per day
gpm	gallons per minute
HAA	Haloacetic Acid
HDPE	high-density polyethylene
HP	horsepower
kva	kilovolt-amps
LCR	Lead and Copper Rule
LF	linear feet
LKSD	Lower Kuskokwim School District
mg/L	milligrams per liter (parts per million)
MLLW	Mean low low water
MSL	Mean Sea Level
NPSH	Net Positive Suction Head
NTU	Nephelometric Turbidity Units
PCU	platinum-cobalt units
PER	Preliminary Engineering Report
PEX	cross-linked polyethylene piping
PLC	Process Logic Control system
ppm	parts per million (milligrams per liter)
PSF	pounds per square foot
psi	pounds per square inch
PVC	polyvinyl chloride
PWSID	Public Water System Identification
RCA	Regulatory Commission of Alaska
SCD	Streaming Current Detector

sqft	Square Feet
SUVA	Specific ultraviolet absorbance (UVA/DOC *100)
TTHM	Total Trihalomethane
USDA	United States Department of Agriculture
UVA	Ultraviolet Absorbance
VSW	Village Safe Water
WST	Water Storage Tank
WTP	Water Treatment Plant
µg/L	micrograms per liter (parts per billion)

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Executive Summary

Scope

This Phase II Design Analysis Report (DAR) follows a Phase I DAR which provided additional information on the existing Water Treatment Plant (WTP), to supplement the information provided in a June 2018 Preliminary Engineering Report (PER) completed by Summit Consulting Services, Inc. (Summit). The Phase I DAR documented the status of the existing WTP systems and provided information on what was needed to bring the systems into compliance with the regulatory requirements of the Surface Water Treatment Rule (SWTR), while ensuring compliance with the Disinfectants and Disinfection By-Products (DBP) Rule, and the Lead and Copper Rule.

This Phase II of the DAR provides the preliminary design of a proposed WTP Annex, located immediately adjacent to the existing WTP building, which will house new water treatment equipment including a direct filtration system, a polishing filter (to optimize organic removal), pH adjustment, pumps and pressure systems, and two treated water storage tanks. The WTP Annex would utilize existing pilings which had been historically used to support a 538,000 gallon water storage tank (WST), which was demolished and replaced in 2008. The water treatment equipment will be removed from the existing WTP. However, the existing WTP will continue to be used for WTP operator office space, work space for pumps and pressure tanks, and storage.

The preliminary design of the WTP Annex is based on:

- Meeting minimum regulatory requirements for safe drinking water as outlined in the Alaska Department of Environmental Conservation (ADEC) Drinking Water Regulations, 18 Alaska Administrative Code (AAC) 80;
- The findings of the 2019 site investigations which included and evaluation of treatment processes, mechanical / electrical systems, and the structural /geotechnical status of the existing WTP building;
- The geotechnical and structural evaluation of the old WST pilings, which was completed in April 2021 *<site visit planned April 4, report to be included at 95%>;*
- The raw water quality, including laboratory test results and the findings of a 2019 Treatability Study;

- The projected future demand (2041, using a 20-year design life) of the community assuming a hauled water system for home service, and a limited piped service providing treated water to the Washeteria, Health Clinic (constructed in 2020), new school (Ayagina'ar Elitnaurvik School), and the Old School Community Building (which includes a preschool and community offices).
- Meetings and correspondence with the community representatives, and representatives of the Lower Kuskokwim School District (LKSD).

A preliminary cost estimate for the new WTP Annex, including structural, mechanical, electrical, and treatment systems will be provided in the 95% DAR Submittal.

1 Introduction

Bristol Engineering Services Company, LLC (Bristol) prepared this Design Analysis Report (DAR) for the Alaska Department of Environmental Conservation (ADEC), Village Safe Water (VSW) program on behalf of the Native Village of Kongiganak (Village). This Phase II report follows a Phase I report, which provided site inspections and an evaluation of the existing WTP building and water system processes. The Phase I report also included an inspection and evaluation of the adjoining Washeteria. However, the Phase II DAR focuses on the WTP. A copy of the Phase I DAR is provided under separate cover for reference.

The purpose of this Phase II DAR is to provide preliminary engineering information (35% design level) for the design of a new WTP Annex, which will house new water treatment equipment needed to bring the system into compliance with the Surface Water Treatment Rule (SWTR), the Disinfectants and Disinfection Byproducts (DBP) Rule, and the Lead and Copper Rule. The new treatment annex will be located immediately adjacent to the existing WTP on a new deck supported by piles. The existing WTP will continue to be used for office space, storage, and for pumps and pressure systems. Two new treated water storage tanks (WSTs), 40,000 gallons each, will be located on the new deck adjacent to the new WTP Annex.

The foundation for the new WTP Annex and new treated WSTs will rely on existing piles constructed in 1978 to support the original 538,000 gallon raw WST, which was demolished when the new 1.2 million gallon (MG), raw WST was completed in 2008. The piles have experienced no observable differential settlement. However, warming permafrost has been found throughout this area and may have impacted the load bearing capacity of the piles. A geotechnical investigation is being planned to verify the subsurface conditions, the structural adequacy of the foundation, and to provide design information for any needed remedial measures, including active or passive thermosyphons.

The following sections detail the condition of the existing systems based on site inspections conducted in 2019, and provide a design basis for a new water treatment system housed in a separate annex, that will provide a reliable source of safe drinking water for the Village. Figures are included in the document as referenced, with a full set of compiled Figures included in Appendix A.

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2 Background

This section provides background information about the community and existing sanitation facilities.

2.1 Location

Kongiganak is located approximately 2.5 miles inland to the north from the seacoast of Kuskokwim Bay, approximately five miles southwest of the Kuskokwim River, and approximately 70 miles southwest of Bethel (Latitude, Longitude: 59.9594, -162.8871), within the Yukon Delta National Wildlife Refuge. This boardwalk community was established on a shallow permafrost bluff in the 1960's by former residents of Kwigillingok that were trying to escape the periodic flooding of the Kongiganak (also spelled Kongnignanohk) River.

Figure A-101: Location Map

The WTP and Washeteria building sites are located adjacent to each other and connected by a walkway, on the southeast side of the downtown area of Kongiganak (see Figure C-101), west of the airport.

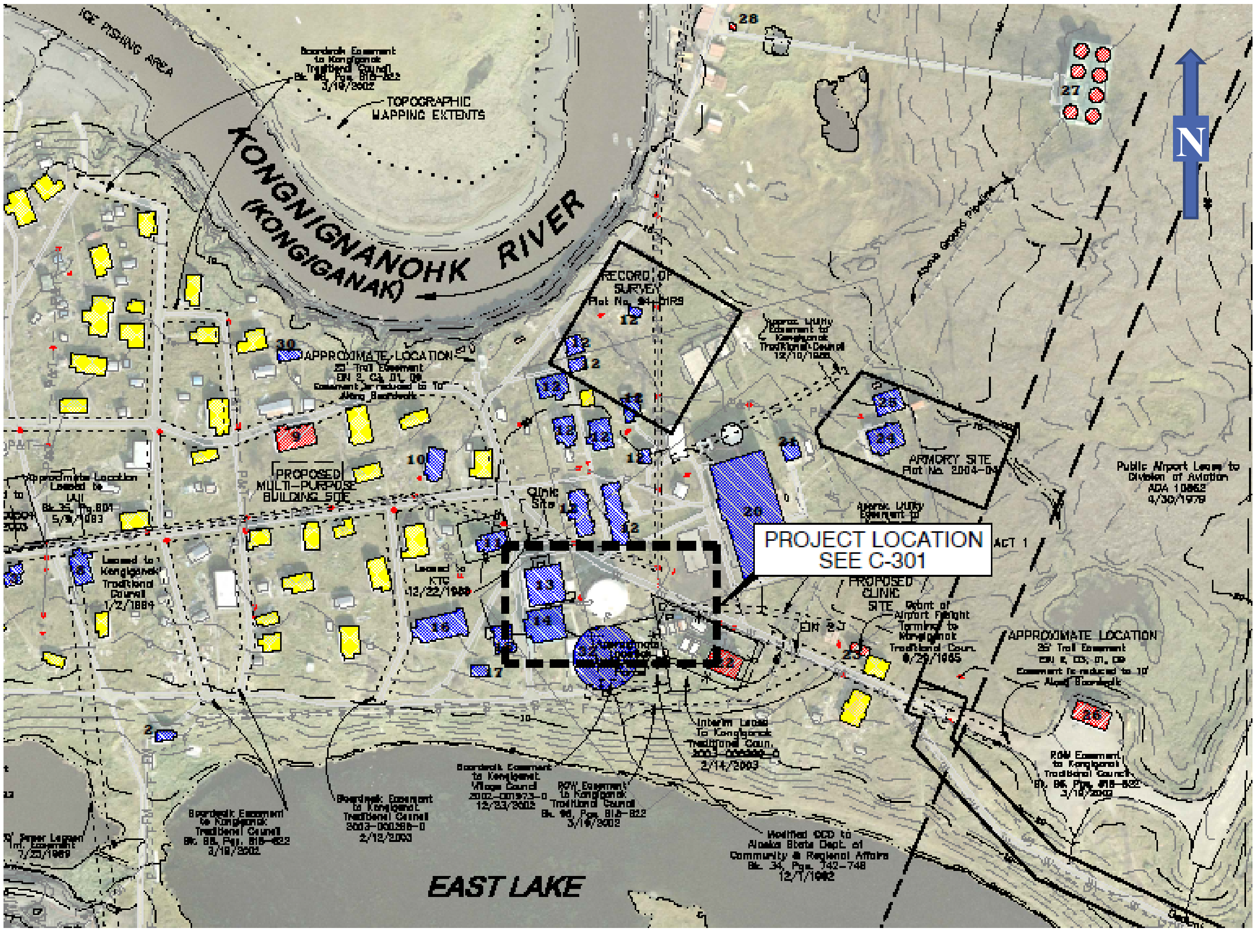
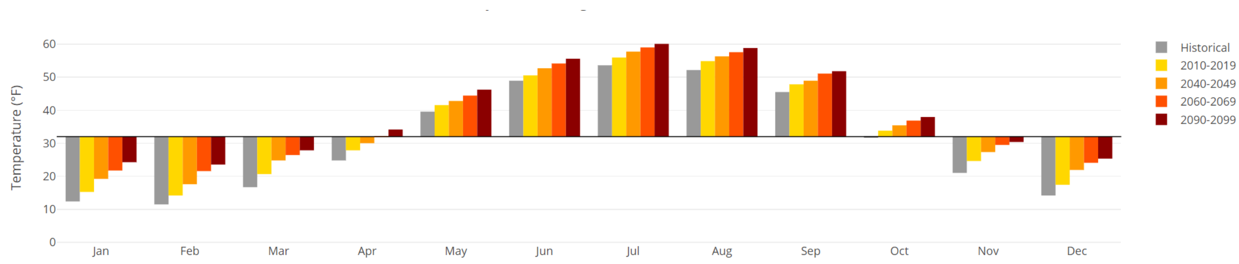


Figure C-101: Vicinity Map

2.1.1 Site Conditions

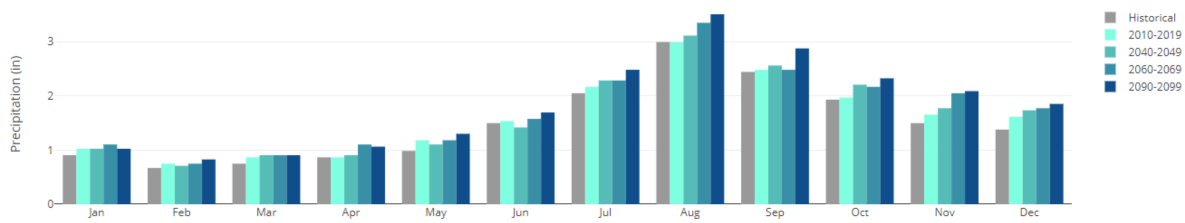
Kongiganak is in a relatively low relief area, surrounded by marshy wetlands, ponds, sloughs, and meandering streams. Kongiganak has an annual average temperature of 30.7 degrees Fahrenheit (F), annual average precipitation of 21.3 inches, and annual average wind speed of 19.19 miles per hour (USA.com, 2021) .

Predicted trends in temperatures and precipitation based on University of Alaska, Fairbanks (UAF) Scenarios Network for Alaska (SNAP) + Arctic Planning are provided in Exhibit 2-1 and Exhibit 2-2, respectively (UAF, 2021).



Source: UAF, 2021

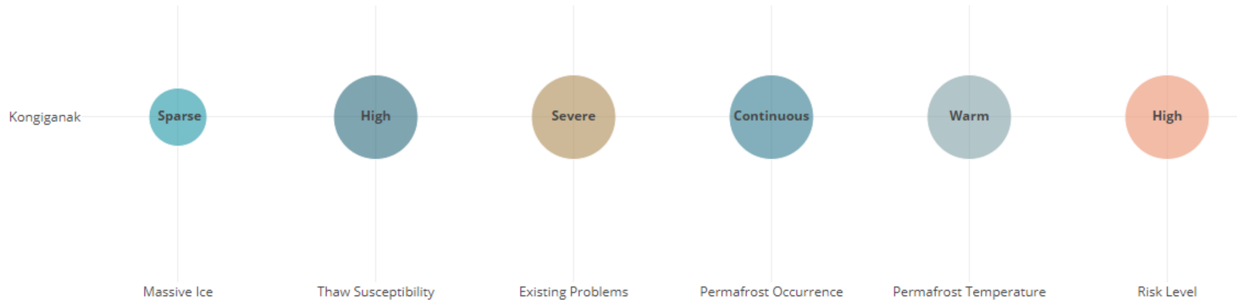
Exhibit 2-1: Kongiganak Predicted Monthly Average Air Temperatures



Source: UAF, 2021

Exhibit 2-2: Kongiganak Predicted Monthly Average Precipitation

The area surrounding Kongiganak is underlain by fine grained, warming permafrost. The average subsurface temperatures measured during the recent site visit (June 2019), indicated higher subsurface temperatures as compared to measurements taken during the initial construction. The UAF SNAP program estimates that warming subsurface conditions poses multiple, serious risks for Kongiganak, as shown in Exhibit 2-3.



Source: UAF, 2021

Exhibit 2-3: Kongiganak Permafrost Risks

The community is also at risk of periodic flooding and surges from the Kuskokwim Bay which are caused by wind and tide events. The base flood elevation is estimated at 20.7 feet Mean Lower Low Water (MLLW), with a correlating surge level of 18.38 feet MLLW (both of these estimates are discussed and referenced in the 2018 PER by Summit). There are no readily available gravels for construction, so the community utilizes elevated boardwalks for pedestrian and all-terrain vehicle (ATV) access.

2.1.2 Population

In the 2010 US Census, the recorded population of Kongiganak was 439 people, living in approximately 90 housing units. The 2018 Preliminary Engineering Report (PER) completed by Summit Consulting Services Inc (Summit), referenced an Alaska Department of Labor and Workforce Development (ADOL) residential population of 503 in 2015 and a 20-year design population of 613 people. Representatives of Kongiganak reported a March 2017 population of 684 people based on applications of corporate membership. The Alaska Department of Commerce, Community, and Economic Development (DCCED), Division of Community and Regional Affairs (DCRA) community database lists a 2018 DCCED Certified Population of 539 people.

The 2018 DCCED Certified Population of 539 people will be used in this report, resulting in an estimated 2041population (approximately 20-year design life), of 644 people, based on a 0.9% growth rate.

2.2 History

Kongiganak is an unincorporated, traditional Yup'ik Eskimo village with a subsistence lifestyle and culture. The residents of the Native Village of Kongiganak (Village) are represented by the Kongiganak

Traditional Council. The community is within the Calista Regional Native Corporation area and is served by one school, Ayagina'ar Elitnaurvik, which is part of the Lower Kuskokwim School District (LKSD).

2.2.1 Sanitation Facilities

Homes in Kongiganak do not have piped water or wastewater services, and rely on private hauling of drinking water and wastewater for each home. The only piped water and wastewater systems at this time serve the WTP / Washeteria, the health clinic, and the school. The WTP provides treated drinking water to the community watering point, as well as to laundry and shower facilities. However, the treated water does not meet current regulatory standards. Residents also utilize untreated, traditional sources of water, including rain catchment and ice melt. The school relies on the raw water from the community raw WST, but owns and operates their own water treatment system.

Exhibit 2-4: Kongiganak WST, WTP/Washeteria, and old WST pilings (2019)

The Kongiganak WTP / Washeteria was constructed in 1978 and has undergone multiple stages of reconstruction since, in an attempt to address decades of changing codes, standards, and regulatory requirements. The WTP was initially a multi-purpose building, including drinking water treatment, wastewater treatment, and laundry facilities. Significant building renovations have included upgrading the drinking water treatment systems (completed in 1999); relocating the laundry facilities to a new Washeteria building addition (completed in 2002); removing the wastewater treatment systems with the construction of a new lagoon system (completed in 2005-2008); and the removal of the original 538,000-gallon raw WST with the construction of a new 1.2-MG raw WST (completed in 2008). An enclosed, coin operated, community watering point was added to the WTP building exterior in 2009.

2.2.2 Past Reports

In 2018, a PER was completed by Summit Consulting Services, Inc. that addressed the aging sanitation systems and noted deficiencies in the lagoon and WTP / Washeteria. However, the scope of Summit's initial site inspections did not include the water treatment system, and did not include a structural evaluation of the WTP / Washeteria building and foundation, or the mechanical/electrical systems serving the building. The 2018 PER recommended an additional engineering design study focusing on the WTP. This information was provided in the Phase I DAR provided by Bristol in 2019.

2.3 Community Involvement

Bristol met onsite with a Tribal representative during two 2019 site visits. A geotechnical / structural inspection was completed in June 2019 (Appendix D). A civil/mechanical/electrical inspection was completed in July 2019 (Appendix G). A second geotechnical / structural inspection is scheduled for April 2021.

Bristol also coordinated with the LKSD school system representatives, as well as the architect for the new Village Health Clinic (completed in 2020).

Travel restrictions and community lock-down measures, associated with the pandemic, limited further community meetings.

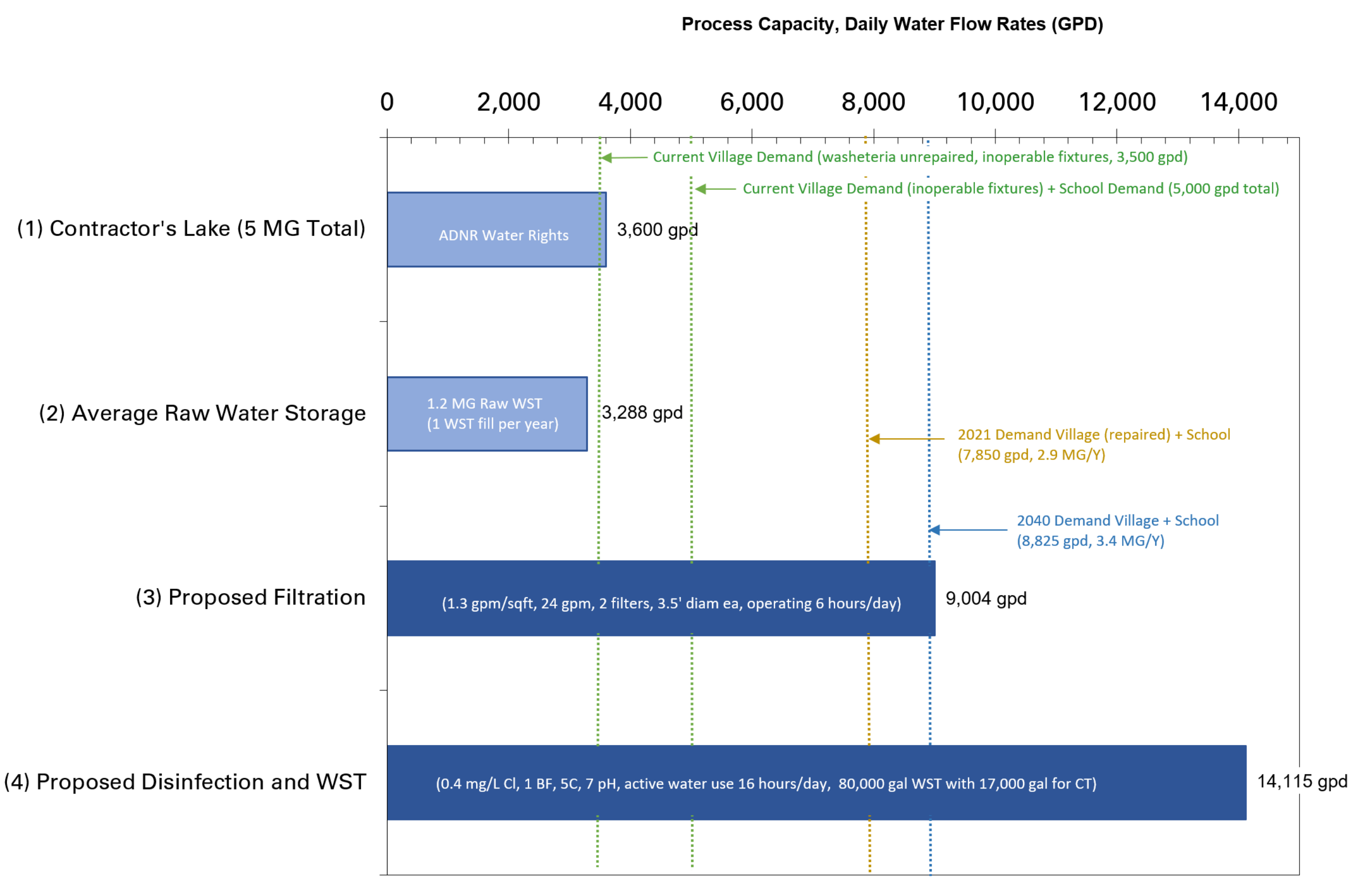
3 Existing Conditions

The following is a description of existing conditions and sanitation facilities in Kongiganak, based on site inspections, historical documentation, and information from community representatives (Joseph Mute, Tribal Administrator, and Paul Paul, WTP Operator). Bristol conducted two site investigations in 2019, which provided the basis for the discussion on existing conditions provided in this section, as well as the basis for the preliminary design provided in Section 4.

3.1.1 WTP Major Unit Process Evaluation

A Major Unit Process (MUP) evaluation provides a comparative graph which shows the strengths and weaknesses of the major unit processes in a water system. A MUP evaluation of treatment processes for Kongiganak is provided in Exhibit 3-1. In this graph, raw water usage rates are averaged on a daily basis to allow a comparison of process capacities (raw water is only accessible during non-frozen months).

Exhibit 3-1: MUP Evaluation, Kongiganak WTP



This MUP diagram indicates that there is sufficient capacity in the proposed new systems to treat water to meet the current and future (2041) demand. However, there is not sufficient raw water, or sufficient raw water storage, if raw water is only accessible for a limited time each year (one WST fill per year). Under the current water rights, Contractor's Lake can only provide 40% of the projected community water demand, indicating it is not a sustainable water source for the future of the community. Calculations for the MUP diagram are included in Appendix J.

3.2 Water System

Kongiganak is currently served by two public water systems:

- Kongiganak WTP / Washeteria (PWSID 271025) – This is a community public water system which provides treated water for the community via a community watering point, as well as treated water for the Washeteria. This system is operated by the Village. Residents self-haul their own water from the watering point in the WTP. The current system is not in compliance with surface water treatment requirements and has exceeded copper action levels. Regulatory concerns for the drinking water system are detailed in the following section.
- Ayagina'ar Elitnaurvik School WTP (PWSID 271245) – This is a non-transient non-community public water system which provides treated water for the school. School facilities include a 90,000 gallon raw WST, with a proposed 500,000 gallon raw WST addition (GV Jones & Associates, Inc., 2013). The school obtains raw water from the Village raw WST. The treatment system was constructed in 2000 and is owned and operated by the school district. Based on information available on the ADEC website (Water Watch), the school water system appears to be in compliance with drinking water quality standards.

A schematic of the existing Kongiganak water treatment system is presented on Figure P-101 – Existing Water Treatment Process Schematic located on the next page and in Appendix A, and an inventory of existing equipment is provided in Appendix D. Current system treatment design calculations are also included in Appendix D.

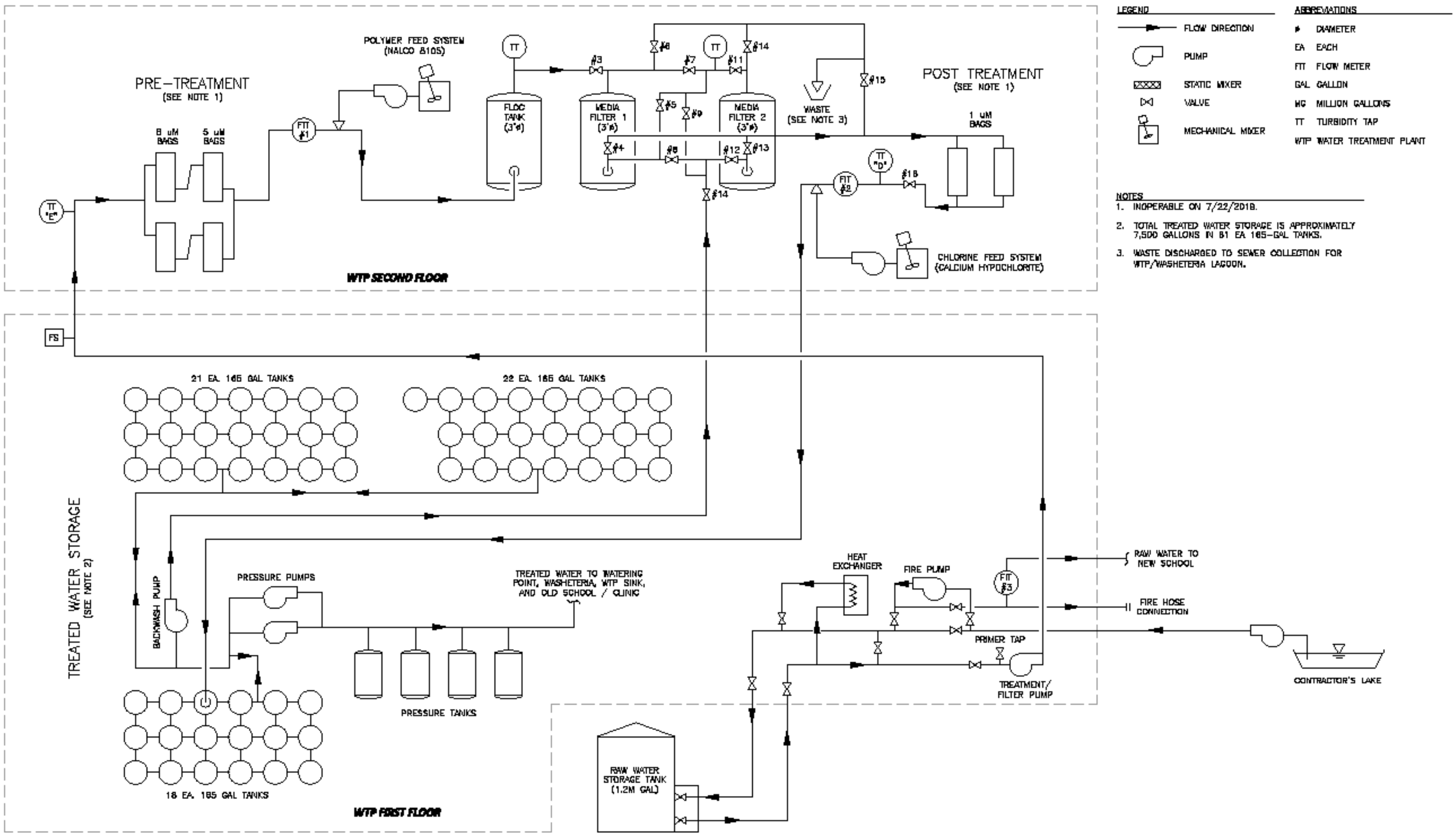


Figure P-101: Existing Process Schematic

3.2.1 Source Water

The original water treatment system was constructed in 1978, and relied on a well located several feet from the facility. However, the well water quality was poor. In 1981 a source water investigation was conducted to identify a better water source (Quadra, 1981). Four lakes, located with approximately 0.5 miles from the WTP, were initially considered. Contractor's Lake was added at the request of the community and VSW. Although further away than the other lakes, Contractor's Lake was chosen because of its comparatively excellent water quality; the separation distance from village development and associated potential contamination; and because it was not impacted by tidal / saltwater flooding. Contractor's Lake is approximately 5.2 acres in size and averages approximately 4 feet deep (Quadra, 1981). Contractor's Lake has provided seasonal source water since the WTP construction.

The *1981 Design Report, Water Supply and Storage Project, Kongiganak VSW Facility,* by Quadra Engineering estimated that Contractor's Lake could provide approximately 4-5 million gallons of available water, with most of the annual recharge provided by normal precipitation. The Village of Kongiganak currently has water rights with the Alaska Department of Natural Resources to withdraw a total of 3,600 gallons per day (issued 2004, LAS 23946, see Appendix B).

Exhibit 3-2: Contractor's Lake (2010)

There have been concerns that Contractor's Lake does not provide a sufficient volume of raw water for both the community and the school. As detailed in the next section, the current, annual, community water use is approximately 1 MG. A recent report by GV Jones indicates that the annual school demand alone is expected to be between 0.5 MG – 1.0 MG (GV Jones & Associates, Inc., 2013). This indicates the total water demand (community and the school) may reach 2.0 MG per year.

Contractor's Lake may not provide a sufficient volume of raw water to meet increased demand. The current DNR Water Rights Permit (issued 2004) lists a withdrawal volume of 3,600 gpd.

The limited raw water capacity in Contractor's Lake is further exacerbated by the limited raw water storage. The current community raw water storage only totals 1.3 MG (including the Village WST with a total volume of 1.2 MG and the school WST with a total volume of 90,000 gallons). An adequate volume of available raw water is a critical element of the community and the school water systems.

Additional efforts to enhance the storage volume of Contractor's Lake through dredging and diking, or the installation of additional snow fences, has been proposed. The installation of vertical infiltration galleries along the lake edge could be considered, for increased seasonal access to raw water and improved water quality. The installation of groundwater wells was attempted in the 1980's, but was unsuccessful due to poor water quality. However, the subsurface conditions have changed with warming temperatures over the last 40 years, which could have changed the feasibility of a groundwater source. Given the critical nature of access to raw water, a study evaluating a new source, capable of meeting the community demand, is recommended.

3.2.2 Water Use

The current water use for this community is based on providing plumbed, treated water, to a single building, the Washeteria. The operator reports using between 1,000 – 3,000 gallons per day.

Treated water flow estimates detailed in Table 3-1 are based on the plumbed appliances that were operable during the July 2019 site visit. There are several washing machines, showers, and toilets that are not operational (broken or disconnected), as indicated in the table. These estimates correlate with operational reports. Treated water flow estimates are fully detailed in Appendix D.

Table 3-1: Kongiganak Washeteria Current Treated Water Use Estimates

APPLIANCE	TOTAL #	OPERATIONAL #	FLOW RATE (gpm)	FLOW TOTAL (gallons/use)	DAILY USES[1] (each)	ESTIMATED DAILY FLOW (gpd)
Washing Machine[2]	6	4	2.5	35	10	1,400
Showers	4	2	2.5	15	12	360
Toilets	4	2	2.5	1.5	24	72
Lavatories	4	4	0.5	2	24	192
Community Watering Point	1	1	2.5	7[3]	100	700
					TOTAL	2,724

NOTES:
1. Assumes 12-hour operational day.
2. Assumes loading/washing/unloading takes 1 hour per load, with some downtime between loads.
3. Assumes 7-gallon jugs used for self-haul.

The largest current water demand is associated with washing machine use. The Washeteria manager maintains a wait list to manage washing machine access. The users pay the Washeteria manager for washing machine use (coin operated systems are not operable). The Washeteria is open approximately 12 hours per day. In this case, the water use rate and daily demand is substantially dictated by available washing machines, within the schedule hours; If more services were available, the water demand of the community will increase significantly to meet the demand. Future flow estimates, based on water system improvements, are discussed in Section 7.

3.2.3 Water Quality

Table 3-2 provides a summary of water quality test results from samples taken during the July 2019 site visit (lab test results are provided in Appendix F). These results represent a snapshot in time. Water quality would vary with seasons (the timing of raw water production), and with the time in storage. The table also compares the results to regulated Maximum Contaminant Level (MCL) and Treatment Techniques (TT), if applicable.

Table 3-2: July 2019 Kongiganak Water Quality Results

ANALYTE	RESULTS	MCL or TT	UNITS
Color	70	15 (secondary standard)	PCU
pH	5.8		
Total Nitrate / Nitrite-N	0.185		mg/L
Arsenic	0.0025 (U)[2]	0.01	mg/L
Iron	0.750	3	mg/L
Manganese	0.00996		mg/L
Calcium	0.282		mg/L
Total Dissolved Solids	27		mg/L
Langelier Index (LI)	-5.97		
Hardness	5.0 (U)		mg/L
Alkalinity	5.0 (U)		mg/L
Total Organic Carbon (TOC)	7.22		mg/L
Dissolved Organic Carbon (DOC)	5.96		mg/L
Ultraviolet 254 Absorption (UVA)	0.350		cm-1
Specific UV Absorbance (SUVA)	5.87		(L/mg)-M
Raw Water Turbidity[1]	1.07		NTU

NOTES:
1. Based on field tests and jar testing in Anchorage lab.
2. Undetected.
3. Samples taken July 2019.
4. Key parameters highlighted.
5. SUVA is a ratio of UVA and DOC. SUVA levels above 4 L/mg-M are typical of waters containing primarily humic substances, which typically have a higher TOC removal capacity.

The raw water sample results indicate the following:

- The source water is aggressive (highly corrosive due to low pH), with high color and high organics (TOC/DOC), but relatively low turbidity. The pH should be closer to 7. Measured low levels of alkalinity indicate a low buffer capacity, which should make needed pH adjustment relatively easy.
- Langelier Index (LI) is a relative measure of a water's calcium carbonate saturation and potential to form scale. An LI below -5 indicates that the source water is not saturated, would not form scale, and would dissolve any calcium carbonate in the water, increasing corrosivity of the water.

- The relatively low level of minerals (iron, manganese) indicates that there would be limited mineral interference for the coagulation process.
- The low alkalinity will make organic removal easier.

In general, the raw water tests characterize a surface water that would be comparatively easy to treat to minimum drinking water quality standards. An assessment of the coagulation, disinfection, and corrosion control processes are summarized below, with full documentation provided in Appendix C. It should be noted that the water samples were taken during a relatively optimum time (mid-summer). A water fill operation in a prolonged rainy season (late fall) would result in worse case organic levels.

Coagulation Assessment

A jar test / treatability study was completed by Bristol in July 2019. A treatability report is attached in Appendix C. The test evaluated three coagulants, Nalco 8105 (the coagulant currently used by the system), Nalco 8185, and Nalco 8186. In addition to turbidity removal, UVA reduction was also considered, as a surrogate for organic removal.

The results of the jar test study indicate that the Nalco 8105 coagulant currently in use is the most effective in turbidity and organic removal. However, the tests also show that Nalco 8185 achieved results that were almost as good, but at a slightly higher dose. Nalco 8185 is less expensive than the Nalco 8105, which could support the use of Nalco 8185. The cost savings would depend on water production.

Table 3-3: Coagulation Assessment Summary

COAGULANT	ESTIMATED DOSE (mg/L)	FILTERED TURBIDITY (NTU)	FILTERED UVA (cm-1)	COST PER GALLON ($)[1]
Nalco 8105	7.0[2]	0.13	0.100	$127.28
Nalco 8185	8.0	0.13	0.123	$70.69
Nalco 8186	6.0	0.13	0.187	$145.85

NOTES:

1. These are unit costs in Anchorage and do not include shipping to Kongiganak (provided by Nalco, September 2019)
2. Extrapolated dosage from test results.

Chlorination / Disinfection By-Product Assessment

A chlorination assessment of the existing treatment system was conducted assuming the use of calcium hypochlorite (Appendix C). In order to provide a 0.3 mg/L residual after the treated WST needed to achieve 1-log *Giardia* disinfection (as discussed in Section 5.4.2: New Water Treatment Processes), a dosage of approximately 2.2 mg/L is currently needed. This minimal level was used to model disinfection by-product (DBP) formation using Water!Pro™, as shown in Table 3-4, with a worse case time in contact of 8 hours. The filtered water organic concentration was based on the measured reduction in UVA of approximately 85% (both 8105 and 8185 were able to achieve this in the jar test), which results in a filtered water DOC estimate of 0.89 mg/L. The table also shows the estimated change in concentration of two types of DBPs, Total Trihalomethanes (TTHMs) and total Halo Acetic Acids (HAAs), formed by addition of calcium hypochlorite to raw vs. filtered water.

Table 3-4: Disinfection By-Product Formation Summary[1]

Parameter	Raw Water	Filtered Water
DOC	5.96 mg/L	0.89 mg/L
TTHM Potential (MCL 80 µg/L)	52.8 µg/L	17.8 µg/L
HAA[2] Potential (MCL 60 µg/L)	72.7 µg/L	12.1 µg/L

NOTES:
1. A pH adjustment was assumed, resulting in a pH of 7.2 for the chlorinated water.
2. The HAA5 by-product formation model included Bromochloroacetic Acid, a sixth HAA.

The results indicate that enhanced filtration using coagulation alone, will reduce the DBPs below regulatory limits, but will not remove all DBPs.

During the site visit it was noted that the containers of calcium hypochlorite in use were seriously degraded. Use of fresh calcium hypochlorite is recommended, due to improved disinfection effectiveness as well as the decreased potential for the formation of degradation compounds.

Corrosion Assessment

The existing system had included pH adjustment via soda ash, which was discontinued as some point in the past. An assessment of corrosion control needs, based on measured water quality is provide in Appendix C. A summary is provided below, which indicates a dose of 35 mg/L would be needed to raise the pH to a desired 7.2.

Table 3-5: Corrosion Control Summary

Raw Water pH (adjusted for temperature)	5.7
Raw Water Dissolved Inorganic Carbon (DIC)	6.7 mg/L
Soda Ash (Sodium Carbonate, Na_2CO_3) Dose	35 mg/L
Treated Water pH Estimate	7.2

This system has a relatively low DIC, so any increase in alkalinity should not cause problems for the system. Re-implementing pH adjustment will likely not result in significant improvement in copper levels or mitigate existing corrosion, because of the deteriorated condition of the piping. However, it would protect new piping and appurtenances and better meet minimum drinking water standards which specify a pH of 6.5-8.5.

3.2.4 Raw Water System

Intake

The raw water intake is installed on a floating platform in Contractor's Lake. Raw water is pumped from the lake to fill the 1.2 MG raw WST in early summer. It takes approximately 2 weeks (operating 24 hours a day, 7 days a week) to fill the raw WST. The WST is topped off again in late fall. The raw water transmission pump is transported to Contractor's Lake for the fill operation. The high capacity pump is also used to initiate flow.

Lake depth could significantly affect the water quality, with the potential to pump higher levels of organics when the lake level is low and the floating intake is closer to the bottom of the lake.

Raw Water Transmission Line

The raw water transmission line is approximately 9,400 feet long, and runs between Contractor's Lake and the WTP. It is a 4-inch high density polyethylene (HDPE) pipe, uninsulated, laying on the surface of the ground. This line is only operational during warmer months when the pipeline is thawed (approximately July through September). The limited availability of this line could become more of a concern as water demand increases.

Add-Heat System

An add-heat system is provided prior to the raw WST. The system consists of a vented, double wall heat exchanger that receives heat from the building hydronic heating system. Two non-potable rated water pumps, piped in a primary/back-up configuration, divert the raw water through the heat exchanger.

3.2.5 Surface Water Treatment

The WTP building houses all of the water treatment equipment on the second floor of the building. The pressure pumps, small plastic water storage tanks, and other distribution system components are located on the first/bottom floor.

Treatment Pump

A 2 horsepower (HP) pump is used to pump raw water from the WST through the treatment system. This pump provides insufficient Net Positive Suction Head (NPSH) to operate at WST levels below approximately 6 feet to 8 feet. In order to pump water at low WST levels, the treated water line must be manually connected to the suction side of the pump via a hose bib, to prime the line and provide additional inlet pressure. This represents a cross connection (and potential contamination point) between a treated water system and the raw WST.

Pre-Filtration (Bag Filters)

There were two banks of housings for 8-micron and 5-micron bag filters in place for pretreatment. However, the housings were empty. There were no pre-filtration systems in use at the time of the site visit.

Coagulation / Flocculation Tank

The current system injects a polymer (Nalco 8105) for coagulation. A flocculation tank is located immediately after chemical injection. The effectiveness of floc formation is unknown. Any floc that is formed could be subject to shearing as it moves through the filter face piping.

Media Filters

The water system uses two 36-inch diameter media filters, operated in series. The current loading rate on the first filter is approximately 1 gpm/square foot (sqft), assuming the current water treatment rate of 7 gpm. The second filter is a polishing filter. This design appears to be effective at meeting turbidity treatment requirements at the current treatment rate. However, the turbidimeters are old/obsolete (as discussed below), and heavy sedimentation was observed in the turbidimeter sample lines, which could artificially decrease the measured turbidity.

The filters have a backwash cycle but no air scour system. The backwash flow is not metered. Based on operator records, approximately 1,000 gallons of treated water is reserved for backwash. Filters are reportedly backwashed for approximately 5-7 minutes (based on visual turbidity), resulting in an estimated backwash flow rate of 85 gpm, and a backwash rate of approximately 12 gpm/sqft. This rate is less than typically recommended, particularly since there is no air scour process. This puts the filters at risk of mudball formation.

The sight glasses are installed on the side of the filters near bottom. This would provide limited information on the backwash process, bed expansion, or the condition of the media. The sight glasses are also heavily fouled.

The largest concern associated with the filters is the lack of adequate structural support in their existing location, putting the system at risk of critical failure. Bracing was installed in 2020, to provide temporary protection against structural failure.

Backwash Supply Pump

A 3HP Gould pump with Baldor motor is currently used for backwash. There is no flow meter on the backwash feed line, and the pressure gauge on the backwash pump is broken.

Protozoa Filters (Bag Filters)

There are two housings for final, protozoal treatment. However, these housings were empty at the time of the site visit. These older housings are not part of a filter system that has been approved for protozoal removal in compliance with current surface water treatment rules (including the Long Term 2 SWTR).

Chlorination

A calcium hypochlorite solution is injected into a single 165-gallon plastic container (which is piped to a series of identical containers for treated water storage and attempted contact time). This container is also the location of the chlorine measurement and bacteria sampling. The chlorine measured in this container would not be representative of the chlorine residual in the water storage system.

There is no dedicated chemical storage area. The hypochlorite containers onsite were seriously degraded. Chlorine could still be mixed to the desired concentration, but the solution could have elevated levels of chlorates, due to the degradation.

Online Monitoring Equipment

There are five installed turbidimeters (two 1720Cs and three 1720Ds). Two of the 1720Ds were operational. The other turbidimeters were not functioning. Turbidimeter feed lines were enclosed in a solid conduit, making it difficult to confirm monitoring locations. One turbidimeter appeared to be monitoring coagulated water after the floc tank. The other appeared to be monitoring filtered water after the first media filter. The observable feed lines for turbidimeters was fouled with particulates, which could result in an artificially low turbidity measurements. The operator indicated that he had recently calibrated the turbidimeters. However, the turbidimeters are decades old, obsolete, and do not meet the higher standards of the new turbidimeters that were developed to comply with the more stringent, current, drinking water standards.

3.2.6 Treated Water Storage

During the water treatment upgrades in 2000, sixty-one 165-gallon, plastic tanks were installed on the lower floor of the original WTP building, as a temporary method of providing treated water storage. However, these tanks are still in use today. The total effective storage (based on volume marks on the containers) is just under 8,000 gallons.

Exhibit 3-3: Current Treated Water Storage

The filtered, chlorinated water is added to one of the tanks, which is part of three storage tank groupings (see Figures C-201 and P-101 in Appendix A). The current piping transfers water from this tank, out to distribution, with no circulation through the other tanks. This results in no reasonable time for chlorine disinfection. There are many dead zones in the existing treated water storage system that never experience chlorination. If replumbed, the existing distribution pump systems would not be sufficient to effectively circulate water through the tanks. This would lead to stored water with a high potential for biofouling. The tanks are currently experiencing excessive algae growth in multiple tanks. However, the most significant issue with the existing storage tanks is the load that they place on the existing building. The existing structure is not capable of safely carrying the load. Since these tanks are on the first floor, failure would be less catastrophic to the building (as compared to the filtration vessels located on the second floor), however, it would result in a similar system failure, causing a disruption to potable water service for the community. Temporary bracing was installed in 2020 to imminent critical structural failure.

3.2.7 Drinking Water Distribution

There are no piped services in Kongiganak. The treated water serves the plumbing fixtures in the WTP and Washeteria as well as a community watering point. There are two Grundfos constant speed pumps for distribution, a low flow pump (1.5 HP), and a high flow pump (3 HP). However only the high flow pump is operational. The pumps are activated based on a pressure switch and pressure is maintained using four pressure tanks that each have 86 gallons of volume with an assumed draw down of 23 gallons each (Amtrol Well-X-Trol model WX-252) .

3.2.8 Community Watering Point

The community added a coin operated watering point, accessible in an exterior, drive thru area. The coin operation system no longer functions, the existing system has no cross connection control on the fill hose, and utilizes a garden hose that is not rated for drinking water. Residents self-haul water on privately owned ATVs using individual holding tanks.

Exhibit 3-4: Community Watering Point

3.2.9 WTP Operations

The operator of the WTP (Paul Paul) was well informed and diligent in documenting WTP operations. Existing water treatment process operator instructions collected during the site visit are presented in Appendix D. Scoring of the existing water treatment system indicates the systems needs a Water Treatment Level II operator. The system does not currently meet this requirement. Currently, the highest level of operational certification for the facility is Small Treated.

The current system operations are shown on Figure P-101 in Appendix A, with Standard Operating Procedures provided in Appendix D. Raw water is pumped in the spring/early summer (when the transmission pipe is not frozen). The tank is topped off as needed before winter. The system treats the stored raw water throughout the winter, at a treatment rate of approximately 7 gpm. The system is currently operating as a direct filtration system, using Nalco 8105, followed by two media filters in series. All filtration operations are performed with manual controls. The system disinfects filtered water using a solution of calcium hypochlorite.

3.2.10 WTP Mechanical Systems

Domestic Plumbing System

Cold domestic water piping for the WTP is fed from the treated water storage tanks in the treatment system, but the domestic hot water is provided from the water heater that serves the Washeteria. The domestic water system is not providing water quality that meets potable water standards.

The entire facility has experienced significant leaks in the domestic water system. There are signs of several wall patches completed to access and repair leaking piping as well as install temporary compression pipe seals to patch pinhole leaks. Exposed piping serving the WTP offices has also been replaced.

- The water analysis showed an aggressive pH which has likely caused these leaks. The heating system was not noted as being affected by the low pH. Since that is a closed system, this corroborates the cause of the leaks being due to the aggressive water as opposed to installation issues.
- The existence of aggressive water and the extent of current leaks means that the pipe thickness has been significantly reduced throughout the system. Pipe leaks will continue to regularly occur even if the water pH is addressed.

High Demand Pump

A high demand centrifugal pump is piped to a fire hose station. This pump can also be valved so that it can be used to initiate pumping raw water from Contractor's Lake to the WST. It is labeled to provide 150 gpm of flow. It is assumed operational.

Heating System

The heating plant in the WTP consists of three fuel oil fired cast iron boilers and a brazed plate heat exchanger that receives "waste" or recovered heat from the nearby power plant. The heating plant provides space heating for both the WTP and Washeteria as well as add-heat systems for the raw water storage system. Boiler B-1 was manually isolated but it was unclear if that was because of low heat demand at the time of inspection or if there were issues with that boiler.

The heat exchanger is valved such that all boiler return flow goes towards the heat exchanger as the first source of heat. A Tekmar controller modulates a bypass control valve based on heating demand and system temperature difference.

The heat plant utilizes a duplex set of pumps, piped in a primary/back-up configuration, for main facility heat distribution. Pump swap-over is manual, and the lead pump appears to run continuously.

There are two add-heat systems in the WTP. The heat exchangers are vented, double-wall, Doucette Industries, tube-in-tube units. As noted, one heat exchanger adds heat to the raw water system prior to the raw WST. The other heat exchanger appears to have been used to provide heat to the treated water system that fed the old school. It is assumed that the water system to the old school was abandoned with the installation of the new school, and this add-heat system is no longer needed.

Space heating for the WTP process area appears to be provided via the ventilation system. One ventilation fan assembly appeared to be operational while another unit has been removed. The heating coil on the operational unit has its own pump with a secondary loop off of the heating plant supply header. The piping to the removed unit has been demolished and isolated.

Ventilation System

The ventilation system for the WTP plant consists of two ventilation systems, each with manually set dampers that mix outside and return air. As noted, one of the units has been removed. These appear to be original equipment and are at the end of their useful life expectancy.

Fuel System

The WTP boilers are fed from a 25-gallon, diked day tank. This tank may also feed the boiler and water heater in the Washeteria mechanical room. Each boiler has a Tiger Loop deaerator assembly with separate spin-on filter.

3.2.11 WTP Electrical Systems

The existing electrical service consists of a 208Y/120 volt, 3-phase overhead utility drop from 25kVA pole mounted utility transformers. The service equipment, located on the northeast corner of the building, consists of a current transformer cabinet with integral meter (meter# 045 0000003) and a service disconnect with 200-amp fuses.

The service is then fed to a 225-amp rated Main Distribution Panel (MDP) located on the second floor of the building. The MDP sub-feeds two branch circuit panelboards ‘B’ and ‘H’. The sub-feed to panel ‘H’ is supplied through an Automatic Transfer Switch (ATS) which provides standby generator power to this panel automatically in the case of an outage. The standby generator is diesel-fired and rated 35kW/44kVA at 208/120 volts, 3-phase. The loads supported by panel ‘H’ are mainly the building heating system (diesel-fired boilers) and the high demand pump providing critical flow during times of high demand. Panel B supports mainly the water treatment system loads including injection pumps, turbidimeters, mixers, etc. The MDP, in addition to feeding sub-panels, supports the pressure pumps #1 and #2, backwash pump and the treatment/filter pump. The MDP has no backup connection from a standby power system, and therefore these pumps will not be functional during an outage.

3.3 Wastewater

3.3.1 Wastewater Lagoon

Construction of a new 5-acre lagoon and honeybucket disposal site was completed in 2008. The wastewater from the WTP / Washeteria and the school is piped to the community lagoon, which is also the dump site for community honeybucket wastes. Honeybucket wastes are individually hauled by the residents. The lagoon was designed assuming the wastewater in the lagoon would be discharged every 2 years. The discharge is authorized under the Small Domestic Lagoon to Surface Water General Permit, (AKG 573008). This discharge has not reportedly occurred as originally planned. The lagoon water level is now above the maximum operating design level of the lagoon (Summit, 2018).

3.3.2 WTP Wastewater Discharge

All wastewater generated during the water treatment process (backwash and discharge from online monitoring equipment), is discharged to the community lagoon. The lagoon has outstanding issues that require attention beyond the scope of this water treatment project, as discussed in the recent PER (Summit, 2018). The current water systems generates approximately 1,000 gallons per backwash (which covers both filters).

3.4 Washeteria

The Washeteria is connected to the WTP and is the first service connection for the water system. Modifications to the existing Washeteria system are not included in this report. Modifications to the existing Washeteria system are not included in this report; this section discusses the existing conditions of the facility for documentation only. In general, the Washeteria is in a decrepit condition with failing architectural finishes, leaking piping, and broken laundry equipment and fixtures. The leaking piping has led to more than half of the plumbing fixtures being abandoned, leaving only two showers, two water closets, and three lavatories to serve a village of over 500 people. These leaking and broken pipes also increase the contamination potential of the public water system.

3.4.1 Operations

Even if all fixtures were repaired and operational, the Washeteria would not meet recommended standards for centralized facilities, as shown in Table 3-6, according to Chapter 12 – Central Facilities of the 1996 *Cold Regions Utilities Manual* (CRUM) published by the American Society of Civil Engineers (ASCE) and the Canadian Society for Civil Engineering (ASCE, 1996):

Table 3-6: Number of Central Facility Service Units

	Population	Washers	ADA Bathrooms	Standard Bathrooms
Existing System	539	6	1	3
1996 CRUM Recommendation	>500	8	0	4

3.4.2 Structural / Geotechnical

The existing Washeteria is supported by piles, similar to the WTP. Since the original construction, the community has noted settlement, reportedly 8-12 inches vertically. The settlement was not immediately apparent, presumably because the settlement was roughly uniform.

There have also been reports of structural issues associated with the vibrational loading of washing machines. However, the larger washers were replaced with smaller washers, which appears to have addressed vibrational issues.

3.4.3 Architectural Finishes

Several areas of the resin floor system have degraded, exposing the wood subfloor. This makes the floor system subject to mold and structural deterioration as well as being a tripping hazard for the public.

The shower stalls use the resin floor as a shower pan with a raised section at the entrance to the shower. Both of the remaining operational showers have large holes in the lower wall or raised resin floor system, exposing the wall structure. Every time the shower is used, more water goes into the wall structure creating an immediate mold and structural issue.

There are several painted plywood wall patches in public spaces where leaking water piping has been replaced. Though practical, these finishes do have the potential for splintering.

3.4.4 Washeteria Mechanical Systems

Domestic Plumbing System

The Washeteria receives water from the WTP via a 2-inch diameter copper line. A 3/4-inch hot water and 1/2-inch hot water circulation PEX tube goes from the Washeteria to the WTP to serve the restrooms and fixtures in the WTP.

As noted under in Section 3.2.10, the domestic water system is not providing water quality that meets potable water standards, and per the Uniform Plumbing Code, all plumbing fixtures in the Washeteria should have labels stating, "CAUTION: NON-POTABLE WATER, DO NOT DRINK". Furthermore, the water to the drinking fountain should be immediately turned off.

The water heater is an oil fired, 68 gallon, 199 MBH input, Bock model 72E. It was just recently replaced.

- At the time of the 2019 inspection, the water heater was set at 165 degrees Fahrenheit. This is above the immediate scalding temperature. A tempering valve was located downstream of the water heater, but there are piping branches prior to this tempering valve that provide scalding temperature water to the facility. It is believed that the temperature was set lower after the site visit but the system should be repiped to verify this does not provide a scalding condition in the future.
- Copper was threaded directly to the steel water heater piping connections. Galvanic corrosion is already visible on the hot water piping connection. These connections should be changed to have dielectric nipples and then converted to copper.
- There is a check valve installed in the cold water service line but no expansion tank was visible. This will lead to regular discharges in the relief valve. Excessive discharges can result in the relief valve getting debris in the valve seats and resulting in leaks or uncontrolled discharge. An expansion tank should be installed.
- There is a leak at the cold water feed line to the water heater. Based on the number of patches/couplings in this section of pipe, that appears to have been a common occurrence.
- The water heater is not seismically braced.

As noted in the WTP section, the domestic water system is failing due to aggressive water, and there are several areas of the Washeteria that have been affected by the pinhole leaks resulting in several plumbing fixtures becoming unusable. The Washeteria has several locations where wall patches have been added to access and replace leaking piping and there are several exposed compression pipe seals to temporarily patch pinhole leaks. The entire domestic water piping is in eminent piping failure condition.

Plumbing Fixture Condition:

- At the time of the July 2019 inspection, there were only two operational showers. As noted, the wall systems are compromised and even these units should not be in operation. One shower was abandoned due to leaking pipes.
- Two water closets were operational, but one was leaking at the tank seal. The other two were abandoned due to leaking pipes and had been cannibalized for parts.
- All four lavatories were in operation.

- The drinking fountain worked, but the water is not safe for drinking, and it is doubtful that any residents actually use the drinking fountain.
- Since the time of the Washeteria construction, a new code has been published that requires American Society of Safety Professionals (ASSE) 1070 tempering valves be installed at each public lavatory. The existing fixtures met code at the time of installation but these should be added for additional protection.

It was noted in the 2018 PER by Summit that sewer gases were present in the Washeteria. The gases not noticed during Bristol's inspection but concur with the PER findings that the dry fixture connections at the abandoned fixtures were allowing sewer gases to enter the building. It should be noted that there are several areas where mold may already exist due to the failed interior finishes.

Three clothes washers were in use during the inspection. Hot and cold water were reported to be available for all operating washers. Two washers were not working and the sixth machine was missing. The clothes washers discharge into an open trough. There is no lint screen in place in the trough.

Heating System

Space heating is provided via a 2-1/2-inch supply and return hydronic line fed from the WTP heating plant. The primary/secondary piping configuration that serves the Washeteria includes the following secondary loop systems:

- Duplex pump set in primary/back-up configuration serves the dryer make-up air unit.
- Duplex pump set in primary/back-up configuration serves the space heating system.
- Single pump with thermostatic activation serves under floor heating loop. This pump appears to operate based on maintaining a hydronic return temperature of 90 degrees F.

Terminal hydronic units are provided throughout the Washeteria and appear to be in operable condition. Thermostats have been replaced or modified over time and several of them are loose from the wall.

The Washeteria has its original construction, cast iron boiler in the mechanical room but that unit only provides heat for the clothes dryers. The boiler is Bryan model D650-WFDO, oil fired cast iron boiler with a 520 MBH rated heat output. The burner looked fairly new. The boiler has a 45 pounds per square inch (psi) pressure relief valve which requires that the expansion tank on the system be American Society of Mechanical Engineers (ASME) rated, which it is not. The boiler flue is fairly sooted. This can be an indicator of several operating concerns including a dirty heat exchanger to improperly set combustion on the burner that will impact energy efficiency and potentially lead to premature failure if left unchecked.

The clothes dryer heating loop consists of a single boiler primary pump and secondary pumping loops for each dryer heating coil. There is a cabinet with relays for each dryer that appeared to be intended to operate the heating coil pumps upon activation of a dryer, but all pumps were operating even when dryers were not running and appeared to be manually turned on. The coil pump for Dryer 4 was field wired to an extension cord. The pump was turned on, though the dryer was non-functional and the temperature of the pump was exceedingly hot.

Ventilation System

Restroom exhaust fans appeared to be operational but are old and nearing the end of their anticipated life of 15 years.

Clothes Dryers

- Four of the six clothes washers were operational at the time of the site visit. An addition unit (far right) was mechanically operational, but had no hot water.
- One of the original construction units was still operational, but it had a damaged door and was in poor condition.
- The units use hydronic heat for air heating as noted under the heating section.
- An air-to-air heat exchanger assembly is used at each unit to transfer heat from the exhaust to the make-up air. It is unclear if these have been cleaned. Based on the amount of lint that was found downstream of the heat exchangers, it is highly likely these are partially plugged and therefore not achieving potential heat transfer energy savings.
- The central dryer exhaust fan was operational. This unit also appears to operate continuously at 100% speed.

Make-up air is being provided for the dryers via a hydronic air handling unit. The original construction drawing integrated Variable Frequency Drive (VFD) into the design so that the fan would only provide the air needed for the number of functioning dryers. This system was not fully installed at the time of construction and has been operating at 100% airflow since. This is a significant energy consumer.

Fuel System

The Washeteria water heater and boiler are fed from single pipe fuel systems. The boiler utilized a deaerating Tiger Loop assembly but the water heater did not.

3.4.5 Washeteria Electrical Systems

In the existing branch circuit distribution system, there are several significant electrical issues that require correction, including:

1. The existing washers in the Washeteria are using extension cords from adjacent general-use duplex receptacles, routed overhead along the ceiling, to supply power to the units. This is both a code violation and a life safety issue for the users.
2. The existing branch circuits, dedicated to the washers, fed from Panel A are currently configured as 208 volt, 3-phase. This configuration is not compatible with the existing and preferred washer configuration at 120 volt, 1-phase.
3. The existing 3-phase branch circuits are routed behind the washers in damp location wireways. The individual circuits exit the wireway at different location in liquid-tight conduit. The circuit conductors have been disconnected from the non-functioning washers and have been left terminated only with wire-nuts on the conductor ends. This current condition represents a significant life-safety hazard given the wires proximity to the water in the adjacent open floor drain behind the washers.
4. The existing circuit connection for a secondary heat circulation pump supplying the dryers is currently connected using an extension cord.
5. The dryer ventilation fan controls currently use a constant speed control scheme regardless of the number of dryers in operation. This is a significantly energy inefficient method of controlling the ventilation rate.

3.5 Solid Waste

There is no permitted solid waste facility in Kongiganak. An unpermitted dumpsite is located northwest of the community. The lack of a permitted facility could be problematic if local disposal of demolition materials is required.

3.6 Structural / Geotechnical

Initial construction of the WTP was completed over 40 years ago. Since that time there have been major modifications to accommodate changes in use, resulting in structural loadings that were not considered in the original building design. Changes in site conditions that result in warming subsurface temperatures amplify foundation concerns, as the load bearing capacity of installed pilings decreases in areas of warming permafrost. In order to assess the structural adequacy of the building and foundation, as well as the potential re-use of the old WST pilings, a structural and geotechnical investigation was conducted June 20-21, 2019 by Kraig Hughes (Bristol) and Richard Mitchells (Golder).

Pertinent findings from the Structural Condition Report are discussed in a separate report (Appendix H), but summarized below:

- The existing structural systems cannot safely carry the loads of the 61 water storage tanks on the first floor, or the 3 floc/filtration vessels on the second floor of the WTP.
- In addition to the extreme loading issues, multiple instances were observed where support joists had been cut during renovations, and needed support columns were absent or undersized.
- The center pressure vessel (filtration vessel 1), has tank leg pads that are supported by a channel. The other two vessels have no support.
- There is inadequate framing to carry the operating load of the second-floor pressure vessels. Failure in this area would be catastrophic, resulting in a cascading failure onto the first floor, which would demolish the 61 water storage tanks.
- The current support piles have a diminished load bearing capacity, due to warmer subsurface temperatures (as compared to the temperatures at the original construction).
- The old WST foundation piles consist of 88 timber piles on a nominal 5.5-foot rectangular grid. These pilings are in good shape and could successfully be reused to support new structures. Reuse of these piles will likely require rigid insulation and possibly subgrade cooling. An additional assessment will be required to estimate their axial and lateral capacities.

Community representatives were advised of the structural risk during the site inspection in June 2019, and the following site inspection in July 2019, as well as in writing. A temporary bracing system was completed in 2020 to stabilize the structure under the existing loadings. This will address the risk of immediate catastrophic failure, but the existing system framing and foundation cannot provide safe, long term support for the pressure vessels or the storage tanks. It is recommended to move these components to a new WTP annex located adjacent to the existing WTP.

3.7 Survey

No site survey was completed under this project. The information in this report is based on the most recent (2004) community mapping from DCCED-DCRA. Since available mapping is outdated, site and floor plans were updated to reflect current conditions based on photographs, measurements, and information collected during the 2019 site visits. These updates are approximate and will need to be verified before final design.

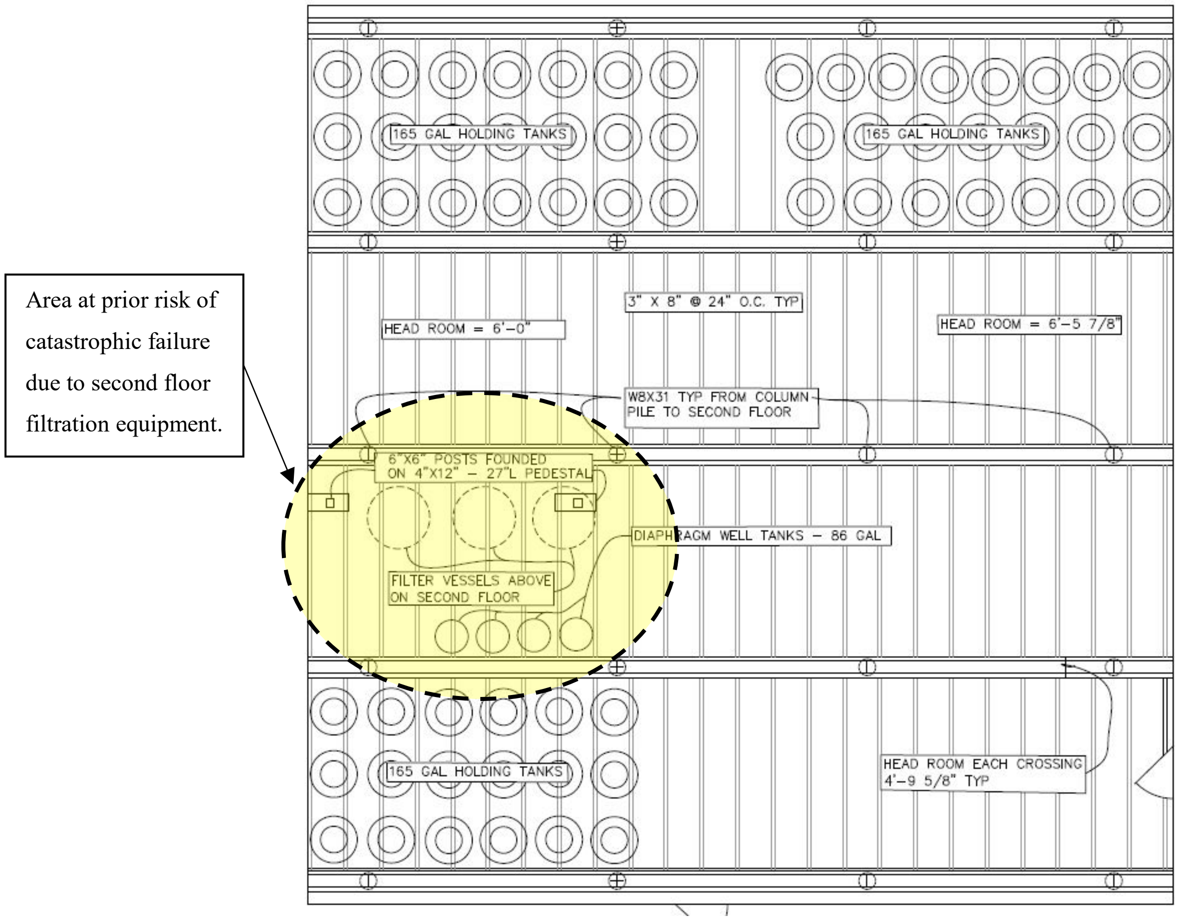


Exhibit 3-5: WTP Loading Plan View

Source: Kongiganak Water Treatment Plant and Washeteria, Structural Condition Report, June 2019.

4 Design Requirements and Considerations

4.1 Regulatory

The following regulatory requirement summaries are included due to their significance to the design of the system and this report. This is not a complete list of all possible regulatory requirements.

4.1.1 Drinking Water Quality

The Environmental Protection Agency (EPA) Safe Drinking Water Act is implemented by the ADEC Drinking Water Program (Alaska Drinking Water Regulations 18 AAC 80). The State regulations adopt most parts of the Code of Federal Regulations (CFR) by reference (40 CFR 141, 142, 143). The compliance monitoring summary for Kongiganak is included in Appendix B. Specific drinking water rules that would have the greatest impact to the Kongiganak system are described below.

Surface Water Treatment Rule

The SWTR has been updated multiple times since its original promulgation in 1989. The main objective of the rule is to protect the public from microbial contaminants that cause acute illnesses. Required treatment is achieved through a combination of filtration (using turbidity as a measure of effectiveness), and inactivation (most commonly chlorine disinfection).

The current treatment requirements for surface water sources are:

4 log (99.99%) virus reduction

3 log (99.9%) *Giardia* reduction

2 log (99%) *Cryptosporidium* reduction (higher levels of removal can be required for source water determined to be at higher risk of contamination).

The current water treatment system does not meet the surface water treatment rule requirements.

Disinfectants and Disinfection-By-Product Rule

EPA began regulating DBPs in 1979, and updated the rule in 1998 and 2006. This rule is intended to optimize disinfection practices to reduce public exposure to DBPs. DBPs form when disinfectants react with naturally occurring organics in the water. Current federal regulatory limits for DBPs generated through the use of sodium or calcium hypochlorite disinfection include TTHMs and five HAAs.

There are current proposals to increase the regulated DBPs to include:

- Bromochloroacetic Acid, a sixth HAA. This is currently a regulated DBP in Canada.

- Chloral hydrate (CH), Canada has established a health-based value of 0.2 milligrams per liter (mg/L), the World Health Organization has set a provisional guideline value of 0.1 mg/L. CH is being evaluated by EPA for regulatory oversight.

In addition to the above chlorination by-products, there is also growing scrutiny on chlorates, which are formed from the slow decomposition of hypochlorite solutions. As chlorine residuals drop over long-term storage, and increased dosages are needed to maintain a desired residual, increased chlorate concentrates in the water. Chlorate formation has been particularly noted when using chlorine dioxide, sodium hypochlorite, or electrochlorination processes (like Miox). Chlorate is on the EPA Third Chemical Contaminant List and has been evaluated as a candidate for regulation. Currently EPA lists a chlorate health reference level of 0.21 mg/L, while Canada regulates chlorate at a maximum level of 1.0 mg/L, and the World Health Organization recommends a chlorate limit of 0.7 mg/L. Water age and associated chlorate formation was considered during the water treatment process evaluation and is included in the DBP modeling.

The regulatory limits for DPBs (based on a running annual average of quarterly results) are currently:

80 µg/L (parts per billion) of Trihalomethanes (TTHMs)

60 µg/L (parts per billion) of Halo acetic acids (HAAs)

There have been no reported DBP exceedances with the existing system. However, the DBP samples results could be affected by the inefficiencies in the current chlorination system. DBP formation potential would need to be considered in system upgrades due to the high level of organics (approximately 7 mg/L) in the raw water.

Lead / Copper Rule (LCR)

The LCR was first issued in 1991 to address corrosive water, aging piping, and lead solder. Multiple updates to LCR rule have refined the definition of “lead free”, modified sampling methods, and defined steps that must be taken if regulatory action levels are exceeded.

The current LCR action levels are:

0.015 mg/L for lead (Pb)

1.3 mg/L for copper (Cu)

The most recent test results for copper (1.39 mg/L in 2011) on ADECs Water Watch website indicate that the system is exceeding the action level for copper.

4.1.2 Operator Certification

The ADEC Division of Water Operations Assistance Program oversees operator certification requirements for public water systems in Alaska (18 AAC 74). Higher operator certification levels are required for more complex treatment systems, with points added for each treatment process. Operator certification at higher levels requires passing exams, as well as meeting experience requirements. Current system operations are discussed in Section 5.4. Estimated certification levels are included in Appendix B).

Operator Certification Levels for Drinking Water Treatment:

Water Treatment Level 1: 1-30 points

Water Treatment Level 2: 31-55 points

The current system requires a Level 2 Water Treatment operator certification (31 pts, see Appendix B). The system does not currently meet this operator requirement. System modifications will be considered that could reasonably allow a Level 1 operator certification.

4.2 Site Civil / Geotechnical

TO BE ADDED FOLLOWING THE APRIL 2021 SITE INVESTIGATION

4.3 Structural

From a structural evaluation standpoint, ASCE 7-10 (Minimum Design Loads for Buildings and Other Structures) and the International Building Code (IBC) 2012 will be used to determine risk category and load parameters for this building, the platform/decking, the walkway, and the water storage tanks.

Risk Category: III Buildings and other structures, the failure of which could pose a substantial risk to human life. ASCE Table 1.5-1. Importance Factors listed below are from ASCE Table 1.5-2.

Snow Importance:	Is = 1.10
Ice Importance:	Ii = 1.25
Ice Importance-Wind:	Iw = 1.00
Seismic Importance:	Ie = 1.25, Seismic design parameters are provided in Appendix G.

Live Load:	LL = 100 pounds per square foot (psf) No specific category listed in Table 4.1 or IBC Table 1607.1
Dead Load:	DL = Actual (Operational loads for vessels) + Minimal collateral loads
Snow Load:	SL (Pg) = 40 psf (based on Table 7-1, using Bethel's load designation)
Wind Velocity:	160 miles per hour, 3-second gust. ASCE 7-10 Figure 26.5-1B

The proposed building platform will be constructed on top of the existing wooden pilings. The pilings should be inspected for competency prior to final design (this is scheduled for April 2021). The geotechnical considerations for pile capacity as well as the structural review of the pilings are instrumental to the structural performance of the entire project.

These loads will be combined in accordance with IBC load combinations shown in 1605.3 to determine the maximum and minimum loads applied to the structures.

4.4 Mechanical

The plumbing, mechanical, and fuel system design will conform to the current adopted editions of the following codes and guidelines, as amended by the State of Alaska:

- International Building Code (IBC)
- International Fire Code (IFC)
- International Fuel Gas Code (IFGC)
- International Mechanical Code (IMC)
- Uniform Plumbing Code (UPC)
- ASHRAE Handbooks and Standards
- National Sanitation Foundation (NSF) Standards 60 and 61
- SMACNA Standards

- State of Alaska, Occupational Safety and Health Standards
- ICC/ANSI A117.1-03 Accessible and Usable Buildings and Facilities

4.5 Electrical

The design work shall comply with the following, as applicable:

NEC (NFPA 70)	National Electrical Code – Latest Adopted Version
NESC	National Electrical Safety Code – Latest Adopted Version
NFPA 70E	Standard for Electrical Safety in the Workplace– Latest Adopted Version
NEMA	National Electrical Manufacturer's Association

Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL).

Installation of electrical equipment and materials shall comply with Occupational Safety and Health Administration (OSHA) Standards, state building standards, and applicable local codes and regulations.

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5 Water System

Design criteria, and a discussion of new water system components and existing system components (including any proposed upgrades or modifications) is provided below.

5.1 Water Treatment Design Criteria

Water treatment design criteria, including estimates of increased water system demand and associated calculations are provided in Appendix J. A summary of criteria is provided in Table 5-1, with specific criteria provided with each treatment process.

Table 5-1: Water System Design Criteria

2021 COMMUNITY POPULATION (2018 DCCED CERTIFIED)	539	PEOPLE
POPULATION GROWTH RATE (ADOL)	0.9	%
2041 COMMUNITY POPULATION	645	PEOPLE
2041 SCHOOL POPULATION (STUDENTS AND STAFF)	232	PEOPLE
SOURCE WATER	CONTRACTOR'S LAKE	
ESTIMATED SOURCE WATER VOLUME AVAILABLE	4-5	MG
ADNR WATER RIGHTS (2002, LAS 23946)	3,600	GPD
RAW WATER STORAGE	1.20	MG
STORAGE INTERVAL	10-12	MONTHS
2041 AVERAGE TOTAL DAILY DEMAND	8,800	GPD
2041 MAX TOTAL DAILY DEMAND	10,100	GPD

5.1.1 Water Treatment Pilot Testing

A treatability study was completed in 2019. Results are included in Appendix F. No onsite pilot testing is planned.

5.2 Water Source

The proposed project does not involve modifications to the existing water source or intake system. The water system will continue to draw raw water from Contractor's Lake. No changes to water quality are anticipated as part of this project.

5.3 Raw Water Intake, Transmission Main, and WST

The proposed project does not include any modifications to the existing raw water intake or raw WST. A mesh strainer / roughing filter addition on the raw water transmission line is proposed between Contractor's Lake and the raw WST to minimize the concentration of organic materials in the raw WST.

5.4 New WTP Annex

5.4.1 Structural

New water treatment equipment will be housed in a new WTP Annex (approximately 20.5' x 43.5'), immediately adjacent to the existing WTP, as shown on Figure C-301.

The old water treatment equipment will be demolished and removed from the existing WTP. The existing water storage barrels will be removed and reserved for community re-use (Figure C-201). The existing WTP will continue to be used for office space, storage, workspace for the operators, and to house the pressure tanks and some pumps. The two buildings will be connected by a covered walkway which will run between the Annex and the operator office area and a new exterior staircase leading to the second floor of the existing WTP. Two new treated WSTs (40,000 gallons each), will be located outside the WTP Annex. Two WSTs are proposed to spread the loading on the existing piles, limit the height of the WST, and to provide flexibility in treatment system operations (as discussed below).

The WTP Annex and new WSTs will utilize the existing pile foundation left from the old WST. The existing pile foundation will require some updates to provide thermal stabilization and prevent problems associated with warming permafrost. *<To be completed following the April 2021 site inspection>*

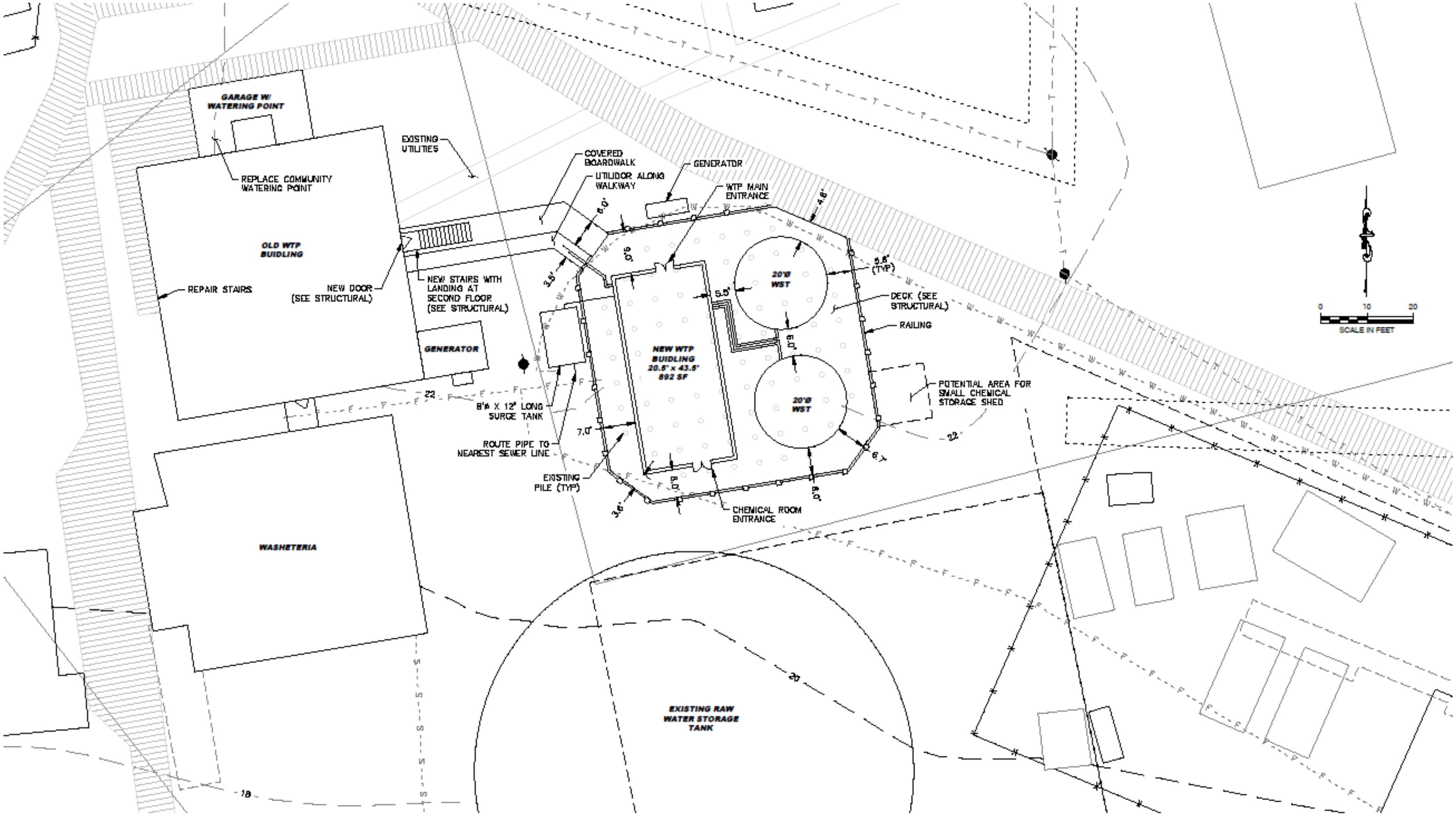


Figure C-301: Site Plan

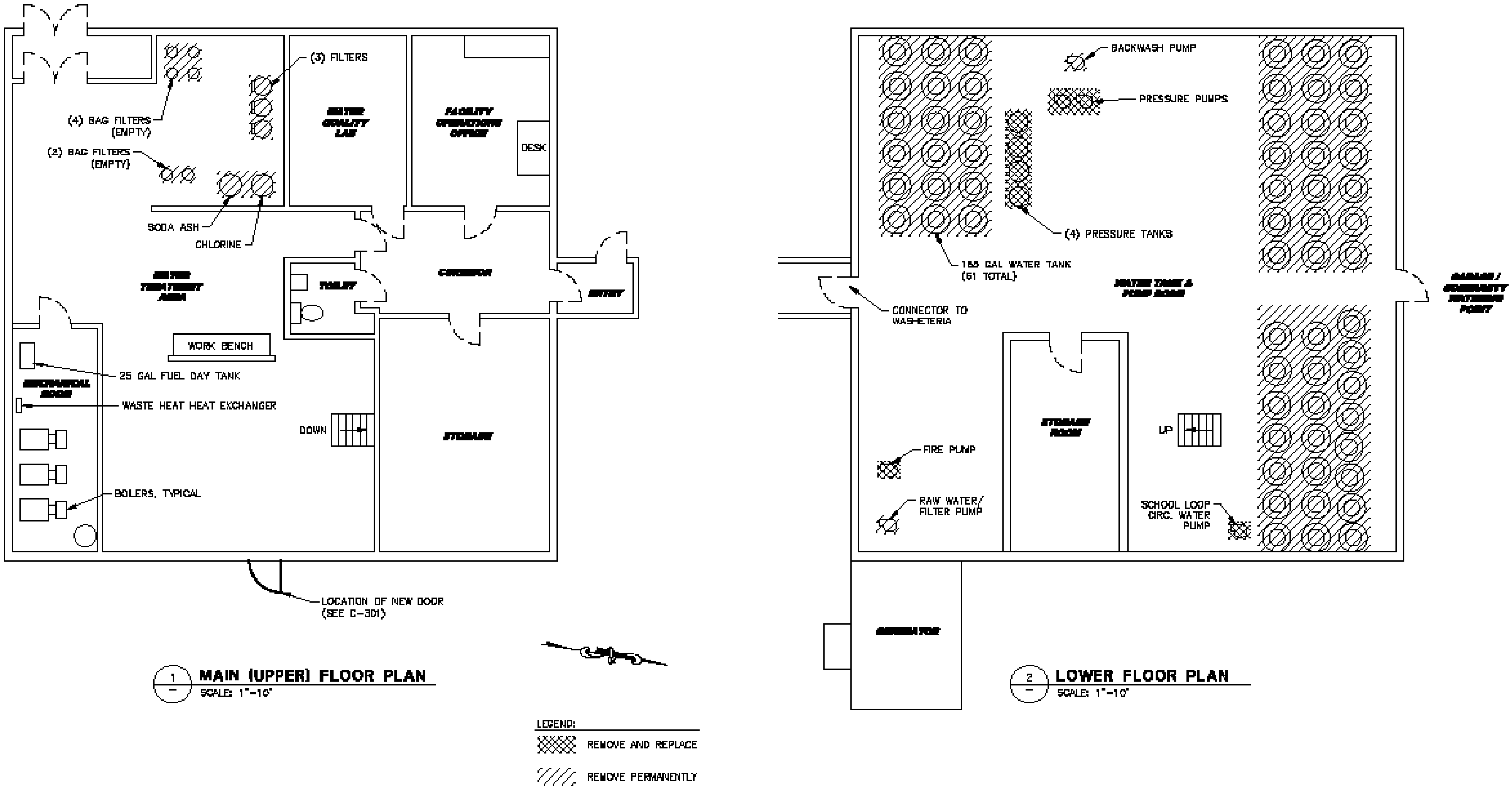


Figure C-201: Demolition Plan, Old WTP

5.4.2 New Water Treatment Processes

The proposed project involves installation of new treatment components to meet minimum safe drinking water standards. The proposed water treatment system design considers raw water quality as well as increased demand to support improved facilities and population growth. An estimated design life of 20 years was assumed. The proposed treatment system also considers operator certification requirements, with the new system expected to require a Water Treatment Level 1 Operator Certification Level (estimate scoring calculation provided in Appendix B). A summary of the treatment processes for the new WTP Annex is provided in Table 5-2. A schematic of the existing WTP and the schematic for the new treatment processes are shown on Figures P-201 and P-202, respectively.

In addition to meeting the requirements of the SWTR, two important considerations in the system design are the high level of naturally occurring organics and the limited access to raw water. These are discussed in more detail in the discussion of treatment processes.

Pre-Oxidation

The high levels of organics in the raw water increase the potential for DBP formation. Pre-oxidation with Potassium Permanganate ($KMnO_4$) is proposed to oxidize the organics and optimize removal on the media filters and the final polishing filter.

A detention pipe (20 linear feet of 12 inch diameter pipe) is included in the WTP Annex to provide 14 minutes of detention time and ensure the Potassium Permanganate is adequately dissolved prior to filtration.

The raw water will enter the new WTP Annex from the existing WTP, in an arctic pipe that will also house the hydronic heat loop which will heat the Annex (as described in the Mechanical section). This will also pre-heat the raw water and improve solubility of the Potassium Permanganate.

Table 5-2: New WTP Annex Water Treatment Process Summary

PROCESS	COMPONENT	OBJECTIVE / DESCRIPTION
Pre-Oxidation	Potassium Permanganate ($KMnO_4$)	Potassium permanganate will be injected (flow paced) to pre-oxidize organics, for optimized organic removal. Detention piping (12-inch) will be included that provides approximatelly 14 minutes of detention time, to allow the potassium permangante to react prior to filtration.
Coagulation	Polymer (Nalco 8105)	Particulate and organic removal, would be supported with the use of a Streamin Current Detector (SCD) system. Backwash process control would be supported with the use of a Process Logic Control (PLC) system.
Flocculation	In-line	Coagulant will be injected (flow paced) into the system via a static mixer. The floc will form in-line, prior to the media filters.
Filtration	(2) 42-inch diameter media filters operated in parallel. (1) 42-inch diameter polishing filter. Expansion area for (1) additional 42-inch filter.	Two media filters, in parallel, for particulate (2 log for *Giardia*, 4 log for virus) and organic removal, at a loading rate of 1.3 gpm/sqft. A third filter would be provided in series to provide additional polishing and organic removal. Space would be reserved for one additional filter, if needed.
Disinfection	Calcium Hypochlorite	Hypochlorite will be injected (flow paced) prior to WST, sufficient for 1 log disinfection, and prior to distribution system sufficient to maintain a free chlorine residule of 0.2 mg/L.
Water Storage	(2) 40,000 gallon treated water storage tanks (80,000 gallons total). 17,000 gallons reserved for chlorination (1-log *Giardia* disinfection)	Exterior treated WSTs will be provided to meet community demand and to meet disinfection contact time. Tanks will be configured to allow separate operation to accommodate maintentance activities.
pH Adjustment	Soda Ash	Flow paced pH adjustment (to 7.2 pH), will provide corrosion control. This will be injected after the treated WST, and prior to distribution, to optimize chlorine contact time.
Wastewater Discharge	5,000 gallon Surge Tank	PLC control for optimized backwash.

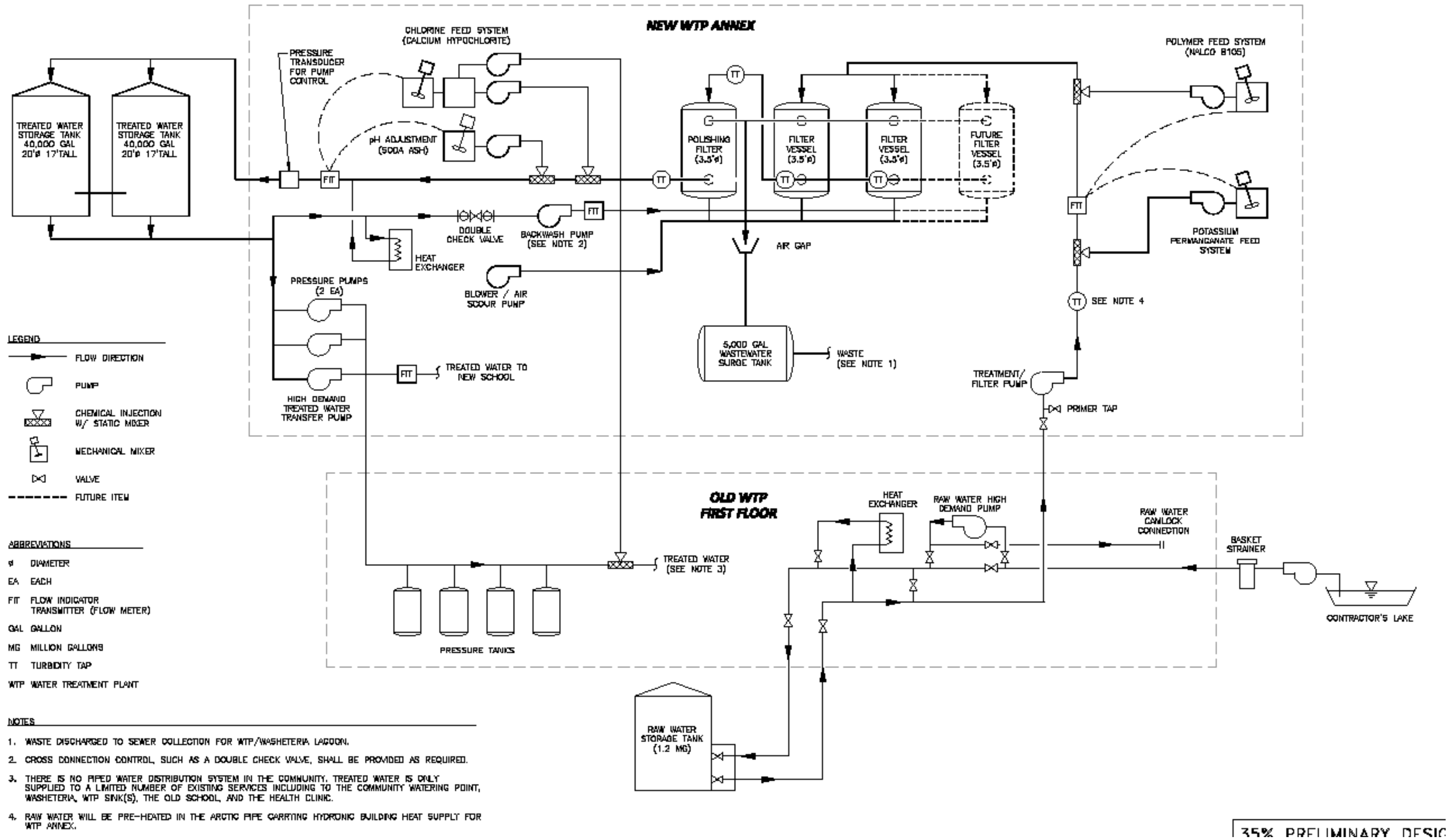


Figure P-201: New Process Schematic

Direct Filtration

Direct filtration (coagulation, in-line flocculation, and filtration) will be used to provide microbial removal that is in compliance with SWTR requirements. Two media filters (42-inch in diameter each), operated in parallel, will be provide primary filtration. A third media filter (42-inch in diameter), will follow the primary filters, and provide final polishing and additional organic removal. The WTP Annex will include space for an additional filter (42-inch), to provide increased treatment capacity, which is expected to be needed in the future. The filters are shown on Figures P-401 and P-402.

Table 5-3: Filtration Design Criteria

MINIMUM *CRYPTOSPORIDIUM* REMOVAL	2	LOG
MINIMUM *GIARDIA* REMOVAL	1	LOG
MINIMUM VIRUS REMOVAL	2	LOG
HOURS OF FILTER OPERATION PER DAY	6	HOURS
MINIMUM FILTRATION RATE (TOTAL)	24	GPM
NUMBER OF FILTERS	2	
FILTER DIAMETER	42	INCHES
FILTER LOADING RATE	1.30	GPM/SQFT
POLISHING MEDIA FILTER DIAMETER	42	INCHES

The high level of organics in the raw water increases the potential for DBP formation. The quality of raw water in the 1.2 MG raw WST will change over time, with the decomposition and growth of organics during the 10-12 months of storage in the WST. A streaming Current Detector (SCD) will assist the operator in maintaining optimized turbidity and organic removal, by adapting coagulant dosage to changes in raw water quality. Chemical tanks for the chemical feed systems are shown of Figure P-403.

Continuous turbidity measurements would be monitored for:

- Raw water
- Individual Filter Effluent (IFE) for Filter 1 and Filter 2
- Combined Filter Effluent (CFE) immediately prior to the Polishing Filter
- Polishing Filter Effluent (which is also a final, combined filter effluent).

The instrumentation panels are shown on Figure P-404.

As discussed in Section 3.2.3, it is estimated that a dose of 7 mg/L of Nalco 8105 would provide optimum turbidity and organic removal (complete jar test results are provided in Appendix F).

Disinfection

Calcium hypochlorite will be used for disinfection. A minimum free chlorine residual of 0.3 mg/L, measured after the treated WST, is needed to provide a minimum of 1-log *Giardia* inactivation. This is based on:

- pH = 6 (this assumes pH adjustment occurs after the treated WST)
- Free Chlorine Residual = 0.3 mg/L
- Total Peak Hourly Flow = 28 gpm
- Peak Hourly Flow per WST = 14 gpm (for treated WSTs operated in parallel)
- Minimum Storage Volume = 17,000 gallons
- Baffle Factor = 0.1 (for treated WSTs operated in parallel)
- Temperature = 5 degrees Celsius

Chlorine contact calculations are provided in Appendix J.

Treated Water Storage

A total of 80,000 gallons of treated water storage will be provided in (2) 40,000-gallon, insulated, bolted steel WSTs. This will provide approximately 6.5 days of treated water storage for the estimated 2041 population, which correlates to the ANTHC *Draft Technical Directive for Design Considerations for Village Water Storage Tank Facilities* (ANTHC, 2021), which recommends 7 days of treated water storage for non-circulating systems.

Table 5-4: Treated Water Storage Design Criteria

DAYS OF TREATED WATER STORAGE	6.5	DAYS
TREATED WATER STORAGE (TOTAL)	80,000	GALLONS
NUMBER OF TANKS	2	
TANK VOLUME (EA)	40,000	GALLONS
TANK DIAMETER	20	FEET
TANK HEIGHT	17	FEET

Two tanks are used to distribute the loading over the existing piles, limit the tank height, and provide operational flexibility. The tanks would be plumbed to allow the tanks to operate in series or parallel. Either operational method minimizes the need for disinfection:

- If the tanks are operated in series, the mixing efficiency or baffle factor of the tank would be at least 0.2. This would minimize the chlorine dose to meet SWTR disinfection requirements.
- If the tanks are operated in parallel, this would split the peak hourly flow evenly across the tanks, also minimizing the chlorine dose to meet SWTR requirements.

It is assumed that the tanks would typically be operated in parallel, because it allows one tank to be easily taken offline for maintenance, while the other WST services the system.

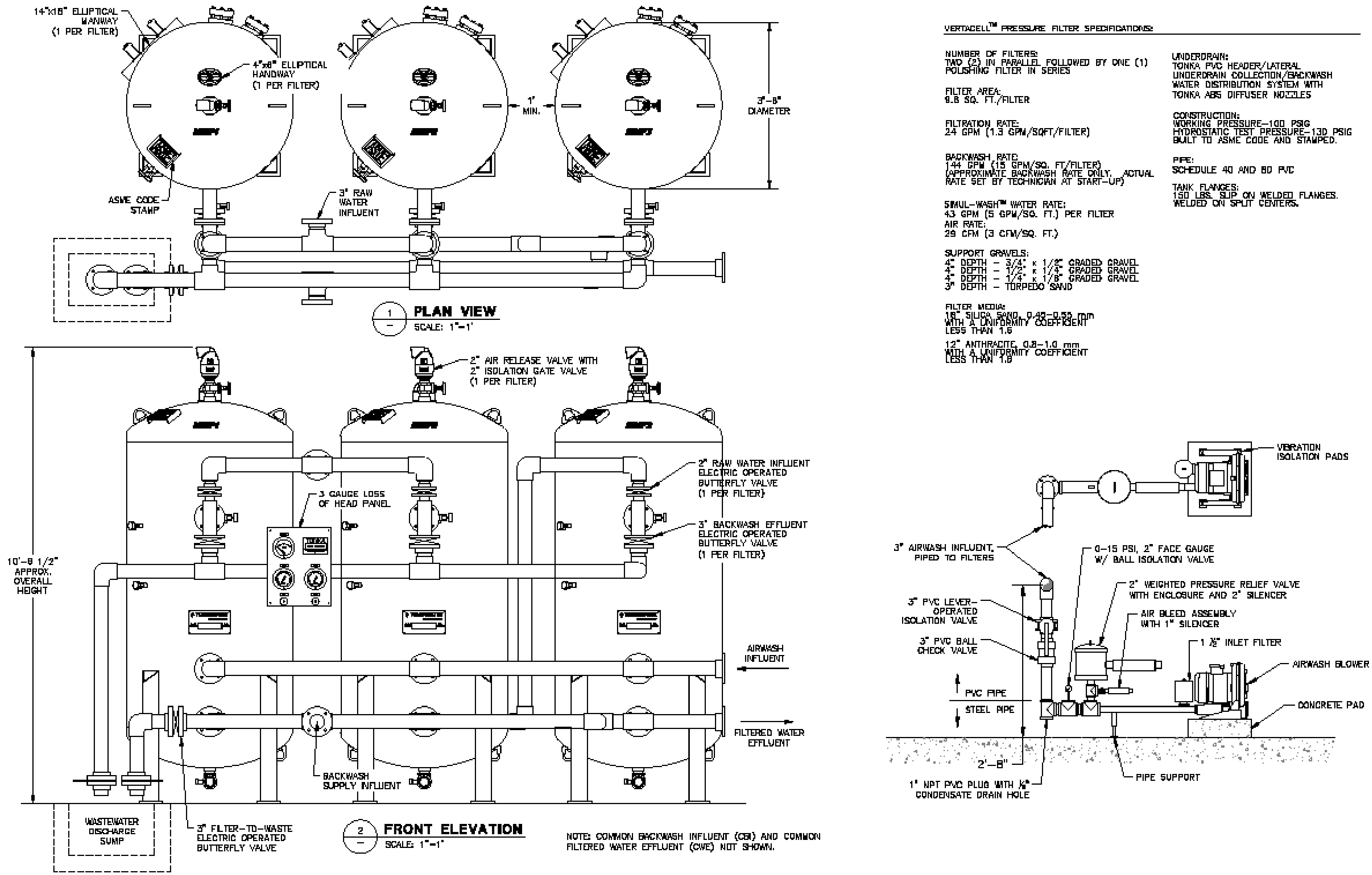
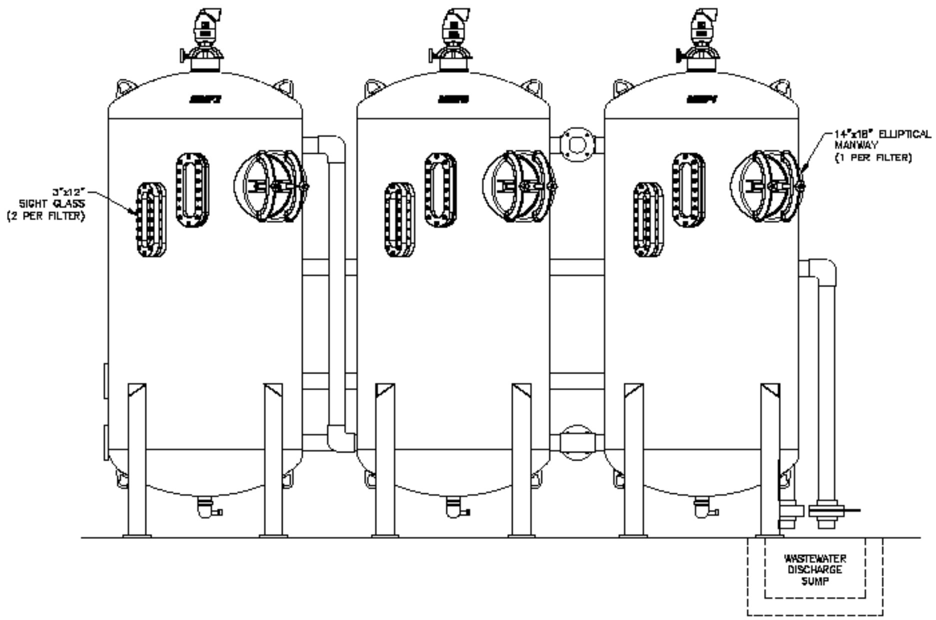
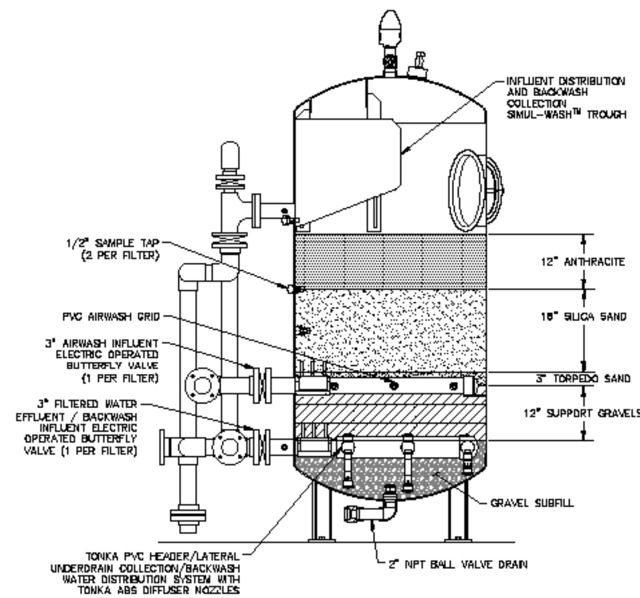


Figure P-401: Process Details - Filters

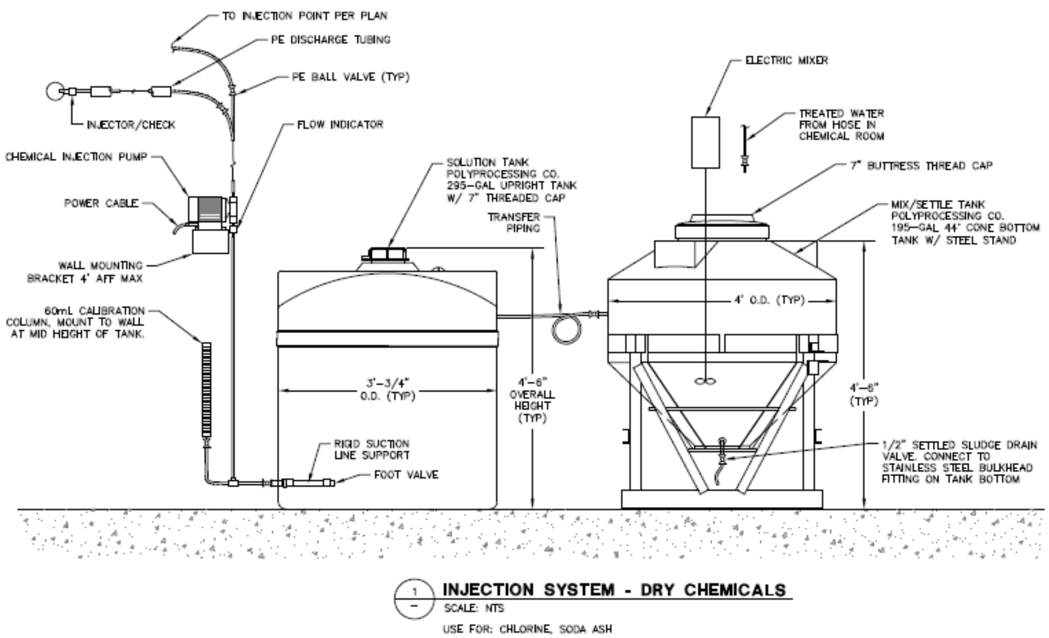


1 REAR ELEVATION
SCALE: 1"=1'



2 SECTION / SIDE ELEVATION
SCALE: 1"=1'

Figure P-402: Process Details - Filters



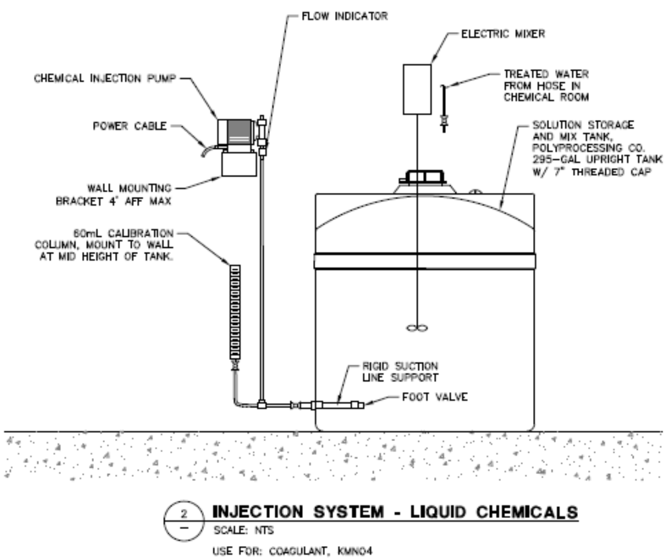
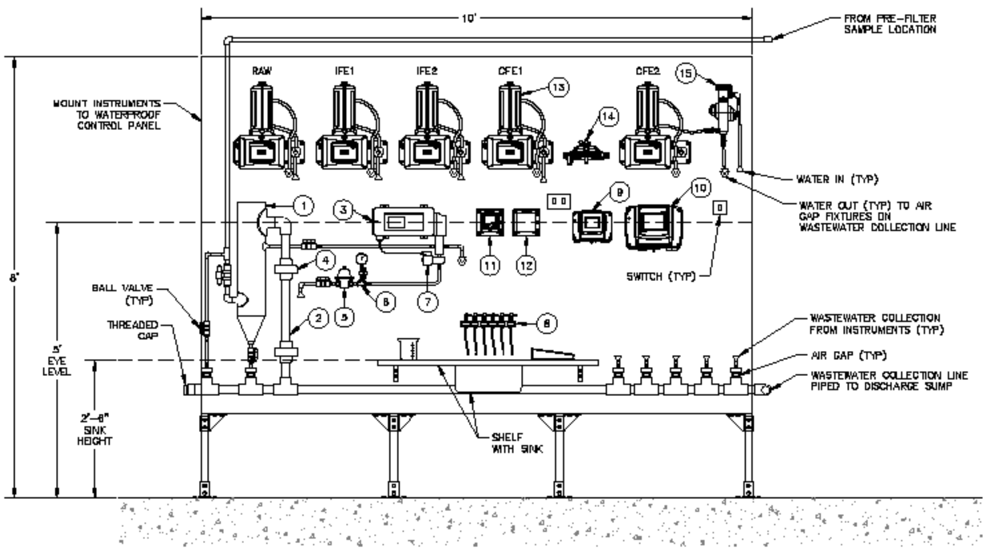
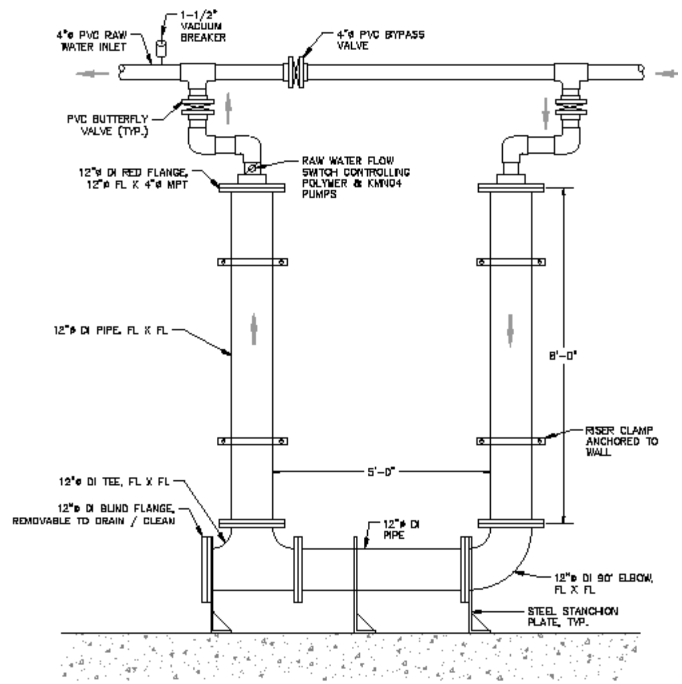


Figure P-403: Process Details – Chemical Tanks



1 CONTROL PANEL
SCALE: NTS



2 DETENTION CHAMBER DETAIL
SCALE: NTS

TURBIDIMETERS:

RAW – RAW WATER PRIOR TO TREATMENT
IFE1 – INDIVIDUAL FILTER EFFLUENT FROM MMF1
IFE2 – INDIVIDUAL FILTER EFFLUENT FROM MMF2
CFE1 – COMBINED FILTER EFFLUENT FROM MMF1 + MMF2
CFE2 – COMBINED FILTER EFFLUENT FROM POLISHING FILTER (COMPLIANCE POINT)

NOTES:

1. WATER IN / OUT PIPING TO / FROM INSTRUMENTS AND ELECTRICAL CONNECTIONS NOT SHOWN FOR CLARITY.

INSTRUMENTATION KEY:

1 CYCLONE SEPARATOR
2 CLEAR PVC
3 MILTON ROY SC5200
4 UNION (TYP)
5 PRESSURE REGULATOR
6 PRESSURE GAUGE WITH ISOLATION VALVE
7 JET WASH
8 SAMPLE TAPS
9 HACH SC200
10 HACH SC1000
11 HACH SC1000 PROBE MODULE 1 AND SCREEN
12 HACH SC1000 PROBE MODULE 2
13 HACH TU5300 TURBIDIMETER WITH WASHER (TYP)
14 SERVICE BRACKET FOR TURBIDIMETERS
15 BUBBLE TRAP INSTALLED WITH CFE2 TURBIDIMETER

DESIGN CRITERIA:

DESIGN FLOW RATE = 24 GPM
DETENTION PIPE DIAMETER = 12 INCHES
DETENTION VOLUME PER FOOT = 15 GAL/FT
TOTAL DETENTION PIPE LENGTH = 22 FT
TOTAL DETENTION VOLUME = 330 GAL
TOTAL DETENTION TIME = 14 MIN

Figure P-404: Process Details – Control Panel and Detention Chamber

pH Adjustment

As discussed in Section 3.2.3, the raw water has a low pH, putting the system piping and appurtenances at risk of corrosion. A Soda Ash dose of approximately 35 mg/L would be used to bring the pH up to approximately 7.2 (modeling results provided in Appendix F). The pH adjustment will occur after the treated WSTs, to minimize the chlorine dosage needed for *Giardia* inactivation. The new piping will be plastic, and will not be susceptible to corrosion.

WTP Wastewater Discharge

Effective backwash processes are important to optimize filter performance (including organic removal), as well as to limit the amount of treated water wasted in the backwash process. This is particularly important in this system due to the limited access to source water to replenish supplies. Therefore, a process logic control (PLC) system is proposed, with automated valves, to carefully manage the water used in the backwash / filter cleaning processes, and optimize backwash efficiency. A new backwash pump and blower will be included in the new WTP Annex. *<The location and sizing of the WW surge tank will be determined following the April 2021 inspection>.*

5.4.3 Mechanical

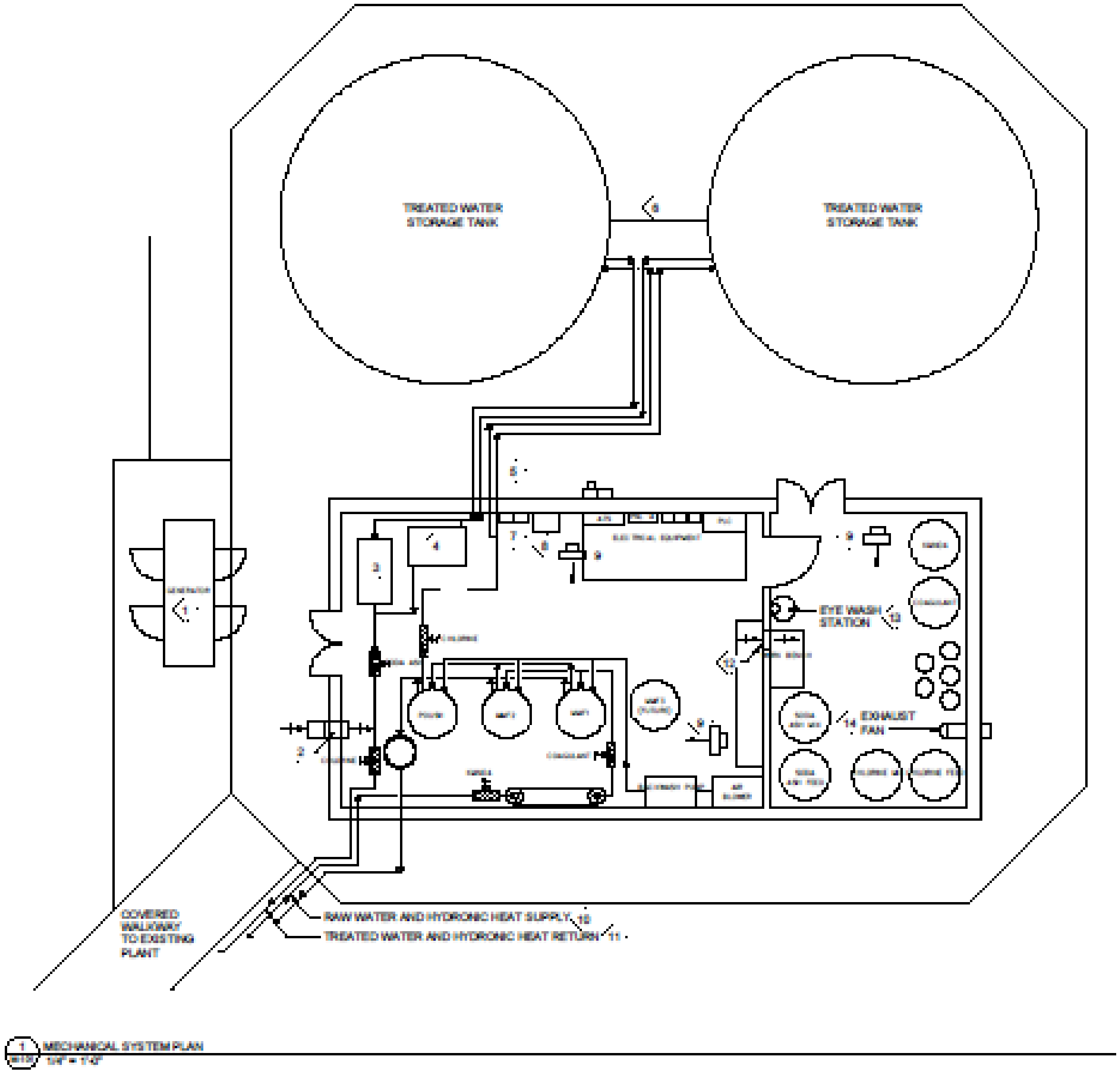
The mechanical plan is shown on Figure M-101.

Domestic Plumbing System

Emergency eye wash / shower will be needed in the chemical storage room due to the presence of chlorine. A new tempered water line would be routed from the treated water system and heated using an indirect fired water heater.

Requirements for the treated water and backwash piping distribution have been noted in previous sections. Water lines will be routed from the existing plant to the new building along the covered walkway. The piping will be hydronically heat traced via the glycol supply and return lines that serve the addition, routed within the raw water and treated water arctic pipes.

A treated water supply pump skid, consisting of two pumps, will be located in the new Annex. This will be used to send treated water from the treated WSTs to the existing building and watering point. The pump skid will have VFD control for each pump, controlled based on maintaining building pressure. These pumps are <u>not</u> sized for distribution beyond the existing building (which currently only includes the Washeteria, watering point, old school building, new school building, and health clinic); additional pumps or larger pumps would be required for any expansion to the distribution system.



GENERAL SHEET NOTES

1. ALL WORK TO BE COMPLETED IN ACCORDANCE WITH CURRENT CODE.
2. REFERENCE CIVIL AND PROCESS DRAWINGS FOR RAW AND TREATED WATER SYSTEM DESIGN.

SHEET KEY NOTES

1. GENERATOR MODULE. UNIT TO HAVE BELLY-TANK FUEL OIL STORAGE.
2. CHEMICAL ROOM MAKE-UP OUTSIDE AIR INTAKE HOOD W/ INSULATED CONTROL DAMPER.
3. HIGH FLOW/HIGH CAPACITY PUMP.
4. DOMESTIC WATER PRESSURE PUMPS. TWO PUMP SKID W/ VFDS. CONTROLLED BASED ON DISCHARGE PRESSURE.
   A. EXISTING PRESSURE TANKS INSIDE EXISTING BUILDING TO REMAIN.
5. INDIVIDUAL WATER LINES TO AND FROM EACH STORAGE TANK FOR INDIVIDUAL HEAT-ADD CONTROL AS WELL AS RESILIENCY IN TREATED WATER STORAGE.
6. COMMON CONNECTOR TO MAINTAIN EQUAL TANK LEVELS. PROVIDED WITH ISOLATION VALVE FOR MAINTENANCE.
7. HEAT ADD SYSTEM PUMPS. SEPARATE PUMP FOR EACH TANK TO ALLOW INDIVIDUAL CONTROL.
8. DOUBLE WALL, BRAZED PLATE HEAT EXCHANGER FOR HEAT-ADD SYSTEM.
9. HYDRONIC UNIT HEATER FOR SPACE HEAT.
10. GLYCOL HEATED SUPPLY MAIN FROM EXISTING BOILER PLANT, ROUTED WITHIN THE RAW WATER ARCTIC PIPE.
11. GLYCOL HEATED RETURN MAIN BACK TO EXISTING BOILER PLANT. ROUTED WITHIN THE TREATED WATER ARCTIC PIPE.
12. CHEMICAL STORAGE MAKE-UP AIR DRAWN FROM PROCESS ROOM PLANT. PROVIDE BACKDRAFT DAMPER WITH CHEMICAL RESISTANT BLADE SEALS.
13. EYE/FACE WASH STATION.
   A. PROVIDE TEMPERED WATER MIXING VALVE.
   B. CW CONNECTED DOWNSTREAM OF TREATED WATER PRESSURE SKID.
   C. HW TO PROVIDED FROM AN INDIRECT FIRED WATER HEATER.
14. EXHAUST FAN AND EXHAUST HOOD FOR CHEMICAL STORAGE ROOM. PLASTIC CONSTRUCTION.

Figure M-101: Mechanical Plan

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Heating System

The new WTP Annex and WSTs would be heated from the existing WTP heating plant. This will allow the use of the waste heat system to be used. Calculations would also be completed prior to final design to verify the additional heat load that will be required to heat the Annex as well as a new add-heat system for the new treated WSTs. An assessment would need to be completed on the current heating requirements of the existing facilities to ensure that additional heat is available. It is anticipated that the existing boiler plant has ample redundancy with the addition of the waste heat system.

It is possible that the existing waste heat system heat exchanger could be replaced with a larger unit to handle the additional load. The waste heat system from the power plant would need to evaluated for both generation and distribution to ensure this is possible.

Space heat and add-heat systems would be located in the addition. A new secondary loop heating line would be taken from the heating plant supply and return headers. Two pumps, in a primary/back-up configuration, would be provided for distribution.

The heating supply main will be routed to the new Annex within the raw water arctic pipe to provide both hydronic heat trace as well as enhance the treatment process. The heating return main will be routed back to the old WTP building within the treated water arctic pipe, also to provide hydronic heat trace protection on that line.

Space heat will be provided from hydronic unit heaters. The new treated WST add-heat system will consist of a double-wall brazed plate heat exchanger. Each storage tank will be provided with its own separate heat-add injection pump and sensors so that each tank can be individually heated as needed. The "hot" side of the heat exchanger will have a three-way valve to modulate the temperature of the "cold" side of the heat exchanger which is the domestic water heat-add system.

Ventilation System

An exhaust fan will be located in the chemical storage room. Make-up air will be transferred from the process room with a backdraft damper with chemically resistant blade seals. An outside air opening will be provided in the process area for outside make-up.

A cooling fan assembly may be needed in the new Annex based on the heat-gain from the pumps and other heat producing equipment that is placed in the Annex. The fan would be controlled from a close-on-rise local thermostat.

Fuel System

Since the existing heating system is being extended from the existing heat plant, there will be no impact to the fuel oil system.

5.4.4 Electrical Systems

The preliminary electric plan is provided on Figure E-601.

Utility Service and Power Distribution

The new treatment plant is expected to have a 100-amp, 208Y/120V 3-phase overhead electrical service connection to exterior mounted meter/main equipment. The meter/main will feed an interior mounted distribution panelboard (Panel 'A') inside the plant, which in turn will feed branch circuits for lighting, power, controls, and other loads.

The plant will be supported by a standby generator that will allow the WTP Annex to operate during an outage. The generator will be housed in an exterior enclosure separate from the plant (approximate location shown on Figure C-301) and will be diesel-fired with a sub-base fuel tank. An automatic transfer switch (ATS) will provide a generator start command by sensing utility power loss and switch to backup power once the generator is running at full speed. When utility power is restored, the ATS will switch to normal power and shut down the generator.

Lighting

All lighting will be LED type. Interior lighting will consist of 48-inch damp location pendant mounted fixtures. Exterior lighting will be wall packs located over doors and illuminating work areas. Exit and emergency lighting fixtures will have battery backup and provide egress illumination during a power outage.

Controls and Instrumentation

The proposed control panel (CP) will utilize a solid-state programable logic controller (PLC). The controller functionality will include a touch screen human-machine operator interface (HMI), discrete and analog input/output modules, power monitoring, pump performance monitoring, and alarm management. The control panel will receive input/output data including: residual chlorine, turbidity, pressure, flow, and temperature. Controls are expected to include chlorine and polymer injection (and other chemicals, if needed), heat add, backwash and distribution pressure pump regulation. The distribution pressure control system for the treated water will utilize a consolidated, skid-mounted pump and controller unit with input of status to the PLC.

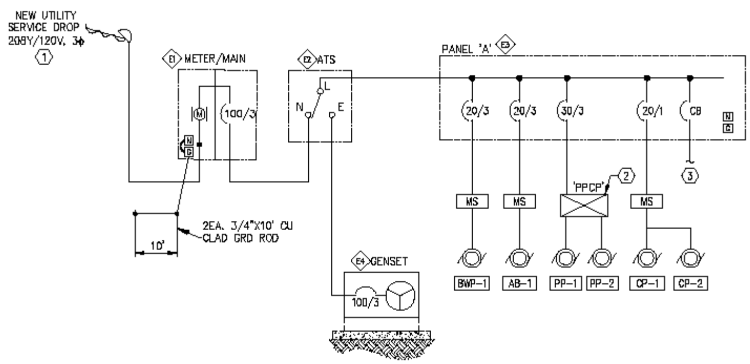
The new WTP is not anticipated to have any external data communications in the form of ethernet connectivity or web-based remote monitoring.

SHEET NOTES

1. PROVIDE INSTALLATION OF NEW 3Ø UTILITY SERVICE. COORDINATE ALL WORK IN ACCORDNACE WITH THE UTILITY'S REQUIREMENTS.
2. PRESSURE PUMP CONTROL PANEL (PPCP). SKID MOUNTED CONTROL PANEL AND PUMPS, USING VARIABLE FREQUENCY DRIVES (VFD) TO MAINTAIN DISTRIBUTION PRESSURE SET POINT.
3. ALL OTHER BRANCH CIRCUIT LOADS SUCH AS LIGHTING, RECEPTACLES AND 120V EQUIPMENT ARE NOT SHOWN. ONLY MAJOR EQUIPMENT LOADS RELATED TO THE TREATMENT PROCESS.

EQUIPMENT CONNECTION SCHEDULE

TAG ID	LOAD					CIRCUIT SIZE	NOTES
	KVA	HP	FLA	V	PH		
BWP-1				208	3	SEE POWER ONE-LINE	BACKWASH PUMP
AB-1				208	3	SEE POWER ONE-LINE	AIR BLOWER
PP-1				208	3	SEE POWER ONE-LINE	PRESSURE PUMP 1
PP-2				208	3	SEE POWER ONE-LINE	PRESSURE PUMP 2
CP-1				120	1	SEE POWER ONE-LINE	GLYCOL CIRC PUMP 1
CP-2				120	1	SEE POWER ONE-LINE	GLYCOL CIRC PUMP 2



1 POWER ONE-LINE - NEW WATER TREATMENT PLANT
E-601 SCALE: NTS

ELECTRICAL EQUIPMENT SCHEDULE

ITEM NO.	DESCRIPTION	MANUFACTURER/ NOTES
E1	100A, 208Y/120V, 3Ø, 4W METER/MAIN, NEMA 3R	EQUIPMENT IN ACCORDANCE WITH UTILITY STANDARDS
E2	100A, 208V, 3Ø, 4W, 3PDT, NEMA 3R AUTOMATIC TRANSFER SWITCH 'ATS'	
E3	100A, 208Y/120V, 3Ø, 4W PANELBOARD, 42 SPACE, NEMA 1	SQUARE D
E4	25KW, 208Y/120V, 3Ø, 4W, STANDBY DIESEL-FIRED GENERATOR SET WITH INTEGRAL FUEL TANK IN WEATHERPROOF/SOUND ATTENUATED ENCLOSURE	

Figure E-601: WTP Power One-Line

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5.5 Existing WTP Building Modifications

5.5.1 Structural

Structural stabilization was added to the existing WTP in 2020. The existing water treatment equipment (including the media filters and flocculation tank) will be demolished and removed from the second floor of the existing WTP. The 61 water storage barrels on the first floor of the old WTP will be removed and provided to the community for re-use.

Following the construction of building stabilization and the removal of water treatment equipment and storage barrels, the existing WTP would be safe for use as an office, or work space for the operators, or for small equipment storage. The WTP building would not be permitted for overnight accommodations.

5.5.2 Mechanical

Domestic Plumbing System

All domestic water outlets in the existing WTP should have non-potable water identification installed in accordance with the Uniform Plumbing Code.

Wide spread leaking in the domestic water system due to aggressive water is a symptom that the remaining piping is in an eminent failure condition. Therefore, it is recommended that all domestic water distribution piping throughout the facility be replaced with cross-linked polyethylene (PEX) tubing. This includes the piping that serves the existing WTP facility.

- PEX tubing is recommended due to its ease of installation, the ability to install without the need of open flame, and insurance against future potentials in aggressive water conditions.
- This includes new angle stops at plumbing fixtures, independently supported at the wall penetration for rigidity of the stops.
- It is recommended that, as water piping is being replaced, ball isolation valves are installed with access doors at each restroom and cluster of fixtures so that the entire system does not need to be drained for leaks. Draining of the entire system requires re-sterilizing of the system in accordance with ADEC regulation.
- The entire system, including all existing fixtures that may be used for potable water should be flushed and disinfected in accordance with ADEC standards, and replaced as needed.

Heating System

The existing heat plant, with the augmentation of waste heat, should be capable of supporting the new addition. It should be noted that the ventilation system in the existing building is non-functional.

The add-heat system that served the school should be isolated, capped and demolished to reduce potential areas for future leaking as well as potential stagnant-water issues.

As noted under the Washeteria section, the Washeteria dryers are heated from a separate, stand-alone boiler. That system does not have any redundancy with a single boiler and it also does not allow the use of waste heat system for that system. Although the Washeteria is not part of this project, operations of the heating system may impact the WTP. It is recommended that the Washeteria dryer heat be consolidated with the Washeteria heat plant. This addition may require a new boiler to be added to the WTP heat plant and/or upgrading the waste heat system.

Ventilation System

Additional investigation is needed to see if the removed ventilation fan needs to be replaced or if the facility can operate without it. The remaining unit is in place is at the end of its expected life and should be replaced. A new ventilation assembly, including hydronic heating coil, electronic damper controls, and associated duct modifications is recommended for both systems.

Fuel System

No needed improvements were noted for the fuel system that serves the WTP equipment.

5.5.3 Electrical

The electrical distribution system for the existing WTP building is in fair to good condition. There does not appear to be any immediate needs for upgrading this system as it is currently configured. The most immediate electrical needs include supporting the recommended new equipment in the WTP Annex.

5.6 Existing Distribution System

The proposed project does not involve new water distribution systems or changes to the existing distribution system. The existing distribution pumps located in the existing WTP building will be replaced in-kind, and all existing services will remain.

6 Sewer System and Lagoon

The proposed project does not involve construction of new sewer system facilities or any changes to the existing sewer or lagoon system. Any new wastewater discharges associated with the proposed water treatment facilities will be connected to the existing wastewater system. The new water treatment facilities include similar processes as those already in use. Therefore the wastewater discharge would be similar to the current discharge, with increased discharge rates based on increased water use due to improved facilities or population growth. Although out of the scope of this project, due to noted deficiencies of the existing lagoon, it is critical that these are addressed as soon as possible.

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7 Site Control

No additional site control is required for the proposed project. Project activities will not extend beyond the already developed footprint of existing sanitation facilities.

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8 Permit Requirements

The following Permits and regulatory approvals would be needed for the construction or reconstruction, and operation of a public water treatment system.

- ADEC Drinking Water Program review and approvals for construction and operation (interim and final) would be needed. The operation approvals typically reference a requirement for a Water Treatment Operator, certified at the appropriate level, as discussed in Section 4.1.2
- ADNR Water Rights would need to be modified because the existing water rights are insufficient to meet the system demand (current water rights are included in Appendix I).
- Alaska Department of Public Safety, Fire and Life Safety (F&LS) requires review and approval of any project that includes construction, remodel, addition, or change of occupancy. Conversations with F&LS indicated the following:
  - Existing WTP Building – Since there is no record of a prior approval, a separate application for an "Unreviewed Existing Building" is needed, to provide missing file information. This application is $150.

    An application for a "renovation" will be needed for the existing building. If the occupancy of the existing WTP does not change, then there would likely be no changes required by F&LS. The one exception is maintaining a safe exit pathway. To avoid access issues, the New Annex will be connected to the existing WTP through the second floor, at the existing water treatment plant operator office area. The fee for the renovation application will be determined upon application.
  - New WTP Annex – A plan review through the State Fire Marshal's office will be required. The fee will be determined upon application. It is estimated at approximately $730 based on building size, type, etc. This application would include the new building and covered pathway between buildings.

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9 Cost Estimates

This section discusses estimated capital costs and operations and maintenance (O&M) costs associated with the proposed upgrades to the Kongiganak community water system. Since the proposed project does not include modifications to the existing sewer system, the sewer system costs are not included.

9.1 Water System Capital Costs

Capital construction cost estimates will be provided by HMS at 95% submittal.

9.2 Water System NPV and O&M Costs

O&M costs will be provided at 95% submittal.

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10 References

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Appendix A – 35% Design Drawings

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KONGIGANAK
WATER TREATMENT PLANT

CONSULTANT PROJECT NO. 32190078
VSW PROJECT NO. 19-VSW-KKH-014
PWSID 271025

PROJECT SCOPE

THIS PROJECT PROVIDES THE PRELIMINARY DESIGN OF WATER TREATMENT SYSTEM UPGRADES WHICH ARE NEEDED TO BRING THE SYSTEM INTO COMPLIANCE WITH THE SURFACE WATER TREATMENT RULE (SWTR) AS WELL AS THE LEAD COPPER RULE. THIS PROJECT FOLLOWS A 2018 PRELIMINARY ENGINEERING REPORT BY SUMMIT CONSTRUCTION.

A NEW WATER TREATMENT SYSTEM WILL BE PROVIDED THAT MEETS THE SWTR REQUIREMENTS FOR FILTRATION AND DISINFECTION. PH ADJUSTMENT WILL BE INCLUDED TO BRING THE PH UP TO 7. PLASTIC PIPING WILL BE USED IN ALL NEW PIPING. THE EXISTING WATER TREATMENT EQUIPMENT AND WATER STORAGE CONTAINERS WILL BE DEMOLISHED AND REMOVED FROM THE ORIGINAL WTP. A NEW WTP ANNEX HOUSING NEW TREATMENT EQUIPMENT AND (2) NEW TREATED WATER STORAGE TANKS (40,000 GALLONS EACH) WILL BE CONSTRUCTED ON EXISTING PILINGS LOCATED ADJACENT TO THE EXISTING WTP WHICH WERE LEFT FROM THE OLD RAW WATER STORAGE TANK (570,000 GALLONS).

PROJECT CONSTRUCTION WILL INCLUDE:

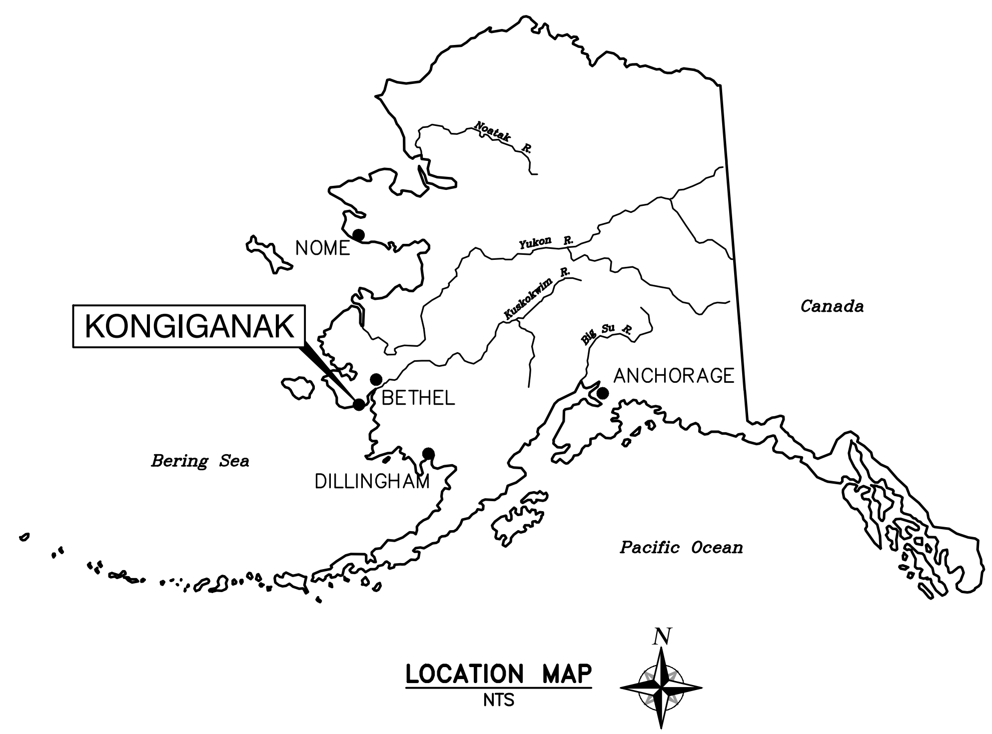
1. NEW WTP BUILDING CONSTRUCTED ON EXISTING STEEL PILES. TREATMENT COMPONENTS TO BE INSTALLED WITHIN NEW BUILDING INCLUDE:
   - 1.1. POTASSIUM PERMANGANATE INJECTION
   - 1.2. COAGULATION VIA ADDITION OF NALCO 8105 WITH INLINE MIXING & FLOCCULATION
   - 1.3. THREE (3) 36-INCH DIAMETER MULTI-MEDIA FILTERS
   - 1.4. PRE-WST & PRE-DISTRIBUTION CHLORINATION VIA ADDITION OF CALCIUM HYPOCHLORITE
   - 1.5. pH ADJUSTMENT VIA ADDITION OF SODA ASH
   - 1.6. SCADA SYSTEM
2. TWO (2) NEW 40,000 GALLON INSULATED, BOLTED STEEL POTABLE WATER STORAGE TANKS CONSTRUCTED ON EXISTING STEEL PILES ADJACENT TO NEW WTP BUILDING.
3. DEMOLITION OF TREATMENT COMPONENTS WITHIN EXISTING WTP, INCLUDING:
   - 3.1. SERIES OF (61) 165-GAL TANKS CURRENTLY USED FOR TREATED WATER STORAGE AND DISINFECTION.
   - 3.2. (6) BAG CARTRIDGE FILTERS
   - 3.3. POLYMER AND CHLORINE FEED SYSTEMS
   - 3.4. FLOCCULATION TANK
   - 3.5. (2) MEDIA FILTERS
   - 3.6. BACKWASH AND FILTER PUMPS
   - 3.7. ASSOCIATED PIPING & APPURTENANCES
4. THE FOLLOWING ITEMS WILL BE REPLACED IN-KIND IN THE EXISTING WTP BUILDING:
   - 4.1. (4) PRESSURE TANKS
   - 4.2. (2) PRESSURE PUMPS
   - 4.3. (1) FIRE PUMP

THE EXISTING WTP BUILDING WILL REMAIN FOR USE AS AN OFFICE, AS WELL AS TO HOUSE PRESSURE TANKS AND PRESSURE PUMPS.

IN COOPERATION WITH THE STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
VILLAGE SAFE WATER PROGRAM

VSW PROJECT ENGINEER: ______________________

CONSTRUCTION FOREMAN: ______________________



LOCATION MAP
NTS

SHEET INDEX

35% PRELIMINARY DESIGN

REVISIONS				REVISIONS			
NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

Project No. 32190078
AECC No. 697
Bristol ENGINEERING SERVICES COMPANY, LLC
Phone (907) 563-0013 Fax (907) 563-6713

VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

TITLE PAGE, SCOPE, INDEX OF SHEETS, LOCATION MAP

SHEET NO. A-101

SCALE: N/A | DESIGNED: VBW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET 1 OF X

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Xrefs: BR22X34REV.DWG – Images: None

OPERATIONAL NARRATIVE

SITE DESCRIPTION

KONGIGANAK IS AN UNINCORPORATED, TRADITIONAL YUP'IK ESKIMO VILLAGE WITH A SUBSISTENCE LIFESTYLE AND CULTURE. THE RESIDENTS OF THE NATIVE VILLAGE OF KONGIGANAK (VILLAGE) ARE REPRESENTED BY THE KONGIGANAK TRADITIONAL COUNCIL. THE COMMUNITY IS WITHIN THE CALISTA REGIONAL NATIVE CORPORATION.

KONGIGANAK IS LOCATED ON THE KUSKOKWIM RIVER, APPROXIMATELY 2.5 MILES INLAND FROM KUSKOKWIM BAY AND 70 MILES SOUTHWEST OF BETHEL (LATITUDE: 59.9594 LONGITUDE: −162.8871), WITHIN THE YUKON DELTA NATIONAL WILDLIFE REFUGE.

KONGIGANAK IS IN A LOW RELIEF AREA, SURROUNDED BY MARSHY WETLANDS, PONDS, AND MEANDERING STREAMS. THE AREA IS AT RISK OF PERIODIC FLOODING WITH A BASE FLOOD ELEVATION OF 20.7 FEET MEAN LOWER LOW WATER (MLLW) AND A SURGE ELEVATION OF 18.4 FEET MLLW. THE SUBSURFACE CONSISTS OF FINE GRAINED, WARMING PERMAFROST. KONGIGANAK HAS AN ANNUAL AVERAGE TEMPERATURE OF 30.7 DEGREES FAHRENHEIT (F), AN ANNUAL AVERAGE PRECIPITATION OF 21.3 INCHES, AND AN ANNUAL AVERAGE WIND SPEED OF 19.2 MILES PER HOUR (USA.COM).

HOMES IN KONGIGANAK DO NOT HAVE INTERIOR PLUMBING FOR WATER OR WASTEWATER. RESIDENTS SELF-HAUL DRINKING WATER AND AND WASTES USING ALL TERRAIN VEHICLES (ATVS). BUILDINGS ARE GENERALLY CONSTRUCTED ON PILINGS. THERE ARE NO GRAVEL SOURCE AREAS IN KONGIGANAK, SO THERE ARE VERY FEW ROADWAYS. THE COMMUNITY PRIMARILY RELIES ON A BOARDWALK SYSTEM FOR PEDESTRIAN AND ATV TRAFFIC.

2021 KONGIGANAK COMMUNITY WATER SYSTEM

THE KONGIGANAK PUBLIC WATER SYSTEM (PWS) HAS BEEN DESIGNATED AS A COMMUNITY PUBLIC WATER SYSTEM BY THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION (ADEC) DRINKING WATER PROGRAM, WITH A PUBLIC WATER SYSTEM IDENTIFICATION (PWSID) NUMBER OF 271025.

RAW WATER

THE WATER SYSTEM OBTAINS RAW SURFACE WATER FROM CONTRACTOR'S LAKE.

RAW WATER IS TRANSFERRED VIA A SEASONAL TRANSMISSION LINE (9,400 LINEAR FEET, UN-INSULATED, 4-INCH DIAMETER, HIGH DENSITY POLYETHYLENE PIPE) WHICH IS INSTALLED ON THE GROUND SURFACE. A 1.2 MILLION GALLON RAW WATER STORAGE TANK (WST) IS FILLED AS SOON AS THE TRANSMISSION LINE THAWS IN THE LATE SPRING, AND IS TYPICALLY TOPPED OFF BEFORE THE TRANSMISSION LINE FREEZES IN THE FALL. THE SYSTEM HAS TO OPERATE OFF OF STORED WATER FOR APPROXIMATELY 10–11 MONTHS.

AT THE END OF WINTER THERE IS OFTEN INSUFFICIENT STORED WATER TO MEET DEMAND. THE COMMUNITY HAS REPORTED WATER SHORTAGES AND HAVING TO RATION WATER.

TREATMENT PROCESSES

THE CURRENT TREATMENT SYSTEMS ARE IN POOR REPAIR, WITH MOST COMPONENTS WELL PAST THEIR DESIGN LIFE. THE DIRECT FILTRATION SYSTEM CURRENTLY FILTERS WATER AT 7 GALLONS PER MINUTE (GPM). FILTERED WATER IS STORED IN (61) 165-GALLON CONTAINERS THAT CONNECT TO A BASE MANIFOLD. CHLORINE IS INJECTED INTO A CENTRAL CONTAINER AND DOES NOT DISTRIBUTE THROUGH THE CONTAINERS. THE CURRENT SYSTEM DOES NOT MEET THE DISINFECTION REQUIREMENTS OF THE SWTR.

2021 SERVICE CONNECTIONS

THE KONGIGANAK PWS DOES NOT HAVE A PIPED DISTRIBUTION SYSTEM. WATER IS ONLY PROVIDED TO THE FOLLOWING FACILITIES.

WASHETERIA

RESIDENTS RELY ON THE WASHETERIA FOR ACCESS TO TREATED WATER. THE WASHETERIA IS ATTACHED TO THE WTP AND CONNECTED BY INTERIOR PLUMBING. THE HIGHLY CORROSIVE NATURE OF THE FINISHED WATER HAS CONTRIBUTED TO OBSERVABLE CORROSION IN THE COPPER PIPING IN THE WTP AND WASHETERIA. THE PLUMBED EQUIPMENT WITHIN THE WASHETERIA IS DETERIORATED AND IN POOR REPAIR. A LIMITED NUMBER OF WASHING MACHINES AND SHOWER ROOMS ARE OPERABLE.

RESIDENTS INDIVIDUALLY HAUL TREATED WATER TO THEIR HOMES FROM A COMMUNITY WATERING POINT LOCATED ON THE EXTERIOR OF THE WASHETERIA. WATER IS TYPICALLY HAULED IN 5-GALLON CONTAINERS USING 4-WHEEL ATVS.

OLD SCHOOL

A 3-INCH DIAMETER, HDPE SERVICE LINE WAS CONSTRUCTED BETWEEN THE WTP AND THE OLD SCHOOL. THE OLD SCHOOL CURRENTLY HAS LIMITED USE. HOWEVER THE COMMUNITY HAS PLANS FOR FUTURE, EXPANDED USE. THE NEW HEALTH CLINIC (2020), LOCATED ADJACENT TO THE OLD SCHOOL, IS CONNECTED TO THE EXISTING SCHOOL SERVICE LINE.

AYAGINA'AR ELITNAURVIK SCHOOL WATER SYSTEM

THE AUYAINA'AR ELITNAURVIK SCHOOL WAS CONSTRUCTED IN 2010. THE LOWER KUSKOKWIM SCHOOL DISTRICT (LKSD) CURRENTLY OWNS AND OPERATES A SEPARATE NON-TRANSIENT NON-COMMUNITY PWS (PWSID 271245) WHICH SERVES THE SCHOOL AND TEACHER HOUSING. THE VILLAGE PROVIDES RAW WATER TO THE SCHOOL WITH A RAW WATER TRANSMISSION LINE (4,600 FEET, ARCTIC PIPE). MEMBRANE TREATMENT MODULES (PCI FYNE, NANOFILTRATION) FILTER THE RAW WATER AT A RATE OF APPROXIMATELY 2,300 GPD. WATER IS CHLORINATED AND STORED IN (4) TANKS PROVIDING 2,600 GALLONS OF STORAGE EACH. TREATED WATER IS DISTRIBUTED TO THE SCHOOL AND TEACHER HOUSING.

THE LKSD REPORTS THAT THE 2020–2021 SCHOOL TREATED WATER DEMAND IS APPROXIMATELY 1,500 TO 1,600 GPD, HOWEVER THIS USE RATE MAY HAVE BEEN IMPACTED BY THE PANDEMIC.

2041 KONGIGANAK COMMUNITY WATER SYSTEM

THE FOLLOWING SECTION DESCRIBES THE PROPOSED WATER SYSTEM ASSOCIATED WITH THIS PROJECT.

RAW WATER

THE COMMUNITY WILL CONTINUE TO RELY ON CONTRACTOR'S LAKE FOR RAW WATER. THERE WILL BE NO CHANGE TO RAW WATER STORAGE.

TREATMENT PROCESSES

NEW TREATMENT PROCESSES INCLUDE:

- COAGULATION – USING NALCO 8105 COAGULANT
- DIRECT FILTRATION – (2) 42 INCH DIAMETER PRESSURE FILTERS, OPERATED IN PARALLEL AT 24 GPM
- A POLISHING FILTER – (1) MEDIA FILTER, 42 INCH DIAMETER, FOLLOWING PRIMARY FILTRATION
- CHLORINATION – USING CALCIUM HYPOCHLORITE
- PH ADJUSTMENT – USING SODA ASH
- TREATED WATER STORAGE – PROVIDED IN (2) 40,000-GALLON, BOLTED STEEL (INSULATED) TANKS, WITH INLET AND OUTLET SEPARATED TO PROVIDE 0.1 BAFFLE FACTOR (BF)

2041 SERVICE CONNECTIONS

THIS PROJECT DOES NOT INCLUDE OR ASSUME ANY FUTURE EXPANSION OF THE LIMITED COMMUNITY DISTRIBUTION SYSTEM. HOWEVER, SOME CHANGES IN USAGE ARE ANTICIPATED.

WASHETERIA

THE WASHETERIA WILL CONTINUE TO BE THE COMMUNITY'S PRIMARY SOURCE FOR TREATED WATER. BASED ON COMMUNITY SURVEYS AND CURRENT WASHETERIA USE DATA, THE DEMAND FOR WASHETERIA SERVICES EXCEEDS THE CAPACITY OF OPERABLE FACILITIES. ONCE THE WASHERS AND SHOWERS ARE REPAIRED, IT IS EXPECT THAT USE WILL INCREASE TO MEET DEMAND.

OLD SCHOOL

IT IS EXPECTED THAT THE COMMUNITY USE OF THE OLD SCHOOL FOR A PRESCHOOL AND OFFICE AREA WILL CONTINUE. NO ADDITIONAL USES WERE IDENTIFIED OR INCLUDED.

HEALTH CLINIC

IT IS EXPECTED THAT THE NEW TREATMENT SYSTEM WILL CONTINUE TO PROVIDE TREATED WATER TO THE HEALTH CLINIC, AND THAT USAGE WOULD INCREASE AT THE SAME RATE AS THE PROJECTED POPULATION INCREASE.

AYAGINA'AR ELITNAURVIK SCHOOL WATER SYSTEM

LKSD SCHOOL REPRESENTATIVES HAVE EXPRESSED INTEREST IN PURCHASING TREATED WATER FROM THE VILLAGE INSTEAD OF RAW WATER. THEREFORE, SCHOOL DEMAND WAS INCLUDED IN THE DEMAND ESTIMATES FOR THE NEW SYSTEM. THE POPULATION GROWTH RATE (0.9%) WAS USED TO ESTIMATE THE 2041 SCHOOL POPULATION. A SCHOOL DEMAND OF 10 GPD PER PERSON WAS ASSUMED.

2041 OPERATIONS

THE 1.2 MG RAW WST WILL BE FILLED AS SOON AS THE RAW WATER LINE IS THAWED IN THE LATE SPRING / EARLY SUMMER. WATER WILL BE PUMPED FROM CONTRACTOR'S LAKE UNTIL THE RAW WST IS FULL.

RAW WATER WILL BE PUMPED FROM THE RAW WST THROUGH THE WATER TREATMENT SYSTEM IN THE NEW WTP ANNEX AT A MAXIMUM RATE OF 24 GPM. THE RAW WATER LINE WILL BE ENCLOSED IN AN INSULATED ARCTIC PIPE THAT ALSO CONTAINS THE HYDRONIC HEAT LOOP WHICH WILL PROVIDE WASTE HEAT TO THE ANNEX FROM THE EXISTING BOILERS. THIS WILL ALSO HEAT THE RAW WATER PRIOR TO TREATMENT.

THE WATER TREATMENT SYSTEM INCLUDES THE FOLLOWING PROCESSES. *NOTE: THE CHEMICAL DOSAGES ARE BASED ON PRELIMINARY JAR TEST RESULTS, AND ARE EXPECTED TO BE FINALIZED AT SYSTEM START UP.

1. PRE-OXIDATION WITH POTASSIUM PERMANGANATE (KMNO4) AS NEEDED TO CONTROL ORGANICS. THE KMNO4 WILL BE INJECTED AT THE POINT THAT THE RAW WATER ENTERS THE WTP ANNEX. A DETENTION CHAMBER (APPROXIMATELY 19 FEET OF 12 INCH PIPING) WILL PROVIDE TIME (14 MINUTES) FOR THE KNMO4 TO DISSOLVE PRIOR TO THE ADDITION OF COAGULANT.
2. COAGULATION USING NALCO 8105 AT A DOSAGE OF APPROXIMATELY 7 MG/L.
3. FILTRATION USING TWO MEDIA FILTERS (42 INCHES IN DIAMETER EACH), IN PARALLEL (12 GPM EACH), AT A LOADING RATE OF APPROXIMATELY 1.3 GPM PER SQUARE FOOT OF FILTER AREA.
4. THE FILTERED WATER FROM BOTH FILTERS WILL THEN FLOW THROUGH A FINAL, MEDIA POLISHING FILTER (42 INCHES IN DIAMETER), AT A TOTAL FLOW OF 24 GPM, AND A LOADING RATE OF 2.5 GPM PER SQUARE FOOT OF FILTER AREA.
5. A SOLUTION OF CALCIUM HYPOCHLORITE WILL BE INJECTED INTO THE WATER PRIOR TO DISCHARGE INTO TWO 40,000-GALLON TREATED WSTs, FOR A TOTAL TREATED WATER STORAGE VOLUME OF 80,000 GALLONS.
   a. THE TWO TANKS WILL NORMALLY BE OPERATED IN SERIES. A MINIMUM VOLUME OF 17,000 GALLONS (7.5 FEET) WILL BE RESERVED IN THE FIRST TANK IN ORDER TO MEET REQUIRED 1-LOG CHLORINE INACTIVATION OF GIARDIA.
   b. A MINIMUM FREE CHLORINE RESIDUAL OF 0.3 MG/L, AS MEASURED IMMEDIATELY AFTER THE FIRST WST, WILL BE MAINTAINED IN ORDER TO MEET THE REQUIRED 1-LOG CHLORINE INACTIVATION OF GIARDIA.
6. SODA ASH WILL BE INJECTED AT A DOSAGE OF APPROXIMATELY 35 MG/L AFTER THE TREATED WST IN ORDER TO ACHIEVE A FINISHED WATER PH OF APPROXIMATELY 7.2, PRIOR TO DISTRIBUTION.

THE FILTER CLEANING PROCESS WILL INCLUDE:

1. THE TWO MEDIA FILTERS AND THE POLISHING FILTER WILL BE BACKWASHED SEQUENTIALLY AT A RATE OF 144 GPM (15 GPM PER SQUARE FOOT) < INSERT TONKA PROCESS AT 95% > BACKWASH WILL OCCUR BASED ON:
   a. PRESSURE DIFFERENTIAL (8 – 10 PSI), OR
   b. FINISHED WATER TURBIDITY GREATER THAN 0.25 NTU, OR
   c. ULTRAVIOLET LIGHT ABSORBANCE (UVA) GREATER THAN 0.1.
2. FOLLOWING BACKWASH, THE FILTERS (INCLUDING POLISHING FILTER) WILL BE RINSED TO WASTE AT THE DESIGN FLOW OF THE WTP (24 GPM), UNTIL THE COMBINED FILTER EFFLUENT TURBIDITY, MEASURED AFTER THE POLISHING FILTER, IS LESS THAN 1.5 NTU.

DESIGN CRITERIA

RAW WATER QUALITY (JULY 2019)

COLOR	70	PCU
PH	5.8	
TOTAL NITRATE/NITRITE	0.185	MG/L
ARSENIC	–	BELOW DETECTION LIMIT
IRON	0.75	MG/L
MANGANESE	0.00996	MG/L
CALCIUM	0.282	MG/L
TOTAL DISSOLVED SOLIDS	27	MG/L
LANGELIER INDEX	−5.97	MG/L
HARDNESS	–	BELOW DETECTION LIMIT
ALKALINITY	–	BELOW DETECTION LIMIT
TOTAL ORGANIC CARBON	7.22	MG/L
DISSOLVED ORGANIC CARBON	5.96	MG/L
UV 254 ABSORPTION	0.350	CM-1
SPECIFIC UV ABSORBANCE	5.87	L/MG-M
RAW WATER TURBIDITY	1.07	NTU

POPULATION & DEMAND

2021 COMMUNITY POPULATION	539	PEOPLE (2018 DCCED CERTIFIED)
POPULATION GROWTH RATE	0.9	% (ADOL)
2041 COMMUNITY POPULATION	645	PEOPLE
2041 SCHOOL POPULATION	232	PEOPLE (STUDENTS AND STAFF)
2041 AVERAGE TOTAL DAILY DEMAND	8,800	GPD
2041 MAX TOTAL DAILY DEMAND	10,100	GPD

RAW WATER

ESTIMATED SOURCE WATER VOLUME	4–5	MG (CONTRACTOR'S LAKE)
ADNR WATER RIGHTS	3,600	GPD (2002, LAS 23946)
RAW WATER STORAGE	1.20	MG
STORAGE INTERVAL	10–12	MONTHS

TREATED WATER STORAGE

DAYS OF TREATED WATER STORAGE	6.5	DAYS
TOTAL STORAGE VOLUME	80,000	GALLONS
NUMBER OF TANKS	2	EA
TANK VOLUME (EA)	40,000	GALLONS
TANK DIAMETER	20	FEET
TANK HEIGHT	17	FEET

FILTRATION

MINIMUM CRYPTOSPORIDIUM REMOVAL	2	LOG
MINIMUM GIARDIA REMOVAL	1	LOG
MINIMUM VIRUS REMOVAL	2	LOG
HOURS OF FILTER OPERATION PER DAY	6	HOURS
MINIMUM FILTRATION RATE (TOTAL)	24	GPM
NUMBER OF FILTERS	2	
FILTER DIAMETER	42	INCHES
FILTER LOADING RATE	1.3	GPM/SQFT
POLISHING MEDIA FILTER DIAMETER	42	INCHES

BACKWASH (BW)

NUMBER OF BACKWASHES PER FILTER	1	PER WEEK
FILTERS BACKWASHED	3	EA (INCLUDING POLISHING FILTER)
BW LOADING RATE	15	GPM/SQFT
BW RATE (EA)	144	GPM
BW INTERVAL (EA)	15	MINUTES
BW VOLUME PER FILTER	2,165	GALLONS
AIR SCOUR LOADING RATE	4	CFM/SQFT
AIR SCOUR RATE (EA)	38	CFM

FILTER TO WASTE (FTW)

MAXIMUM FTW CYCLES	1	PER WEEK
FTW RATE	24	GPM (ALL FILTERS SIMULTANEOUSLY)
FTW INTERVAL	20	MINUTES
FTW VOLUME	489	GALLONS

WASTEWATER SURGE TANK

TANK HEIGHT	6	FEET
TANK DIAMETER	6	FEET
TANK VOLUME	5,000	GALLONS

CHLORINATION

MINIMUM GIARDIA DISINFECTION	1	LOG
MINIMUM VIRUS DISINFECTION	2	LOG
HOURS OF ACTIVE WATER USE	16	HOURS/DAY
PEAKING FACTOR	3	
PEAK HOURLY FLOW FOR CT	28	GPM
MINIMUM REQUIRED VOLUME FOR CT	17,000	GALLONS
GIARDIA DISINFECTION	1	LOG
CHLORINE FREE RESIDUAL	0.40	MG/L
PH	7	

35% PRELIMINARY DESIGN

REVISIONS				REVISIONS			
NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

Project No. 32190078
AECC No. 697

Bristol
ENGINEERING SERVICES COMPANY, LLC
Phone (907) 563-0013 Fax (907) 563-6713

VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

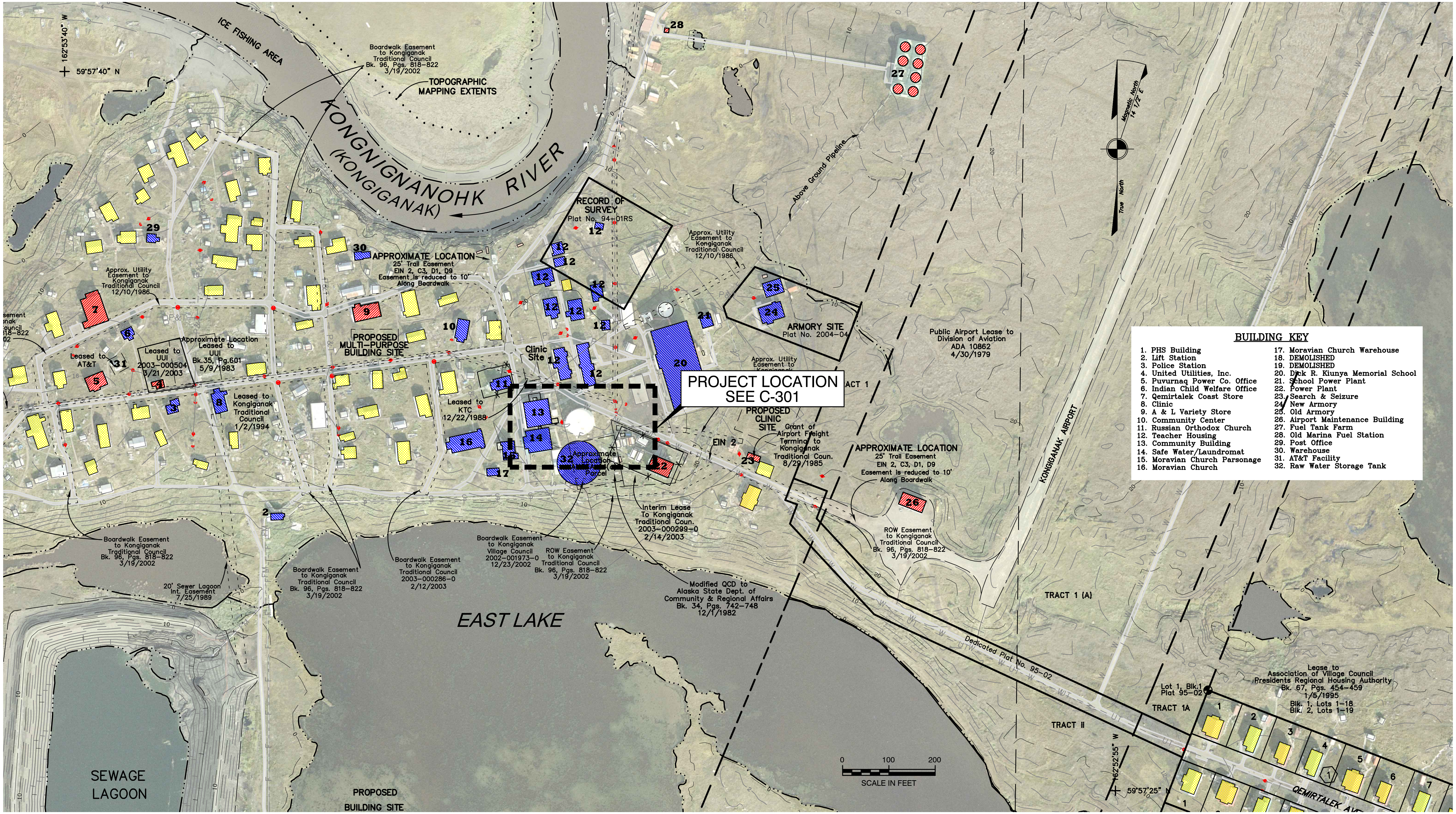
KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

OPERATIONAL NARRATIVE & DESIGN CRITERIA

SHEET NO. A-102

SCALE: N/A | DESIGNED: VBW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET 2 OF X

User: JWANDER Mar 17, 2021 – 1:22pm
Drawing: C:\USERS\JWANDER\APPDATA\LOCAL\TEMP\ACPUBLISH_47052\32190078_KONG_A-101-102_COVER SHEET.DWG – Layout: A-102
Xrefs: BR22X34REV.DWG – Images: None



NOTE: THIS MAP WAS PREPARED BY THE ALASKA DEPARTMENT OF COMMERCE, COMMUNITY, AND ECONOMIC DEVELOPMENT (DCCED) USING FUNDING FROM MULTIPLE MUNICIPAL, STATE, FEDERAL AND TRIBAL PARTNERS. THE MAP WAS DEVELOPED IN 2004 AND MAY NOT ACCURATELY REPRESENT EXISTING CONDITIONS. DATA FROM THIS MAP WAS USED TO DEVELOP DRAWINGS FOR THE 2021 KONGIGANAK WTP PROJECT.

35% PRELIMINARY DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

REVISIONS

NO.	DATE	BY	DESCRIPTION

Project No. 32190078
AECC No. 697

Bristol ENGINEERING SERVICES COMPANY, LLC
Phone (907) 563-0013 Fax (907) 563-6713

VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

VICINITY MAP / EXISTING CONDITIONS

SHEET NO.
C-101

SCALE: SHOWN | DESIGNED: JDW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET X OF X

User: JWANDER Mar 17, 2021 - 1:22pm
Drawing: K:\JOBS\32190078 KONGIGANAK VSW\ACAD-DESIGN\DAR PHASE II\32190078_KONG_C-101_VICINITY MAP.DWG - Layout: C-101
Xrefs: BR22X34REV.DWG KONGIGANAK_NAD_83.DWG KONGIGANAK_100.DWG - Images: KONG_1FT.TIF KONG_2FT.TIF

KONGIGANAK
WATER TREATMENT PLANT

CONSULTANT PROJECT NO. 32190078

VSW PROJECT NO. 19-VSW-KKH-014

PWSID 271025

PROJECT SCOPE

THIS PROJECT PROVIDES THE PRELIMINARY DESIGN OF WATER TREATMENT SYSTEM UPGRADES WHICH ARE NEEDED TO BRING THE SYSTEM INTO COMPLIANCE WITH THE SURFACE WATER TREATMENT RULE (SWTR) AS WELL AS THE LEAD COPPER RULE. THIS PROJECT FOLLOWS A 2018 PRELIMINARY ENGINEERING REPORT BY SUMMIT CONSTRUCTION.

A NEW WATER TREATMENT SYSTEM WILL BE PROVIDED THAT MEETS THE SWTR REQUIREMENTS FOR FILTRATION AND DISINFECTION. PH ADJUSTMENT WILL BE INCLUDED TO BRING THE PH UP TO 7. PLASTIC PIPING WILL BE USED IN ALL NEW PIPING. THE EXISTING WATER TREATMENT EQUIPMENT AND WATER STORAGE CONTAINERS WILL BE DEMOLISHED AND REMOVED FROM THE ORIGINAL WTP. A NEW WTP ANNEX HOUSING NEW TREATMENT EQUIPMENT AND (2) NEW TREATED WATER STORAGE TANKS (40,000 GALLONS EACH) WILL BE CONSTRUCTED ON EXISTING PILINGS LOCATED ADJACENT TO THE EXISTING WTP WHICH WERE LEFT FROM THE OLD RAW WATER STORAGE TANK (570,000 GALLONS).

PROJECT CONSTRUCTION WILL INCLUDE:

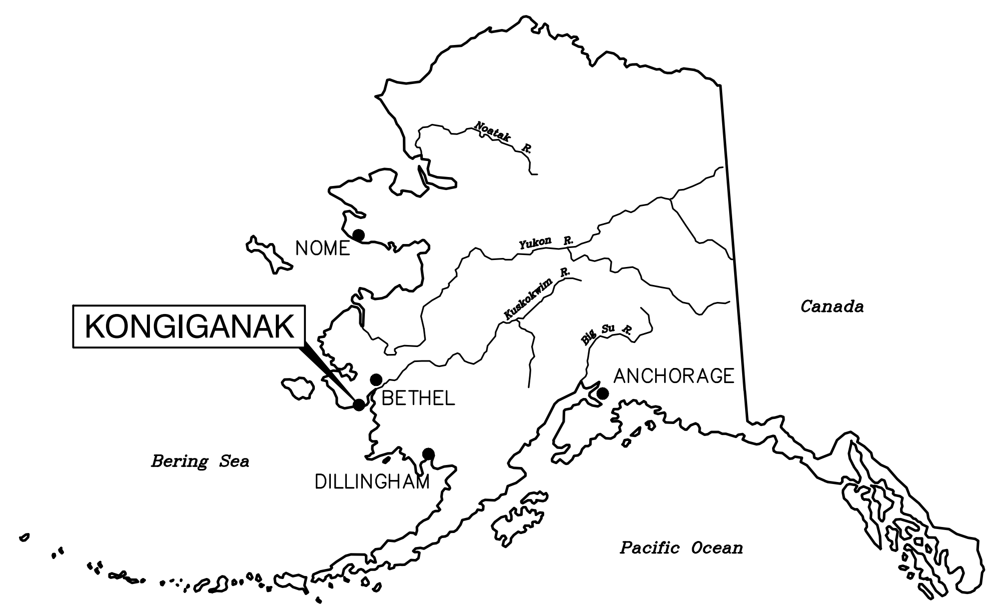
1. NEW WTP BUILDING CONSTRUCTED ON EXISTING STEEL PILES. TREATMENT COMPONENTS TO BE INSTALLED WITHIN NEW BUILDING INCLUDE:
   - 1.1. POTASSIUM PERMANGANATE INJECTION
   - 1.2. COAGULATION VIA ADDITION OF NALCO 8105 WITH INLINE MIXING & FLOCCULATION
   - 1.3. THREE (3) 36-INCH DIAMETER MULTI-MEDIA FILTERS
   - 1.4. PRE-WST & PRE-DISTRIBUTION CHLORINATION VIA ADDITION OF CALCIUM HYPOCHLORITE
   - 1.5. pH ADJUSTMENT VIA ADDITION OF SODA ASH
   - 1.6. SCADA SYSTEM
2. TWO (2) NEW 40,000 GALLON INSULATED, BOLTED STEEL POTABLE WATER STORAGE TANKS CONSTRUCTED ON EXISTING STEEL PILES ADJACENT TO NEW WTP BUILDING.
3. DEMOLITION OF TREATMENT COMPONENTS WITHIN EXISTING WTP, INCLUDING:
   - 3.1. SERIES OF (61) 165-GAL TANKS CURRENTLY USED FOR TREATED WATER STORAGE AND DISINFECTION.
   - 3.2. (6) BAG CARTRIDGE FILTERS
   - 3.3. POLYMER AND CHLORINE FEED SYSTEMS
   - 3.4. FLOCCULATION TANK
   - 3.5. (2) MEDIA FILTERS
   - 3.6. BACKWASH AND FILTER PUMPS
   - 3.7. ASSOCIATED PIPING & APPURTENANCES
4. THE FOLLOWING ITEMS WILL BE REPLACED IN-KIND IN THE EXISTING WTP BUILDING:
   - 4.1. (4) PRESSURE TANKS
   - 4.2. (2) PRESSURE PUMPS
   - 4.3. (1) FIRE PUMP

THE EXISTING WTP BUILDING WILL REMAIN FOR USE AS AN OFFICE, AS WELL AS TO HOUSE PRESSURE TANKS AND PRESSURE PUMPS.

IN COOPERATION WITH THE STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
VILLAGE SAFE WATER PROGRAM

VSW PROJECT ENGINEER: ______________________

CONSTRUCTION FOREMAN: ______________________



LOCATION MAP
NTS

N

SHEET INDEX

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VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

TITLE PAGE, SCOPE, INDEX OF SHEETS, LOCATION MAP

SHEET NO. **A-101**

SCALE: N/A | DESIGNED: VBW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET 1 OF X

OPERATIONAL NARRATIVE

SITE DESCRIPTION

KONGIGANAK IS AN UNINCORPORATED, TRADITIONAL YUP'IK ESKIMO VILLAGE WITH A SUBSISTENCE LIFESTYLE AND CULTURE. THE RESIDENTS OF THE NATIVE VILLAGE OF KONGIGANAK (VILLAGE) ARE REPRESENTED BY THE KONGIGANAK TRADITIONAL COUNCIL. THE COMMUNITY IS WITHIN THE CALISTA REGIONAL NATIVE CORPORATION.

KONGIGANAK IS LOCATED ON THE KUSKOKWIM RIVER, APPROXIMATELY 2.5 MILES INLAND FROM KUSKOKWIM BAY AND 70 MILES SOUTHWEST OF BETHEL (LATITUDE: 59.9594 LONGITUDE: −162.8871), WITHIN THE YUKON DELTA NATIONAL WILDLIFE REFUGE.

KONGIGANAK IS IN A LOW RELIEF AREA, SURROUNDED BY MARSHY WETLANDS, PONDS, AND MEANDERING STREAMS. THE AREA IS AT RISK OF PERIODIC FLOODING WITH A BASE FLOOD ELEVATION OF 20.7 FEET MEAN LOWER LOW WATER (MLLW) AND A SURGE ELEVATION OF 18.4 FEET MLLW. THE SUBSURFACE CONSISTS OF FINE GRAINED, WARMING PERMAFROST. KONGIGANAK HAS AN ANNUAL AVERAGE TEMPERATURE OF 30.7 DEGREES FAHRENHEIT (F), AN ANNUAL AVERAGE PRECIPITATION OF 21.3 INCHES, AND AN ANNUAL AVERAGE WIND SPEED OF 19.2 MILES PER HOUR (USA.COM).

HOMES IN KONGIGANAK DO NOT HAVE INTERIOR PLUMBING FOR WATER OR WASTEWATER. RESIDENTS SELF-HAUL DRINKING WATER AND AND WASTES USING ALL TERRAIN VEHICLES (ATVS). BUILDINGS ARE GENERALLY CONSTRUCTED ON PILINGS. THERE ARE NO GRAVEL SOURCE AREAS IN KONGIGANAK, SO THERE ARE VERY FEW ROADWAYS. THE COMMUNITY PRIMARILY RELIES ON A BOARDWALK SYSTEM FOR PEDESTRIAN AND ATV TRAFFIC.

2021 KONGIGANAK COMMUNITY WATER SYSTEM

THE KONGIGANAK PUBLIC WATER SYSTEM (PWS) HAS BEEN DESIGNATED AS A COMMUNITY PUBLIC WATER SYSTEM BY THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION (ADEC) DRINKING WATER PROGRAM, WITH A PUBLIC WATER SYSTEM IDENTIFICATION (PWSID) NUMBER OF 271025.

RAW WATER

THE WATER SYSTEM OBTAINS RAW SURFACE WATER FROM CONTRACTOR'S LAKE.

RAW WATER IS TRANSFERRED VIA A SEASONAL TRANSMISSION LINE (9,400 LINEAR FEET, UN-INSULATED, 4-INCH DIAMETER, HIGH DENSITY POLYETHYLENE PIPE) WHICH IS INSTALLED ON THE GROUND SURFACE. A 1.2 MILLION GALLON RAW WATER STORAGE TANK (WST) IS FILLED AS SOON AS THE TRANSMISSION LINE THAWS IN THE LATE SPRING, AND IS TYPICALLY TOPPED OFF BEFORE THE TRANSMISSION LINE FREEZES IN THE FALL. THE SYSTEM HAS TO OPERATE OFF OF STORED WATER FOR APPROXIMATELY 10-11 MONTHS.

AT THE END OF WINTER THERE IS OFTEN INSUFFICIENT STORED WATER TO MEET DEMAND. THE COMMUNITY HAS REPORTED WATER SHORTAGES AND HAVING TO RATION WATER.

TREATMENT PROCESSES

THE CURRENT TREATMENT SYSTEMS ARE IN POOR REPAIR, WITH MOST COMPONENTS WELL PAST THEIR DESIGN LIFE. THE DIRECT FILTRATION SYSTEM CURRENTLY FILTERS WATER AT 7 GALLONS PER MINUTE (GPM). FILTERED WATER IS STORED IN (61) 165-GALLON CONTAINERS THAT CONNECT TO A BASE MANIFOLD. CHLORINE IS INJECTED INTO A CENTRAL CONTAINER AND DOES NOT DISTRIBUTE THROUGH THE CONTAINERS. THE CURRENT SYSTEM DOES NOT MEET THE DISINFECTION REQUIREMENTS OF THE SWTR.

2021 SERVICE CONNECTIONS

THE KONGIGANAK PWS DOES NOT HAVE A PIPED DISTRIBUTION SYSTEM. WATER IS ONLY PROVIDED TO THE FOLLOWING FACILITIES.

WASHETERIA

RESIDENTS RELY ON THE WASHETERIA FOR ACCESS TO TREATED WATER. THE WASHETERIA IS ATTACHED TO THE WTP AND CONNECTED BY INTERIOR PLUMBING. THE HIGHLY CORROSIVE NATURE OF THE FINISHED WATER HAS CONTRIBUTED TO OBSERVABLE CORROSION IN THE COPPER PIPING IN THE WTP AND WASHETERIA. THE PLUMBED EQUIPMENT WITHIN THE WASHETERIA IS DETERIORATED AND IN POOR REPAIR. A LIMITED NUMBER OF WASHING MACHINES AND SHOWER ROOMS ARE OPERABLE.

RESIDENTS INDIVIDUALLY HAUL TREATED WATER TO THEIR HOMES FROM A COMMUNITY WATERING POINT LOCATED ON THE EXTERIOR OF THE WASHETERIA. WATER IS TYPICALLY HAULED IN 5-GALLON CONTAINERS USING 4-WHEEL ATVS.

OLD SCHOOL

A 3-INCH DIAMETER, HDPE SERVICE LINE WAS CONSTRUCTED BETWEEN THE WTP AND THE OLD SCHOOL. THE OLD SCHOOL CURRENTLY HAS LIMITED USE. HOWEVER THE COMMUNITY HAS PLANS FOR FUTURE, EXPANDED USE. THE NEW HEALTH CLINIC (2020), LOCATED ADJACENT TO THE OLD SCHOOL, IS CONNECTED TO THE EXISTING SCHOOL SERVICE LINE.

AYAGINA'AR ELITNAURVIK SCHOOL WATER SYSTEM

THE AUYAINA'AR ELITNAURVIK SCHOOL WAS CONSTRUCTED IN 2010. THE LOWER KUSKOKWIM SCHOOL DISTRICT (LKSD) CURRENTLY OWNS AND OPERATES A SEPARATE NON-TRANSIENT NON-COMMUNITY PWS (PWSID 271245) WHICH SERVES THE SCHOOL AND TEACHER HOUSING. THE VILLAGE PROVIDES RAW WATER TO THE SCHOOL WITH A RAW WATER TRANSMISSION LINE (4,600 FEET, ARCTIC PIPE). MEMBRANE TREATMENT MODULES (PCI FYNE, NANOFILTRATION) FILTER THE RAW WATER AT A RATE OF APPROXIMATELY 2,300 GPD. WATER IS CHLORINATED AND STORED IN (4) TANKS PROVIDING 2,600 GALLONS OF STORAGE EACH. TREATED WATER IS DISTRIBUTED TO THE SCHOOL AND TEACHER HOUSING.

THE LKSD REPORTS THAT THE 2020-2021 SCHOOL TREATED WATER DEMAND IS APPROXIMATELY 1,500 TO 1,600 GPD, HOWEVER THIS USE RATE MAY HAVE BEEN IMPACTED BY THE PANDEMIC.

2041 KONGIGANAK COMMUNITY WATER SYSTEM

THE FOLLOWING SECTION DESCRIBES THE PROPOSED WATER SYSTEM ASSOCIATED WITH THIS PROJECT.

RAW WATER

THE COMMUNITY WILL CONTINUE TO RELY ON CONTRACTOR'S LAKE FOR RAW WATER. THERE WILL BE NO CHANGE TO RAW WATER STORAGE.

TREATMENT PROCESSES

NEW TREATMENT PROCESSES INCLUDE:

- COAGULATION – USING NALCO 8105 COAGULANT
- DIRECT FILTRATION – (2) 42 INCH DIAMETER PRESSURE FILTERS, OPERATED IN PARALLEL AT 24 GPM
- A POLISHING FILTER – (1) MEDIA FILTER, 42 INCH DIAMETER, FOLLOWING PRIMARY FILTRATION
- CHLORINATION – USING CALCIUM HYPOCHLORITE
- PH ADJUSTMENT – USING SODA ASH
- TREATED WATER STORAGE – PROVIDED IN (2) 40,000-GALLON, BOLTED STEEL (INSULATED) TANKS, WITH INLET AND OUTLET SEPARATED TO PROVIDE 0.1 BAFFLE FACTOR (BF)

2041 SERVICE CONNECTIONS

THIS PROJECT DOES NOT INCLUDE OR ASSUME ANY FUTURE EXPANSION OF THE LIMITED COMMUNITY DISTRIBUTION SYSTEM. HOWEVER, SOME CHANGES IN USAGE ARE ANTICIPATED.

WASHETERIA

THE WASHETERIA WILL CONTINUE TO BE THE COMMUNITY'S PRIMARY SOURCE FOR TREATED WATER. BASED ON COMMUNITY SURVEYS AND CURRENT WASHETERIA USE DATA, THE DEMAND FOR WASHETERIA SERVICES EXCEEDS THE CAPACITY OF OPERABLE FACILITIES. ONCE THE WASHERS AND SHOWERS ARE REPAIRED, IT IS EXPECT THAT USE WILL INCREASE TO MEET DEMAND.

OLD SCHOOL

IT IS EXPECTED THAT THE COMMUNITY USE OF THE OLD SCHOOL FOR A PRESCHOOL AND OFFICE AREA WILL CONTINUE. NO ADDITIONAL USES WERE IDENTIFIED OR INCLUDED.

HEALTH CLINIC

IT IS EXPECTED THAT THE NEW TREATMENT SYSTEM WILL CONTINUE TO PROVIDE TREATED WATER TO THE HEALTH CLINIC, AND THAT WATER USE WOULD INCREASE AT THE SAME RATE AS THE PROJECTED POPULATION INCREASE.

AYAGINA'AR ELITNAURVIK SCHOOL WATER SYSTEM

LKSD SCHOOL REPRESENTATIVES HAVE EXPRESSED INTEREST IN PURCHASING TREATED WATER FROM THE VILLAGE INSTEAD OF RAW WATER. THEREFORE, SCHOOL DEMAND WAS INCLUDED IN THE DEMAND ESTIMATES FOR THE NEW SYSTEM. THE POPULATION GROWTH RATE (0.9%) WAS USED TO ESTIMATE THE 2041 SCHOOL POPULATION. A SCHOOL DEMAND OF 10 GPD PER PERSON WAS ASSUMED.

2041 OPERATIONS

THE 1.2 MG RAW WST WILL BE FILLED AS SOON AS THE RAW WATER LINE IS THAWED IN THE LATE SPRING / EARLY SUMMER. WATER WILL BE PUMPED FROM CONTRACTOR'S LAKE UNTIL THE RAW WST IS FULL.

RAW WATER WILL BE PUMPED FROM THE RAW WST THROUGH THE WATER TREATMENT SYSTEM IN THE NEW WTP ANNEX AT A MAXIMUM RATE OF 24 GPM. THE RAW WATER LINE WILL BE ENCLOSED IN AN INSULATED ARCTIC PIPE THAT ALSO CONTAINS THE HYDRONIC HEAT LOOP WHICH WILL PROVIDE WASTE HEAT TO THE ANNEX FROM THE EXISTING BOILERS. THIS WILL ALSO HEAT THE RAW WATER PRIOR TO TREATMENT.

THE WATER TREATMENT SYSTEM INCLUDES THE FOLLOWING PROCESSES. *NOTE: THE CHEMICAL DOSAGES ARE BASED ON PRELIMINARY JAR TEST RESULTS, AND ARE EXPECTED TO BE FINALIZED AT SYSTEM START UP.

1. PRE-OXIDATION WITH POTASSIUM PERMANGANATE (KMNO4) AS NEEDED TO CONTROL ORGANICS. THE KMNO4 WILL BE INJECTED AT THE POINT THAT THE RAW WATER ENTERS THE WTP ANNEX. A DETENTION CHAMBER (APPROXIMATELY 19 FEET OF 12 INCH PIPING) WILL PROVIDE TIME (14 MINUTES) FOR THE KNMO4 TO DISSOLVE PRIOR TO THE ADDITION OF COAGULANT.
2. COAGULATION USING NALCO 8105 AT A DOSAGE OF APPROXIMATELY 7 MG/L.
3. FILTRATION USING TWO MEDIA FILTERS (42 INCHES IN DIAMETER EACH), IN PARALLEL (12 GPM EACH), AT A LOADING RATE OF APPROXIMATELY 1.3 GPM PER SQUARE FOOT OF FILTER AREA.
4. THE FILTERED WATER FROM BOTH FILTERS WILL THEN FLOW THROUGH A FINAL, MEDIA POLISHING FILTER (42 INCHES IN DIAMETER), AT A TOTAL FLOW OF 24 GPM, AND A LOADING RATE OF 2.5 GPM PER SQUARE FOOT OF FILTER AREA.
5. A SOLUTION OF CALCIUM HYPOCHLORITE WILL BE INJECTED INTO THE WATER PRIOR TO DISCHARGE INTO TWO 40,000-GALLON TREATED WSTs, FOR A TOTAL TREATED WATER STORAGE VOLUME OF 80,000 GALLONS.
   a. THE TWO TANKS WILL NORMALLY BE OPERATED IN SERIES. A MINIMUM VOLUME OF 17,000 GALLONS (7.5 FEET) WILL BE RESERVED IN THE FIRST TANK IN ORDER TO MEET REQUIRED 1-LOG CHLORINE INACTIVATION OF GIARDIA.
   b. A MINIMUM FREE CHLORINE RESIDUAL OF 0.3 MG/L, AS MEASURED IMMEDIATELY AFTER THE FIRST WST, WILL BE MAINTAINED IN ORDER TO MEET THE REQUIRED 1-LOG CHLORINE INACTIVATION OF GIARDIA.
6. SODA ASH WILL BE INJECTED AT A DOSAGE OF APPROXIMATELY 35 MG/L AFTER THE TREATED WST IN ORDER TO ACHIEVE A FINISHED WATER PH OF APPROXIMATELY 7.2, PRIOR TO DISTRIBUTION.

THE FILTER CLEANING PROCESS WILL INCLUDE:

1. THE TWO MEDIA FILTERS AND THE POLISHING FILTER WILL BE BACKWASHED SEQUENTIALLY AT A RATE OF 144 GPM (15 GPM PER SQUARE FOOT) < INSERT TONKA PROCESS AT 95% > BACKWASH WILL OCCUR BASED ON:
   a. PRESSURE DIFFERENTIAL (8 – 10 PSI), OR
   b. FINISHED WATER TURBIDITY GREATER THAN 0.25 NTU, OR
   c. ULTRAVIOLET LIGHT ABSORBANCE (UVA) GREATER THAN 0.1.
2. FOLLOWING BACKWASH, THE FILTERS (INCLUDING POLISHING FILTER) WILL BE RINSED TO WASTE AT THE DESIGN FLOW OF THE WTP (24 GPM), UNTIL THE COMBINED FILTER EFFLUENT TURBIDITY, MEASURED AFTER THE POLISHING FILTER, IS LESS THAN 1.5 NTU.

DESIGN CRITERIA

RAW WATER QUALITY (JULY 2019)

COLOR	70	PCU
PH	5.8	
TOTAL NITRATE/NITRITE	0.185	MG/L
ARSENIC	–	BELOW DETECTION LIMIT
IRON	0.75	MG/L
MANGANESE	0.00996	MG/L
CALCIUM	0.282	MG/L
TOTAL DISSOLVED SOLIDS	27	MG/L
LANGELIER INDEX	−5.97	MG/L
HARDNESS	–	BELOW DETECTION LIMIT
ALKALINITY	–	BELOW DETECTION LIMIT
TOTAL ORGANIC CARBON	7.22	MG/L
DISSOLVED ORGANIC CARBON	5.96	MG/L
UV 254 ABSORPTION	0.350	CM-1
SPECIFIC UV ABSORBANCE	5.87	L/MG-M
RAW WATER TURBIDITY	1.07	NTU

POPULATION & DEMAND

2021 COMMUNITY POPULATION	539	PEOPLE (2018 DCCED CERTIFIED)
POPULATION GROWTH RATE	0.9	% (ADOL)
2041 COMMUNITY POPULATION	645	PEOPLE
2041 SCHOOL POPULATION	232	PEOPLE (STUDENTS AND STAFF)
2041 AVERAGE TOTAL DAILY DEMAND	8,800	GPD
2041 MAX TOTAL DAILY DEMAND	10,100	GPD

RAW WATER

ESTIMATED SOURCE WATER VOLUME	4–5	MG (CONTRACTOR'S LAKE)
ADNR WATER RIGHTS	3,600	GPD (2002, LAS 23946)
RAW WATER STORAGE	1.20	MG
STORAGE INTERVAL	10–12	MONTHS

TREATED WATER STORAGE

DAYS OF TREATED WATER STORAGE	6.5	DAYS
TOTAL STORAGE VOLUME	80,000	GALLONS
NUMBER OF TANKS	2	EA
TANK VOLUME (EA)	40,000	GALLONS
TANK DIAMETER	20	FEET
TANK HEIGHT	17	FEET

FILTRATION

MINIMUM CRYPTOSPORIDIUM REMOVAL	2	LOG
MINIMUM GIARDIA REMOVAL	1	LOG
MINIMUM VIRUS REMOVAL	2	LOG
HOURS OF FILTER OPERATION PER DAY	6	HOURS
MINIMUM FILTRATION RATE (TOTAL)	24	GPM
NUMBER OF FILTERS	2	
FILTER DIAMETER	42	INCHES
FILTER LOADING RATE	1.3	GPM/SQFT
POLISHING MEDIA FILTER DIAMETER	42	INCHES

BACKWASH (BW)

NUMBER OF BACKWASHES PER FILTER	1	PER WEEK
FILTERS BACKWASHED	3	EA (INCLUDING POLISHING FILTER)
BW LOADING RATE	15	GPM/SQFT
BW RATE (EA)	144	GPM
BW INTERVAL (EA)	15	MINUTES
BW VOLUME PER FILTER	2,165	GALLONS
AIR SCOUR LOADING RATE	4	CFM/SQFT
AIR SCOUR RATE (EA)	38	CFM

FILTER TO WASTE (FTW)

MAXIMUM FTW CYCLES	1	PER WEEK
FTW RATE	24	GPM (ALL FILTERS SIMULTANEOUSLY)
FTW INTERVAL	20	MINUTES
FTW VOLUME	489	GALLONS

WASTEWATER SURGE TANK

TANK HEIGHT	6	FEET
TANK DIAMETER	6	FEET
TANK VOLUME	5,000	GALLONS

CHLORINATION

MINIMUM GIARDIA DISINFECTION	1	LOG
MINIMUM VIRUS DISINFECTION	2	LOG
HOURS OF ACTIVE WATER USE	16	HOURS/DAY
PEAKING FACTOR	3	
PEAK HOURLY FLOW FOR CT	28	GPM
MINIMUM REQUIRED VOLUME FOR CT	17,000	GALLONS
GIARDIA DISINFECTION	1	LOG
CHLORINE FREE RESIDUAL	0.40	MG/L
PH	7	

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VILLAGE SAFE WATER

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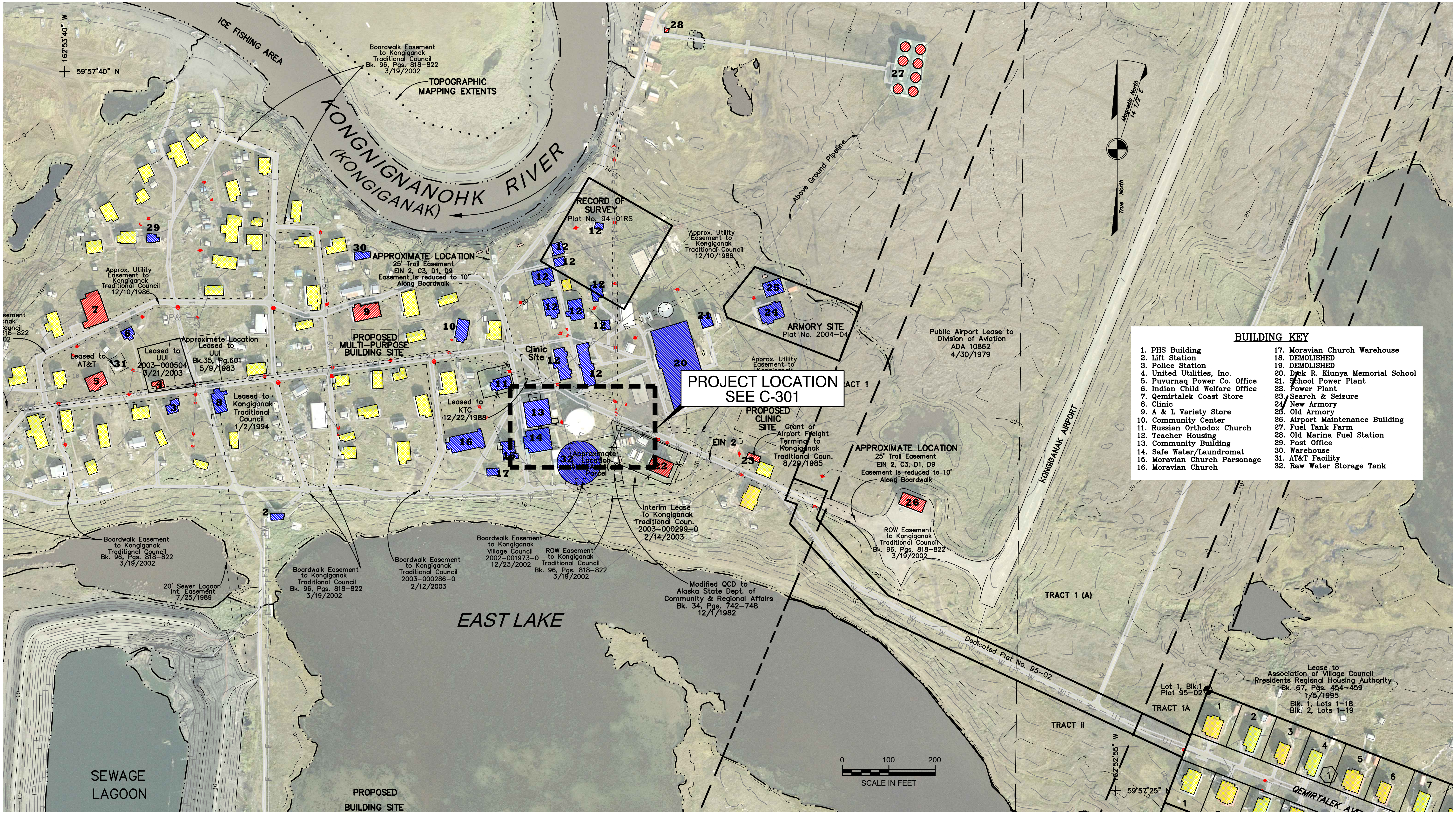
KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

OPERATIONAL NARRATIVE & DESIGN CRITERIA

SHEET NO. A-102

SCALE: N/A | DESIGNED: VBW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET 2 OF X



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VILLAGE SAFE WATER

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KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

VICINITY MAP / EXISTING CONDITIONS

SCALE: SHOWN | DESIGNED: JDW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021

SHEET NO.
C-101
SHEET X OF X

User: JWANDER Mar 17, 2021 - 1:22pm
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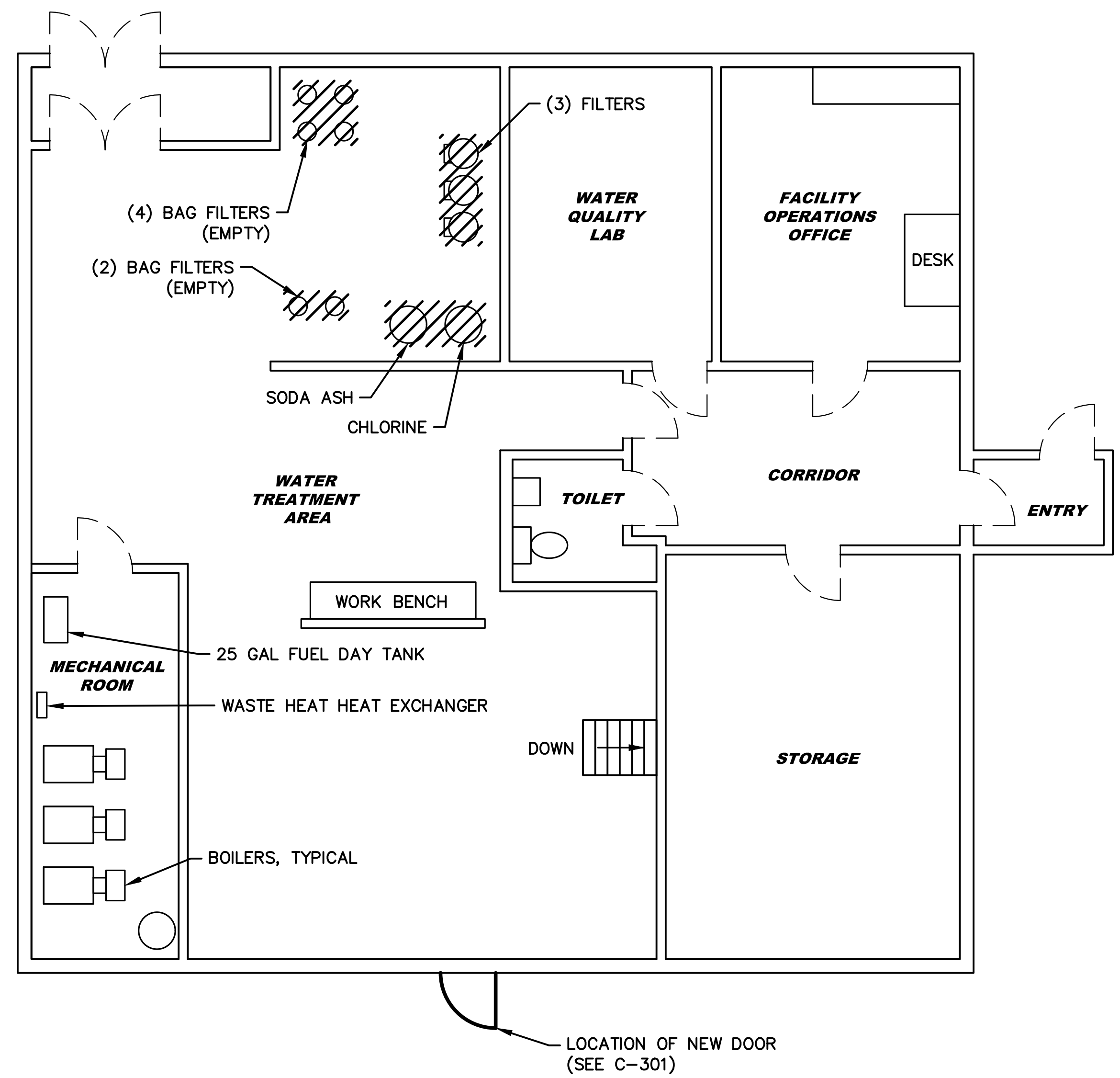
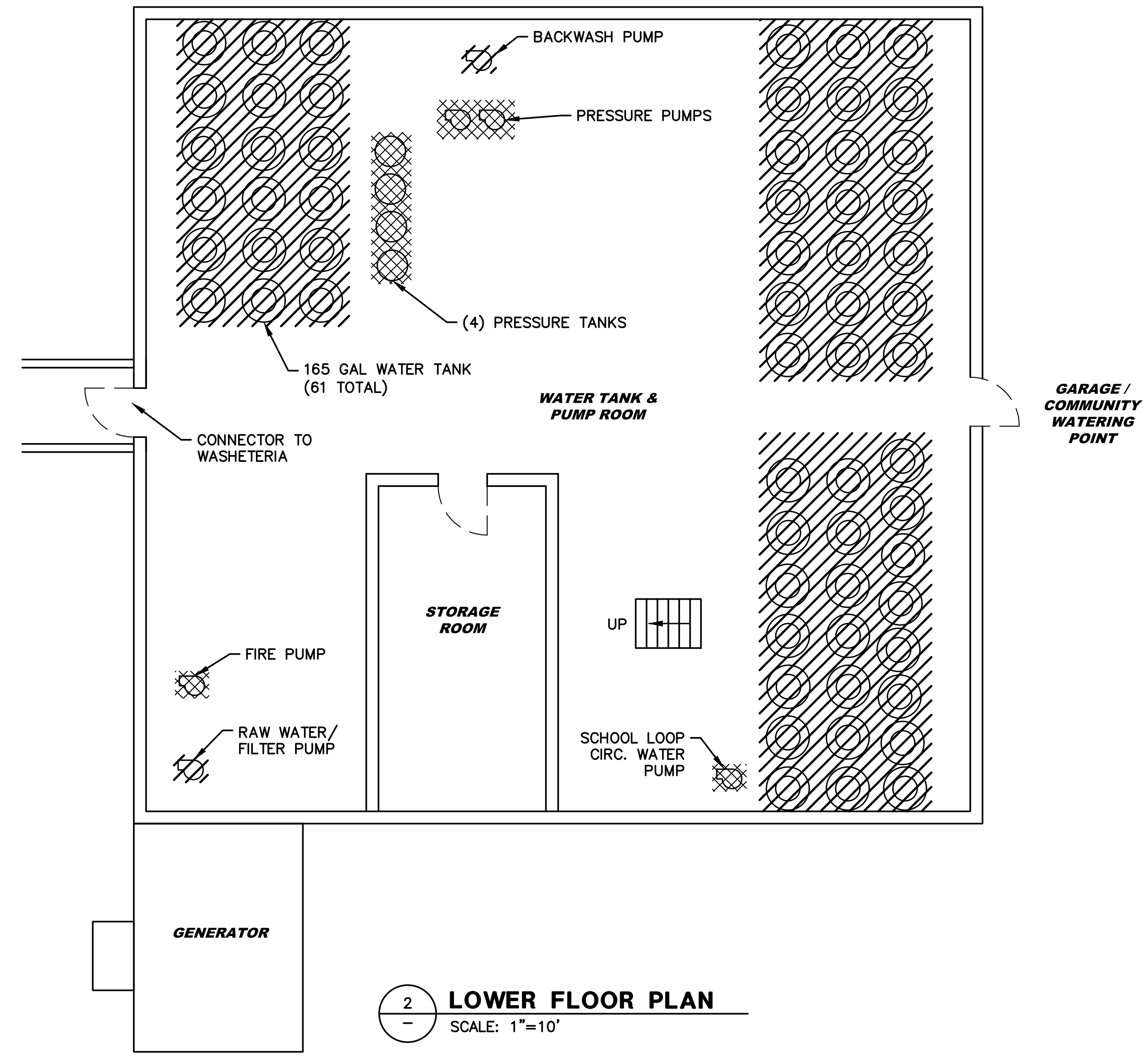


1 MAIN (UPPER) FLOOR PLAN
SCALE: 1"=10'



2 LOWER FLOOR PLAN
SCALE: 1"=10'

LEGEND:

REMOVE AND REPLACE

REMOVE PERMANENTLY

35% PRELIMINARY DESIGN

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VILLAGE SAFE WATER

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KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

DEMOLITION PLAN
OLD WTP

SHEET NO.
C-201

SCALE: SHOWN | DESIGNED: JDW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET X OF X

User: JWANDER Mar 17, 2021 – 1:22pm
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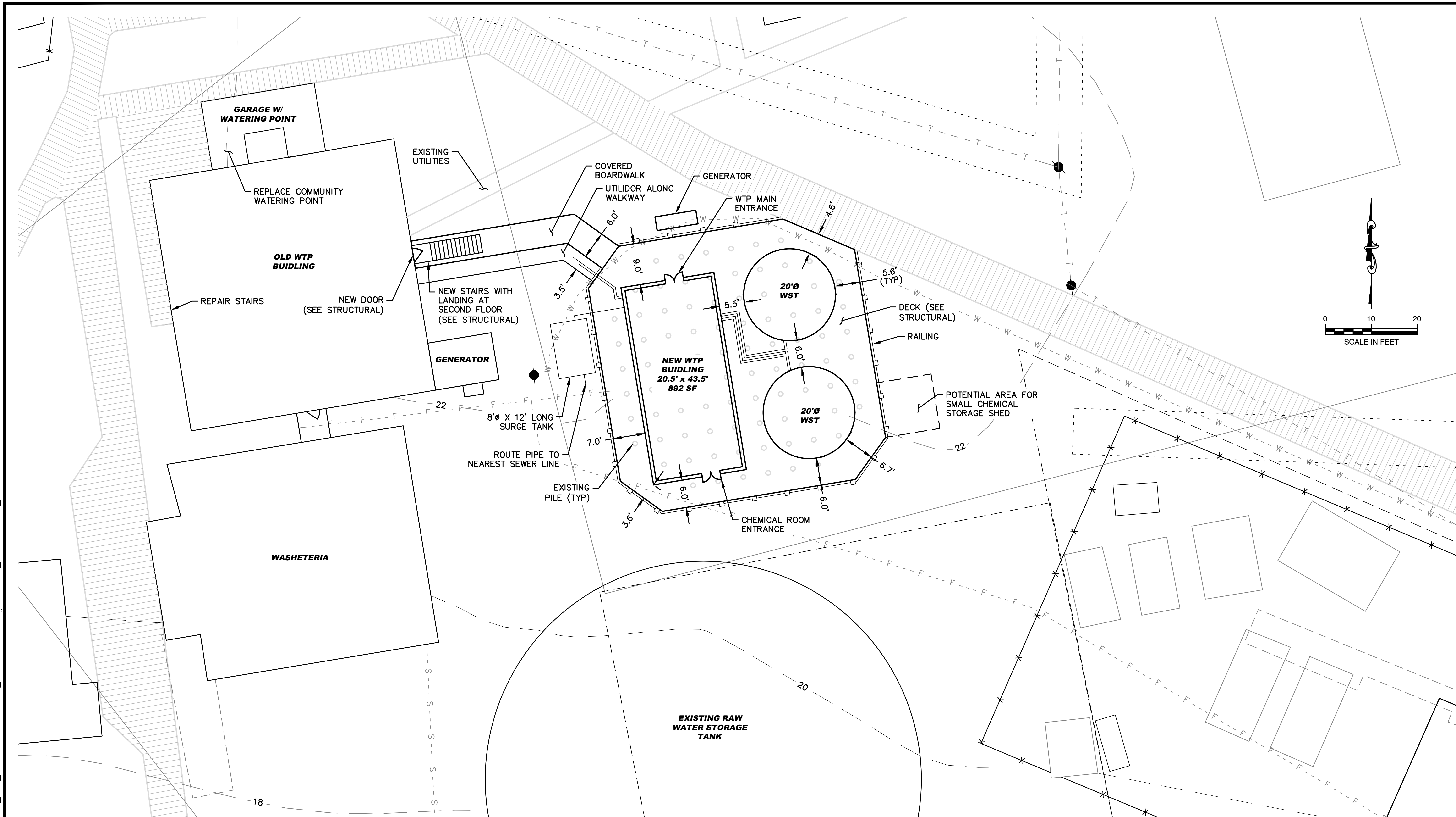

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VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

SITE PLAN

SHEET NO.
C-301

SCALE: SHOWN | DESIGNED: JDW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET X OF X

User: JWANDER Mar 17, 2021 – 1:22pm
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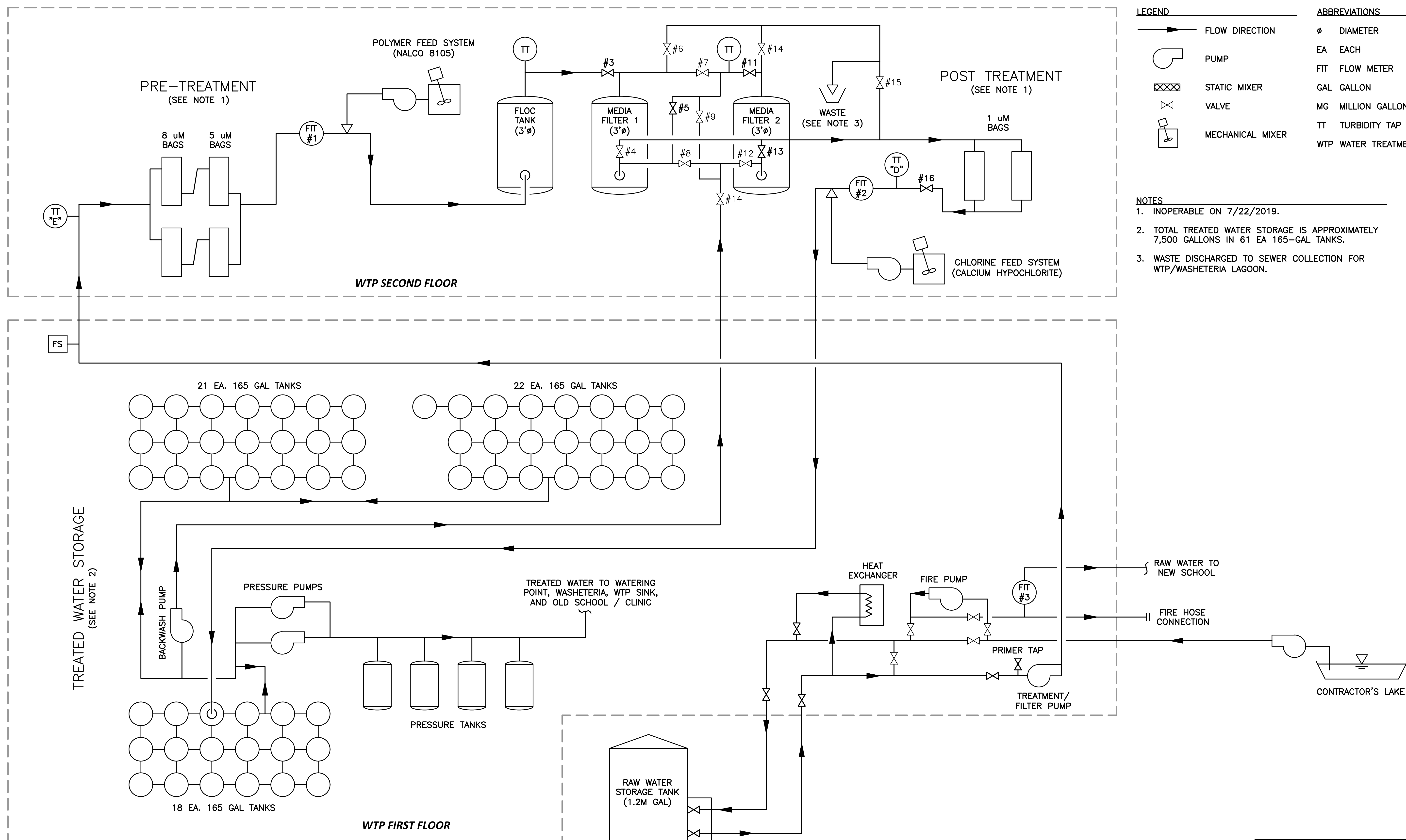
Xrefs: BR22X34REV.DWG KONGIGANAK_NAD_83.DWG KONGIGANAK_100.DWG – Images: KONG_1FT.TIF KONG_2FT.TIF



LEGEND

- FLOW DIRECTION
- PUMP
- STATIC MIXER
- VALVE
- MECHANICAL MIXER

ABBREVIATIONS

ø	DIAMETER
EA	EACH
FIT	FLOW METER
GAL	GALLON
MG	MILLION GALLONS
TT	TURBIDITY TAP
WTP	WATER TREATMENT PLANT

NOTES

1. INOPERABLE ON 7/22/2019.
2. TOTAL TREATED WATER STORAGE IS APPROXIMATELY 7,500 GALLONS IN 61 EA 165–GAL TANKS.
3. WASTE DISCHARGED TO SEWER COLLECTION FOR WTP/WASHETERIA LAGOON.

35% PRELIMINARY DESIGN

REVISIONS				REVISIONS			
NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

Project No. 32190078
AECC No. 697

Bristol
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VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

EXISTING PROCESS SCHEMATIC

SHEET NO. **P-101**

SCALE: NTS | DESIGNED: DWB | CHECKED: VBW | DRAWN: DWB | DATE: MAR 2021 | SHEET X OF X

User: JWANDER Mar 17, 2021 – 1:22pm Drawing: K:\JOBS\32190078 KONGIGANAK VSW\ACAD-DESIGN\DAR PHASE II\32190078_KONG_P-101_EXISTING PROCESS SCHEMATIC.DWG – Layout: P-101
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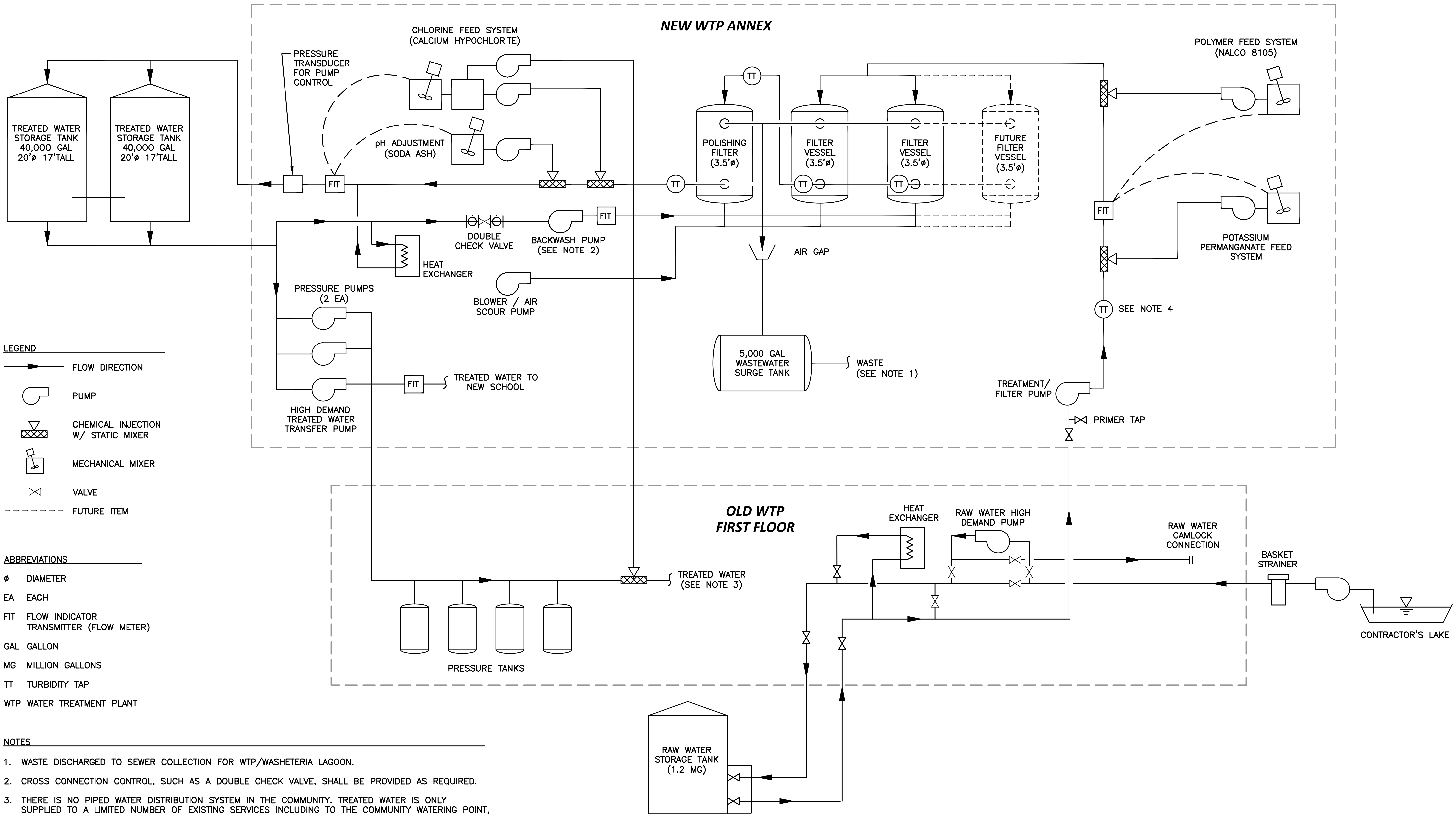

LEGEND

- FLOW DIRECTION
- PUMP
- CHEMICAL INJECTION W/ STATIC MIXER
- MECHANICAL MIXER
- VALVE
- FUTURE ITEM

ABBREVIATIONS

ø DIAMETER
EA EACH
FIT FLOW INDICATOR TRANSMITTER (FLOW METER)
GAL GALLON
MG MILLION GALLONS
TT TURBIDITY TAP
WTP WATER TREATMENT PLANT

NOTES

1. WASTE DISCHARGED TO SEWER COLLECTION FOR WTP/WASHETERIA LAGOON.
2. CROSS CONNECTION CONTROL, SUCH AS A DOUBLE CHECK VALVE, SHALL BE PROVIDED AS REQUIRED.
3. THERE IS NO PIPED WATER DISTRIBUTION SYSTEM IN THE COMMUNITY. TREATED WATER IS ONLY SUPPLIED TO A LIMITED NUMBER OF EXISTING SERVICES INCLUDING TO THE COMMUNITY WATERING POINT, WASHETERIA, WTP SINK(S), THE OLD SCHOOL, AND THE HEALTH CLINIC.
4. RAW WATER WILL BE PRE-HEATED IN THE ARCTIC PIPE CARRYING HYDRONIC BUILDING HEAT SUPPLY FOR WTP ANNEX.

User: JWANDER Mar 17, 2021 – 1:22pm
Drawing: K:\JOBS\32190078_KONGIGANAK VSW\ACAD-DESIGN\DAR PHASE II\32190078_KONG_P-201_NEW PROCESS SCHEMATIC.DWG – Layout: P-201
Xrefs: BR22X34REV.DWG – Images: None

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VILLAGE SAFE WATER

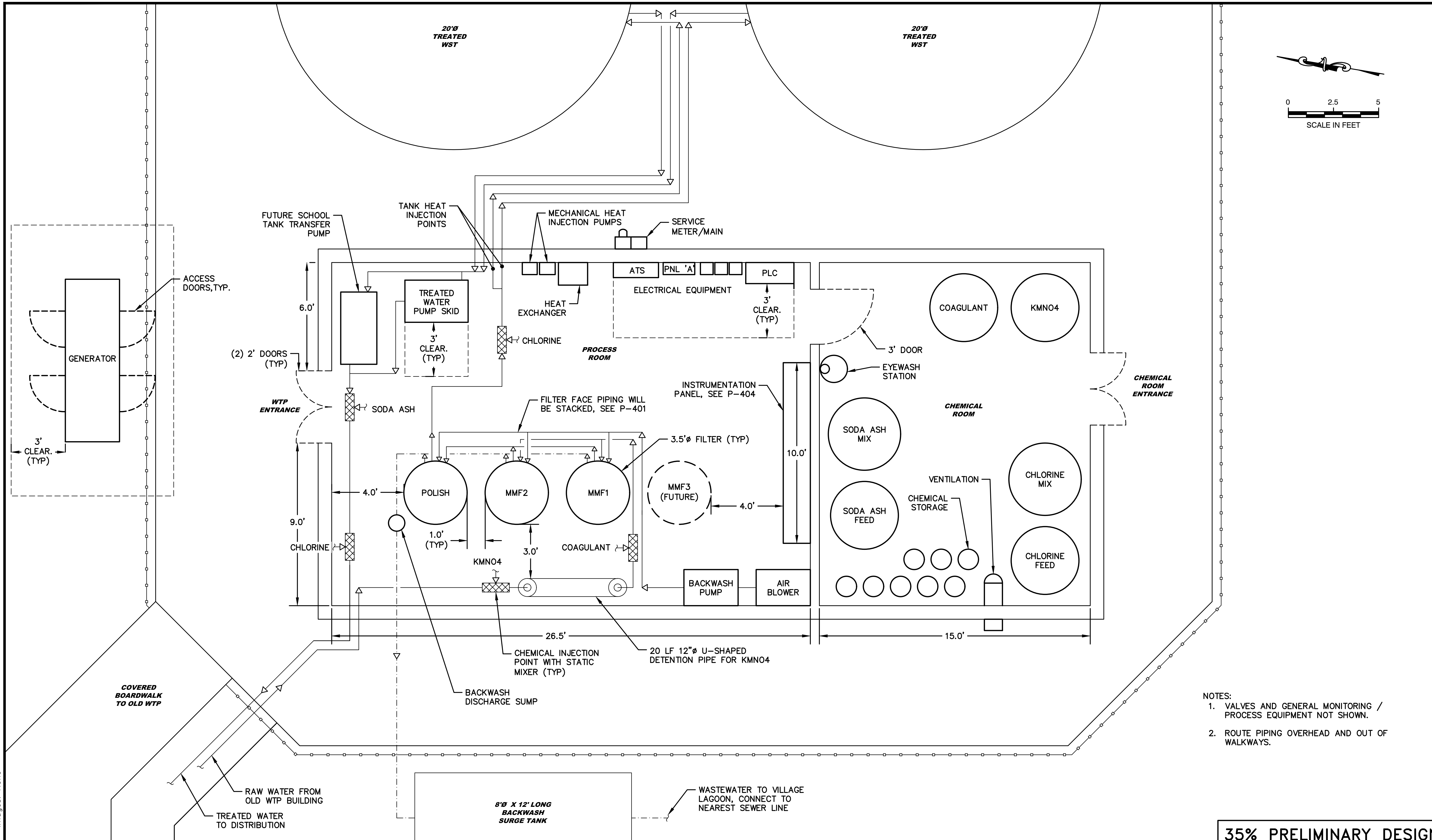
NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

NEW PROCESS SCHEMATIC

SHEET NO. **P-201**

SCALE: NTS | DESIGNED: VBW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET X OF X



NOTES:
1. VALVES AND GENERAL MONITORING / PROCESS EQUIPMENT NOT SHOWN.
2. ROUTE PIPING OVERHEAD AND OUT OF WALKWAYS.

35% PRELIMINARY DESIGN

REVISIONS			
NO.	DATE	BY	DESCRIPTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

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VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

FLOOR PLAN
NEW WTP

SHEET NO. **P-301**

SCALE: SHOWN | DESIGNED: JDW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET X OF X

User: JWANDER Mar 17, 2021 – 1:23pm
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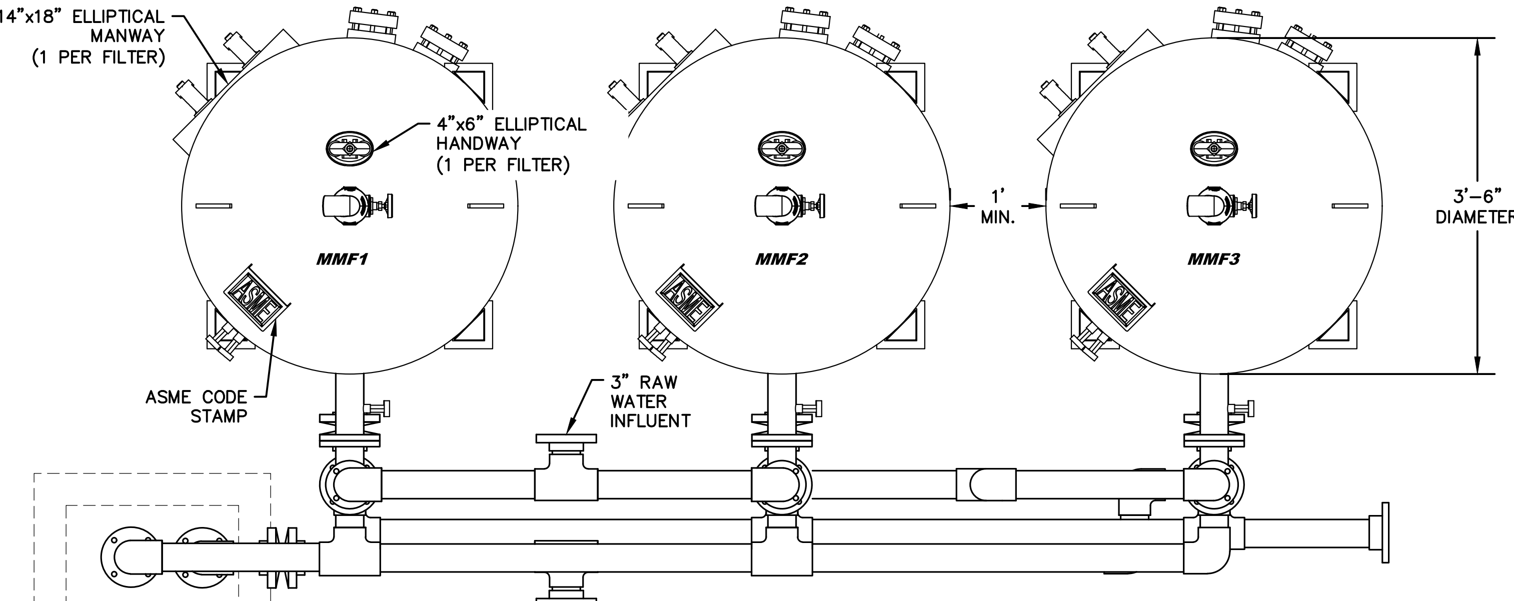


1 PLAN VIEW
SCALE: 1"=1'

VERTACELL™ PRESSURE FILTER SPECIFICATIONS:

NUMBER OF FILTERS:
TWO (2) IN PARALLEL FOLLOWED BY ONE (1) POLISHING FILTER IN SERIES

FILTER AREA:
9.6 SQ. FT./FILTER

FILTRATION RATE:
24 GPM (1.3 GPM/SQFT/FILTER)

BACKWASH RATE:
144 GPM (15 GPM/SQ. FT/FILTER)
(APPROXIMATE BACKWASH RATE ONLY. ACTUAL RATE SET BY TECHNICIAN AT START-UP)

SIMUL-WASH™ WATER RATE:
43 GPM (5 GPM/SQ. FT.) PER FILTER
AIR RATE:
29 CFM (3 CFM/SQ. FT.)

SUPPORT GRAVELS:
4" DEPTH – 3/4" x 1/2" GRADED GRAVEL
4" DEPTH – 1/2" x 1/4" GRADED GRAVEL
4" DEPTH – 1/4" x 1/8" GRADED GRAVEL
3" DEPTH – TORPEDO SAND

FILTER MEDIA:
18" SILICA SAND, 0.45–0.55 mm WITH A UNIFORMITY COEFFICIENT LESS THAN 1.6

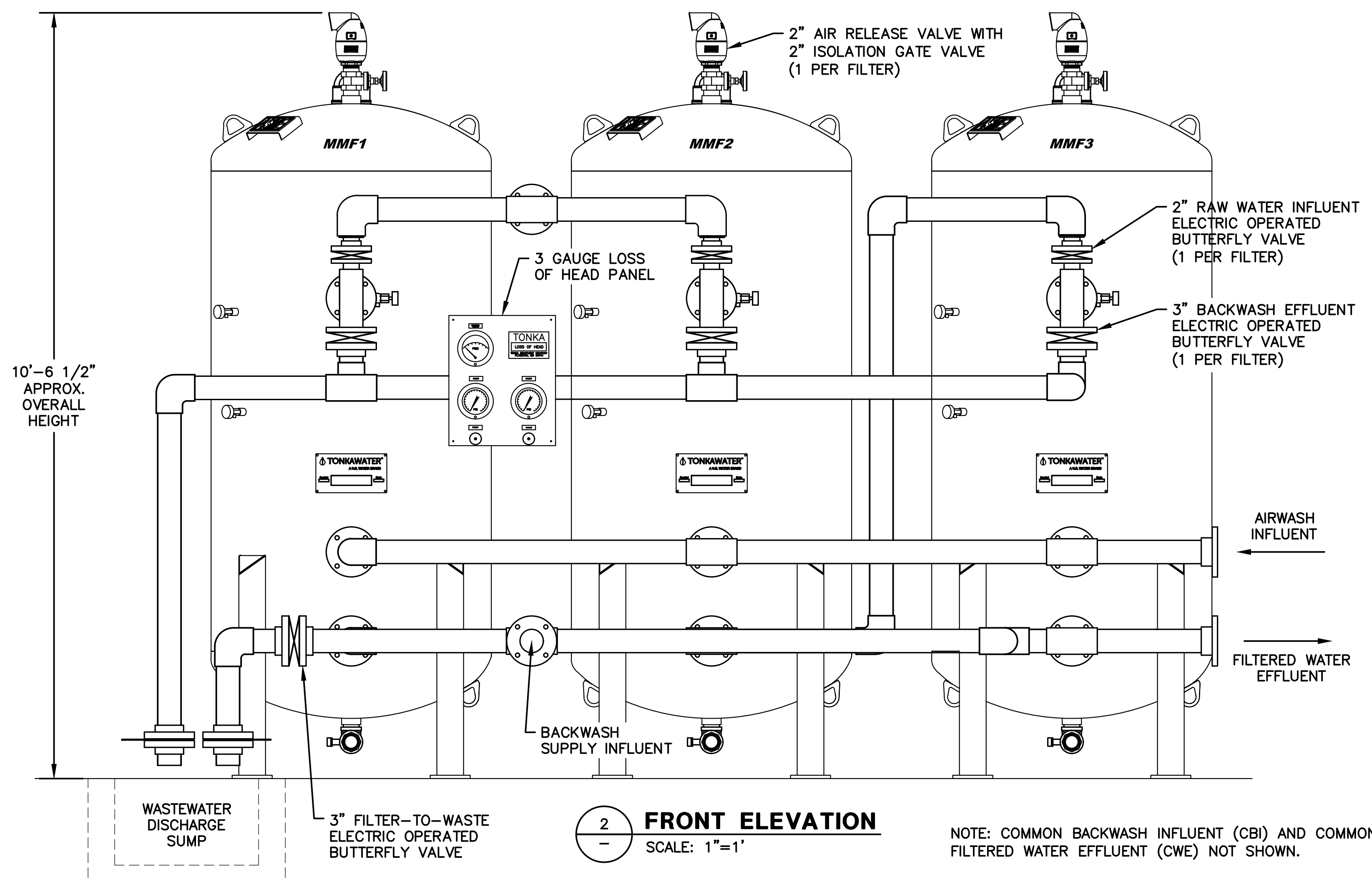
12" ANTHRACITE, 0.8–1.0 mm WITH A UNIFORMITY COEFFICIENT LESS THAN 1.6

UNDERDRAIN:
TONKA PVC HEADER/LATERAL UNDERDRAIN COLLECTION/BACKWASH WATER DISTRIBUTION SYSTEM WITH TONKA ABS DIFFUSER NOZZLES

CONSTRUCTION:
WORKING PRESSURE–100 PSIG
HYDROSTATIC TEST PRESSURE–130 PSIG
BUILT TO ASME CODE AND STAMPED.

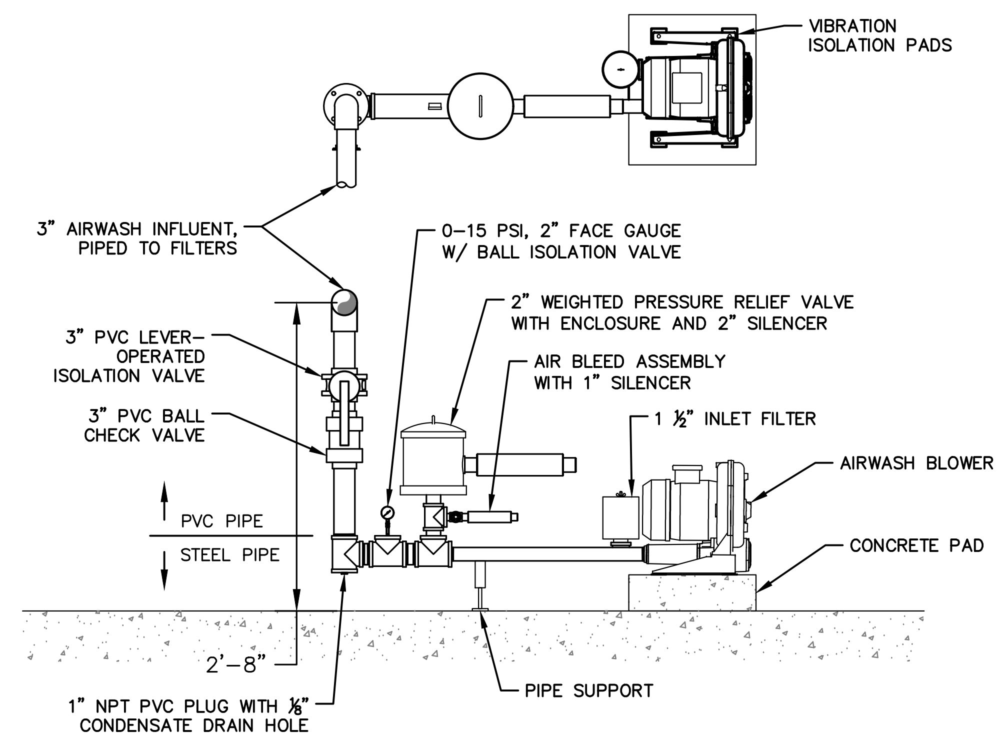
PIPE:
SCHEDULE 40 AND 80 PVC

TANK FLANGES:
150 LBS. SLIP ON WELDED FLANGES. WELDED ON SPLIT CENTERS.



2 FRONT ELEVATION
SCALE: 1"=1'

NOTE: COMMON BACKWASH INFLUENT (CBI) AND COMMON FILTERED WATER EFFLUENT (CWE) NOT SHOWN.



3 AIR SCOUR BLOWER DETAIL
SCALE: NTS

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REVISIONS				REVISIONS			
NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

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VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

PROCESS DETAILS FILTERS

SHEET NO. P-401

SCALE: SHOWN | DESIGNED: VBW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET X OF X

User: JWANDER Mar 17, 2021 – 1:23pm
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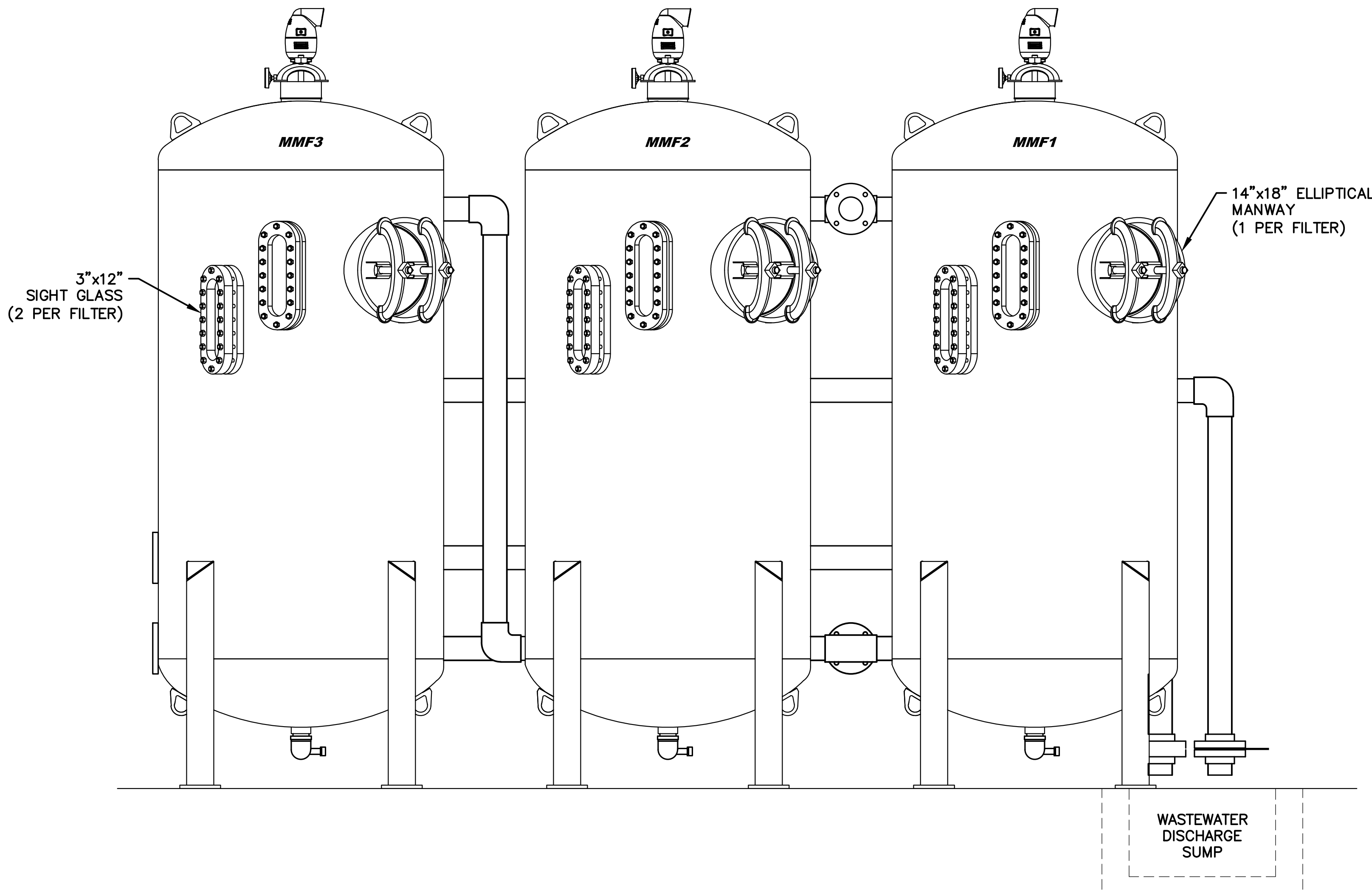
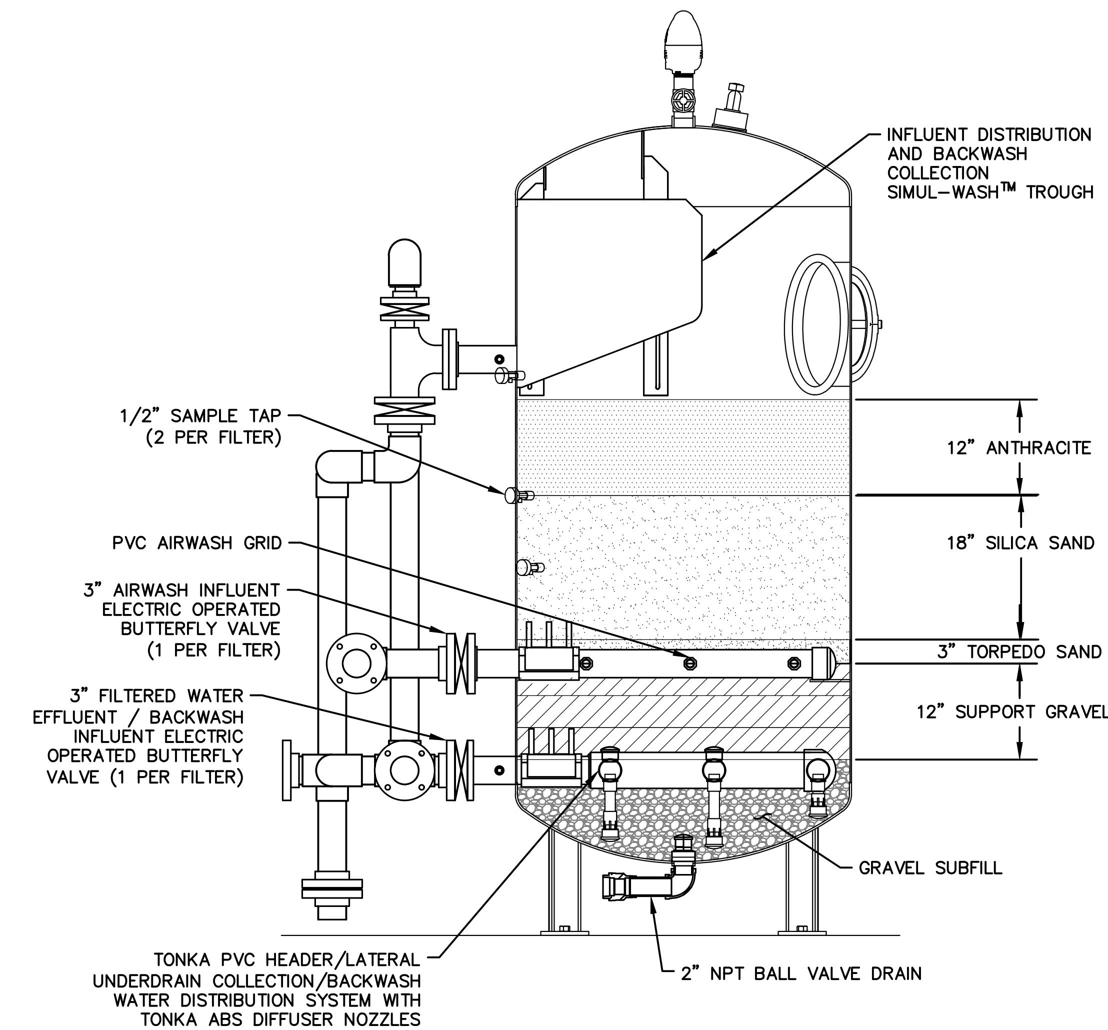


1 – REAR ELEVATION
SCALE: 1"=1'



2 – SECTION / SIDE ELEVATION
SCALE: 1"=1'

35% PRELIMINARY DESIGN

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NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

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Bristol
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VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

PROCESS DETAILS
FILTERS

SCALE: SHOWN	DESIGNED: VBW	CHECKED: VBW	DRAWN: JDW	DATE: MAR 2021

SHEET NO.
P-402
SHEET X OF X

User: JWANDER Mar 17, 2021 – 1:23pm
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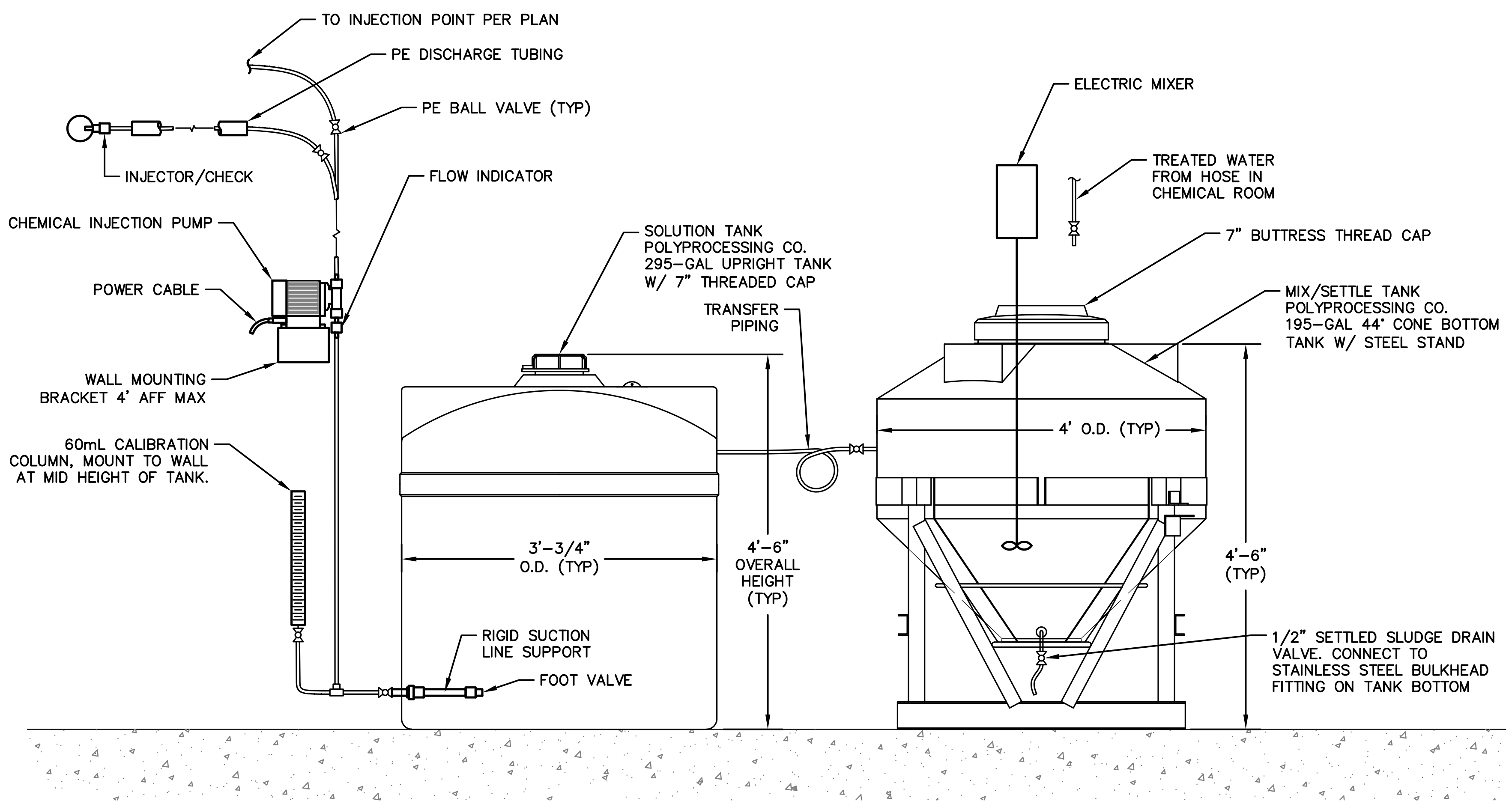
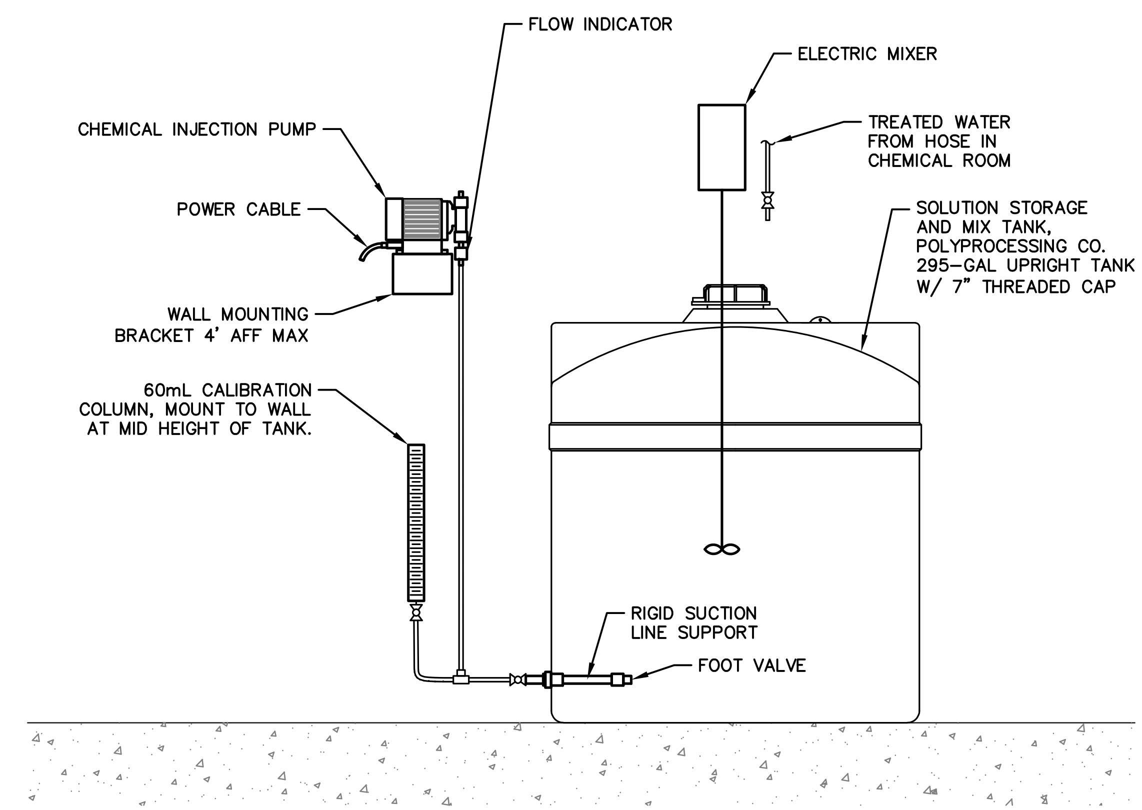


1
–
INJECTION SYSTEM - DRY CHEMICALS
SCALE: NTS
USE FOR: CHLORINE, SODA ASH



2
–
INJECTION SYSTEM - LIQUID CHEMICALS
SCALE: NTS
USE FOR: COAGULANT, KMNO4

User: JWANDER Mar 26, 2021 - 4:11pm
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Xrefs: BR22X34REV.DWG - Images: None

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REVISIONS			
NO.	DATE	BY	DESCRIPTION

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AECC No. 697

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VILLAGE SAFE WATER

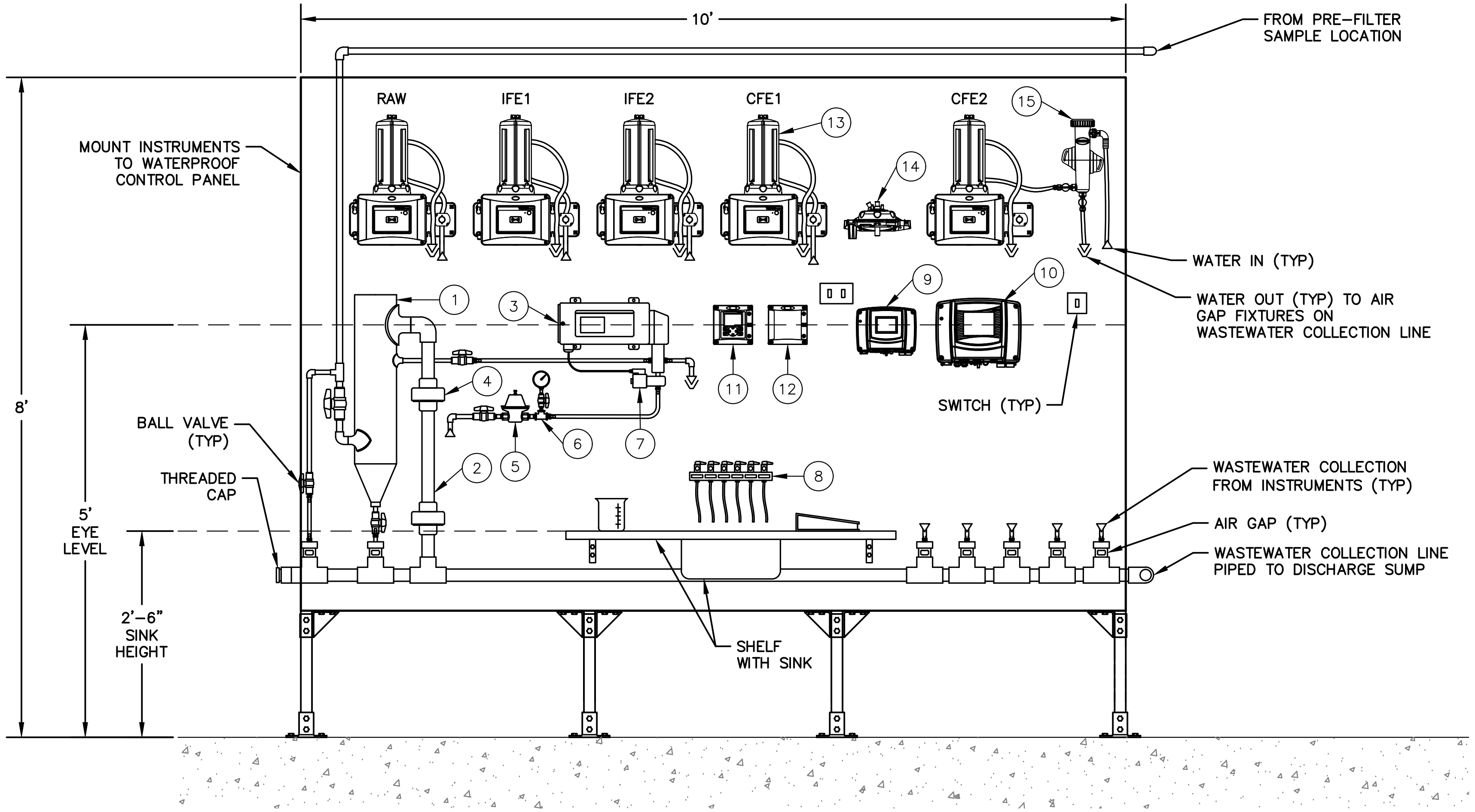
NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

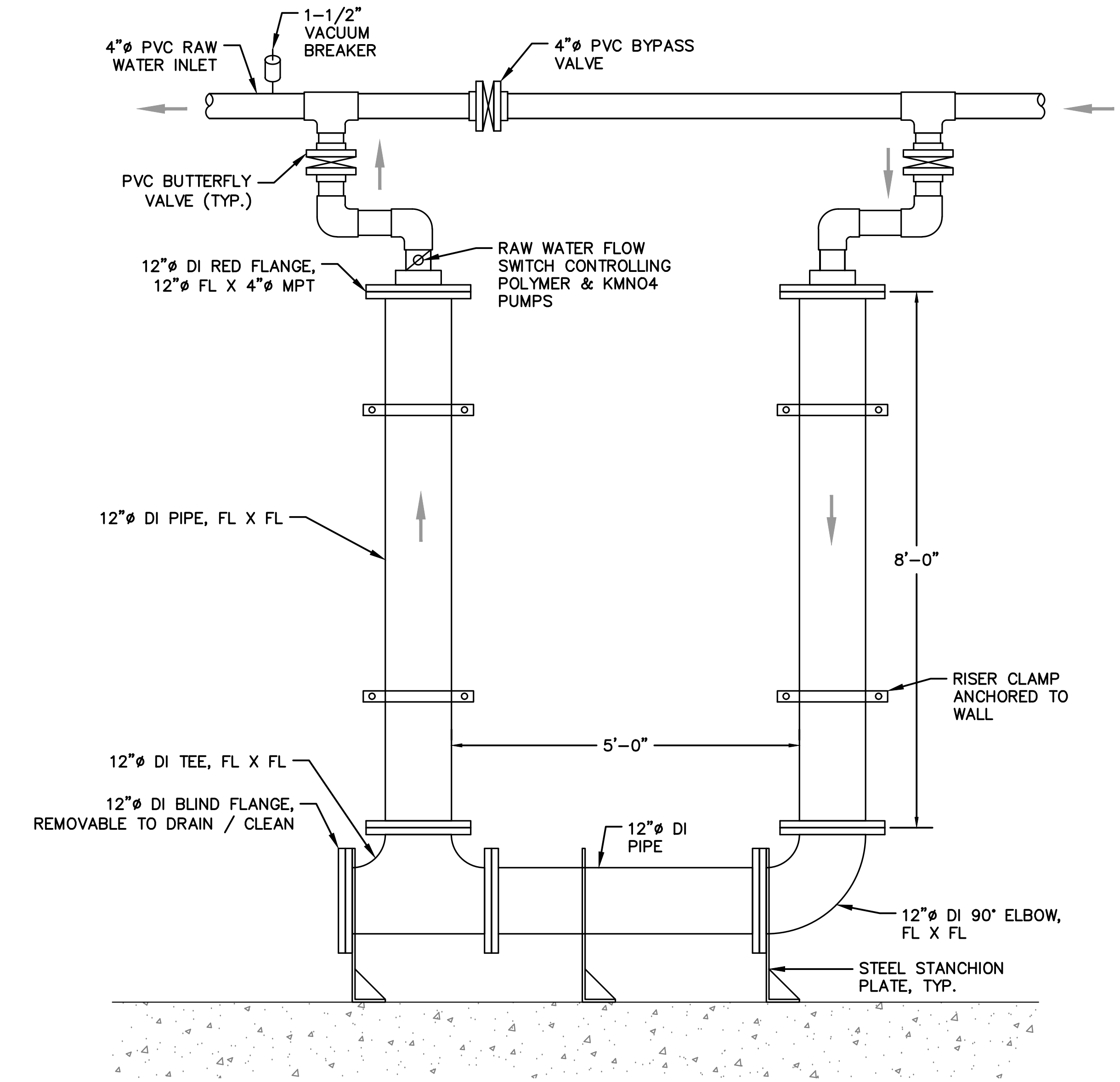
PROCESS DETAILS
CHEMICAL TANKS

SHEET NO.
P-403

SCALE: NTS | DESIGNED: VBW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET X OF X



1 CONTROL PANEL
SCALE: NTS



2 DETENTION CHAMBER DETAIL
SCALE: NTS

DESIGN CRITERIA:

DESIGN FLOW RATE = 24 GPM
DETENTION PIPE DIAMETER = 12 INCHES
DETENTION VOLUME PER FOOT = 15 GAL/FT
TOTAL DETENTION PIPE LENGTH = 22 FT
TOTAL DETENTION VOLUME = 330 GAL
TOTAL DETENTION TIME = 14 MIN

TURBIDIMETERS:

RAW – RAW WATER PRIOR TO TREATMENT
IFE1 – INDIVIDUAL FILTER EFFLUENT FROM MMF1
IFE2 – INDIVIDUAL FILTER EFFLUENT FROM MMF2
CFE1 – COMBINED FILTER EFFLUENT FROM MMF1 + MMF2
CFE2 – COMBINED FILTER EFFLUENT FROM POLISHING FILTER (COMPLIANCE POINT)

NOTES:

1. WATER IN / OUT PIPING TO / FROM INSTRUMENTS AND ELECTRICAL CONNECTIONS NOT SHOWN FOR CLARITY.

INSTRUMENTATION KEY:

1 CYCLONE SEPARATOR
2 CLEAR PVC
3 MILTON ROY SC5200
4 UNION (TYP)
5 PRESSURE REGULATOR
6 PRESSURE GAUGE WITH ISOLATION VALVE
7 JET WASH
8 SAMPLE TAPS
9 HACH SC200
10 HACH SC1000
11 HACH SC1000 PROBE MODULE 1 AND SCREEN
12 HACH SC1000 PROBE MODULE 2
13 HACH TU5300 TURBIDIMETER WITH WASHER (TYP)
14 SERVICE BRACKET FOR TURBIDIMETERS
15 BUBBLE TRAP INSTALLED WITH CFE2 TURBIDIMETER

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REVISIONS				REVISIONS			
NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

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AECC No. 697
Bristol
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VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

PROCESS DETAILS
CONTROL PANEL & DETENTION CHAMBER

SCALE: NTS | DESIGNED: VBW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021

SHEET NO. P-404

SHEET X OF X

User: JWANDER Mar 17, 2021 – 1:23pm
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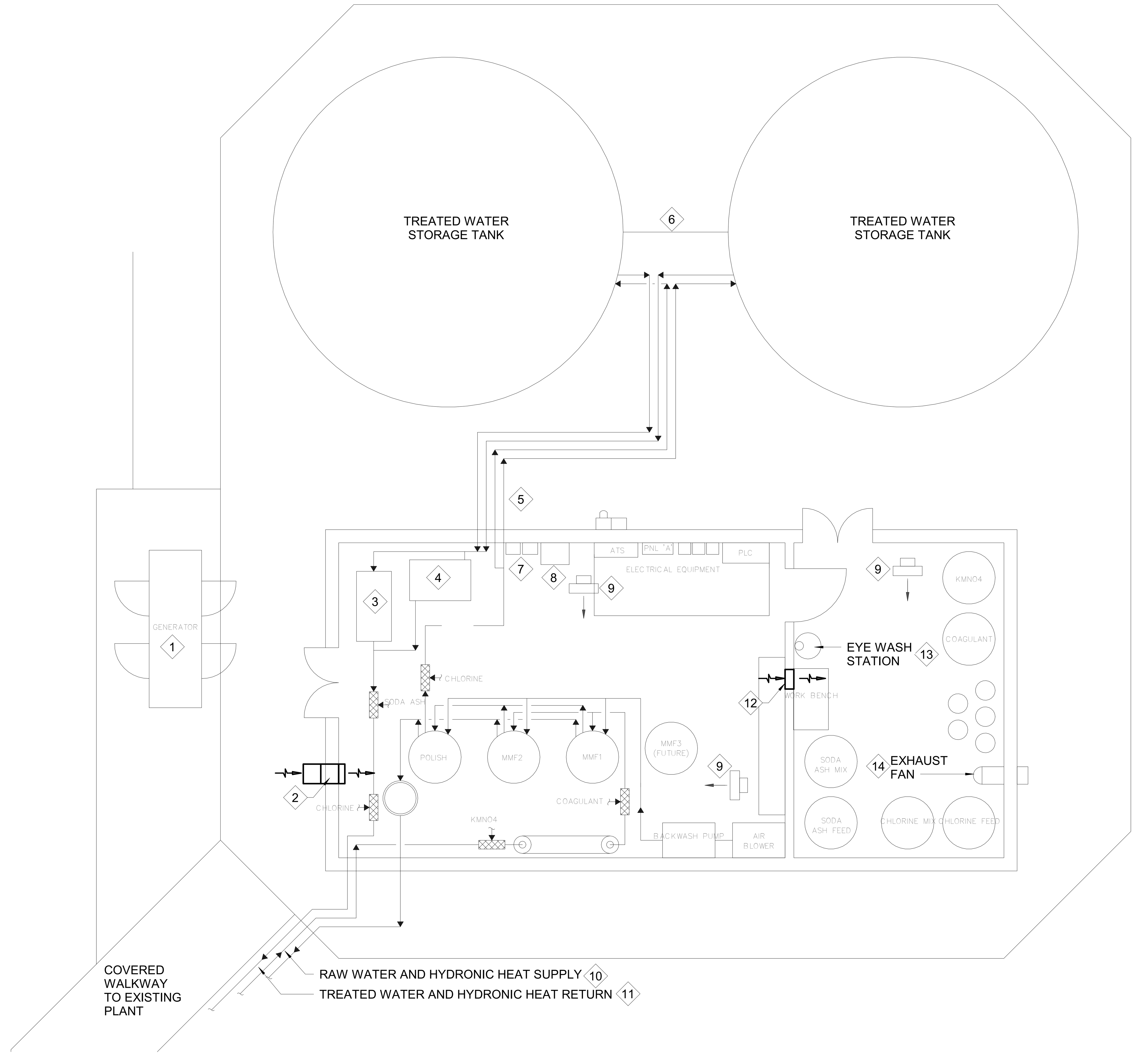


1 M-101 MECHANICAL SYSTEM PLAN
1/4" = 1'-0"

GENERAL SHEET NOTES

1. ALL WORK TO BE COMPLETED IN ACCORDANCE WITH CURRENT CODE.
2. REFERENCE CIVIL AND PROCESS DRAWINGS FOR RAW AND TREATED WATER SYSTEM DESIGN.

X SHEET KEY NOTES

1. GENERATOR MODULE. UNIT TO HAVE BELLY-TANK FUEL OIL STORAGE.
2. CHEMICAL ROOM MAKE-UP OUTSIDE AIR INTAKE HOOD W/ INSULATED CONTROL DAMPER.
3. HIGH FLOW/HIGH CAPACITY PUMP.
4. DOMESTIC WATER PRESSURE PUMPS. TWO PUMP SKID W/ VFDS. CONTROLLED BASED ON DISCHARGE PRESSURE.
   A. EXISTING PRESSURE TANKS INSIDE EXISTING BUILDING TO REMAIN.
5. INDIVIDUAL WATER LINES TO AND FROM EACH STORAGE TANK FOR INDIVIDUAL HEAT-ADD CONTROL AS WELL AS RESILIENCY IN TREATED WATER STORAGE.
6. COMMON CONNECTOR TO MAINTAIN EQUAL TANK LEVELS. PROVIDED WITH ISOLATION VALVE FOR MAINTENANCE.
7. HEAT ADD SYSTEM PUMPS, SEPARATE PUMP FOR EACH TANK TO ALLOW INDIVIDUAL CONTROL.
8. DOUBLE WALL, BRAZED PLATE HEAT EXCHANGER FOR HEAT-ADD SYSTEM.
9. HYDRONIC UNIT HEATER FOR SPACE HEAT.
10. GLYCOL HEATED SUPPLY MAIN FROM EXISTING BOILER PLANT, ROUTED WITHIN THE RAW WATER ARCTIC PIPE.
11. GLYCOL HEATED RETURN MAIN BACK TO EXISTING BOILER PLANT, ROUTED WITHIN THE TREATED WATER ARCTIC PIPE.
12. CHEMICAL STORAGE MAKE-UP AIR DRAWN FROM PROCESS ROOM PLANT. PROVIDE BACKDRAFT DAMPER WITH CHEMICAL RESISTANT BLADE SEALS.
13. EYE/FACE WASH STATION.
   A. PROVIDE TEMPERED WATER MIXING VALVE.
   B. CW CONNECTED DOWNSTREAM OF TREATED WATER PRESSURE SKID.
   C. HW TO PROVIDED FROM AN INDIRECT FIRED WATER HEATER.
14. EXHAUST FAN AND EXHAUST HOOD FOR CHEMICAL STORAGE ROOM. PLASTIC CONSTRUCTION.

35% DESIGN SUBMITTAL

REVISIONS				REVISIONS			
NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

Project No. 32190032

EDC, INC.
213 W. FIREWEED LANE
ANCHORAGE, AK 99503
(907) 276-7933
LICENSE NO. AECC705

VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

MECHANICAL PLAN

SHEET NO. **M-101**

SCALE: 1/4" = 1'-0"	DESIGNED: CDF	CHECKED: CDF	DRAWN: CDF	DATE: MAR 2021	SHEET OF

SHEET NOTES

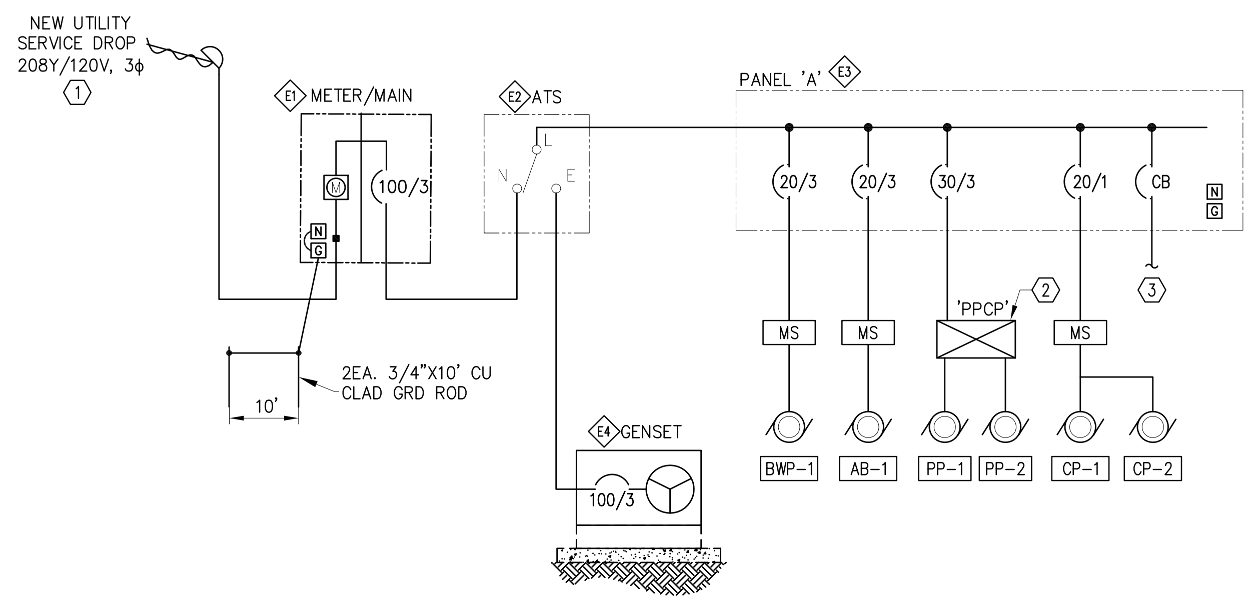
1. PROVIDE INSTALLATION OF NEW 3ø UTILITY SERVICE. COORDINATE ALL WORK IN ACCORDNACE WITH THE UTILITY'S REQUIREMENTS.
2. PRESSURE PUMP CONTROL PANEL (PPCP). SKID MOUNTED CONTROL PANEL AND PUMPS, USING VARIABLE FREQUENCY DRIVES (VFD) TO MAINTAIN DISTRIBUTION PRESSURE SET POINT.
3. ALL OTHER BRANCH CIRCUIT LOADS SUCH AS LIGHTING, RECEPTACLES AND 120V EQUIPMENT ARE NOT SHOWN. ONLY MAJOR EQUIPMENT LOADS RELATED TO THE TREATMENT PROCESS.

EQUIPMENT CONNECTION SCHEDULE

TAG ID	LOAD KVA	LOAD HP	LOAD FLA	LOAD V	LOAD PH	CIRCUIT SIZE	NOTES
BWP-1				208	3	SEE POWER ONE-LINE	BACKWASH PUMP
AB-1				208	3	SEE POWER ONE-LINE	AIR BLOWER
PP-1				208	3	SEE POWER ONE-LINE	PRESSURE PUMP 1
PP-2				208	3	SEE POWER ONE-LINE	PRESSURE PUMP 2
CP-1				120	1	SEE POWER ONE-LINE	GLYCOL CIRC PUMP 1
CP-2				120	1	SEE POWER ONE-LINE	GLYCOL CIRC PUMP 2

ELECTRICAL EQUIPMENT SCHEDULE

ITEM NO.	DESCRIPTION	MANUFACTURER/ NOTES
E1	100A, 208Y/120V, 3ø, 4W METER/MAIN, NEMA 3R	EQUIPMENT IN ACCORDANCE WITH UTILITY STANDARDS
E2	100A, 208V, 3ø, 4W, 3PDT, NEMA 3R AUTOMATIC TRANSFER SWITCH 'ATS'	
E3	100A, 208Y/120V, 3ø, 4W PANELBOARD, 42 SPACE, NEMA 1	SQUARE D
E4	25KW, 208Y/120V, 3ø, 4W, STANDBY DIESEL-FIRED GENERATOR SET WITH INTEGRAL FUEL TANK IN WEATHERPROOF/SOUND ATTENUATED ENCLOSURE	



1 E-601 **POWER ONE-LINE - NEW WATER TREATMENT PLANT**
SCALE: NTS

35% DESIGN SUBMITTAL

NO.	DATE	BY	DESCRIPTION

REVISIONS

NO.	DATE	BY	DESCRIPTION

REVISIONS

EDC, INC.
213 W. FIREWEED LANE
ANCHORAGE, AK 99503
(907) 276-7933
LICENSE NO. AECC705

VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

WTP POWER ONE-LINE

SHEET NO. **E-601**

SCALE: AS NOTED | DESIGNED: JP | CHECKED: JP | DRAWN: OM | DATE: MAR 2021 | SHEET X OF X

Appendix B – Specification Outline

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KONGIGANAK WTP UPGRADE
SPECIFICATIONS
DRAFT -- TABLE OF CONTENTS -- *DRAFT*

Early completion of final design for the new WSTs and the structural decking will be completed by force account labor and will include sheet specifications. The following specifications will be used for final construction, based on a bid – build process.

DIVISION 33 – UTILITIES

DIVISION 40 – PROCESS INTERCONNECTIONS

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

Appendix C – Equipment Data Sheets

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Materials

Check Valve Bodies: Epoxy coated cast iron
Seats: Stainless Steel

Pressure — Temperature

Temperatures Range: 33°F – 110°F (0.5°C – 43°C) continuous, 140°F (60°C) intermittent

Maximum Working Pressure: 175psi (12.1 bar)

Standards

AWWA C510-92

IAPMO PA 31

USC Manual for Cross-Connection Control, 8th Edition

Approvals

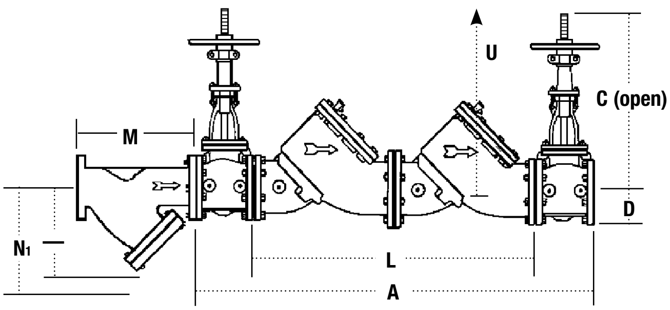
1015 B64.5

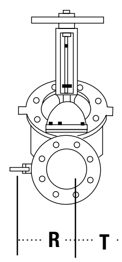
Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Sizes 4" – 10" approved horizontal and vertical “flow up”. Size 2½" and 3" approved horizontal only.

Factory Mutual approved 4" – 10" vertical “flow up” with OSY gate valves only.

Note: Model “S” not listed

Dimensions — Weights





SIZE	DIMENSIONS															
	A		C (OSY)		C (NRS)		D		L		U††		M		N	
in.	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*
2½	39⅜	1000	16⅜	416	9⅜	238	3½	89	24⅛	613	11	279	10	254	6½	165
3	40⅜	1025	18⅞	479	10¼	260	3¾	95	24⅛	613	14	356	10⅛	257	7	178
4	52⅜	1330	22¾	578	12³⁄₁₆	310	4½	114	34⅛	867	14	356	12⅛	308	8¼	210
6	62⅞	1597	30⅛	765	16	406	5½	140	41⅛	1057	16	406	18½	470	13½	343
8	75	1905	37¾	959	19¹⁵⁄₁₆	506	6½	165	52	1321	21	533	21⅝	549	15½	394
10	90	2286	45¾	1162	23¹³⁄₁₆	605	8	203	64	1626	25	635	26	660	18½	470

SIZE	DIMENSIONS								WEIGHT						STRAINER	
	N1†		R		R❖		T		NRS		OSY		QT		Weight	
in.	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs*	*lbs.*	*kgs*	*lbs.*	*kgs*	*lbs.*	*kgs*
2½	10	254	4	102	16	406	3	76	167	76	170	77	154	70	28	13
3	10	254	5	127	16	406	3	76	167	76	170	77	162	73	34	15
4	12	305	6	152	19¾	502	6	152	368	167	383	174	275	125	60	27
6	20	508	11	279	26	660	7½	191	627	284	707	321	611	277	122	55
8	22¾	578	11¼	286	11¼	286	9	229	1201	545	1307	593	1419	644	247	112
10	28	711	12½	318	12½	318	10¼	260	2003	909	2073	940	2466	1119	370	168

†Dimension required for screen removal. ❖Quarter-turn (QT) valve dimensions.

††Service clearance for check assembly from center.

Job Name ______________________ Contractor ______________________

Job Location ______________________ Approval ______________________

Engineer ______________________ Contractor's P.O. No. ______________________

Approval ______________________ Representative ______________________

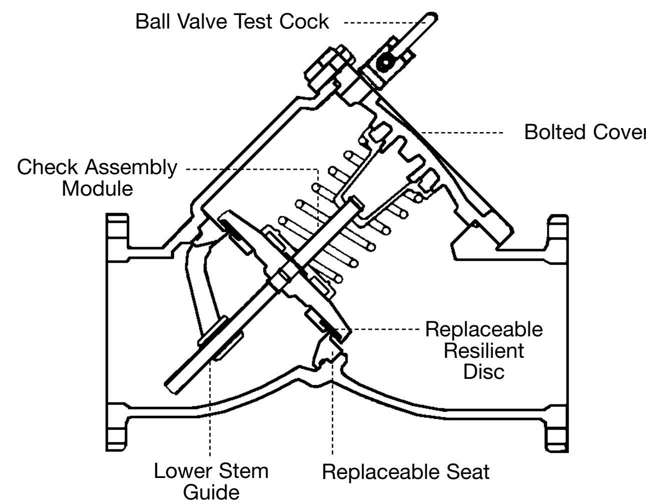
LEAD FREE*

Series LF709

Double Check Valve Assemblies

Sizes: 2½" – 10"

Series LF709 Double Check Valve Assemblies are designed to prevent the reverse flow of polluted water from entering into the potable water system. This series can be applied, where approved by the local authority having jurisdiction, on non-health hazard installations. Series LF709 features a modular check design concept to facilitate easy maintenance. Check with local jurisdictional authority as to installation requirements. The LF709 features Lead Free* construction to comply with Lead Free* installation requirements.



Features

- Replaceable stainless steel seats
- Maximum flow at low pressure drop
- Design simplicity for easy maintenance
- No special tools required for servicing
- Captured spring assemblies for safety
- Approved for vertical flow up installation

Models

Suffix:

NRS	non-rising stem resilient seated gate valves
OSY	UL/FM outside stem and yoke resilient seated gate valves
S-FDA	FDA epoxy coated strainer
QT-FDA	FDA epoxy coated ball valve shutoffs
LF	without shutoff valves

Specifications

A Double Check Valve Assembly shall be installed at referenced cross-connections to prevent the backflow of polluted water into the potable water supply. The cross-connections shall be determined by local inspection authority for use where a high hazard situation does not exist. Valve shall feature modular check assemblies with center stem guiding. Each check module shall have a captured spring and be accessible through a bolted cover plate. Seats shall be replaceable without special tools. It shall be a complete assembly including tight-closing resilient seated shutoff valves, test cocks, and a strainer is recommended. The Lead Free* Double Check Assemblies shall comply with state codes and standards, where applicable, requiring reduced lead content. The assembly shall meet the requirements of ASSE No. 1015; AWWA C510-92; CSA B64.5 and UL Classified File No. EX3185. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Assembly shall be a Watts Series LF709.

Check Assembly Module

Series LF709 features a modular design concept which facilitates complete maintenance and assembly by retaining the spring load. Also, the first and second check module are identical and can be interchanged.

NOTICE

The information contained herein is not intended to replace the full product installation and safety information available or the experience of a trained product installer. You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product.

NOTICE

Inquire with governing authorities for local installation requirements

***The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.**

Materials

Check Valve Bodies: Epoxy coated cast iron
Seats: Stainless Steel

Pressure — Temperature

Temperatures Range: 33°F – 110°F (0.5°C – 43°C) continuous, 140°F (60°C) intermittent

Maximum Working Pressure: 175psi (12.1 bar)

Standards

AWWA C510-92

IAPMO PA 31

USC Manual for Cross-Connection Control, 8th Edition

Approvals

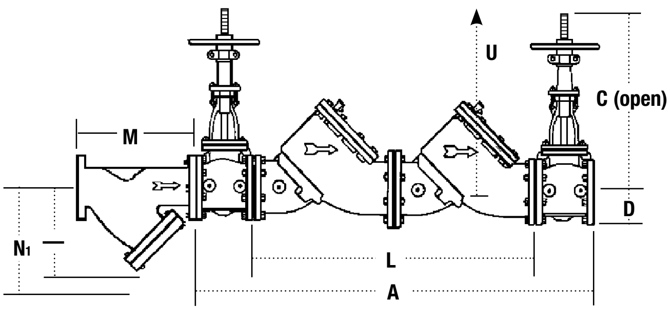
1015 B64.5

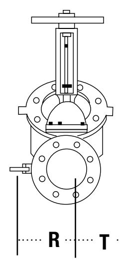
Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Sizes 4" – 10" approved horizontal and vertical "flow up". Size 2½" and 3" approved horizontal only.

Factory Mutual approved 4" – 10" vertical "flow up" with OSY gate valves only.

Note: Model "S" not listed

Dimensions — Weights





SIZE	DIMENSIONS															
	A		C (OSY)		C (NRS)		D		L		U††		M		N	
in.	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*
2½	39⅜	1000	16⅜	416	9⅜	238	3½	89	24⅛	613	11	279	10	254	6½	165
3	40⅜	1025	18⅞	479	10¼	260	3¾	95	24⅛	613	14	356	10⅛	257	7	178
4	52⅜	1330	22¾	578	12 3/16	310	4½	114	34⅛	867	14	356	12⅛	308	8¼	210
6	62⅞	1597	30⅛	765	16	406	5½	140	41⅛	1057	16	406	18½	470	13½	343
8	75	1905	37¾	959	19 15/16	506	6½	165	52	1321	21	533	21⅝	549	15½	394
10	90	2286	45¾	1162	23 13/16	605	8	203	64	1626	25	635	26	660	18½	470

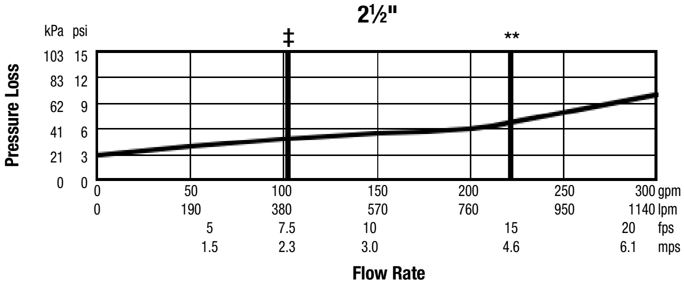
SIZE	DIMENSIONS								WEIGHT						STRAINER	
	N1†		R		R❖		T		NRS		OSY		QT		Weight	
in.	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs*	*lbs.*	*kgs*	*lbs.*	*kgs*	*lbs.*	*kgs*
2½	10	254	4	102	16	406	3	76	167	76	170	77	154	70	28	13
3	10	254	5	127	16	406	3	76	167	76	170	77	162	73	34	15
4	12	305	6	152	19¾	502	6	152	368	167	383	174	275	125	60	27
6	20	508	11	279	26	660	7½	191	627	284	707	321	611	277	122	55
8	22¾	578	11¼	286	11¼	286	9	229	1201	545	1307	593	1419	644	247	112
10	28	711	12½	318	12½	318	10¼	260	2003	909	2073	940	2466	1119	370	168

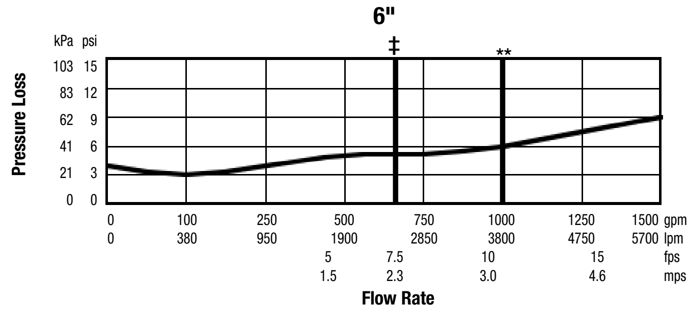
†Dimension required for screen removal. ❖Quarter-turn (QT) valve dimensions.

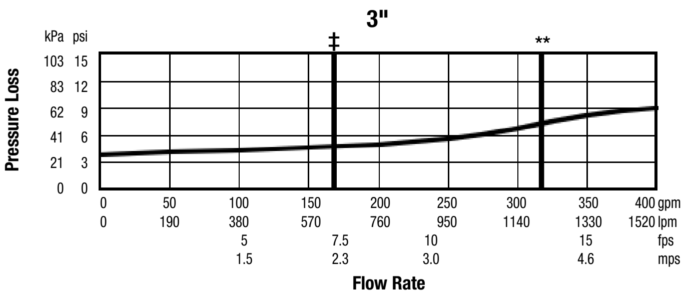
††Service clearance for check assembly from center.

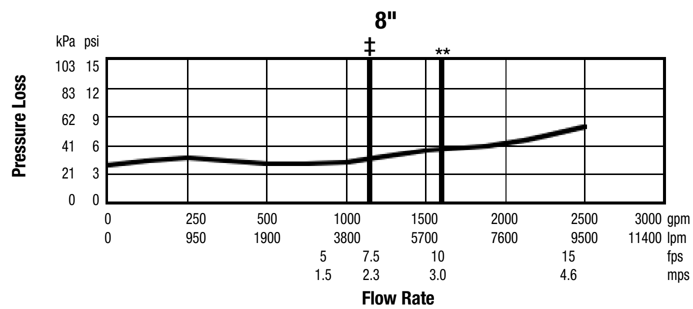
Capacity

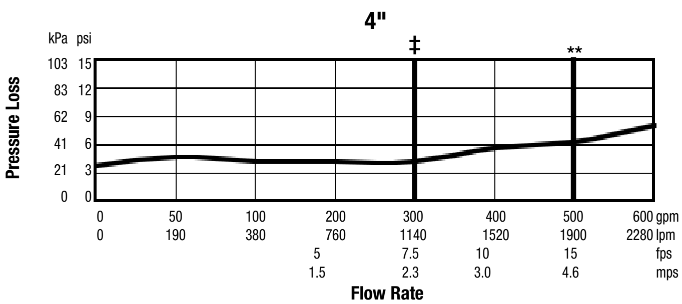
‡Typical maximum system flow rate (7.5 feet/sec.)
**UL rated flow

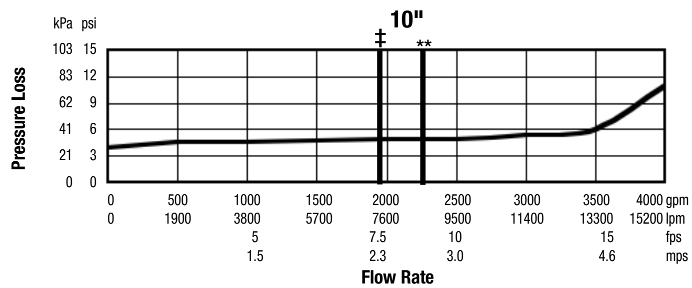












SMART Digital S - DDA

up to 30 l/h

Installation and operating instructions

Further languages

http://net.grundfos.com/qr/i/95724708

be
think
innovate

GRUNDFOS

English (GB) Installation and operating instructions

Original installation and operating instructions

CONTENTS

Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Safety instructions

These installation and operating instructions contain general instructions that must be observed during installation, operation and maintenance of the pump. It must therefore be read by the installation engineer and the relevant qualified operator prior to installation and start-up, and must be available at the installation location at all times.

1.1 Symbols used in this document

Warning
If these safety instructions are not observed, it may result in personal injury.

Caution: If these safety instructions are not observed, it may result in malfunction or damage to the equipment.

Note: Notes or instructions that make the job easier and ensure safe operation.

1.2 Qualification and training of personnel

The personnel responsible for the installation, operation and service must be appropriately qualified for these tasks. Areas of responsibility, levels of authority and the supervision of the personnel must be precisely defined by the operator. If necessary, the personnel must be trained appropriately.

Risks of not observing the safety instructions

Non-observance of the safety instructions may have dangerous consequences for the personnel, the environment and the pump and may result in the loss of any claims for damages.

It may lead to the following hazards:

- Personal injury from exposure to electrical, mechanical and chemical influences.
- Damage to the environment and personal injury from leakage of harmful substances.

1.3 Safety instructions for the operator/user

The safety instructions described in these instructions, existing national regulations on health protection, environmental protection and for accident prevention and any internal working, operating and safety regulations of the operator must be observed.

Information attached to the pump must be observed.

Leakages of dangerous substances must be disposed of in a way that is not harmful to the personnel or the environment.

Damage caused by electrical energy must be prevented, see the regulations of the local electricity supply company.

Caution: Before any work to the pump, the pump must be in the "Stop" operating state or be disconnected from the power supply. The system must be pressureless!

Note: The mains plug is the separator separating the pump from the mains.

Only original accessories and original spare parts should be used. Using other parts can result in exemption from liability for any resulting consequences.

1.4 Safety of the system in the event of a failure in the dosing pump

The dosing pump was designed according to the latest technologies and is carefully manufactured and tested.

If it fails regardless of this, the safety of the overall system must be ensured. Use the relevant monitoring and control functions for this.

Caution: Make sure that any chemicals that are released from the pump or any damaged lines do not cause damage to system parts and buildings.

The installation of leak monitoring solutions and drip trays is recommended.

1.5 Dosing chemicals

Warning

Before switching the supply voltage back on, the dosing lines must be connected in such a way that any chemicals in the dosing head cannot spray out and put people at risk.

The dosing medium is pressurised and can be harmful to health and the environment.

Warning

When working with chemicals, the accident prevention regulations applicable at the installation site should be applied (e.g. wearing protective clothing).

Observe the chemical manufacturer's safety data sheets and safety instructions when handling chemicals!

Caution

A deaeration hose, which is routed into a container, e.g. a drip tray, must be connected to the deaeration valve.

Caution

The dosing medium must be in liquid aggregate state!

Observe the freezing and boiling points of the dosing medium!

The resistance of the parts that come into contact with the dosing medium, such as the dosing head, valve ball, gaskets and lines, depends on the medium, media temperature and operating pressure.

Caution

Ensure that parts in contact with the dosing media are resistant to the dosing medium under operating conditions, see data booklet!

Should you have any questions regarding the material resistance and suitability of the pump for specific dosing media, please contact Grundfos.

1.6 Diaphragm breakage

If the diaphragm leaks or is broken, dosing liquid escapes from the drain opening (fig. 41, pos. 11) on the dosing head. Observe section *7.6 Diaphragm breakage*.

Warning

Danger of explosion, if dosing liquid has entered the pump housing!

Operation with damaged diaphragm can lead to dosing liquid entering the pump housing.

In case of diaphragm breakage, immediately separate the pump from the power supply!

Make sure the pump cannot be put back into operation by accident!

Dismantle the dosing head without connecting the pump to the power supply and make sure no dosing liquid has entered the pump housing. Proceed as described in section *7.6.1 Dismantling in case of diaphragm breakage*.

To avoid any danger resulting from diaphragm breakage, observe the following:

- Perform regular maintenance. See section *7.1 Regular maintenance*.
- Never operate the pump with blocked or soiled drain opening.
  - If the drain opening is blocked or soiled, proceed as described in section *7.6.1 Dismantling in case of diaphragm breakage*.
- Never attach a hose to the drain opening. If a hose is attached to the drain opening, it is impossible to recognise escaping dosing liquid.
- Take suitable precautions to prevent harm to health and damage to property from escaping dosing liquid.
- Never operate the pump with damaged or loose dosing head screws.

2. General information

The DDA dosing pump is a self-priming diaphragm pump. It consists of a housing with stepper motor and electronics, a dosing head with diaphragm and valves and the control cube.

Excellent dosing features of the pump:

- Optimal intake even with degassing media, as the pump always works at full suction stroke volume.
- Continuous dosing, as the medium is sucked up with a short suction stroke, regardless of the current dosing flow, and dosed with the longest possible dosing stroke.

2.1 Applications

The pump is suitable for liquid, non-abrasive, non-flammable and non-combustible media strictly in accordance with the instructions in these installation and operating instructions.

Areas of application

- Drinking water treatment
- Wastewater treatment
- Swimming pool water treatment
- Boiler water treatment
- CIP (Clean-In-Place) Observe section *3.2 Technical data for CIP (Clean-In-Place) applications*.
- Cooling water treatment
- Process water treatment
- Wash plants
- Chemical industry
- Ultrafiltration processes and reverse osmosis
- Irrigation
- Paper and pulp industry
- Food and beverage industries

2.2 Improper operating methods

The operational safety of the pump is only guaranteed if it is used in accordance with section *2.1 Applications*.

Warning

Other applications or the operation of pumps in ambient and operating conditions, which are not approved, are considered improper and are not permitted. Grundfos cannot be held liable for any damage resulting from incorrect use.

Warning

The pump is NOT approved for operation in potentially explosive areas!

Warning

A sunscreen is required for outdoor installation!

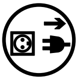
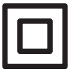
Caution

Frequent disengagement from the mains voltage, e.g. via a relay, can result in damage to the pump electronics and in the breakdown of the pump. The dosing accuracy is also reduced as a result of internal start procedures.

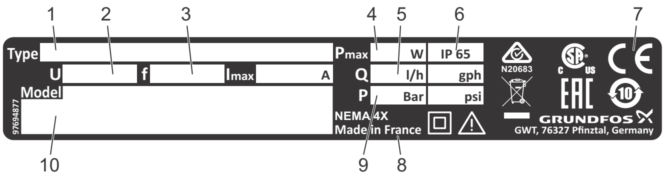
Do not control the pump via the mains voltage for dosing purposes!

Only use the "External stop" function to start and stop the pump!

2.3 Symbols on the pump

Symbol	Description
	Indication of universally dangerous spot.
	In case of emergency and prior to all maintenance work and repairs, take the mains plug out of the mains supply!
	The device complies with electrical safety class II.
	Connection for deaeration hose at dosing head. If the deaeration hose is not correctly connected, danger will arise due to possible leakage of dosing liquid!

2.4 Nameplate



TM04 8144 1720

Fig. 1 Nameplate

Pos.	Description	Pos.	Description
1	Type designation	6	Enclosure class
2	Voltage	7	Mark of approval, CE mark, etc.
3	Frequency	8	Country of origin
4	Power consumption	9	Max. operating pressure
5	Max. dosing flow	10	Model

English (GB)

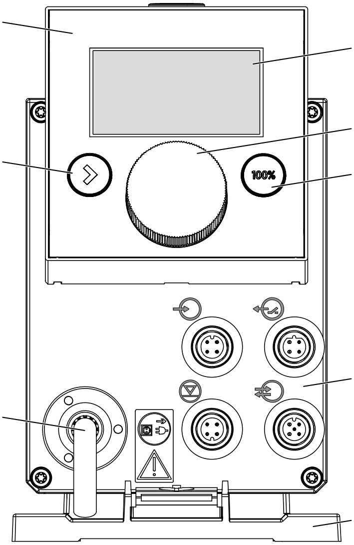
2.5 Type key

The type key is used to identify the precise pump and is not used for configuration purposes.

Code	Example	DDA	7.5-	16	AR-	PP/	V/	C-	F-	3	1	U2U2	F	G
	Pump type													
	Max. flow [l/h]													
	Max. pressure [bar]													
	Control variant													
AR	Standard													
FC	AR with FlowControl													
FCM	FC with integrated flow measurement													
	Dosing head material													
PP	Polypropylene													
PVC	PVC (polyvinyl chloride, only up to 10 bar)													
PV	PVDF (polyvinylidene fluoride)													
SS	Stainless steel DIN 1.4401													
	Gasket material													
E	EPDM													
V	FKM													
T	PTFE													
	Valve ball material													
C	Ceramic													
SS	Stainless steel DIN 1.4401													
	Control cube position													
F	Front-mounted (can be changed to the right or left)													
	Voltage													
3	1 x 100-240 V, 50/60 Hz													
	Valve type													
1	Standard													
2	Spring-loaded (HV version)													
	Suction/discharge side connection													
U2U2	Hose, 4/6 mm, 6/9 mm, 6/12 mm, 9/12 mm													
U7U7	Hose 0.17" x 1/4"; 1/4" x 3/8"; 3/8" x 1/2"													
AA	Threaded Rp 1/4, female (stainless steel)													
VV	Threaded 1/4 NPT, female (stainless steel)													
XX	No connection													
	Installation set*													
I001	Hose, 4/6 mm (up to 7.5 l/h, 13 bar)													
I002	Hose, 9/12 mm (up to 60 l/h, 9 bar)													
I003	Hose, 0.17" x 1/4" (up to 7.5 l/h, 13 bar)													
I004	Hose, 3/8" x 1/2" (up to 60 l/h, 10 bar)													
	Mains plug													
F	EU													
B	USA, Canada													
G	UK													
I	Australia, New Zealand, Taiwan													
E	Switzerland													
J	Japan													
L	Argentina													
	Design													
G	Grundfos													

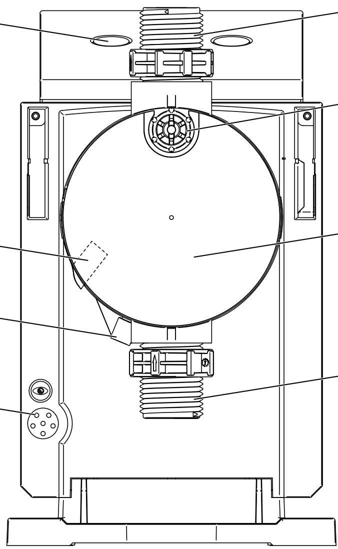
* including: 2 pump connections, foot valve, injection unit, 6 m PE discharge hose, 2 m PVC suction hose, 2 m PVC deaeration hose (4/6 mm)

2.6 Product overview



TM04 1129 3117

Fig. 2 Front view of the pump



TM04 1129 3117

Fig. 3 Rear view of the pump

3. Technical data / Dimensions

3.1 Technical data

Data			7.5-16	12-10	17-7	30-4
Mechanical data	Turn-down ratio (setting range)	[1:X]	3000	1000	1000	1000
	Max. dosing capacity	[l/h]	7.5	12.0	17.0	30.0
		[gph]	2.0	3.1	4.5	8.0
	Max. dosing capacity with SlowMode 50 %	[l/h]	3.75	6.00	8.50	15.00
		[gph]	1.00	1.55	2.25	4.00
	Max. dosing capacity with SlowMode 25 %	[l/h]	1.88	3.00	4.25	7.50
		[gph]	0.50	0.78	1.13	2.00
	Min. dosing capacity	[l/h]	0.0025	0.0120	0.0170	0.0300
		[gph]	0.0007	0.0031	0.0045	0.0080
	Max. operating pressure[6)]	[bar]	16	10	7	4
		[psi]	230	150	100	60
	Max. stroke frequency[1)]	[strokes/ min]	190	155	205	180
	Stroke volume	[ml]	0.74	1.45	1.55	3.10
	Accuracy of repeatability	[%]	± 1			
	Max. suction lift during operation[2)]	[m]	6			
	Max. suction lift when priming with wet valves[2)]	[m]	2	3	3	2
	Min. pressure difference between suction and discharge side	[bar]	1 (FC and FCM: 2)			
	Max. inlet pressure, suction side	[bar]	2			
	Max. viscosity in SlowMode 25 % with spring-loaded valves[3)]	[mPas] (= cP)	2500	2500	2000	1500
	Max. viscosity in SlowMode 50 % with spring-loaded valves[3)]	[mPas] (= cP)	1800	1300	1300	600
	Max. viscosity without SlowMode with spring-loaded valves[3)]	[mPas] (= cP)	600	500	500	200
	Max. viscosity without spring-loaded valves[3)]	[mPas] (= cP)	50	300	300	150
	Min. internal hose/pipe diameter suction/discharge side[2), 4)]	[mm]	4	6	6	9
	Min. internal hose/pipe diameter suction/discharge side (high viscosity)[4)]	[mm]	9			
	Min./Max. liquid temperature	[°C]	-10/45			
	Min./Max. ambient temperature	[°C]	0/45			
	Min./Max. storage temperature	[°C]	-20/70			
	Max. relative humidity (non-condensing)	[%]	96			
	Max. altitude above sea level	[m]	2000			

Data			7.5-16	12-10	17-7	30-4
Electrical data	Voltage	[V]	100-240 V, - 10 %/+ 10 %, 50/60 Hz			
	Length of mains cable	[m]	1.5			
	Max. inrush current for 2 ms (100 V)	[A]	8			
	Max. inrush current for 2 ms (230 V)	[A]	25			
	Max. power consumption P_1	[W]	24[5)]			
	Enclosure class		IP65, Nema 4X			
	Electrical safety class		II			
	Pollution degree		2			
Signal input	Max. load for level input		12 V, 5 mA			
	Max. load for pulse input		12 V, 5 mA			
	Max. load for External stop input		12 V, 5 mA			
	Min. pulse length	[ms]	5			
	Max. pulse frequency	[Hz]	100			
	Impedance at 0/4-20 mA analog input	[Ω]	15			
	Accuracy of analog input (full-scale value)	[%]	± 1.5			
	Min. resolution of analog input	[mA]	0.05			
	Max. resistance in level/pulse circuit	[Ω]	1000			
Signal output	Max. ohmic load on relay output	[A]	0.5			
	Max. voltage on relay/analog output	[V]	30 VDC/30 VAC			
	Impedance at 0/4-20 mA analog output	[Ω]	500			
	Accuracy of analog output (full-scale value)	[%]	± 1.5			
	Min. resolution of analog output	[mA]	0.02			
Weight/size	Weight (PVC, PP, PVDF)	[kg]	2.4	2.4		2.6
	Weight (stainless steel)	[kg]	3.2	3.2		4.0
	Diaphragm diameter	[mm]	44	50		74
Sound pressure	Max. sound pressure level	[dB(A)]	60			
Approvals			CE, CB, CSA-US, NSF61, EAC, ACS, RCM			

1) The maximum stroke frequency varies depending on calibration

2) Data is based on measurements with water

3) Maximum suction lift: 1 m, dosing capacity reduced (approx. 30 %)

4) Length of suction line: 1.5 m, length of discharge line: 10 m (at max. viscosity)

5) With E-Box

6) PVC (polyvinyl chloride), only up to 10 bar

3.2 Technical data for CIP (Clean-In-Place) applications

Short-term temperature limits for max. 40 minutes at max. 2 bar operating pressure:

Max. liquid temperature for dosing head material PVDF	[°C]	85
Max. liquid temperature for dosing head material stainless steel	[°C]	120

The dosing head material Polyvinyl chloride (PVC) must not be used in CIP applications.

3.3 Dimensions

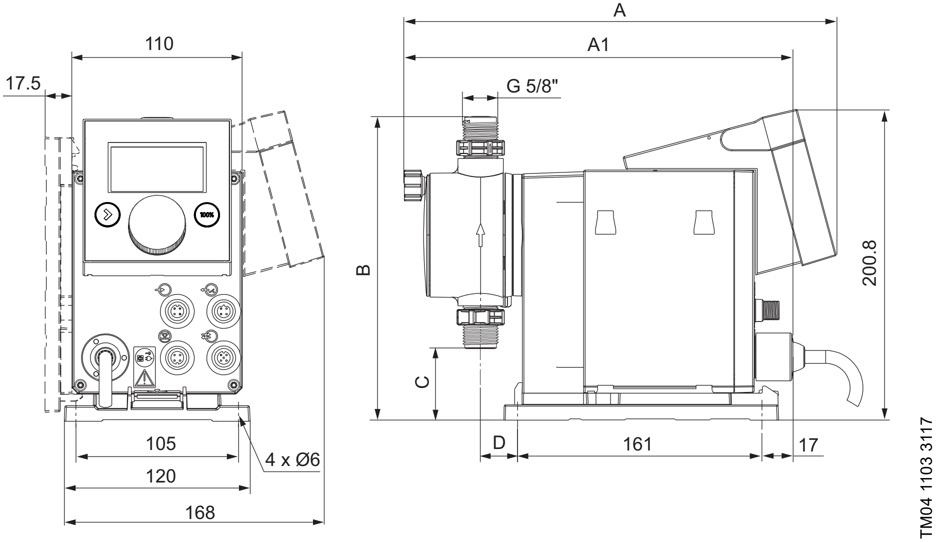


Fig. 4 Dimensional sketch

Pump type	A [mm]	A1 [mm]	B [mm]	C [mm]	D [mm]
DDA 7.5-16	280	251	196	46.5	24
DDA 12-10/17-7	280	251	200.5	39.5	24
DDA 30-4	295	267	204.5	35.5	38.5

4. Assembly and installation

Note

For use in Australia:

Installation of this product must comply with AS/NZS3500!

Certificate of suitability number: CS9431

RCM number: N20683

4.1 Pump assembly

Warning

Install the pump in such a way that the plug can easily be reached by the operator during operation! This will enable the operator to separate the pump from the mains quickly in case of emergency!

The pump is delivered with a mounting plate. The mounting plate can be mounted vertically e.g. on a wall or horizontally e.g. on a tank. It takes just a few quick steps to firmly secure the pump to the mounting plate by means of a slot mechanism.

The pump can easily be released from the mounting plate for maintenance.

4.1.1 Requirements

- The mounting surface must be stable and must not vibrate.
- Dosing must flow upwards vertically.

4.1.2 Align and install mounting plate

- **Vertical installation**: Mounting plate slot mechanism must be above.
- **Horizontal installation**: Mounting plate slot mechanism must be opposite the dosing head.
- The mounting plate can be used as a drill template, please see fig. 4 for drill hole distances.

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Fig. 5 Locate mounting plate

Warning

Make sure that you do not damage any cables and lines during installation!

1. Indicate drill holes.
2. Drill holes.
3. Secure mounting plate using four screws, diameter 5 mm, to the wall, on the bracket or the tank.

4.1.3 Engage pump in mounting plate

1. Attach the pump to the mounting plate support clamps and slide under slight pressure until it engages.

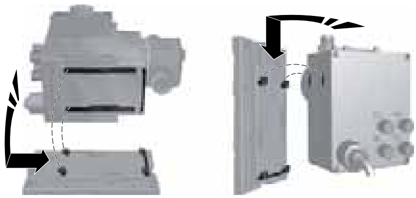

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Fig. 6 Engaging the pump

4.1.4 Adjusting control cube position

The control cube is fitted to the front of the pump on delivery. It can be turned by 90 ° so that the user can select to operate the pump from the right or left side.

Caution

The enclosure class (IP65/Nema 4X) and shock protection are only guaranteed if the control cube is installed correctly!

Caution

Pump must be disconnected from the power supply!

1. Carefully remove both protective caps on the control cube using a thin screwdriver.
2. Loosen screws.
3. Carefully lift off control cube only so far from the pump housing that no tensile stress is produced on the flat band cable.
4. Turn control cube by 90 ° and re-attach.
   – Make sure the O-ring is secure.
5. Tighten screws slightly and attach protective caps.

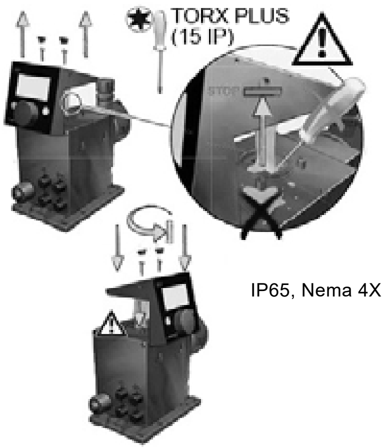

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Fig. 7 Adjusting control cube

4.2 Hydraulic connection

Warning

Risk of chemical burns!

Wear protective clothing (gloves and goggles) when working on the dosing head, connections or lines!

Caution

The dosing head may contain water from the factory check!

When dosing media which should not come into contact with water, another medium must be dosed beforehand!

Caution

Faultless function can only be guaranteed in conjunction with lines supplied by Grundfos!

Caution

The lines used must comply with the pressure limits as per section *3.1 Technical data*!

Important information on installation

- Observe suction lift and line diameter, see section *3.1 Technical data*.
- Shorten hoses at right angles.
- Ensure that there are no loops or kinks in the hoses.
- Keep suction line as short as possible.
- Route suction line up towards the suction valve.
- Installing a filter in the suction line protects the entire installation against dirt and reduces the risk of leakage.
- Only control variant FC/FCM: For discharge quantities < 1 l/h we recommend the use of an additional spring-loaded valve (approx. 3 bar) on the discharge side for the safe generation of the necessary differential pressure.

Hose connection procedure

1. Push union nut and tensioning ring across hose.
2. Push cone part fully into hose, see fig. 8.
3. Attach cone part with hose to corresponding pump valve.
4. Tighten union nut manually.
   – Do not use tools!
5. Tighten up union nuts after 2-5 operating hours if using PTFE gaskets!
6. Attach deaeration hose to the corresponding connection (see fig. 3) and run into a container or a collecting tray.

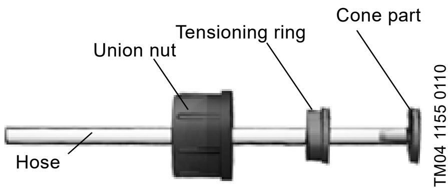


Fig. 8 Hydraulic connection

Note

Pressure differential between suction and discharge side must be at least 1 bar/14.5 psi!

Caution

Tighten the dosing head screws with a torque wrench once before commissioning and again after 2-5 operating hours at 4 Nm.

Installation example

The pump offers various installation options. In the picture below, the pump is installed in conjunction with a suction line, level switch and multifunction valve on a Grundfos tank.

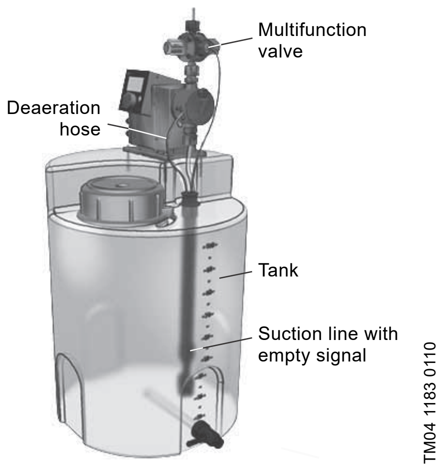


Fig. 9 Installation example

4.3 Electrical connection

Warning

The enclosure class (IP65/Nema 4X) is only guaranteed if plugs or protective caps are correctly installed!

Warning

The pump can start automatically when the mains voltage is switched on!

Do not manipulate mains plug or cable!

Note

The mains plug is the separator separating the pump from the mains.

The rated voltage of the pump, see section *2.4 Nameplate*, must conform to local conditions.

Signal connections

Warning

Electric circuits of external devices connected to the pump inputs must be separated from dangerous voltage by means of double or reinforced insulation!

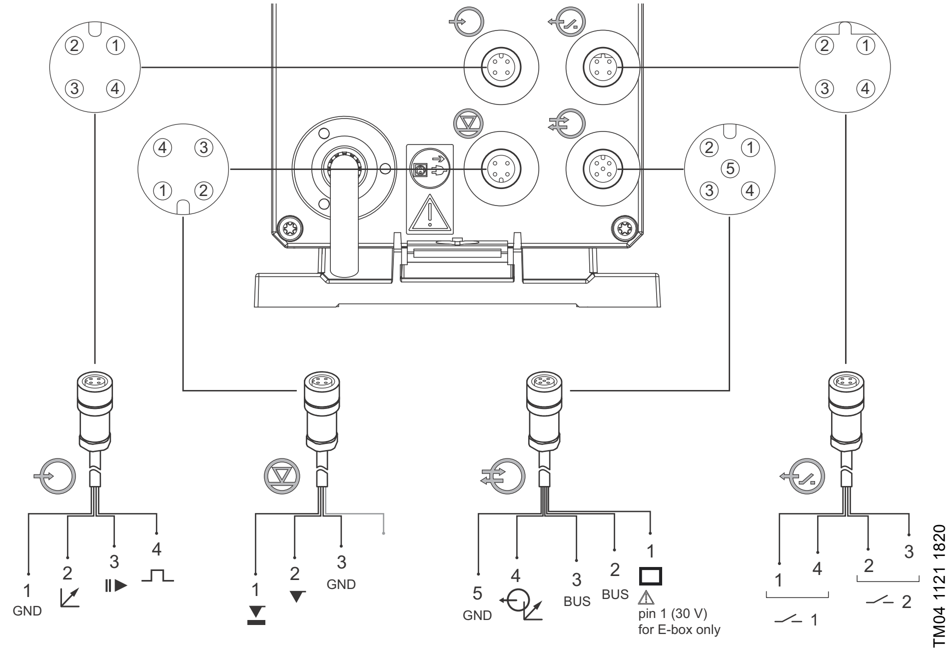


Fig. 10 Wiring diagram of the electrical connections

Analog, External stop and pulse input

Function	Pins			
	1/brown	2/white	3/blue	4/black
Analog	GND/(-) mA	(+) mA		
External stop	GND		X	
Pulse	GND			X

Level signals: Empty signal and Low-level signal

Function	Pins			
	1	2	3	4
Low-level signal	X		GND	
Empty signal		X	GND	

GENIbus, Analog output

Caution Danger of damage to the product due to short circuit! Pin 1 supplies 30 VDC.
Never short-circuit pin 1 with any of the other pins!

Function	Pins				
	1/brown	2/white	3/blue	4/black	5/yellow/ green
GENIbus	+30 V	RS-485 A	RS-485 B		GND
Analog output				(+) mA	GND/(-) mA

Relay outputs

Function	Pins			
	1/brown	2/white	3/blue	4/black
Relay 1	X			X
Relay 2		X	X	

FlowControl signal connection

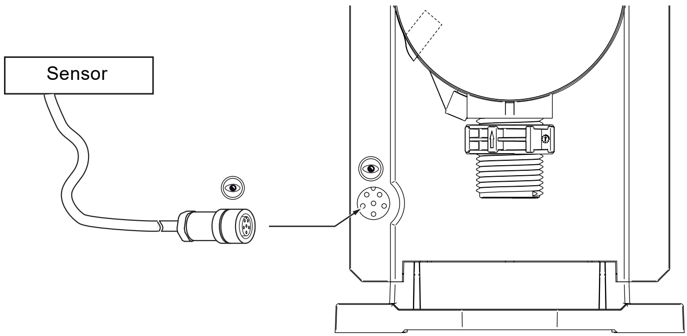
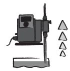


Fig. 11 FlowControl signal connection

5. Startup



5.1 Setting the menu language

For description of control elements, see section 6.

1. Turn click wheel to highlight the cog symbol.
2. Press the click wheel to open the "Setup" menu.
3. Turn the click wheel to highlight the "Language" menu.
4. Press the click wheel to open the "Language" menu.
5. Turn the click wheel to highlight the desired language.
6. Press the click wheel to select the highlighted language.
7. Press the click wheel again to confirm the "Confirm settings?" prompt and apply the setting.

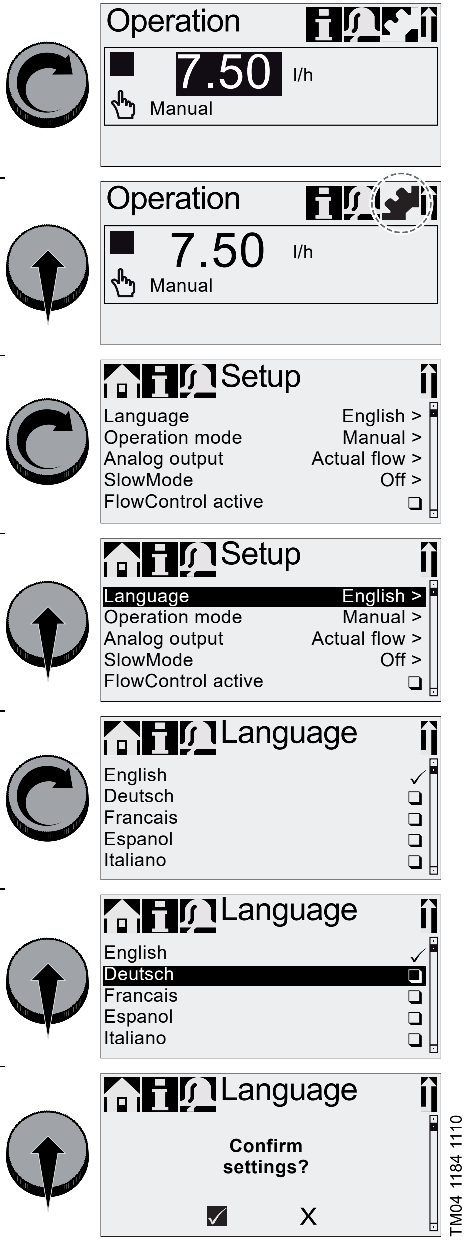


Fig. 12 Set menu language

5.2 Deaerating the pump

Warning

The deaeration hose must be connected correctly and inserted into a suitable tank!

1. Open deaeration valve by approximately half a turn.
2. Press and hold down the [100%] key (deaeration key) until liquid flows continuously without any bubbles from the deaeration hose.
3. Close deaeration valve.

Note

Press the [100%] key and simultaneously turn the click wheel clockwise to increase the duration of the process to up to 300 seconds. After setting the seconds, do not press the key any longer.

5.3 Calibrating the pump

The pump is calibrated in the factory for media with a viscosity similar to water at maximum pump backpressure (see section *3.1 Technical data*).

If the pump is operated with a backpressure that deviates or if dosing a medium whose viscosity deviates, the pump must be calibrated.

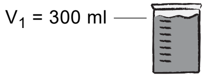
For pumps with FCM control variant, it is not necessary to calibrate the pump if there is deviating or fluctuating backpressure as long as the "AutoFlowAdapt" function has been enabled (see section *6.10 AutoFlowAdapt*).

Requirements

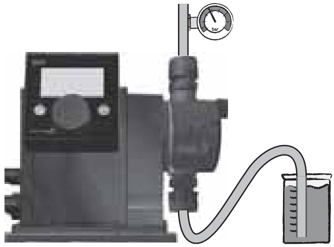
- The hydraulics and electrics of the pump are connected (see section *4. Assembly and installation*).
- The pump is integrated into the dosing process under operating conditions.
- The dosing head and suction hose are filled with dosing medium.
- The pump has been deaerated.

Calibration process - example for DDA 7.5-16

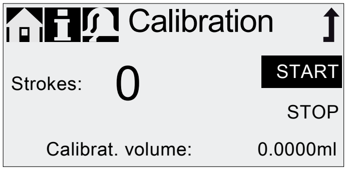
1. Fill a measuring beaker with dosing medium. Recommended filling volumes V_1:
   – DDA 7.5-16: 0.3 l
   – DDA 12-10: 0.5 l
   – DDA 17-7: 1.0 l
   – DDA 30-4: 1.5 l



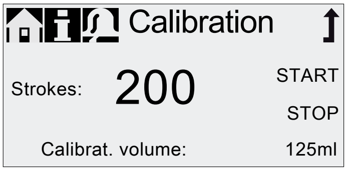
2. Read off and note down the fill volume V_1 (e.g. 300 ml).
3. Place the suction hose in the measuring beaker.



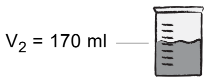
4. Start the calibration process in the "Setup > Calibration" menu.



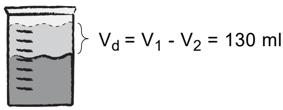
5. The pump executes 200 dosing strokes and displays the factory calibration value (e.g. 125 ml).



6. Remove the suction hose from the measuring beaker and check the remaining volume V_2 (e.g. 170 ml).

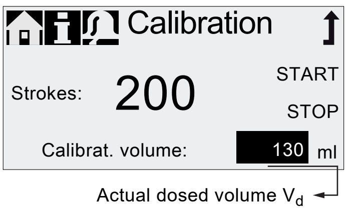


7. From V_1 and V_2, calculate the actual dosed volume $V_d = V_1 - V_2$ (e.g. 300 ml - 170 ml = 130 ml).



8. Set and apply V_d in the calibration menu.

• The pump is calibrated.



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6. Operation

6.1 Control elements

The pump control panel includes a display and the following control elements.

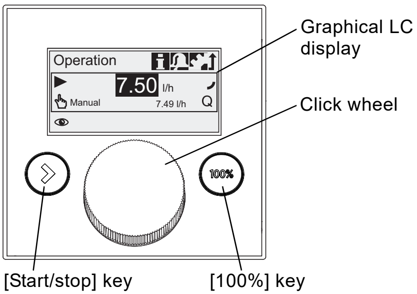


Fig. 13 Control panel

Keys

Key	Function
[Start/stop] key	Starting and stopping the pump.
[100%] key	The pump doses at maximum flow regardless of the operation mode.

Click wheel

The click wheel is used to navigate through the menus, select settings and confirm them.

Turning the click wheel clockwise moves the cursor clockwise in increments in the display. Turning the click wheel counter-clockwise moves the cursor counter-clockwise.

6.2 Display and symbols

6.2.1 Navigation

In the "Info", "Alarm" and "Setup" main menus, the options and submenus are displayed in the rows below. Use the "Back" symbol to return to the higher menu level. The scroll bar at the right edge of the display indicates that there are further menu items which are not shown.

The active symbol (current cursor position) flashes. Press the click wheel to confirm your selection and open the next menu level. The active main menu is displayed as text, the other main menus are displayed as symbols. The position of the cursor is highlighted in black in the sub-menus.

When you position the cursor on a value and press the click wheel, a value is selected. Turning the click wheel clockwise increases the value, turning the click wheel counter-clockwise reduces the value. When you now press the click wheel, the cursor will be released again.

6.2.2 Operating states

The operating state of the pump is indicated by a symbol and display colour.

Display	Fault	Operating state		
White	-	Stop ■	Standby ❚❚	
Green	-			Running ▶
Yellow	Warning	Stop ■	Standby ❚❚	Running ▶
Red	Alarm	Stop ■	Standby ❚❚	

6.2.3 Sleep mode (energy-saving mode)

If in the "Operation" main menu the pump is not operated for 30 seconds, the header disappears. After two minutes, the display brightness is reduced.

If in any other menu the pump is not operated for two minutes, the display switches back to the "Operation" main menu and the display brightness is reduced. This state will be cancelled when the pump is operated or a fault occurs.

6.2.4 Overview of display symbols

The following display symbols may appear in the menus.

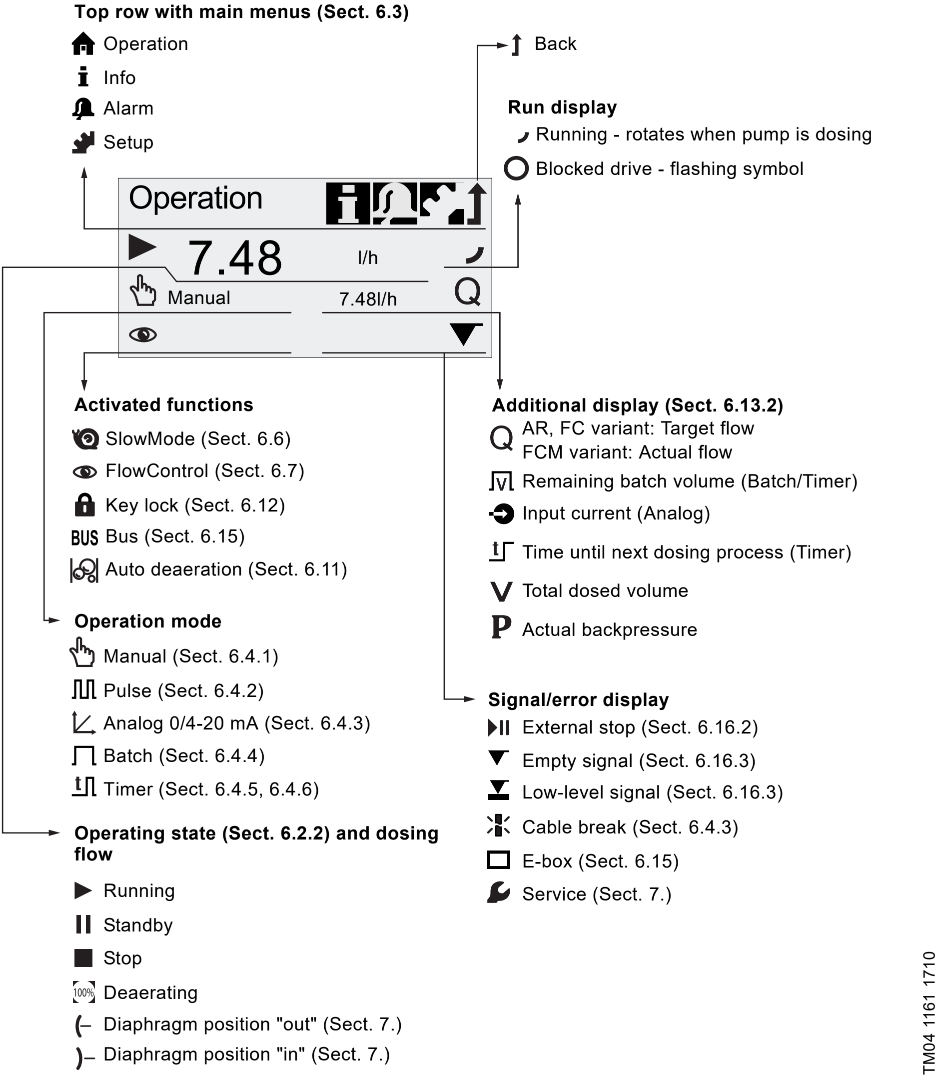


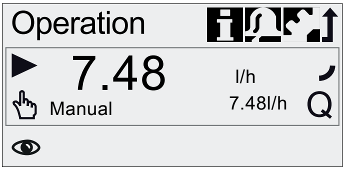
Fig. 14 Overview of display symbols

6.3 Main menus

The main menus are displayed as symbols at the top of the display. The currently active main menu is displayed as text.

6.3.1 Operation

Status information such as the dosing flow, selected operation mode and operating state is displayed in the "Operation" main menu.



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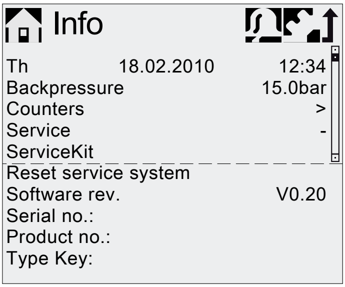
6.3.2 Info

You can find the date, time and information about the active dosing process, various counters, product data and the service system status in the "Info" main menu. The information can be accessed during operation.

The service system can also be reset from here.



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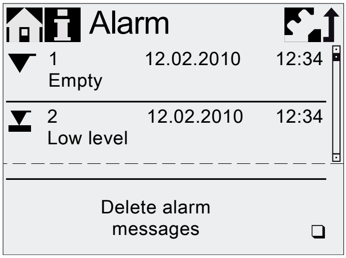
Counters

The "Info > Counters" menu contains the following counters:

Counters	Resettable
Volume Total dosed volume [l] or US gallons	Yes
Operating hours Accumulated operating hours (pump switched on) [h]	No
Motor runtime Accumulated motor runtime [h]	No
Strokes Accumulated number of dosing strokes	No
Power on/off Accumulated frequency of switching mains voltage on	No

6.3.3 Alarm

You can view errors in the "Alarm" main menu.



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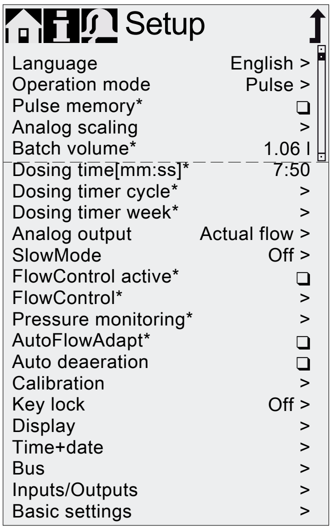
Up to 10 warnings and alarms, together with their date, time and cause, are listed in chronological order. If the list is full, the oldest entry will be overwritten, see section *8. Faults*.

6.3.4 Setup

The "Setup" main menu contains menus for pump configuration. These menus are described in the following sections.

Note: Check all pump settings after any change in the "Setup" menu.



		Section
Language	English >	5.1
Operation mode	Pulse >	6.4
Pulse memory*	❑	6.4.2
Analog scaling	>	6.4.3
Batch volume*	1.06 l	6.4.4
Dosing time[mm:ss]*	7:50	6.4.4
Dosing timer cycle*	>	6.4.5
Dosing timer week*	>	6.4.6
Analog output	Actual flow >	6.5
SlowMode	Off >	6.6
FlowControl active*	❑	6.7
FlowControl*	>	6.7
Pressure monitoring*	>	6.8
AutoFlowAdapt*	❑	6.10
Auto deaeration	❑	6.11
Calibration	>	5.3
Key lock	Off >	6.12
Display	>	6.13
Time+date	>	6.14
Bus	>	6.15
Inputs/Outputs	>	6.16
Basic settings	>	6.17

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* These submenus are only displayed for specific default settings and control variants. The contents of the "Setup" menu also vary depending on the operation mode.

6.4 Operation modes

Six different operation modes can be set in the "Setup > Operation mode" menu.

- Manual, see section 6.4.1
- Pulse, see section 6.4.2
- Analog 0-20mA, see section 6.4.3
  Analog 4-20mA, see section 6.4.3
- Batch (pulse-based), see section 6.4.4
- Dosing timer cycle, see section 6.4.5
- Dosing timer week, see section 6.4.6

6.4.1 Manual

In this operation mode, the pump constantly doses the dosing flow set with the click wheel. The dosing flow is set in l/h or ml/h in the "Operation" menu. The pump automatically switches between the units. Alternatively, the display can be reset to US units (gph). See section *6.13 Display Setup*.

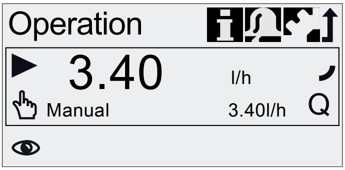

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Fig. 15 Manual mode

The setting range depends on the pump type:

Type	Setting range*	
	[l/h]	**[gph]**
DDA 7.5-16	0.0025 - 7.5	0.0007 - 2.0
DDA 12-10	0.012 - 12	0.0031 - 3.1
DDA 17-7	0.017 - 17	0.0045 - 4.5
DDA 30-4	0.03 - 30	0.0080 - 8.0

* When the "SlowMode" function is active, the maximum dosing flow is reduced, see section *3.1 Technical data*.

6.4.2 Pulse

In this operation mode, the pump doses the set dosing volume for each incoming (potential-free) pulse, e.g. from a water meter. The pump automatically calculates the optimum stroke frequency for dosing the set volume per pulse.

The calculation is based on:

- the frequency of external pulses
- the set dosing volume/pulse.

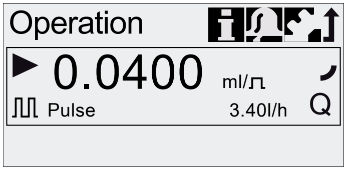

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Fig. 16 Pulse mode

The dosing volume per pulse is set in ml/pulse in the "Operation" menu using the click wheel. The setting range for the dosing volume depends on the pump type:

Type	Setting range [ml/pulse]
DDA 7.5-16	0.0015 - 14.9
DDA 12-10	0.0029 - 29.0
DDA 17-7	0.0031 - 31.0
DDA 30-4	0.0062 - 62.0

The frequency of incoming pulses is multiplied by the set dosing volume. If the pump receives more pulses than it can process at the maximum dosing flow, it runs at the maximum stroke frequency in continuous operation. Excess pulses will be ignored if the memory function is not enabled.

Memory function

When the "Setup > Pulse memory" function is enabled, up to 65,000 unprocessed pulses can be saved for subsequent processing.

Warning
Subsequent processing of saved pulses can cause local increase in concentration!

The contents of the memory will be deleted by:

- Switching off the power supply
- Changing the operation mode
- Interruption (e.g. alarm, External stop).

6.4.3 Analog 0/4-20 mA

In this operation mode, the pump doses according to the external analog signal.
The dosing volume is proportional to the signal input value in mA.

Operation mode	Input value [mA]	Dosing flow [%]
4-20 mA	≤ 4.1	0
	≥ 19.8	100
0-20 mA	≤ 0.1	0
	≥ 19.8	100

If the input value in operation mode 4-20 mA falls below 2 mA, an alarm is displayed and the pump stops. A cable break or signal transmitter error has occurred. The "Cable break" symbol is displayed in the "Signal and error display" area of the display.

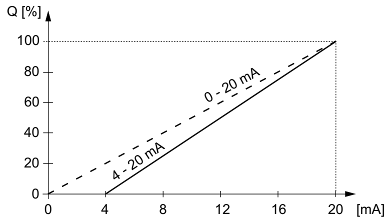


Fig. 17 Analog scaling

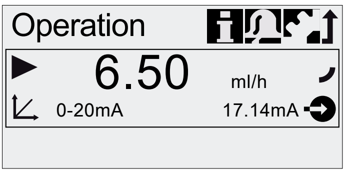


Fig. 18 Analog operation mode

Set analog scaling

Analog scaling refers to the assignment of the current input value to the dosing flow.

Changes of analog scaling affect also the analog output signal. See section *6.5 Analog output*.

Analog scaling passes through the two reference points (I_1/Q_1) and (I_2/Q_2), which are set in the "Setup > Analog scaling" menu. The dosing flow is controlled according to this setting.

Example 1 (DDA 7.5-16)

Analog scaling with positive gradient:

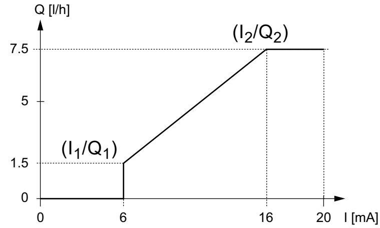


Fig. 19 Analog scaling with pos. gradient

In example 1, the reference points I_1 = 6 mA, Q_1 = 1.5 l/h and I_2 = 16 mA, Q_2 = 7.5 l/h have been set.

From 0 to 6 mA analog scaling is described by a line that passes through Q = 0 l/h, between 6 mA and 16 mA it rises proportionally from 1.5 l/h to 7.5 l/h and from 16 mA onwards it passes through Q = 7.5 l/h.

Example 2 (DDA 7.5-16)

Analog scaling with negative gradient (Operation mode 0-20 mA):

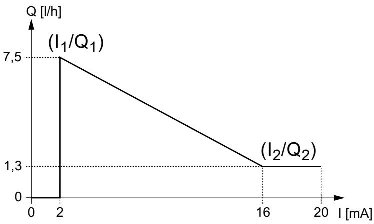


Fig. 20 Analog scaling with neg. gradient

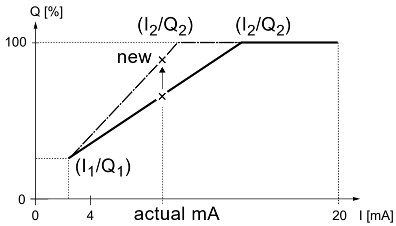
In example 2, the reference points I_1 = 2 mA, Q_1 = 7.5 l/h and I_2 = 16 mA, Q_2 = 1.3 l/h have been set.

From 0 to 2 mA analog scaling is described by a line that passes through Q = 0 l/h, between 2 mA and 16 mA it drops proportionally from 7.5 l/h to 1.3 l/h and from 16 mA onwards it passes through Q_2 = 1.3 l/h.

Set analog scaling in the "Operation" menu

Analog scaling can also be modified after a security prompt directly in the "Operation" menu. This is how the dosing flow is directly modified for the current flow input value.

Caution Please observe that changes also have a direct effect on point I_2/Q_2 (see fig. 21)!

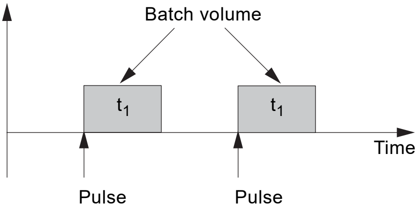


TM04 1132 2010

Fig. 21 Set analog scaling ("Operation" menu)

6.4.4 Batch (pulse-based)

In this operation mode, the pump doses the set batch volume in the set dosing time (t_1). A batch is dosed with each incoming pulse.



TM04 1105 2010

Fig. 22 Batch (pulse-based)

The setting range depends on the pump type:

Type	Setting range per batch		
	from [ml]	to [l]	Resolution* [ml]
DDA 7.5-16	0.74	999	0.0925
DDA 12-10	1.45	999	0.1813
DDA 17-7	1.55	999	0.1938
DDA 30-4	3.10	999	0.3875

* Thanks to the digital motor control, dosing quantities with a resolution of up to 1/8 of the dosing stroke volume can be dosed.

The batch volume (e.g. 75 ml) is set in the "Setup > Batch volume" menu. The minimum dosing time required for this (e.g. 36 seconds) is displayed and can be increased.

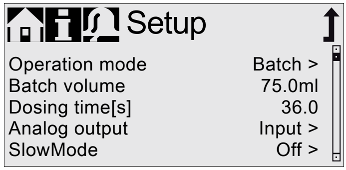


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Fig. 23 Batch mode

Signals received during a batch process or an interruption (e.g. alarm, External stop) will be ignored. If the pump is restarted following an interruption, the next batch volume is dosed on the next incoming pulse.

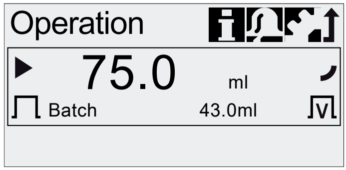

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Fig. 24 Batch mode

In the "Operation" menu, the total batch volume (e.g. 75 ml) and the remaining batch volume still to be dosed (e.g. 43 ml) are shown in the display.

6.4.5 Dosing timer cycle

In this operation mode, the pump doses the set batch volume in regular cycles.
Dosing starts when the pump is started after a singular start delay. The setting range for the batch volume corresponds to the values in section *6.4.4 Batch (pulse-based)*.

Warning
When time or date is changed in "Time+date" menu, timer dosing and timer relay output functions (Relay 2) are stopped!
Timer dosing and timer relay output functions must be restarted manually!
Changing time or date can cause increase or decrease in concentration!

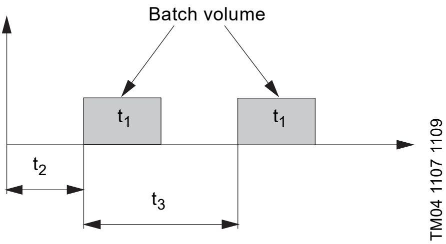

Fig. 25 Dosing timer cycle diagram

t_1	Dosing time
t_2	Start delay
t_3	Cycle time

In the event of an interruption (e.g. interruption of the mains voltage, External stop), the dosing will be stopped while the time continues running.
After suspending the interruption, the pump will continue to dose according to the actual timeline position.
The following settings are required in the "Setup > Dosing timer cycle" menu:

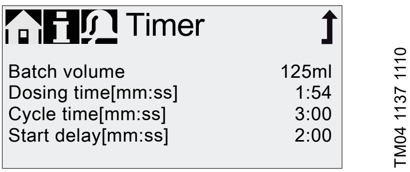

Fig. 26 Dosing timer cycle

The batch volume to be dosed (e.g. 125 ml) is set in the "Setup > Dosing timer cycle" menu. The dosing time required for this (e.g. 1:54) is displayed and can be changed.

The total batch volume (e.g. 125 ml) and the remaining batch volume still to be dosed are displayed in the "Operation" menu. During breaks in dosing, the time until the next dosing process (e.g. 1:21) is displayed.

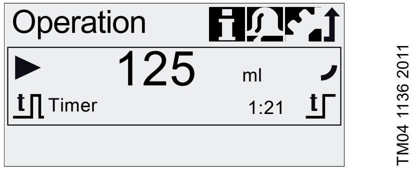

Fig. 27 Dosing timer cycle

6.4.6 Dosing timer week

In this operation mode, up to 16 dosing procedures are defined for a week.
These dosing procedures may take place regularly on one or several week days. The setting range for the batch volume corresponds to the values in section *6.4.4 Batch (pulse-based)*.

Warning
When time or date is changed in "Time+date" menu, timer dosing and timer relay output functions (Relay 2) are stopped!
Timer dosing and timer relay output functions must be restarted manually!
Changing time or date can cause increase or decrease in concentration!

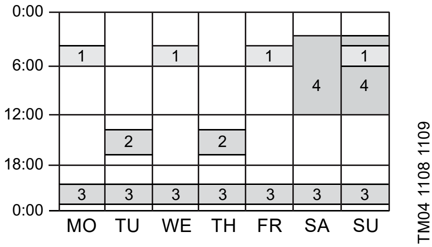

Fig. 28 Example for Dosing timer week function

Note
If several procedures overlap, the process with the higher dosing flow has priority!

In the event of an interruption (e.g. disconnection of the mains voltage, External stop), the dosing is stopped while the time continues running.
After suspending the interruption, the pump continues to dose according to the actual timeline position.

The following settings are required in the "Setup > Dosing timer week" menu for each dosing procedure:

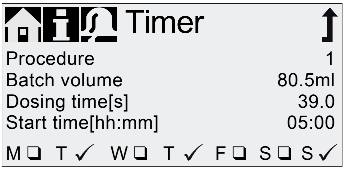

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Fig. 29 Setting the timer

The batch volume (e.g. 80.5 ml) is set in the "Setup > Dosing timer week" menu. The dosing time required for this (e.g. 39.0) is displayed and can be changed.

In the "Operation" menu, the total batch volume (e.g. 80.5 ml) and the remaining batch volume to be dosed is displayed. During breaks in dosing, the time (e.g. 43:32) until the next dosing is displayed.

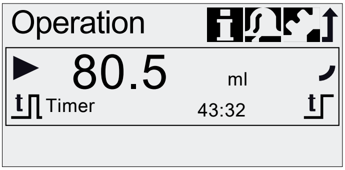

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Fig. 30 Weekly timer dosing (break in dosing)

6.5 Analog output

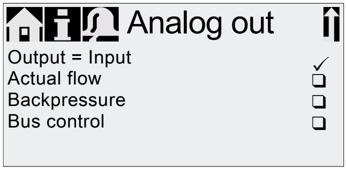

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Fig. 31 Configure analog output

The analog output of the pump is parametrised in the "Setup > Analog output" menu. The following settings are possible:

Setting	Description of output signal	Variant		
		FCM	FC	AR
Output = Input	Analog feedback signal (not for master-slave application). The analog input signal is mapped 1:1 to the analog output.	X	X	X
Actual flow**	Current actual flow • 0/4 mA = 0 % • 20 mA = 100 % see section *6.9 Flow measurement*	X	X*	X*
Backpressure	Backpressure, measured in the dosing head • 0/4 mA = 0 bar • 20 mA = Max. operating pressure see section *6.8 Pressure monitoring*	X	X	
Bus control	Enabled by command in Bus control, see section *6.15 Bus communication*	X	X	X

* Output signal is based on motor speed and pump status (target flow).

** Signal has same analog scaling as the current analog input signal. See *6.4.3 Analog 0/4-20 mA*.

Wiring diagram see section *4.3 Electrical connection*.

Note: In all operation modes, the analog output has a range of 4-20 mA. Exception: Operation mode 0-20 mA. Here, the analog output range is 0-20 mA.

6.6 SlowMode

When the "SlowMode" function is enabled, the pump slows down the suction stroke. The function is enabled in the "Setup > SlowMode" menu and is used to prevent cavitation in the following cases:

- for dosing media with a high viscosity
- for degassing dosing media
- for long suction lines
- for large suction lift.

In the "Setup > SlowMode" menu, the speed of the suction stroke can be reduced to 50 % or 25 %.

Caution Enabling the 'SlowMode' function reduces the maximum dosing flow of the pump to the set percentage value!

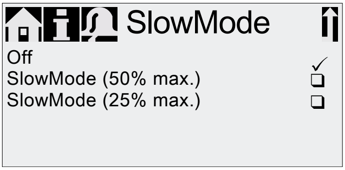

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Fig. 32 SlowMode menu

6.7 FlowControl

Applies to DDA-FC/FCM control variant.

This function is used to monitor the dosing process. Although the pump is running, various influences e.g. air bubbles, can cause a reduced flow or even stop the dosing process. In order to guarantee optimum process safety, the enabled "FlowControl" function directly detects and indicates the following errors and deviations:

- Overpressure
- Damaged discharge line
- Air in the dosing chamber
- Cavitation
- Suction valve leakage > 70 %
- Discharge valve leakage > 70 %.

The occurrence of a fault is indicated by the "eye" symbol flashing. The faults are displayed in the "Alarm" menu (see section *8. Faults*).

FlowControl works with a maintenance-free sensor in the dosing head. During the dosing process, the sensor measures the current pressure and continuously sends the measured value to the microprocessor in the pump. An internal indicator diagram is created from the current measured values and the current diaphragm position (stroke length). Causes for deviations can be identified immediately by aligning the current indicator diagram with a calculated optimum indicator diagram. Air bubbles in the dosing head reduce e.g. the discharge phase and consequently the stroke volume (see fig. 33).

Requirements for a correct indicator diagram are:

- FlowControl function is active
- pressure difference between suction and discharge side is > 2 bar
- No interruption/pause in discharge stroke
- Pressure sensor and cable are functioning properly
- No leakage > 50 % in suction or discharge valve

If one of these requirements is not met, the indicator diagram cannot be evaluated.

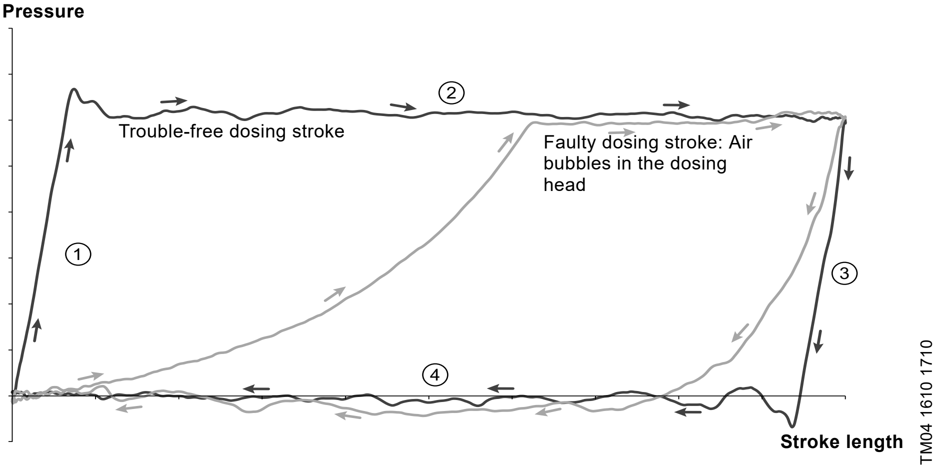


Fig. 33 Indicator diagram

1	Compression phase
2	Discharge phase
3	Expansion phase
4	Suction phase

Setting FlowControl

The "FlowControl" function is set using the two parameters "Sensitivity" and "Delay" in the "Setup > FlowControl" menu.

Sensitivity

In "Sensitivity" the deviation in stroke volume, which will result in an error message, is set in percent.

Sensitivity	Deviation
low	approx. 70 %
medium	approx. 50 %
high	approx. 30 %

Delay

The "Delay" parameter is used to define the time period until an error message is generated: "short", "medium" or "long". The delay depends on the set dosing flow and therefore cannot be measured in strokes or time.

Air bubbles

The "FlowControl" function identifies air bubbles > 60 % of the stroke volume. After switching to "Air bubble" warning status, the pump adapts the stroke frequency to approximately 30-40 % of max. stroke frequency, and starts a special motor drive strategy. The adaptation of the stroke frequency allows the air bubbles to rise from suction to discharge valve. Due to the special motor drive strategy the air bubbles are displaced from the dosing head into the discharge line.

If the air bubbles have not been eliminated after a maximum of 60 strokes, the pump returns to the normal motor drive strategy.

6.8 Pressure monitoring

Applies to DDA-FC/FCM control variant.

A pressure sensor monitors the pressure in the dosing head. If the pressure during the discharge phase falls below 2 bar, a warning is generated (pump continues running). If in the "Setup > Pressure monitoring" menu the function "Min. pressure alarm" is activated, an alarm is generated and the pump is stopped.

If the pressure exceeds the "Max. pressure" set in the "Setup > Pressure monitoring" menu, the pump is shut down, enters the standby state and indicates an alarm.

Caution — The pump restarts automatically once the backpressure falls below the set "Max. pressure"!

6.8.1 Pressure setting ranges

Type	Fixed min. pressure [bar]	Adjustable max. pressure [bar]
DDA 7.5-16	< 2	3-17
DDA 12-10	< 2	3-11
DDA 17-7	< 2	3-8
DDA 30-4	< 2	3-5

Warning

Install a pressure-relief valve in the pressure line to provide protection against impermissibly high pressure!

Caution — The pressure measured in the dosing head is slightly higher than the actual system pressure.
Therefore the "Max. pressure " should be set at least 0.5 bar higher than the system pressure.

6.8.2 Calibration of pressure sensor

The pressure sensor is calibrated in the factory. As a rule, it does not need to be re-calibrated. If specific circumstances (e.g. pressure sensor exchange, extreme air pressure values at the location of the pump) necessitate a calibration, the sensor can be calibrated as follows:

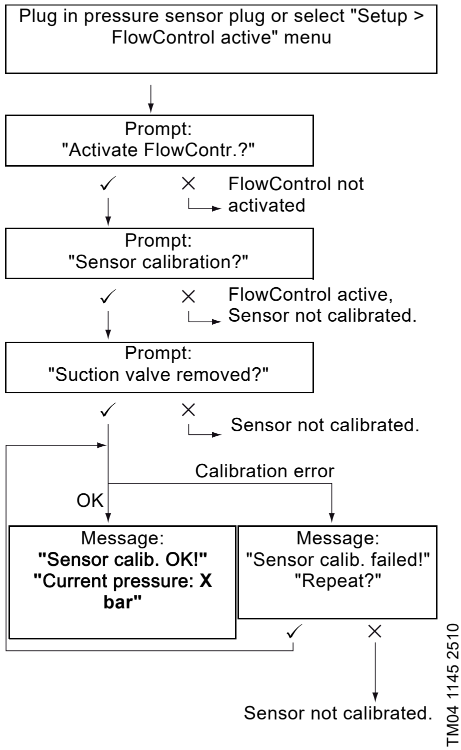
1. Set pump to "Stop" operating state.
2. Make system pressureless and flush.
3. Dismantle suction line and suction valve.

Warning

Calibrating when the suction valve is installed produces incorrect calibration and can cause personal injuries and damage to property!

Only carry out a calibration if this is technically required!

4. Proceed as described below to calibrate:



If a calibration is not successfully possible, check plug connections, cable and sensor and replace defective parts where necessary.

6.9 Flow measurement

Applies to DDA-FCM control variant.

The pump accurately measures the actual flow and displays it. Via the 0/4-20 mA analog output, the actual flow signal can easily be integrated into an external process control without additional measuring equipment (see section *6.5 Analog output*).

The flow measurement is based on the indicator diagram as described in section *6.7 FlowControl*. The accumulated length of the discharge phase multiplied by the stroke frequency produces the displayed actual flow. Faults e.g. air bubbles or backpressure that is too low result in a smaller or larger actual flow. When the "AutoFlowAdapt" function is activated (see section *6.10 AutoFlowAdapt*), the pump compensates for these influences by correction of the stroke frequency.

Note: Strokes which cannot be analysed (partial strokes, pressure differential which is too low) are provisionally calculated based on the setpoint value and displayed.

6.10 AutoFlowAdapt

Applies to DDA-FCM control variant.

The "AutoFlowAdapt" function is activated in the "Setup" menu. It detects changes in various parameters and responds accordingly in order to keep the set target flow constant.

Note: Dosing accuracy is increased when "AutoFlowAdapt" is activated.

This function processes information from the pressure sensor in the dosing head. Errors detected by the sensor are processed by the software. The pump responds immediately regardless of the operation mode by adjusting the stroke frequency or where necessary compensating for the deviations with a corresponding indicator diagram.

If the target flow cannot be achieved by the adjustments, a warning is issued.

"AutoFlowAdapt" operates on the basis of the following functions:

- FlowControl: malfunctions are identified (see section *6.7 FlowControl*).
- Pressure monitoring: pressure fluctuations are identified (see section *6.8 Pressure monitoring*).
- Flow measurement: deviations from the target flow are identified (see section *6.9 Flow measurement*).

Example of "AutoFlowAdapt"

Pressure fluctuations

The dosing volume decreases as backpressure increases and conversely the dosing volume increases as the backpressure decreases.

The "AutoFlowAdapt" function identifies pressure fluctuations and responds by adjusting the stroke frequency. The actual flow is thus maintained at a constant level.

6.11 Auto deaeration

Dosing degassing media can result in air pockets in the dosing head during breaks in dosing. This can result in no medium being dosed when restarting the pump. The "Setup > Auto deaeration" function performs pump deaeration automatically at regular intervals. Software-controlled diaphragm movements encourage any bubbles to rise and gather at the discharge valve so that they can be removed on the next dosing stroke.

The function works:

- when the pump is not in the "Stop" operating state
- during breaks in dosing (e.g. External stop, no incoming pulses, etc.).

Note: The diaphragm movements can displace small volumes into the discharge line. When dosing strongly degassing media, this is however virtually impossible.

6.12 Key lock

The key lock is set in the "Setup > Key lock" menu by entering a four-digit code. It protects the pump by preventing changes to settings. Two levels of key lock can be selected:

Level	Description
Settings	All settings can only be changed by entering the lock code. The [Start/stop] key and the [100%] key are not locked.
Settings + keys	The [Start/stop] key and the [100%] key and all settings are locked.

It is still possible to navigate in the "Alarm" and "Info" main menu and reset alarms.

6.12.1 Temporary deactivation

If the "Key lock" function is activated but settings need to be modified, the keys can be unlocked temporarily by entering the deactivation code. If the code is not entered within 10 seconds, the display automatically switches to the "Operation" main menu. The key lock remains active.

6.12.2 Deactivation

The key lock can be deactivated in the "Setup > Key lock" menu via the "Off" menu point. The key lock is deactivated after the general code "2583" or a pre-defined custom code has been entered.

6.13 Display Setup

Use the following settings in the "Setup > Display" menu to adjust the display properties:

- Units (metric/US)
- Display contrast
- Additional display.

6.13.1 Units

Metric units (litres/millilitres/bar) or US units (US gallons/PSI) can be selected. According to the operation mode and menu, the following units of measurement are displayed:

Operation mode / function	Metric units	US units
Manual control	ml/h or l/h	gph
Pulse control	ml/⎍	ml/⎍
0/4-20 mA Analog control	ml/h or l/h	gph
Batch (pulse- or timer-controlled)	ml or l	gal
Calibration	ml	ml
Volume counter	l	gal
Pressure monitoring	bar	psi

6.13.2 Additional display

The additional display provides additional information about the current pump status. The value is shown in the display with the corresponding symbol.

In "Manual" mode the "Actual flow" information can be displayed with Q = 1.28 l/h (see fig. 34).

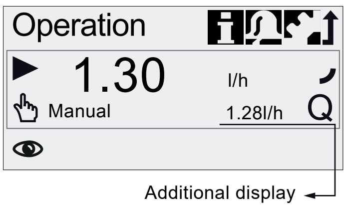


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Fig. 34 Display with additional display

The additional display can be set as follows:

Setting		Description
Default display		Depending on the operation mode:
	Q	Actual flow (Manual/Pulse)[1), 2)]
	Q	Target flow (Pulse)
		Input current (analog)
	V	Remaining batch volume (Batch, Timer)
	t	Period until next dosing (Timer)
Dosed volume	V	Dosed vol. since last reset (see *Counters* on page 21)
Actual flow	Q	Current actual flow[1)]
Backpressure	P	Current backpressure in the dosing head[3)]

1) only DDA-FCM control variant

2) only if indicator diagram can be evaluated (see *6.7 FlowControl*)

3) only DDA-FCM/FC control variant

6.14 Time+date

The time and date can be set in the "Setup > Time+date" menu.

Warning

When time or date is changed in "Time+date" menu, timer dosing and timer relay output functions (Relay 2) are stopped!

Timer dosing and timer relay output functions must be restarted manually!

Changing time or date can cause increase or decrease in concentration!

Caution

The conversion between summer and winter time does not take place automatically!

6.15 Bus communication

BUS

The bus communication enables remote monitoring and setting of the pump via a fieldbus system.

Further manuals, functional profiles and support files (e.g. GSD-files) are available on the CD delivered with the interface hardware and on www.grundfos.com.

6.15.1 GENIbus communication

The pump is supplied with an integrated module for GENIbus communication. The pump identifies the bus control after connecting to the corresponding signal input. The "Activate communication?" prompt is displayed. After confirmation, the corresponding symbol appears in the "Activated functions" area in the "Operation" menu.

In the "Setup > Bus" menu the GENIbus address can be set from 32 to 231 and bus control can be deactivated.

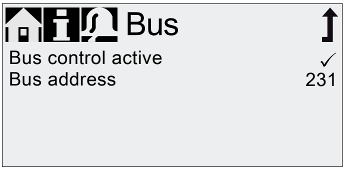

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Fig. 35 Bus menu

Caution: The maximum cable length for GENIbus connection is 3 m and must not be exceeded!

6.15.2 Possible industrial bus types

The pump can be integrated into several networks using the additional E-box (Extension-Box).

Bus type	Interface hardware	Retrofitting possible for pump software
Profibus® DP	E-Box 150	V2.5 and higher
Modbus RTU	E-Box 200	V2.5 and higher
Ethernet	E-Box 500	V2.5 and higher

The pump can also be connected to a Grundfos CIU unit (CIU = Communication Interface Unit) equipped with one of the following CIM modules (CIM = Communication Interface Module):

- CIM150 Profibus
- CIM200 Modbus
- CIM270 GRM
- CIM500 Ethernet

For internal communication between the E-Box/CIU and the dosing pump, GENIbus is used.

Caution: The maximum cable length for GENIbus connection is 3 m and must not be exceeded!

Caution: Prior to installation and start-up, read the documentation delivered with the E-Box or CIU unit!

6.15.3 Activate communication

1. Set the pump to operating state "Stop" with the [Start/stop] key.
2. Switch off the power supply of the pump.
3. Install and connect the E-Box/CIU as described in the respective separate installation and operating instructions.
4. Switch on the power supply of the pump.

The "Activate communication?" prompt is displayed.

After confirmation, the "Bus" symbol appears in the "Activated functions" area of the "Operation" menu, no matter if the prompt was accepted or refused.

If the prompt has been accepted, the bus control function is activated. If the prompt has been refused, bus control function can be activated in "Setup > Bus" menu.

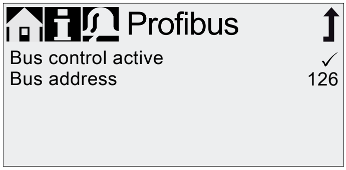

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Fig. 36 Example of submenu for Profibus®

6.15.4 Setting the bus address

1. Enter "Setup > Bus" menu and set desired bus address:

Bus type	Address range
Profibus® DP	0-126
Modbus RTU	1-247

2. The pump needs to be restarted to initialise the new bus address. Switch off the power supply of the pump and wait for approximately 20 seconds.
3. Switch on the power supply of the pump.

The pump is initialised with the new bus address.

6.15.5 Characteristics of bus communication

To start and stop the pump via bus, it needs to be in operating state "Running". When the pump is remotely stopped from bus, the "External stop" symbol is displayed and the pump switches to operating state "Standby".

While bus control function is activated, the "Setup" menu only shows the "Bus" and "Key lock" submenus. The other main menus, the "External stop" function and the keys are still available.

All operation modes (see section *6.4 Operation modes*) can still be used when bus control is activated. This allows to use the bus control only for monitoring and setting the pump. In this case the respective "BusWatchDog" (see funtional profile on E-Box/CIU product CD) should be deactivated in bus control, because otherwise faults in communication can stop the pump.

Note: To change any settings manually, the bus control function must be deactivated temporarily.

The analog output can not be used while the pump is bus-controlled as both functions use the same electrical connection. See section *4.3 Electrical connection*.

6.15.6 Deactivate communication

Warning

After deactivating the bus control function, the pump can start automatically!

Before deactivating the bus control function, set the pump to operating state "Stop"!

Bus control function can be deactivated in the "Setup > Bus" menu. After deactivation all submenus in "Setup" menu are available.

The "Bus" symbol in the display disappears at next restart of the pump, after the E-Box/CIU plug was disconnected.

Caution: After disconnecting any plug, always refit protective cap!

6.15.7 Communication faults

Faults are only detected, if the respective "BusWatchDog" (see functional profile on E-Box/CIU product CD) is activated.

Warning

After a communication fault is repaired, the pump can start automatically, depending on current bus control and pump settings!

Before repairing any fault, set the pump to operating state "Stop"!

In case of bus communication faults (e.g. communication cable break), the pump stops dosing and switches to operating state "Standby" approximately 10 seconds after the fault was detected. An alarm is triggered, detailing the cause of the fault. See section *8. Faults*.

6.16 Inputs/Outputs

In the "Setup > Inputs/Outputs" menu, you can configure the two outputs "Relay 1+Relay 2" and the signal inputs "External stop", "Empty signal" and "Low-level signal".

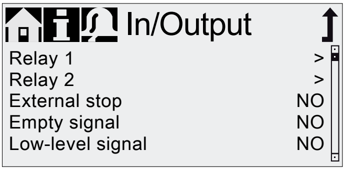

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Fig. 37 Inputs/Outputs menu

Warning

When time or date is changed in "Time+date" menu, timer dosing and timer relay output functions (Relay 2) are stopped!

Timer dosing and timer relay output functions must be restarted manually!

Changing time or date can cause increase or decrease in concentration!

6.16.1 Relay outputs

The pump can switch two external signals using installed relays. The relays are switched by potential-free pulses. The connection diagram of the relays is shown in section *4.3 Electrical connection*. Both relays can be allocated with the following signals:

Relay 1 signal	Relay 2 signal	Description
Alarm*	Alarm	Display red, pump stopped (e.g. empty signal, etc.)
Warning*	Warning	Display yellow, pump is running (e.g. low-level signal, etc.)
Stroke signal	Stroke signal	Each full stroke
Pump dosing	Pump dosing*	Pump running and dosing
Pulse input**	Pulse input**	Each incoming pulse from pulse input
Bus control	Bus control	Activated by a command in the bus communication
	Timer Cycle	See following sections
	Timer Week	See following sections
Contact type		
NO*	NO*	Normally open contact
NC	NC	Normally closed contact

* Factory setting

** The correct transmission of incoming pulses can only be guaranteed up to a pulse frequency of 5 Hz.

Timer Cycle (Relay 2)

For the "Relay 2 > Timer Cycle" function, set the following parameters:

- On (t_1)
- Start delay (t_2)
- Cycle time (t_3)

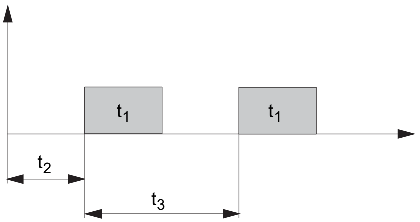

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Fig. 38 Diagram

Timer Week (Relay 2)

This function saves up to 16 relay on-times for a week. The following settings can be made for each relay switching operation in the "Relay 2 > Timer Week" menu:

- Procedure (No.)
- On time (duration)
- Start time
- Weekdays.

6.16.2 External stop

The pump can be stopped via an external contact, e.g. from a control room. When activating the external stop signal, the pump switches from the operating state "Running" into the operating state "Standby". The corresponding symbol appears in the "Signal/error display" area of the display.

Caution

Frequent disengagement from the mains voltage, e.g. via a relay, can result in damage to the pump electronics and in the breakdown of the pump. The dosing accuracy is also reduced as a result of internal start procedures.

Do not control the pump via the mains voltage for dosing purposes!

Only use the "External stop" function to start and stop the pump!

The contact type is factory-set to normally open contact (NO). In the "Setup > Inputs/Outputs > External stop" menu, the setting can be changed to normally closed contact (NC).

6.16.3 Empty and Low level signals

In order to monitor the filling level in the tank, a dual-level sensor can be connected to the pump. The pump responds to the signals as follows:

Sensor signal	Pump status
Low level	• Display is yellow • Flashes • Pump continues running
Empty	• Display is red • Flashes • Pump stops

Caution

When the tank is filled up again, the pump restarts automatically!

Both signal inputs are allocated to the normally open contact (NO) in the factory. They can be re-allocated in the "Setup > Inputs/Outputs" menu to normally closed contact (NC).

6.17 Basic settings

All settings can be reset to the settings default upon delivery in the "Setup > Basic settings" menu.

Selecting "Save customer settings" saves the current configuration to the memory. This can then be activated using "Load customer settings".

The memory always contains the previously saved configuration. Older memory data is overwritten.

7. Service

In order to ensure a long service life and dosing accuracy, wearing parts such as diaphragms and valves must be regularly checked for signs of wear. Where necessary, replace worn parts with original spare parts made from suitable materials.

Should you have any questions, please contact your service partner.

Warning
Maintenance work must only be carried out by qualified staff.

7.1 Regular maintenance

Interval	Task
Daily	Check, if liquid leaks from the drain opening (fig. 41, pos. 11) and if the drain opening is blocked or soiled. If so, follow the instructions given in section *7.6 Diaphragm breakage*.
	Check, if liquid leaks from the dosing head or valves. If necessary, tighten dosing head screws with a torque wrench at 4 Nm. If necessary, tighten valves and cap nuts, or perform service (see *7.4 Perform service*).
	Check, if a service requirement is present at the pump display. If so, follow the instructions given in section *7.3 Service system*.
Weekly	Clean all pump surfaces with a dry and clean cloth.
Every 3 months	Check dosing head screws. If necessary, tighten dosing head screws with a torque wrench at 4 Nm. Replace damaged screws immediately.

7.2 Cleaning

If necessary, clean all pump surfaces with a dry and clean cloth.

7.3 Service system

According to the motor runtime or after a defined period of operation, service requirements will appear. Service requirements appear regardless of the current operating state of the pump and do not affect the dosing process.

Service requirement	Motor runtime [h]*	Time interval [months]*
Service soon!	7500	23
Service now!	8000	24

* Since the last service system reset

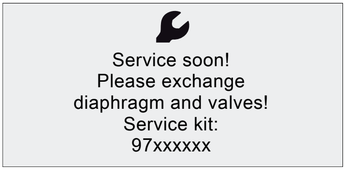

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Fig. 39 Service soon!

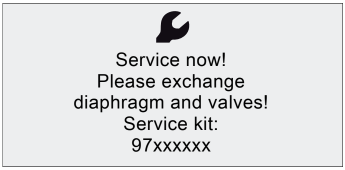

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Fig. 40 Service now!

Caution: For media which result in increased wear, the service interval must be shortened.

The service requirement signals when the replacement of wearing parts is due and displays the number of the service kit. Press the click wheel to temporarily hide the service prompt.

When the "Service now!" message appears (displayed daily), the pump must be serviced immediately. The symbol appears in the "Operation" menu.

The number of the service kit required is also displayed in the "Info" menu.

7.4 Perform service

Only spare parts and accessories from Grundfos should be used for maintenance. The usage of non-original spare parts and accessories renders any liability for resulting damages null and void.

Further information about carrying out maintenance can be found in the service kit catalogue on our homepage. See www.grundfos.com.

Warning

Risk of chemical burns!

When dosing dangerous media, observe the corresponding precautions in the safety data sheets!

Wear protective clothing (gloves and goggles) when working on the dosing head, connections or lines!

Do not allow any chemicals to leak from the pump. Collect and dispose of all chemicals correctly!

Caution

Before any work to the pump, the pump must be in the "Stop" operating state or be disconnected from the power supply. The system must be pressureless!

7.4.1 Dosing head overview

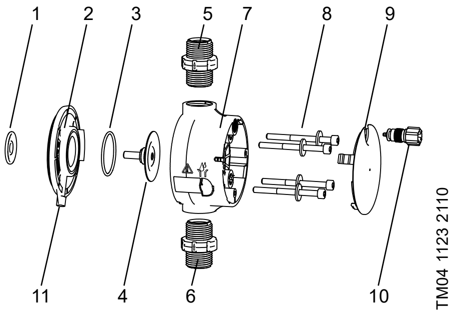


Fig. 41 Changing the diaphragm and valves

1	Safety diaphragm
2	Flange
3	O-ring
4	Diaphragm
5	Valve on discharge side
6	Valve on suction side
7	Dosing head
8	Screws with discs
9	Cover
10	Deaeration valve
11	Drain opening

7.4.2 Dismantling the diaphragm and valves

Warning

Danger of explosion, if dosing liquid has entered the pump housing!

If the diaphragm is possibly damaged, don't connect the pump to the power supply! Proceed as described in section *7.6 Diaphragm breakage*!

This section refers to fig. 41.

1. Make system pressureless.
2. Empty dosing head before maintenance and flush it if necessary.
3. Set pump to "Stop" ■ operating state using the [Start/stop] key.
4. Press the [Start/stop] and [100%] keys at the same time to put the diaphragm into "out" position.
   – Symbol (– must be displayed (see fig. 14).
5. Take suitable steps to ensure that the returning liquid is safely collected.
6. Dismantle suction, pressure and deaeration hose.
7. Dismantle valves on suction and discharge side (5, 6).
8. Remove the cover (9).
9. Loosen screws (8) on the dosing head (7) and remove with discs.
10. Remove the dosing head (7).
11. Unscrew diaphragm (4) counter-clockwise and remove with flange (2).
12. Make sure the drain opening (11) is not blocked or soiled. Clean if necessary.
13. Check the safety diaphragm (1) for wear and damage. Replace if necessary.

If nothing indicates that dosing liquid has entered the pump housing, go on as described in section *7.4.3 Reassembling the diaphragm and valves*. Otherwise proceed as described in section *7.6.2 Dosing liquid in the pump housing*.

7.4.3 Reassembling the diaphragm and valves

The pump must only be reassembled, if nothing indicates that dosing liquid has entered the pump housing. Otherwise proceed as described in section *7.6.2 Dosing liquid in the pump housing*.

This section refers to fig. 41.

1. Attach flange (2) correctly and screw on new diaphragm (4) clockwise.
   – Make sure that the O-ring (3) is seated correctly!
2. Press the [Start/stop] and [100%] keys at the same time to put the diaphragm into "in" position.
   – Symbol)– must be displayed (see fig. 14).
3. Attach the dosing head (7).
4. Install screws with discs (8) and cross-tighten with a torque wrench.
   – Torque: 4 Nm.
5. Attach the cover (9).
6. Install new valves (5, 6).
   – Do not interchange valves and pay attention to direction of arrow.
7. Connect suction, pressure and deaeration hose (see section *4.2 Hydraulic connection*)
8. Press the [Start/stop] key to leave the service mode.

Caution

Tighten the dosing head screws with a torque wrench once before commissioning and again after 2-5 operating hours at 4 Nm.

9. Deaerate dosing pump (see section *5.2 Deaerating the pump*).
10. Please observe the notes on commissioning in section *5. Startup*!

7.5 Resetting the service system

After performing the service, the service system must be reset using the "Info > Reset service system" function.

7.6 Diaphragm breakage

If the diaphragm leaks or is broken, dosing liquid escapes from the drain opening (fig. 41, pos. 11) on the dosing head.

In case of diaphragm breakage, the safety diaphragm (fig. 41, pos. 1) protects the pump housing against ingress of dosing liquid.

When dosing crystallising liquids the drain opening can be blocked by crystallisation. If the pump is not taken out of operation immediately, a pressure can build up between the diaphragm (fig. 41, pos. 4) and the safety diaphragm in the flange (fig. 41, pos. 2). The pressure can press dosing liquid through the safety diaphragm into the pump housing.

Most dosing liquids don’t cause any danger when entering the pump housing. However a view liquids can cause a chemical reaction with inner parts of the pump. In the worst case, this reaction can produce explosive gases in the pump housing.

Warning

Danger of explosion, if dosing liquid has entered the pump housing!

Operation with damaged diaphragm can lead to dosing liquid entering the pump housing.

In case of diaphragm breakage, immediately separate the pump from the power supply!

Make sure the pump cannot be put back into operation by accident!

Dismantle the dosing head without connecting the pump to the power supply and make sure no dosing liquid has entered the pump housing. Proceed as described in section *7.6.1 Dismantling in case of diaphragm breakage*.

To avoid any danger resulting from diaphragm breakage, observe the following:

- Perform regular maintenance. See section *7.1 Regular maintenance*.
- Never operate the pump with blocked or soiled drain opening.
  – If the drain opening is blocked or soiled, proceed as described in section *7.6.1 Dismantling in case of diaphragm breakage*.
- Never attach a hose to the drain opening. If a hose is attached to the drain opening, it is impossible to recognise escaping dosing liquid.
- Take suitable precautions to prevent harm to health and damage to property from escaping dosing liquid.
- Never operate the pump with damaged or loose dosing head screws.

7.6.1 Dismantling in case of diaphragm breakage

Warning

Danger of explosion, if dosing liquid has entered the pump housing!

Do not connect the pump to the power supply!

This section refers to fig. 41.

1. Make system pressureless.
2. Empty dosing head before maintenance and flush it if necessary.
3. Take suitable steps to ensure that the returning liquid is safely collected.
4. Dismantle suction, pressure and deaeration hose.
5. Remove the cover (9).
6. Loosen screws (8) on the dosing head (7) and remove with discs.
7. Remove the dosing head (7).
8. Unscrew diaphragm (4) counter-clockwise and remove with flange (2).
9. Make sure the drain opening (11) is not blocked or soiled. Clean if necessary.
10. Check the safety diaphragm (1) for wear and damage. Replace if necessary.

If nothing indicates that dosing liquid has entered the pump housing, go on as described in section *7.4.3 Reassembling the diaphragm and valves*. Otherwise proceed as described in section *7.6.2 Dosing liquid in the pump housing*.

7.6.2 Dosing liquid in the pump housing

Warning

Danger of explosion!

Immediately separate the pump from the power supply!

Make sure the pump cannot be put back into operation by accident!

If dosing liquid has entered the pump housing:

- Send the pump to Grundfos for repair, following the instructions given in section *7.7 Repairs*.
- If a repair isn't economically reasonable, dispose of the pump observing the information in section *9. Disposal*.

7.7 Repairs

Warning

The pump housing must only be opened by personnel authorised by Grundfos!

Repairs must only be carried out by authorised and qualified personnel!

Switch off the pump and disconnect it from the voltage supply before carrying out maintenance work and repairs!

After consulting Grundfos, please send the pump, together with the safety declaration completed by a specialist, to Grundfos. The safety declaration can be found at the end of these instructions. It must be copied, completed and attached to the pump.

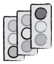
Caution

The pump must be cleaned prior to dispatch!

If dosing liquid has possibly entered the pump housing, state that explicitly in the safety declaration! Observe section *7.6 Diaphragm breakage*.

If the above requirements are not met, Grundfos may refuse to accept delivery of the pump. The shipping costs will be charged to the sender.

8. Faults



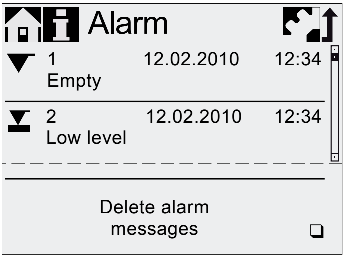
In the event of faults in the dosing pump, a warning or an alarm is triggered.
The corresponding fault symbol flashes in the "Operation" menu, see section *8.1 List of faults*.
The cursor jumps to the "Alarm" main menu symbol.
Press the click wheel to open the "Alarm" menu and, where necessary, faults to be acknowledged will be acknowledged.

A yellow display indicates a warning and the pump continues running.

A red display indicates an alarm and the pump is stopped.

The last 10 faults are stored in the "Alarm" main menu. When a new fault occurs, the oldest fault is deleted.

The two most recent faults are shown in the display, you can scroll through all the other faults. The time and cause of the fault are displayed.



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The list of faults can be deleted at the end of the list.

If there is a service requirement, this appears when the "Alarm" menu is opened. Press the click wheel to temporarily close the service prompt (see section *7.3 Service system*).

8.1 List of faults

8.1.1 Faults with error message

Display in the "Alarm" menu	Possible cause	Possible remedy
Empty (Alarm)	• Dosing medium tank empty	• Fill tank. • Check contact setting (NO/NC).
Low level (Warning)	• Dosing medium tank almost empty	
Overpressure (Alarm)	• Discharge valve blocked • Isolating valve in discharge line closed • Pressure peaks due to high viscosity • Max. pressure set too low (see section *6.8 Pressure monitoring*)	• Replace valve if necessary (see section *7.4 Perform service*). • Check flow direction of valves (arrow) and correct if necessary. • Open the isolating valve (on the discharge side). • Enlarge diameter of discharge line. • Change pressure setting (see section *6.8 Pressure monitoring*).
Low backpressure (Warning/alarm*)	• Faulty diaphragm • Broken discharge line • Pressure differential between suction and discharge side too low • Leakage in the pressure loading valve at Q < 1 l/h • Deaeration valve open	• Change the diaphragm (see section *7.4 Perform service*). • Check discharge line and repair if necessary. • Install additional spring-loaded valve (approx. 3 bar) on the discharge side. • Close the deaeration valve.
Air bubble (Warning)	• Broken/leaky suction line • Strongly degassing medium • Tank dosing medium empty	• Check suction line and repair if necessary. • Provide positive inlet pressure (place dosing medium tank above the pump). • Enable "SlowMode" (see section *6.6 SlowMode*). • Fill tank.
Cavitation (Warning)	• Blocked/constricted/squeezed suction line • Blocked/constricted suction valve • Suction lift too high • Viscosity too high	• Enable "SlowMode" (see section *6.6 SlowMode*). • Reduce suction lift. • Increase suction hose diameter. • Check suction line and open isolating valve if necessary.
Suct. valve leak (Warning)	• Leaky/dirty suction valve • Deaeration valve open	• Check valve and tighten it up. • Flush system. • Replace valve if necessary (see section *7.4 Perform service*). • Check O-ring position. • Install filter in suction line. • Close the deaeration valve.
Disch. valve leak (Warning)	• Leaky/dirty discharge valve • Leakage in the pressure loading valve • Deaeration valve open	• Check valve and tighten it up. • Flush system. • Replace valve if necessary (see section *7.4 Perform service*). • Check O-ring position. • Install screen in suction line. • Close the deaeration valve. • Install spring-loaded valve on the discharge side.
Flow deviation (Warning)	• Considerable deviation between target and actual flow • Pump not or incorrectly calibrated	• Check installation. • Calibrate the pump (see section *5.3 Calibrating the pump*).

Display in the "Alarm" menu	Possible cause	Possible remedy
Pressure sensor (Warning)	• Broken "FlowControl" cable (see fig. 11) • Sensor defect • Pressure sensor not correctly calibrated.	• Check plug connection. • Change sensor if necessary. • Calibrate pressure sensor correctly (see section *6.8.2 Calibration of pressure sensor*).
Motor blocked (Alarm)	• Backpressure greater than nominal pressure • Damage to gears	• Reduce backpressure. • Arrange for repair of gears, if necessary.
BUS Bus error (Alarm)	• Fieldbus communication error	• Check cables for correct specification and damage; replace if necessary. • Check cable routing and shielding; correct if necessary.
E-Box (Alarm)	• E-Box connection error • Faulty E-Box	• Check plug connection. • Replace E-Box if necessary.
Cable break (Alarm)	• Defect in analog cable 4-20 mA (input current < 2 mA)	• Check cable/plug connections and replace, if necessary. • Check signal transmitter.
Service now (Warning)	• Time interval for service expired	• Perform service (see section *7.4 Perform service*).

* Depending on setting

8.1.2 General faults

Fault	Possible cause	Possible remedy
Dosing flow too high	Inlet pressure greater than backpressure	Install additional spring-loaded valve (approx. 3 bar) on the discharge side.
		Increase pressure differential.
	Incorrect calibration	Calibrate the pump (see section *5.3 Calibrating the pump*).
No dosing flow or dosing flow too low	Air in dosing head	Deaerate the pump.
	Faulty diaphragm	Change the diaphragm (see section *7.4 Perform service*).
	Leakage/fracture in lines	Check and repair lines.
	Valves leaking or blocked	Check and clean valves.
	Valves installed incorrectly	Check that the arrow on the valve housing is pointing in the direction of flow. Check whether all O-rings are installed correctly.
	Blocked suction line	Clean suction line/install filter.
	Suction lift too high	Reduce suction lift.
		Install priming aid.
		Enable "SlowMode" (see section *6.6 SlowMode*).
	Viscosity too high	Enable "SlowMode" (see section *6.6 SlowMode*).
		Use hose with larger diameter.
		Install spring-loaded valve on the discharge side.
	Faulty calibration	Calibrate the pump (see section *5.3 Calibrating the pump*).
	Deaeration valve open	Close the deaeration valve.
Irregular dosing	Valves leaking or blocked	Tighten up valves, replace valves if necessary (see section *7.4 Perform service*).
	Backpressure fluctuations	Keep backpressure constant.
		Activate "AutoFlowAdapt" (only DDA-FCM).
Liquid escaping from the drain opening on the flange	Faulty diaphragm	Immediately separate the pump from the power supply! Observe section *7. Service* and especially section *7.6 Diaphragm breakage*.
Liquid escaping	Dosing head screws not tightened	Tighten up screws (see section *4.2 Hydraulic connection*).
	Valves not tightened	Tighten up valves/union nuts (see section *4.2 Hydraulic connection*).
Pump not sucking in	Suction lift too high	Reduce suction lift; if necessary, provide positive inlet pressure.
	Backpressure too high	Open the deaeration valve.
	Soiled valves	Flush system, replace valves if necessary (see section *7.4 Perform service*).

9. Disposal

This product or parts of it must be disposed of in an environmentally sound way.
Use appropriate waste collection services.
If this is not possible, contact the nearest Grundfos company or service workshop.

The crossed-out wheelie bin symbol on a product means that it must be disposed of separately from household waste. When a product marked with this symbol reaches its end of life, take it to a collection point designated by the local waste disposal authorities. The separate collection and recycling of such products will help protect the environment and human health.

See also end-of-life information at www.grundfos.com/product-recycling.

中国 RoHS

产品中有害物质的名称及含量

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6+)	多溴联苯 (PBB)	多溴联苯醚 (PBDE)
泵壳	X	O	O	O	O	O
印刷电路板	X	O	O	O	O	O
紧固件	X	O	O	O	O	O
管件	X	O	O	O	O	O
定子	X	O	O	O	O	O
转子	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制

O：表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。
X： 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 该规定的限量要求。

该产品环保使用期限为 10 年，标识如左图所示。
此环保期限只适用于产品在安装与使用说明书中所规定的条件下工作

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E-mail: info_gnl@grundfos.com

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GRUNDFOS Pumps Corporation
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Grundfos Tashkent, Uzbekistan The Representative Office of Grundfos Kazakhstan in Uzbekistan
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Факс: (+998) 71 150 3292

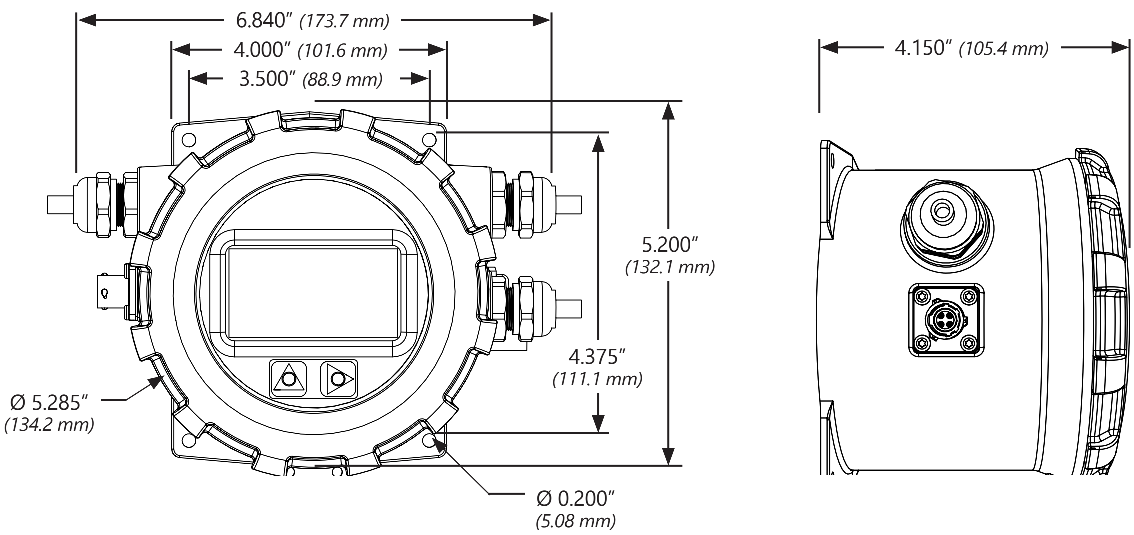
Addresses revised 31.03.2020

95724708 0520

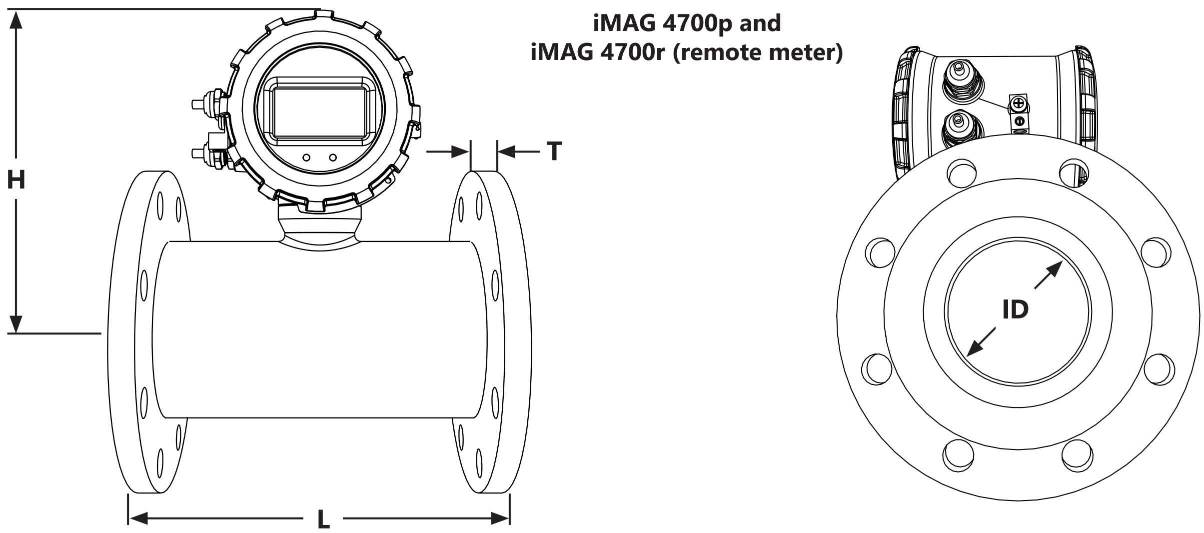
ECM: 1285312

Dimensions - iMAG 4700r and iMAG 4700p

iMAG 4700r (remote display)



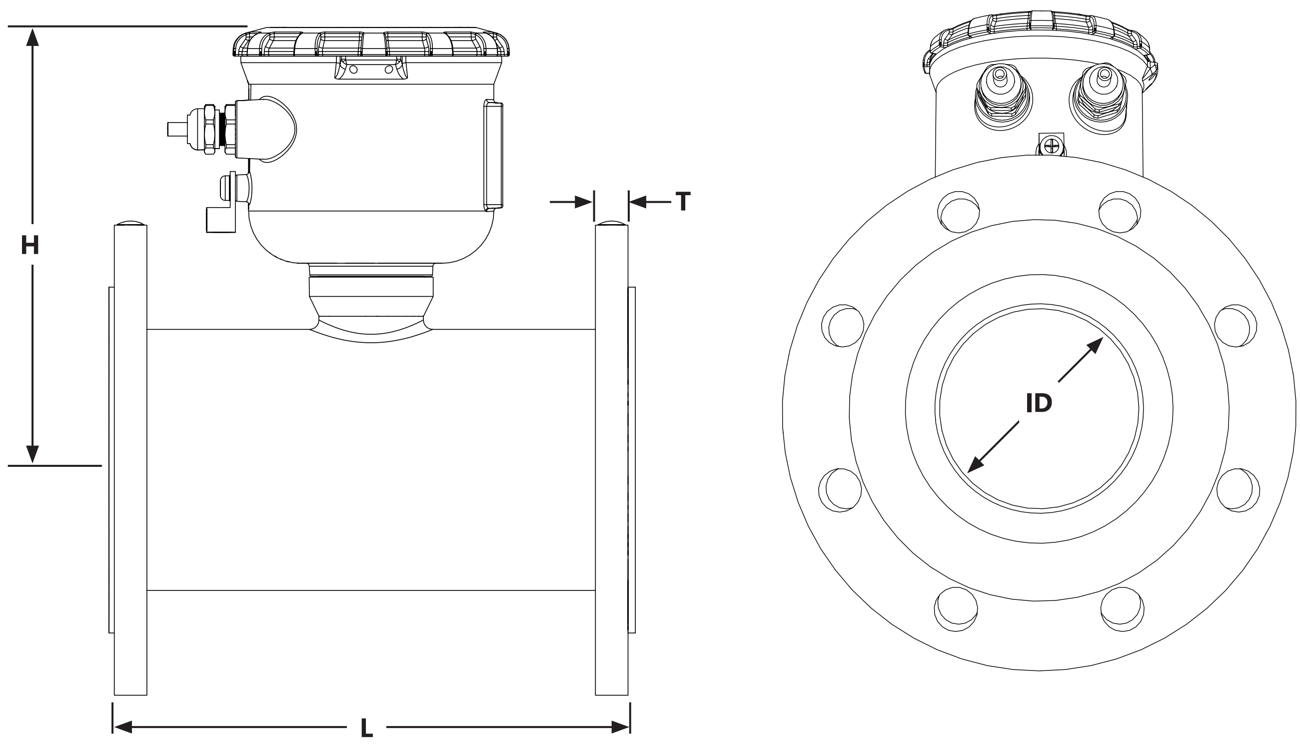
iMAG 4700p and iMAG 4700r (remote meter)



iMAG Meter Size	L		H		T		ID		Shipping Weight			
									AG3000p		AG3000r	
	inch	mm	inch	mm	inch	mm	inch	mm	lbs	Kg	lbs	Kg
3" *	12.25	311.15	7.95	201.9	.68	17.25	2.6	66.04	39	17.5	40	18
4"	10.24	260	8.6	218	.62	15.7	3.12	79	34	15.5	43	19.5
6"	12.27	312	9.4	239	.69	17.5	5.05	128	50	22.5	59	27
8"	14.24	362	10.4	264	.69	17.5	6.44	164	71	32	78	35
10"	18.18	462	11.5	292	.69	17.5	8.61	219	130	59	135	61
12"	19.68	500	12.5	317	.81	20.6	10.55	268	170	77	175	79
Flanges	Standard ANSI 150 lb. drilling								Cable 1 lb.			

**Add 8lbs (3.5kg) for remote display. 3" Only.*

Dimensions - iMAG 4700



iMAG 4700 Meter Size	L		H		T		ID		Shipping Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	lbs	Kg
3"	12.25	311.15	7.08	179.8	.68	17.25	2.6	66.04	38	17
4"	10.24	260	8.3	211	.62	15.7	3.12	79	33	15
6"	12.27	312	9.1	231	.69	17.5	5.05	128	49	22
8"	14.24	362	10.1	257	.69	17.5	6.44	164	70	32
10"	18.18	462	11.2	284	.69	17.5	8.61	219	130	59
12"	19.68	500	12.2	310	.81	20.6	10.55	268	170	77
Flanges	Standard ANSI 150 lb. drilling								Cable 1 lb.	

Section 2

Static Mixers MX1-MX2

WESTFALL

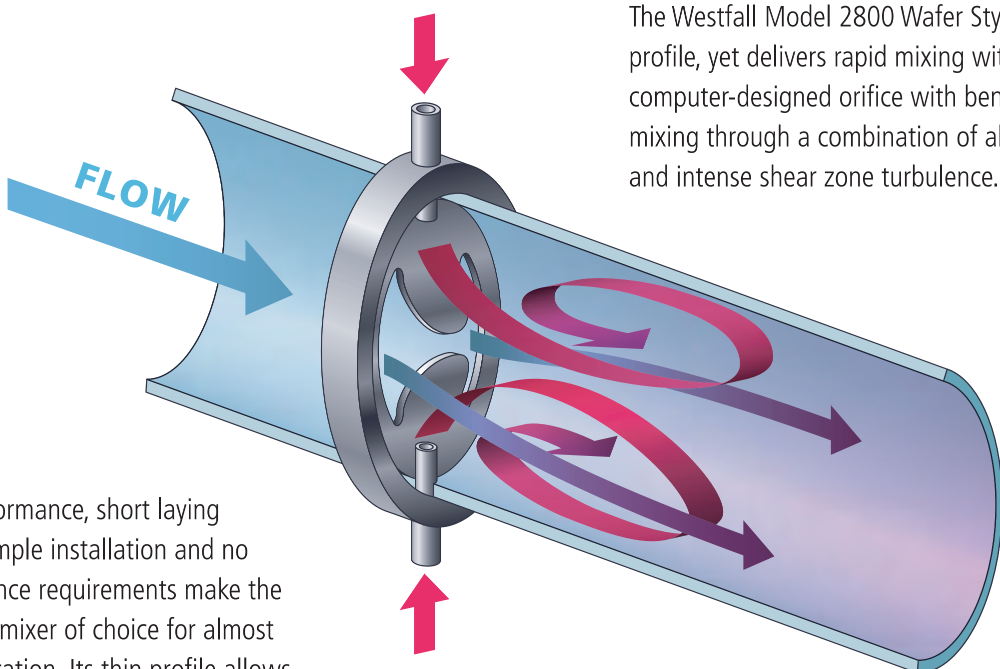
Model 2800

Wafer Style Static Mixer

PATENT NO. 5,839,828

Space Saving Mixer Offers Superior Mixing & Low Headloss

The Westfall Model 2800 Wafer Style Static Mixer has a slim profile, yet delivers rapid mixing with very low headloss. Its computer-designed orifice with bent tabs generates complete mixing through a combination of alternate vortex shedding and intense shear zone turbulence.



High performance, short laying length, simple installation and no maintenance requirements make the 2800 the mixer of choice for almost any application. Its thin profile allows it to be air shipped anywhere in the world at relatively low cost. It is the space-saving and money-saving solution for any installation.

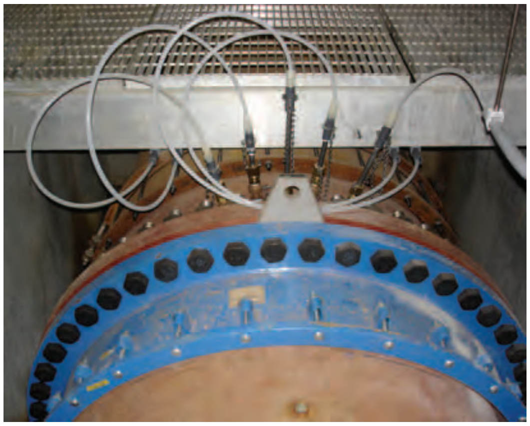
Advantages

- Excellent Mixing
- Low Cost
- Short Laying Length
- Integral Injection Fittings
- Low Headloss
- Easy Installation
- Long Service Life
- No Maintenance Requirements
- No Moving Parts
- Available in pipe diameters up to 120"
- Available in Any Material: PVC, FR, 316 Stainless Steel, Titanium, Kinar, Teflon, etc.

Typical Applications

If you operate any of the following processes, you could benefit from installing Westfall Model 2900 Variable Flow Static Mixers:

- Water Treatment
- Chemical Blending
- Dissolving Gases
- Polymer Blending
- Flocculant Blending
- pH Control
- Potable Water
- Waste Water
- Chlorination
- De-Chlorination



Westfall Model 2800 Static Mixer in-line at Sebago Lake Water Treatment Facility.

Clean Water Plant Conversion Project In Maine

The Portland Water District needed to convert a major chlorine gas feed system to liquid sodium hypochlorite to eliminate hazards and enhance chlorine residual throughout the distribution system. Problems included limited available head in the main between the ozone contactor and the clear-well, low velocities and limited laying length and mixing zone. Engineering company Wright-Pierce Civil and Environmental Engineering Services selected a Westfall Model 2800 60-inch mixer for the application.

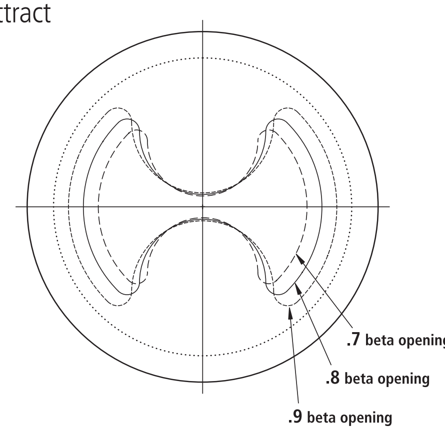
Upon commissioning of the new mixer, the treatment staff noticed an immediate and significant improvement in chlorine residuals. Wright-Pierce's Senior Project manager, Robert J. Williamson, says, "The Westfall mixer stabilized chlorine residual levels in the clearwell over the full range of plant flows. As a result the District has seen an increase and stabilization in residuals further out into the distribution system." Even in spring, when in the past the plant typically dealt with its worst oscillations in pH and chlorine residual, personnel reported "rock steady residual numbers".

The thin profile of the Westfall Model 2800 mixer makes it feasible to air ship anywhere in the world. The short laying length is a fraction of traditional mixers, making it less costly to produce, ship, install and maintain.

72" diameter Westfall Model 2800 mixer, shipped with integral gasket and pre-drilled flange, requiring less heavy equipment for installation.

Simple, Elegant Design Does the Job Efficiently

The Westfall Model 2800 Static Mixer features a uniquely shaped orifice with two bent tabs. The orifice and the angle of the tabs were computer designed and tested to arrive at the optimal shape for mixing with minimal headloss. There are no moving parts to service or attract residue. Suitable for a wide range of applications, the 2800 is highly effective, compact and economical.



Florida Facility Needed Compact Performer

A municipal water treatment facility in Florida needed a mixer that could do the job where space was at a premium. The budget was tight and quality specifications had to be met. The Westfall Model 2800 provided the answer.

The mixer arrived with pre-applied gasket and pre-drilled flange for easy installation.

FIXED K VALUES

.7 Beta: K = 32.59
.8 Beta: K = 13. 63
.9 Beta: K = 6.78

Arizona Treatment Plant Installs Model 2800 Mixers in Special Materials

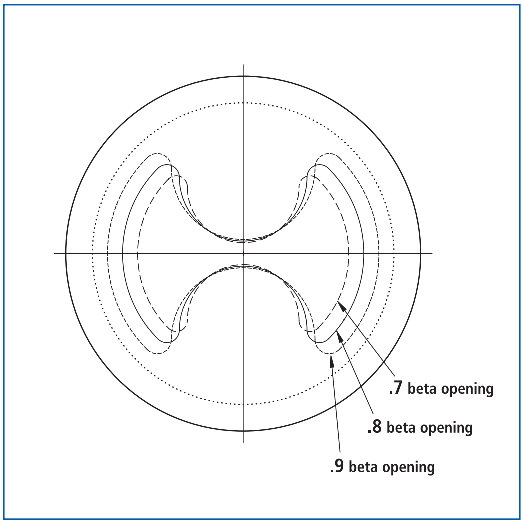
When Currier Construction Inc. built a water treatment plant West of Tucson, they required mixers that could hold their own against the caustic chemicals – Chlorine Sodium Hypochlorite, Sulfuric Acid and Sodium Hydroxide – used to correct pH, chlorinate, disinfect and oxidate.

They installed two 8" and two 6" Westfall Model 2800 Mixers, one made of PVC, with CPVC corp-stop and a PVC solution tube diffuser, and the others made of 25% Glass filled PTFE (Teflon®) with corp-stops and solution tube diffusers made of PVDF (Kynar®). The gaskets are all EPDM.

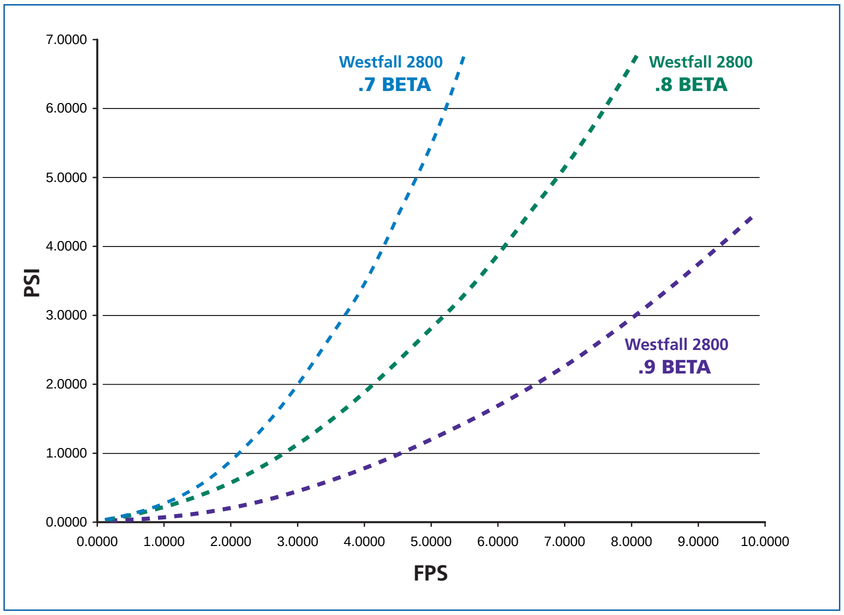
Chuck Reading of REACO Associates LLC says, "Westfall supplied the corp-stops and solution tube diffusers, fitting them and trimming the tubes to the precise spot at the center of the tongue (or bent tab) of the mixer," to facilitate optimal mixing.

Four Westfall Model 2800 Mixers are integral to the system that pre-treats the raw water before it is fed into the filtration tanks for arsenic treatment.

The six and eight-inch diameter Westfall 2800 mixers used in this plant in Ajo, Arizona, have laying lengths between 2.678" and 3", depending on the corp-stop being used.



Westfall 2800 Standard Mixer Sizes



Standard and Custom Designs and Materials

- Materials of Construction: PVC, FRP, 316 Stainless Steel, Titanium, etc.
- Custom materials and configurations are available, with manual or automatic controls
- Mixer plates are offered in 0.7 – 0.9 -Beta ratios

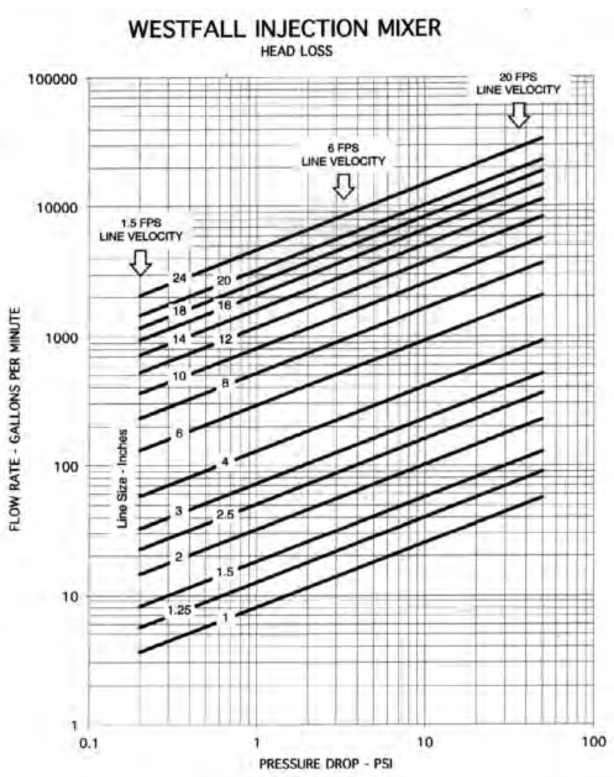
Mixer Plate Beta Openings

Alden laboratory CoV = .008 for .7 beta ratio with excellent mixing at 1-3 FPS
Alden laboratory CoV = .009 for .8 beta ratio with excellent mixing at 3-8 FPS
Alden laboratory CoV = .050 for .9 beta ratio with excellent mixing at 8-11 FPS

CoV = standard deviation of the test data divided by the average of the test data

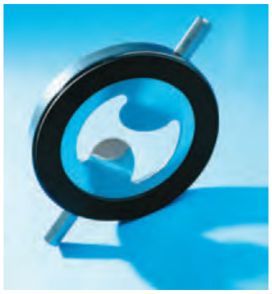
WESTFALL

Visit www.westfallmfg.com



White Papers

- Naval Undersea Warfare Center (NUWC) Hydrodynamics Evaluation
- Alden Research Laboratory, Inc. Mixing Tests of 6" Static Mixer



Westfall's Model 2800
Solving Pipe Line Mixing since 1995

Westfall Manufacturing Company
15 Broad Common Road • Bristol, RI 02809-2733
Voice: Toll Free: 888-928-3747 or 401-253-3799
Fax: 401-253-6530 • E-mail: info@westfallmfg.net
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Westfall Innovates – Others Imitate

WESTFALL

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Static Injection Mixer

Model 2800 US Patent No. 5,839,828

WESTFALL

Westfall Static Mixer

Experience
Westfall Manufacturing Company has extensive experience in the water, wastewater and industrial markets. We have manufactured more than 10,000 Venturi meters since 1965 and more than 2.500 vacuum D.E. filters since 1955. Westfall has been the primary supplier of water treatment components for numerous original equipment manufacturers. We at Westfall are proud of this record of successful applications.

Standard and Custom Designs and Materials:
Standard materials are Fiberglass Reinforced Vinyl Ester resin body with type 316 stainless steel mixer plate. Other materials are available on request. Special size rings, mixer plates and injection fittings can be fabricated to meet specific requirements.

Typical Applications:
Typical applications for the Westfall Static Mixers are:

- Water Treatment
- Chemical Blending
- Dissolving Gases
- Contacting
- Polymer Blending
- Flocculant Blending
- Ph Control
- Potable Water
- Waste Water
- Chlorination
- De-Chlorination

Description:
The Westfall Static Mixer is a motionless static mixer in which fluids are injected and rapidly mixed by a combination of alternate vortex shedding and intense shear zone turbulence.

Description - Tests - Specifications

Typical Specifications:
The Static Mixer shall be of a compact ring body design for mounting between two standard pipe flanges. The ring body shall be a minimum thickness of 0.875 inches and shall be fabricated from ____________________ .

Ring type neoprene gaskets shall be furnished and adhered to both sides of the mixer body. The mixer plate shall be computer designed to provide a geometric shape which will create the mixing vorticies to effectively mix the injected fluid(s) with the main process fluid. The average variation in the process stream of the injected fluid, shall be within 1% of the mean value at 10 pipe diameters downstream of the mixer. The mixing plate shall be no less than 0.125 inches thick and shall be formed from type 316 stainless steel. The mixer plate shall be mounted in a machined cavity on the upstream side of the ring body. The body shall include one or more 316 stainless steel injection fittings . The mixer body and plate materials shall be suitable for handling __________ as the process fluid at the rate of ______ GPM, and ______ PSI. Injection fluids are ____________ , ____________ .

The injection mixer shall be Westfall's Model 2800 .

Available Sizes:
Mixers can be furnished to fit all line sizes 1/2" thru 48". Contact the factory for other sizes. The standard ring body is 0.875" thick plus two .125" gaskets. Special thicknesses will be made to accommodate oversized fluid injection fittings or other requirements. Contact the factory for details.

Advantages of The Static Injection Mixer

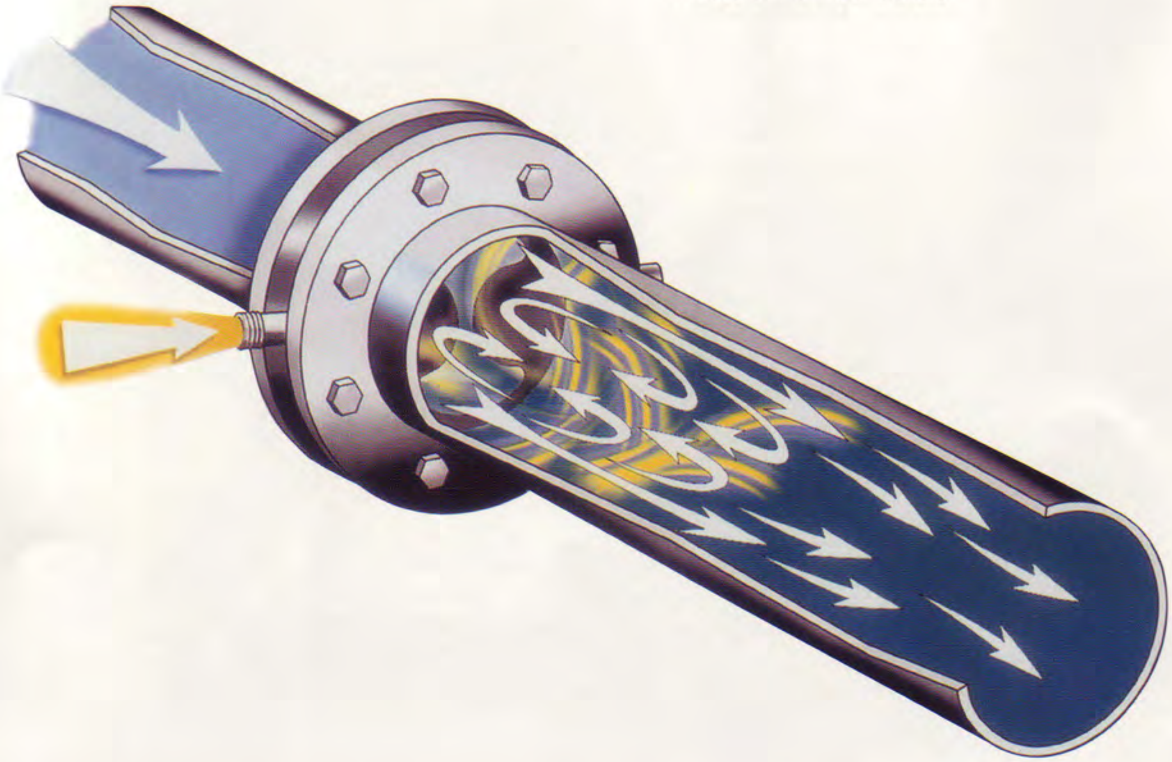
- **Low Cost**
- **Short Laying Length**
- **Integral Injection Fittings**
- **Predictable Mixing**
- **Easy Installation and Hook-up**
- **Long Service Life**
- **No Maintenance Requirements**
- **No Moving Parts**
- **Available in Any Material: PVC, FRP, 316 ST.STL., Titanium, etc.**

Information Required for Express Service Quotation:

- Main Pipe Size and I.D.
- Main Line Fluid and Flow Rate
- Main Line Temperature, Pressure and Viscosity
- Quality of Injected Fluids
- Flow Rate, Temperature, Viscosity of Each Injected Fluid
- Material of Mixer Body Ring
- Material of Mixer Plate
- Injection Fitting Material
- Gasket Material
- Other Special Requirements

Other Westfall Products

- Vacuum Diatomaceous Earth Filter Systems
- Diatomaceous Earth Recovery Flumes
- D.E. and Dry Chemical Feeders
- 3-Way Control Valves
- Rotary Drum Filters
- Venturi Flow Meters
- Rate of Flow Controllers



WESTFALL

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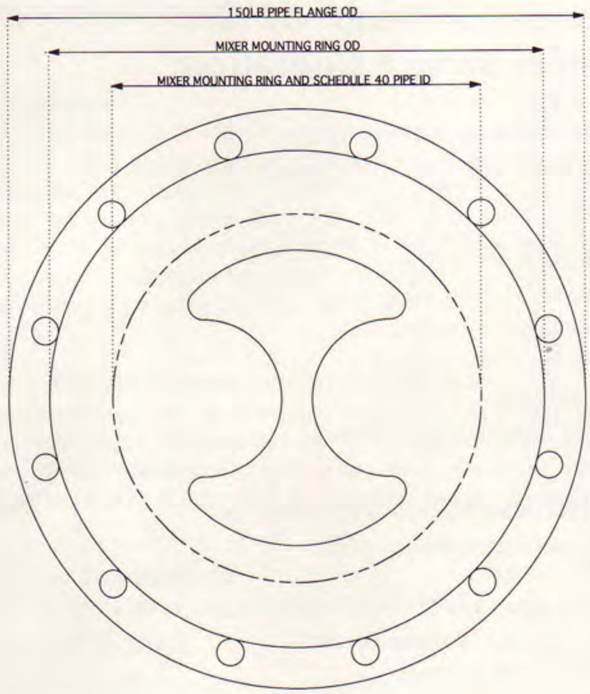
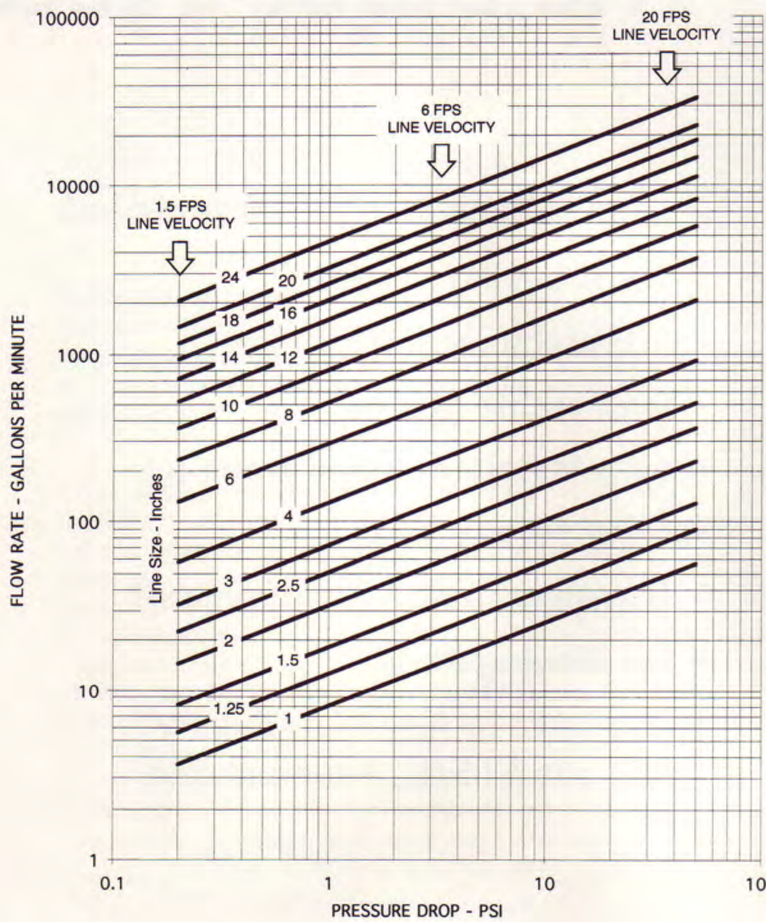


Westfall Injection Mixer - Headloss



150 Lb. Mixer Dimensions in Inches

NOMINAL PIPE SIZE	MIXER MOUNTING RING AND SCHEDULE 40 PIPE ID	MIXER MOUNTING RING OD	150 LB PIPE FLANGE OD	MIXER PLATE THICKNESS	LAYING LENGTH WITH 1/8" GASKETS AND 1/4" NOZZLES	LAYING LENGTH WITH 1/8" GASKETS AND 1/2" NOZZLES
0.50	0.62	1.88	3.50	0.095	1.25	2.00
0.75	0.82	2.25	3.88	0.095	1.25	2.00
1.00	1.05	2.63	4.25	0.095	1.25	2.00
1.25	1.38	3.00	4.63	0.095	1.25	2.00
1.50	1.61	3.38	5.00	0.095	1.25	2.00
2.00	2.07	4.13	6.00	0.125	1.25	2.00
2.50	2.47	4.88	7.00	0.125	1.25	2.00
3.00	3.07	5.38	7.50	0.125	1.25	2.00
4.00	4.03	6.88	9.00	0.125	1.25	2.00
5.00	5.05	7.75	10.00	0.125	1.25	2.00
6.00	6.07	8.75	11.00	0.125	1.25	2.00
8.00	7.98	11.00	13.50	0.188	1.31	2.06
10.00	10.02	13.38	16.00	0.188	1.31	2.06
12.00	11.94	16.13	19.00	0.250	1.38	2.13
14.00	13.12	17.75	21.00	0.250	1.38	2.13
16.00	15.00	20.25	23.50	0.313	1.50	2.19
18.00	16.88	21.63	25.00	0.313	1.75	2.19
20.00	18.81	23.88	27.50	0.375	1.88	2.25
24.00	22.63	28.25	32.00	0.375	2.25	2.25

WINGERT MIXERS

DURABILITY

YOU CAN DEPEND ON

Engineered for Performance

For more than three decades, the J.L. Wingert Company has been manufacturing durable and reliable liquid mixers for a variety of applications. Designed for ease of installation and the flexibility to conform, the complete line of Wingert Mixers offers a wide variety of mounts, motor selections, mixing elements and many installation-enhancing accessories. Whether you are blending liquids, suspending or dissolving solids, there is a dependable Wingert Mixer for every job.

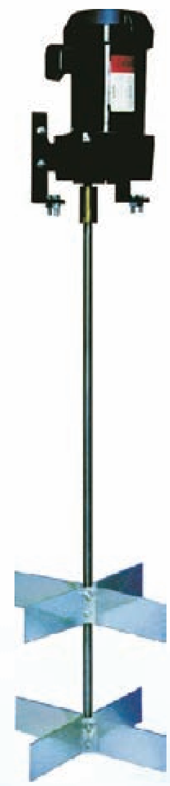
J.L. WINGERT CO.

High Speed (1725 RPM) General Purpose Mixers

Wingert High Speed Mixers are well suited for applications with relatively low viscous liquids (1-500 cps) and tank sizes ranging from 30 to 500 gallons. With a variety of mountings, motor types, voltages and mixing elements, there is a suitable Wingert Mixer for every job.

- 1725 RPM
- Continuous duty
- Bracket, clamp, flange, thread or tank stand mount
- TEFC, open, variable speed, explosion proof or air powered motors
- Available with stainless steel impellers / propellers or neoprene impellers
- Factory wiring, topical coating, variable shaft lengths & other options available

Low Speed (60 RPM) Mixers



Wingert Low Speed Mixers are designed for mild blending applications with fluid viscosities ranging from 1-2000 cps and tank sizes from 30 to 1000 gallons. Durable 3" x 14" blending paddles, coupled with a 60 RPM gear-reduced motor, assure an even and low-shear blend.

- 60 RPM
- Continuous duty
- 1/4, 1/3, 1/2 horsepower
- Bracket, clamp, or tank stand mount
- TEFC, open, explosion proof or air powered motors
- Available with 1, 2, or 3 stainless steel impellers
- Factory wiring, topical coating, variable shaft lengths & other options available

"WXL" (350 RPM) HEAVY DUTY MIXERS

Wingert "WXL" Series Mixers are ideal for blending or dissolving applications with fluid viscosities ranging from 1-2000 cps and tank sizes from 100 to 5,000 gallons. The 1/3 to 5 HP bracket or clamp mount "WXL" will handle even the most demanding mixing applications.

- 350 RPM
- Continuous duty
- 1/3, 1/2, 3/4, 1, 1 1/2, 2, 3, & 5 horsepower bracket mount styles
- 1/3, 1/2, 3/4, 1 & 1 1/2 horsepower clamp mount styles
- TEFC, explosion proof or air powered motors
- Available with single or dual stainless steel propellers
- Factory wiring, topical coating, variable shaft lengths & other options available

MIXER SIZING GRAPH

To select the proper mixer horsepower and speed, follow the sizing graph below. For example: a 50 gallon tank at 100 cps would require a 1/4HP 1725 RPM mixer, and a 3,000 gallon tank at 500 cps would require a 1 1/2HP 350 RPM mixer.

FLUID VISCOSITY	TANK SIZE IN GALLONS 30	50	100	200	230 gal mix tank
1 CPS	1/20HP	1/20HP	1/4HP	1/3HP	
100 CPS	1/20HP	1/4HP	1/3HP	1/2HP	
300 CPS	1/4HP	1/3HP	1/2HP	1HP	
500 CPS	1/2HP	1HP	1/4HP	1/3HP	
1000 CPS	1/4HP	1/3HP	1/2HP	1/3HP	
2000 CPS	1/3HP	1/2HP	1/3HP	1/2HP	

Solutions will be 1-2%, so close to the viscosity of water (1CPS)

1725 RPM MIXERS	60 RPM MIXERS	

- NOTE: Use the above mixing graph for basic mixer sizing. Application or intended use may change manufacturer recommendations. Please consult factory on other than standard mixing applications.

HOW TO ORDER

Wingert Mixers are easily ordered by designating the appropriate order code for each component selected. Find the appropriate mixer horsepower and speed for your application based on the Mixer Sizing Graph on the proceeding page, then use the charts below to order the desired components.

High Speed Mixers

B -1 -TE -PRP /WRD-EK

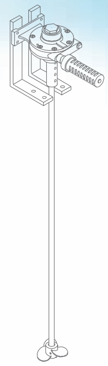
B *Mount:*
- "B" Bracket
- "C" Clamp
- "F" Flange
- "T" Thread
- "X" Tank Stand Mount

-1 *Horsepower and Voltage Codes:*
- "M" 1/20HP
- "1" 1/4HP
- "2" 1/3HP
- "3" 1/2HP
- "4" 1HP

-TE *Motor Type:*
- "O" Open
- "TE" TEFC
- "EXP" Explosion Proof

-PRP *Mixing Agent:*
- "PRP" Stainless Steel Propeller
- "A" Neoprene Impeller
- "H" Stainless Steel Impeller

/WRD-EK *Options:*
- "WRD" Factory Power Cord
- "EK" Epoxy Coating
- "STS" Suction Tube Shield
- "SCP" Stainless Steel Coupling
- "AM" Angle Mount
- "316" Stainless Steel Shaft & Impeller
- " * " Variable Shaft Length (specify inches)



High Speed Air Mixers

A 11 -TE -PRP /316-EK

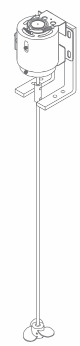
A *Series:*
- "A" Air Mixer

11 *Horsepower:*
- "11" 1/4HP, 9 CFM/40#
- "12" 1/3HP, 11 CFM/43#
- "21" 1/4HP, 15 CFM/18#
- "22" 1/3HP, 20 CFM/20#
- "23" 1/2HP, 27 CFM/38#
- "24" 1HP, 40 CFM/70#

-B *Mount:*
- "B" Bracket
- "C" Clamp
- "F" Flange
- "T" Thread
- "X" Tank Stand Mount

-PRP *Mixing Agent:*
- "PRP" Stainless Steel Propeller
- "A" Neoprene Impeller
- "H" Stainless Steel Impeller

/316-EK *Options:*
- "EK" Epoxy Coating
- "STS" Suction Tube Shield
- "SCP" Stainless Steel Coupling
- "316" Stainless Steel Shaft & Impeller
- " * " Variable Shaft Length (specify inches)



Low Speed Mixers

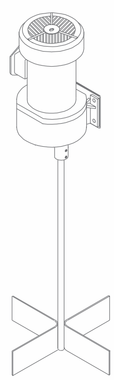
B -1 60 /WRD-EK

B *Mount:*
- "B" Bracket
- "C" Clamp
- "X" Tank Stand Mount

-1 *Horsepower:*
- "1" 1/4HP
- "2" 1/3HP
- "3" 1/2HP

60 *Motor Type / Voltage:*
- "60" 115 V, TEFC
- "62" 230 V, TEFC
- "64" 230 V, Explosion Proof

/WRD-EK *Options:*
- "WRD" Factory Power Cord
- "EK" Epoxy Coating
- "STS" Suction Tube Shield
- "SCP" Stainless Steel Coupling
- "316" Stainless Steel Shaft & Impeller
- " * " Variable Shaft Length (specify inches)



Low Speed Air Mixers

A B -160 /316-EK

A *Series:*
- "A" Air Mixer

B *Mount:*
- "B" Bracket
- "C" Clamp
- "X" Tank Stand Mount

-160 *Horsepower:*
- "160" 1/4HP, 15 CFM/18#
- "260" 1/3HP, 20 CFM/20#
- "360" 1/2HP, 27 CFM/38#

/316-EK *Options:*
- "EK" Epoxy Coating
- "STS" Suction Tube Shield
- "SCP" Stainless Steel Coupling
- "316" Stainless Steel Shaft & Impeller
- " * " Variable Shaft Length (specify inches)

Variable Speed Mixers

VB -1 -TE -PRP /WRD-EK

VB *Series and Mount:*
- "VB" Bracket
- "VC" Clamp
- "VF" Flange
- "VT" Thread
- "VX" Tank Stand Mount

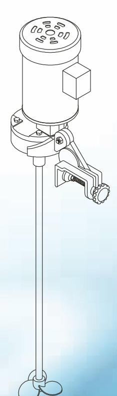
-1 *Horsepower and Voltage Codes:*
- "M" 1/20HP
- "1" 1/4HP
- "2" 1/3HP
- "3" 1/2HP
- "4" 1HP

-TE *Motor Type:*
- "TE" TEFC

-PRP *Mixing Agent:*
- "PRP" Stainless Steel Propeller
- "A" Neoprene Impeller
- "H" Stainless Steel Impeller

/WRD-EK *Options:*
- "WRD" Factory Power Cord
- "EK" Epoxy Coating
- "STS" Suction Tube Shield
- "SCP" Stainless Steel Coupling
- "316" Stainless Steel Shaft & Impeller
- " * " Variable Shaft Length (specify inches)

Need Shaft 48" long (Chem tank = 58.75" from top lip to bottom).



"WXL" Mixers

WXL -2 0 B /WRD-EK

WXL *Series:*
- "WXL" WXL

-2 *Horsepower:*
- "2" 1/3HP
- "3" 1/2HP
- "4" 3/4HP
- "5" 1HP
- "6" 1 1/2HP
- "7" 2HP
- "8" 3HP
- "9" 5HP

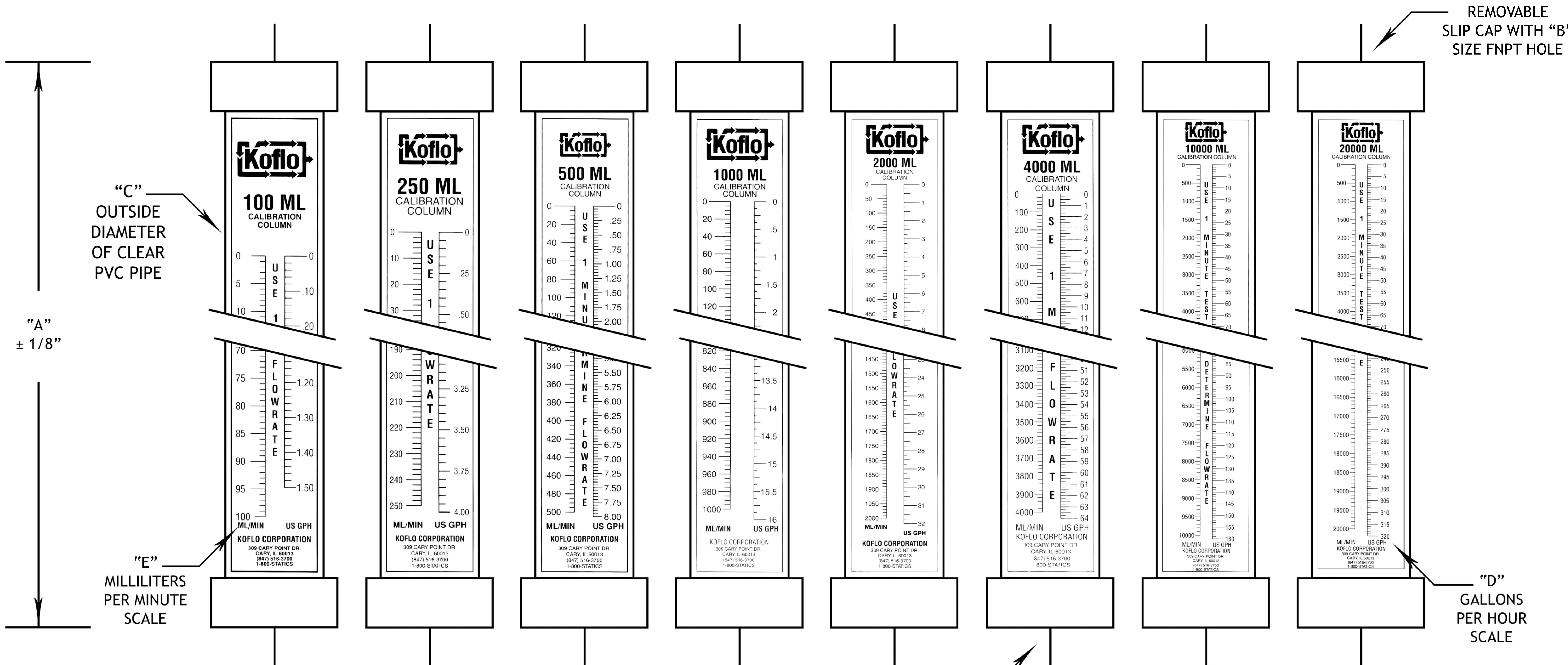
0 *Motor Type:*
- "0" TEFC
- "1" TEFC
- "2" Explosion Proof
- "3" Explosion Proof
- "4" Air-operated

B *Mount:*
- "B" Bracket
- "C" Clamp

/WRD-EK *Options:*
- "WRD" Factory Power Cord
- "EK" Epoxy Coating
- " * " Variable Shaft Length (specify inches)
- "DUAL" Dual Stainless Steel Propellers

Southern CA: P.O. Box 6207 • Garden Grove, CA 92846-6207 | 11800 Monarch Street • Garden Grove, CA 92841-2113
Phone (714) 379-5519 | Fax (714) 379-5549
Southwest Region: Phone (602) 470-1015 ■ Northern CA: Phone (510) 487-5310
www.jlwingert.com | customerservice@jlwingert.com

Calibration Columns with Top Slip Caps



NOTE: - USE ONE (1) MINUTE TEST TO DETERMINE FLOWRATE
- CALIBRATION COLUMNS ARE USED IN GRAVITY SYSTEMS OPEN TO THE ATMOSPHERE AND THEREFORE ARE NOT PRESSURE RATED

MODEL	"A"	"B"	"C"	"D"	"E"	INCREMENTS
100 ML-SC	12-1/2"	1/2"	1.315"	1.5	100	1 ML / 0.020 GPH
250 ML-SC	16-1/4"	1/2"	1.660"	4.0	250	2 ML / 0.050 GPH
500 ML-SC	16"	3/4"	2.375"	8.0	500	5 ML / 0.050 GPH
1000 ML-SC	25"	3/4"	2.375"	16.0	1,000	5 ML / 0.125 GPH
2000 ML-SC	24"	1"	3.500"	32.0	2,000	10 ML / 0.250 GPH
4000 ML-SC	34"	1"	4.000"	64.0	4,000	20 ML / 0.250 GPH
10000 ML-SC	27"	2"	6.625"	160.0	10,000	100 ML / 1.000 GPH
20000 ML-SC	46"	2"	6.625"	320.0	20,000	100 ML / 1.000 GPH

Koflo Corporation
309 CARY POINT DR.
CARY, IL 60013

SCALE: NONE
DATE: 2/6/07
APPROVED BY
DRAWN BY N.J.F
REVISED 8/7/07
REVISED 11/24/10
REVISED 8/14/14
CUSTOMER:
MODEL NO: PVC CALIBRATION COLUMNS WITH TOP SLIP CAPS
DRAWING NUMBER KD-1033

Appendix D – Geotechnical Investigation

June 2019

April 2021

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TECHNICAL MEMORANDUM

DATE 02 July 2019 — 19126567

TO Vanessa Wike, PE, Bristol Engineering Services Company

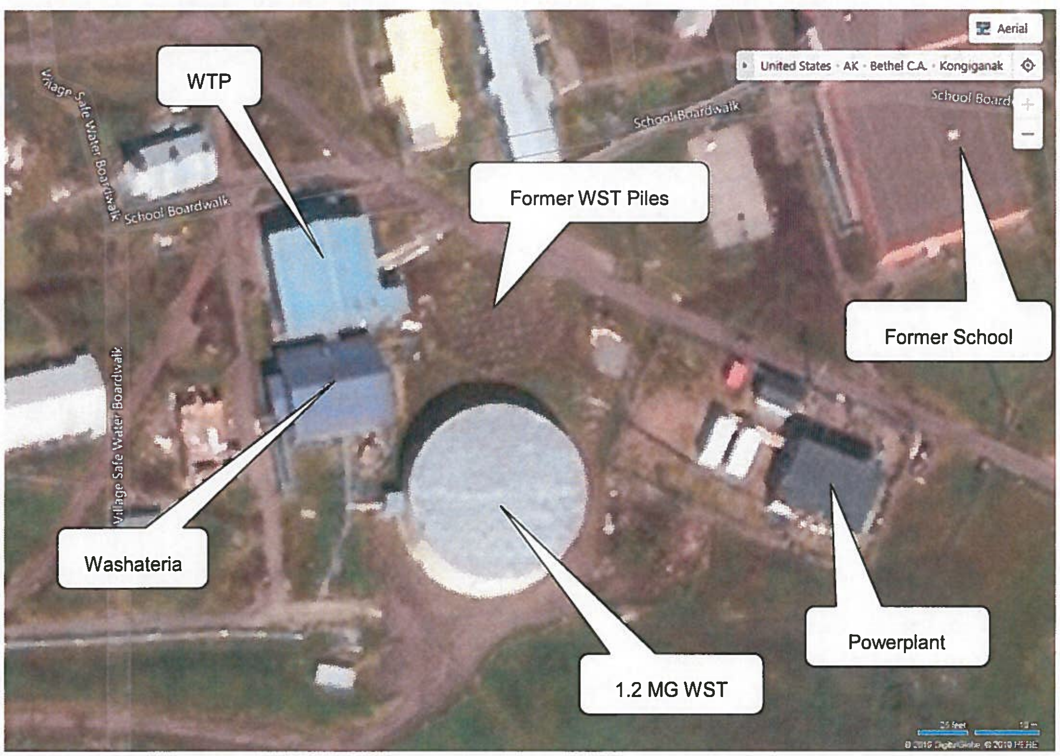
CC Kraig Hughes, SE, PE

FROM Richard Mitchells, PE RAM — **EMAIL** rmitchells@golder.com

KONGIGANAK WTP GEOTECHNICAL RECONNAISSANCE FINDINGS

Richard Mitchells and Kraig Hughes travelled to Kongiganak, Alaska June 20-21, 2019 to conduct a brief structural and geotechnical reconnaissance of the existing Water Treatment Plant (WTP) building and adjacent Washateria/Laundromat. The purpose of the reconnaissance was to ascertain the current structural and foundation condition of the facility in light of proposed improvements that may induce additional design loads on the structure. During the WTP reconnaissance, we also conducted visual assessments of the foundations for the adjacent 1.2-MG at-grade Water Storage Tank (WST) and the existing timber piles that supported the now demolished nominal 0.5 MG-WST.

The general locations of the key structures are noted in the following Bing image.



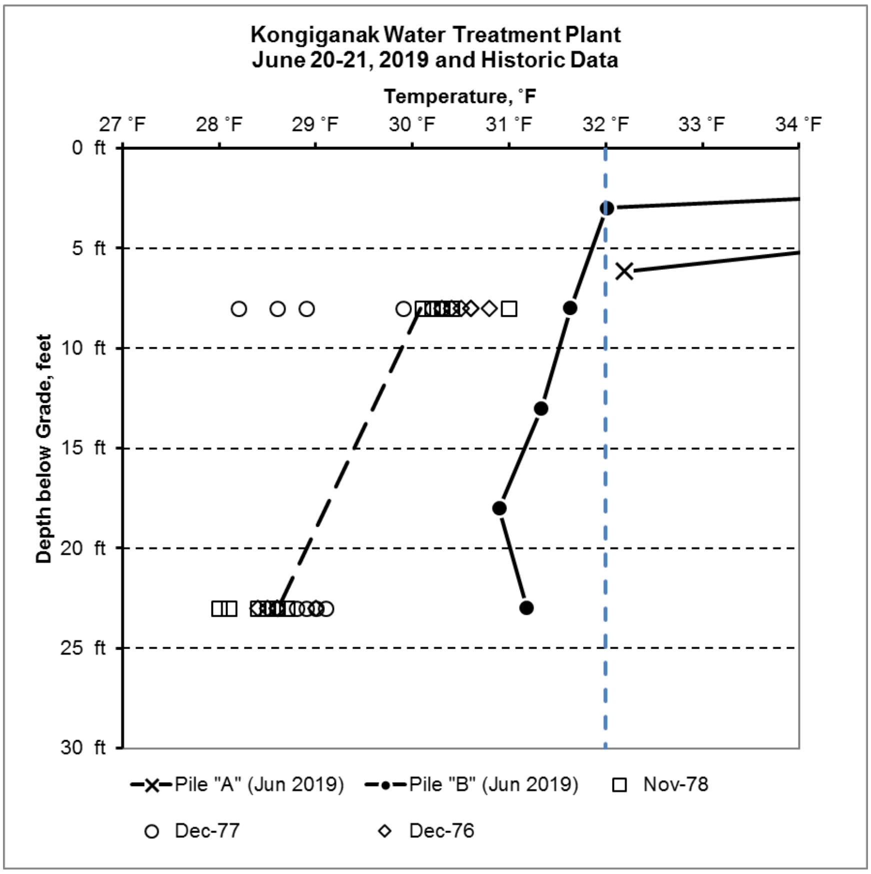
Existing WTP

The existing WTP was constructed in 1978 as a water or wastewater treatment facility. The facility is founded on 20 round timber piles installed using drill and slurry methods. The foundations piles appeared to be treated, at least on their exposed surfaces. The foundation piles are inferred to be adfreeze-type piles. We have assumed the original pile foundation design did not include significant end bearing contribution. Rigid insulation was not observed in the soil underlying the WTP footprint and none was reported with the reviewed as-built data. A summary as-built record of the WTP timber piles is attached for reference.

While there is a considerable amount of building debris under the structure, the exposed portions of the WTP timber piles appeared to be in decent condition with no obvious signs of rot or deterioration. An elevation survey of the pile caps was not conducted during the June 2019 reconnaissance, but no visual indications of excessive pile settlement or heave were noted.

During original installation, a 2-inch diameter ABS standpipe was installed in the borehole annular space adjacent to each timber pile. All but one of these ABS standpipes were either damaged or infilled with material or ice at the time of our June field effort. Ground temperatures were measured in the one accessible ABS standpipe. The location of temperature measured pile is noted on the attached sketch.

Ground temperatures from June 2019 and historic ground temperature data provided with the as-built records are summarized in the following plot. As noted, ground temperatures have warmed significantly since original installation, as expected for this area.



We used the as-built ground temperature data from the late 1970s to derive an estimated ultimate axial capacity at the time of initial installation. The estimated ultimate axial capacity is predicated on a timber pile installed with drill and slurry methods using a non-cohesive mineral soil and potable water slurry and a creep-related settlement of 1-inch over 20 years (approximately year 2000 service life). We also assumed negligible pore water salinity impacts along the piles. We also derived a current estimated ultimate axial capacity for similar conditions based on the June 2019 ground temperature data, ignoring any potential end bearing contribution. For a 22 to 23-foot embedment below existing grade, estimated ultimate axial compression capacity of approximately 65 kips was derived for the initial installation period. The estimated ultimate axial compression capacity is reduced from the initial installation capacities due primarily to ground warming since installation. We estimated current ultimate axial compression capacities in the range of 25 kips per pile.

Additional considerations for current axial capacities include:

- Perimeter piles should be expected to have lower current axial capacities relative to interior piles due to solar gain, runoff water, tundra damage, snow drifts, and albedo impacts along the building perimeter.
- The current facility discharges a considerable amount of water through the floor, particularly along the southeasts corner of the WTP during water pumping. This discharged water is expected to accelerate permafrost degradation in this area.
- The debris under the structure can impede unrestricted air flow under the structure and capture snow drifting. Both may impact colder winter air cooling under and around the structure.
- Climate impacts are expected to continue to further warm the area permafrost and increase the depth of surface thaw. Warming ground will further reduce foundation pile axial capacities and/or increase creep-related settlement rates. Deepening surface thaw will lower the point of fixity along the foundation piles with attendant adverse impacts to lateral capacity and behaviour.

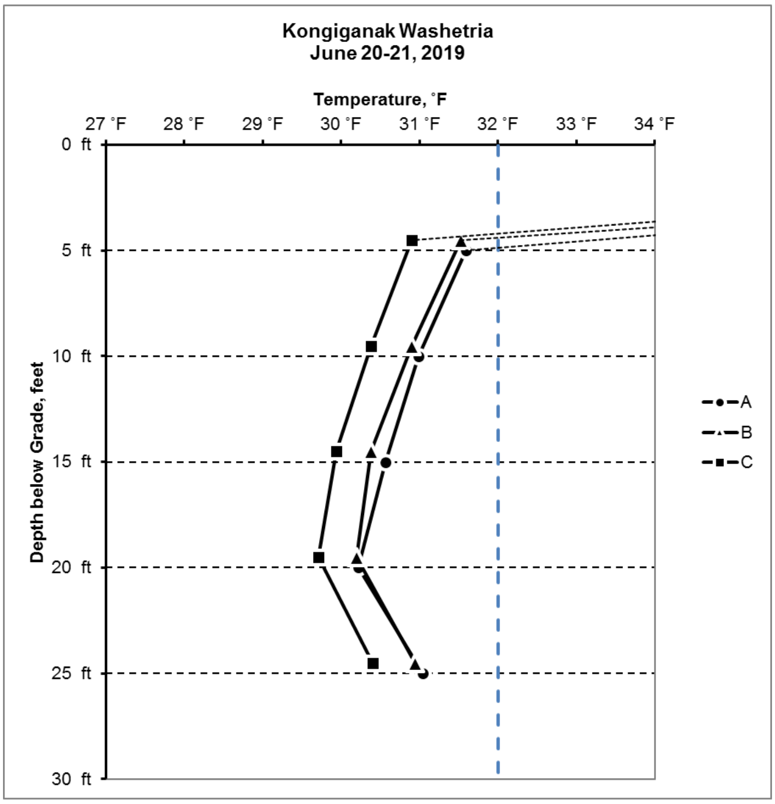
The WTP foundations are considered well beyond their originally intended service life. The current ground temperatures have reduced the estimated axial capacities of these piles. Since only one foundation pile had an accessible ground temperature standpipe, the measured ground temperatures may not accurately reflect ground temperatures along other foundation piles. Select other standpipes that are currently blocked should be opened to determine accurate ground temperatures in other areas of the WTP foundation. We can assist the design team with options for accessing currently blocked ground temperature standpipes.

Assuming the ground temperatures measured on the single standpipe are representative of the site ground thermal states, continued use of the existing WTP foundation pile will almost certainly require geotechnical augmentation for extended use as foundation members under certain loading conditions. Geotechnical augmentation may include installation of rigid insulation and/or use of subgrade cooling around the foundation piles. Redirecting the water discharge through the floor away from the building foundation is also needed.

Existing Washateria

The existing Washateria is founded on 18 each, 6-inch nominal diameter steel Arctic Foundations Inc. (AFI) Thermohelix piles. Pile embedment are estimated to be similar to the WTP foundations, 22 to 23 feet below grade. The foundation piles were installed using drill and slurry methods, assuming a non-cohesive mineral soil and potable water slurry backfill. Rigid insulation was not observed in the soil underlying the structure. Each pile has 2 or 3 steel angle lateral support brackets attached to the structural glulam beam and the base of the pile. Many of the steel lateral supports are damaged, apparently due to frost-related action.

Each foundation pile included a ¾-inch dimeter PVC standpipe assumed installed to the pile embedment depth. Several of the PVC standpipes are damaged or otherwise inaccessible, but an equal number appeared accessible. Of the accessible PVC standpipes, three standpipes along a cross-building transect were accessed for ground temperature measurements, reference the following plot and attached sketch. The Thermohelix piles are apparently cooling the ground around the measured piles within reasonable expectations for their age and assumed as-built conditions.



During our site reconnaissance, local personnel familiar with the facility operations since original construction indicated the Washateria has experienced settlements, reportedly on the order of 8 to 12 inches vertically. There is some evidence supporting differential movements, possibly settlement related, due to select exterior door misalignment. However, widespread evidence of larger differential movements was not visibly supported throughout most of the facility. Also, at the measured ground temperatures referenced above, we would not anticipate foundation differential movements in excess of geotechnical design tolerances, provided the measured ground temperatures reflect the ground thermal regime throughout the entire building footprint.

1.2-MG Water Storage Tank

The current 1.2-MG WST is founded at-grade using 16 AFI Thermoprobes with nominal condenser size of 70 square feet. This WST was installed around 2000 and reliable design and as-built records should be available for the WST. No significant geotechnical issues were observed at the WST. A thermistor reader is located inside the WTP fabricated to provide temperatures for 32 temperature sensors. Temperature measurements for the 32 reader positions are summarized below. We do not have as-built records for the locations of the individual temperature data points, but they are assumed to be located at strategic areas under the WST below a rigid insulation layer installed under and around the WST perimeter.

While temperature data at the Washateria and 12-MG WST indicate the passive subgrade cooling systems are operational, it would be prudent to have AFI conduct a survey of each passive cooling unit to verity their operational status relative to their original basis of design.

Kongiganak 1.2- MG Water Tank
Temperatures (assumed °F)
21-Jun-19

Switch	A	B
1	27.94	27.46
2	28.13	26.96
3	27.76	26.81
4	27.95	27.31
5	28.29	28.37
6	27.42	28.26
7	27.82	28.04
8	28.06	28.06
9	28.42	27.62
10	28.13	28.13
11	27.86	27.42
12	28.04	27.76
13	28.77	28.22
14	29.23	28.40
15	27.76	28.06
16	28.07	28.51

Former WST Foundation Piles

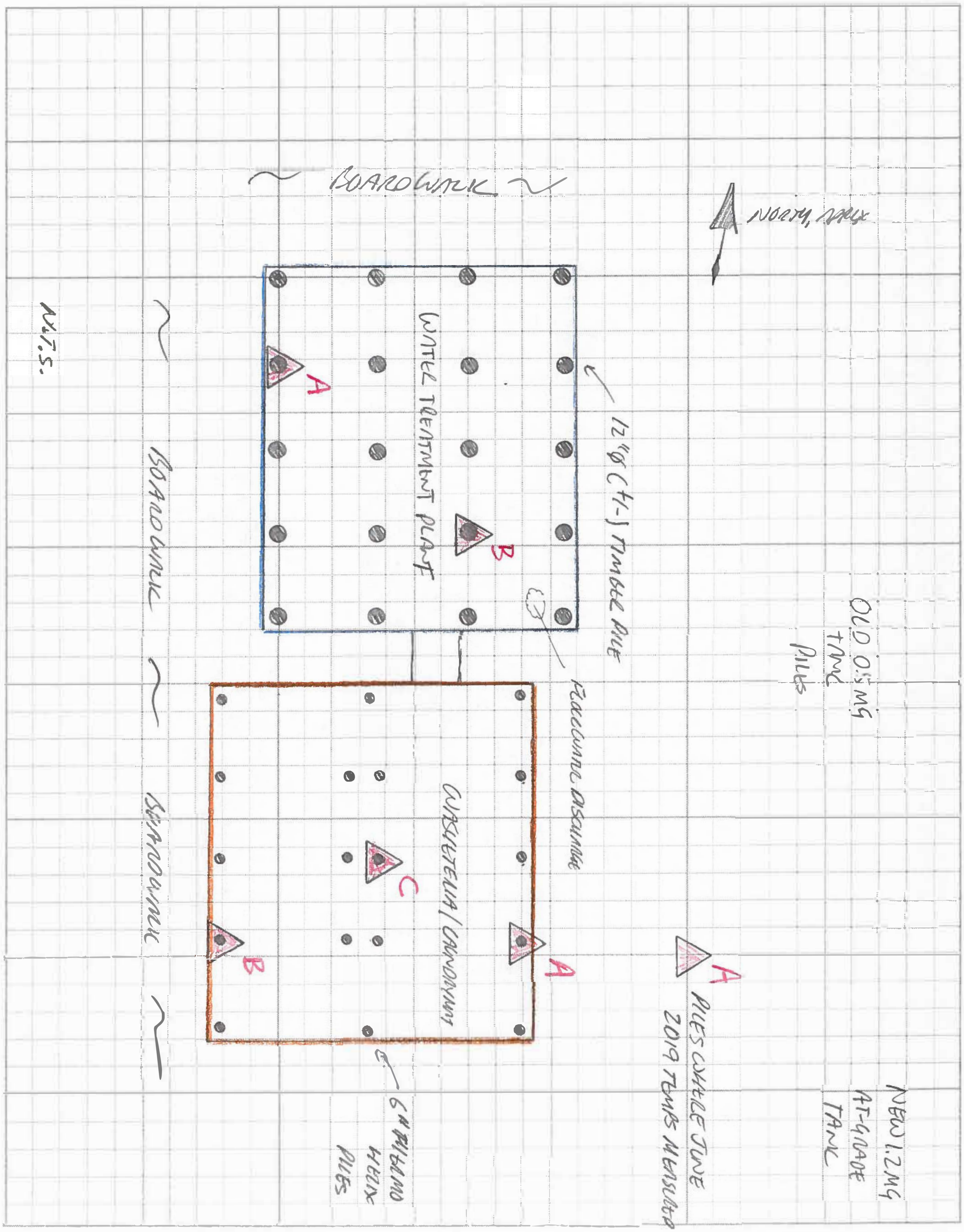
The former WST was founded on 88 timber piles installed on a nominal 5.5-foot rectangular grid. The former WST was demolished concurrent with the 1.2-MG WST project; however, the foundation piles were left in-place. We were unable to locate reliable design or as-built records for these foundation piles. However, it is reasonable to assume they were installed roughly similar to the WTP foundation system. A series of 1-inch diameter PVC standpipes were randomly located throughout the tank foundation footprint. These PVC standpipes were apparently not installed concurrent with original WST pile foundation installation. They may have been installed as part of WST shell post-demolition effort. Only two (2) of the PVC standpipes had caps in place; the remaining PVC standpipes were broken and infilled with soil or ice. The two intact standpipes were both infilled or iced at about 5.5 feet below grade. Reliable ground temperatures were not available from either PVC standpipe.

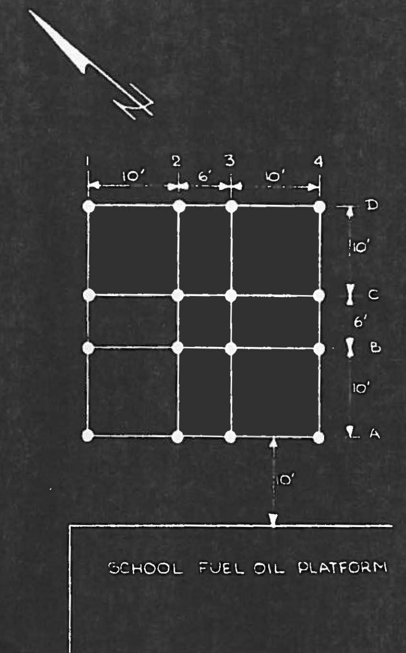
The exposed portions of the timber piles at this location appeared to be in decent condition with no significant rot or damage. The exposed tops of the timber piles have experienced weathering and their structural integrity will need to be confirmed.

If these piles are being considered for new loading, additional geotechnical assessment will be required to estimate their axial and lateral capacities. However, for preliminary considerations, it may be reasonable to assume their current axial capacities could be similar to the WTP foundation piles discussed above, provided both the former WST and WTP foundation piles are of similar design and installation means and methods. Pending the results of a site-specific geotechnical evaluation, reuse of the former WST foundation piles will almost certainly require rigid insulation under and around load bearing piles and possibly subgrade cooling.

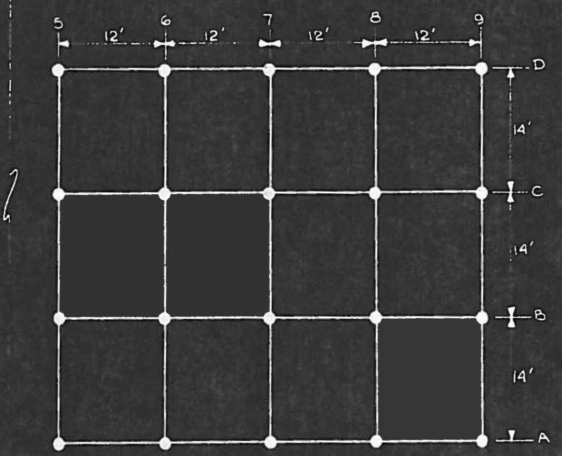
Golder Associates

SUBJECT KONG WTP & WASHETERIA FOUNDATION SCHEMATIC		
Job No. NOT TO SCALE	Made by RAM Reviewed MA	Date 6-24-19 Sheet 1 of 1



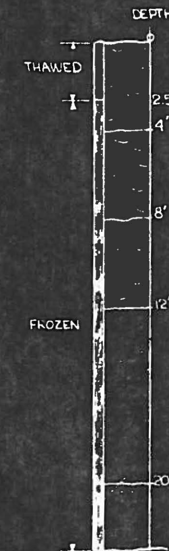


FUEL STORAGE

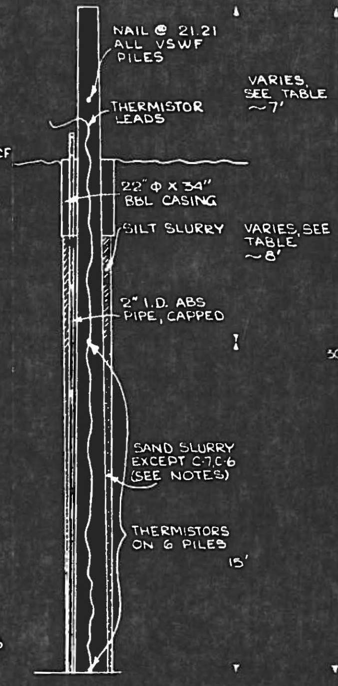


VSWF SITE

GENERALIZED SOIL PROFILE



DESCRIPTION	ESTIMATED USC	W/C %	γd PCF
BROWN ORGANICS ICE ~50% OVERALL AS V_x, V_u	Pt	>200	<40
BROWN ORG. SILT VIS. ICE ~30% AS V_r	OL	~100	
BROWN SILT WITH SOME ORGANICS N_{bN} & V_s	ML	~45	
GREY-GREEN SILT WITH SOME CLAY N_{bN}	ML	~40	
BROWN SILT WITH SOME CLAY, TRACE ORG. N_{bN}	ML-CL	~35	~85



TYPICAL VSWF PILE

SCALE: 1" = 4'

PILE	DATE SET	ORIG. LENGTH	ELEV. OF TOP	ELEV. OF GROUND	DIAM. OF TOP	TOTAL EMBED.	SAND BACKFILL
A5	10/14/76		23.7	16.9	11.8"	23.2	
B5	10/28	30'	25.3	17.3	10.7"	22.0	
C5	10/28	30'	25.4	17.4	11.3"	22.0	
P5	10/12	30'	24.5	17.1	11.9"	22.6	
A6	10/13	30'	24.2	17.1	12.1"	22.9	
B6	10/28	30'	25.3	17.5	13.0"	22.3	
C6	10/28	30'	24.0	17.2	11.5"	23.1	
D6	10/12	30'	24.7	17.2	13.4"	22.5	
A7	10/13	30'	23.1	16.5	10.9"	23.4	
B7	10/15	30'	22.8	16.9	10.8"	24.1	
C7	10/28	30'	24.5	16.8	10.7"	22.3	
D7	10/11	30'	25.2	17.9	11.8"	22.7	
A8	10/13	30'	23.7	16.5	10.4"	22.8	
B8	10/15	30'	22.4	16.7	13.5"	24.3	~ 15
C8	10/28	30'	22.9	17.2	12.0"	24.3	~ 15
D8	10/11	30'	25.0	17.6	12.4"	22.6	~ 15
A9	10/12	30'	23.3	16.7	10.7"	23.4	~ 15
B9	10/14	30'	23.6	16.8	11.9"	23.3	~ 15
C9	10/9	30'	23.5	17.2	10.7"	23.7	~ 15
D9	10/28	30'	24.8	17.7	11.5"	23'	~ 15

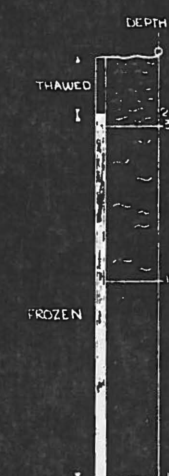
NOTE:

1) PILE C-7 WAS BACKFILLED ENTIRELY WITH A SILT SLURRY.

2) PILE C-6 WAS BACKFILLED IN THE LOWER 5 FEET WITH SILT AND THE NEXT 15 FEET WITH SAND AND THE REMAINDER WITH SILT.

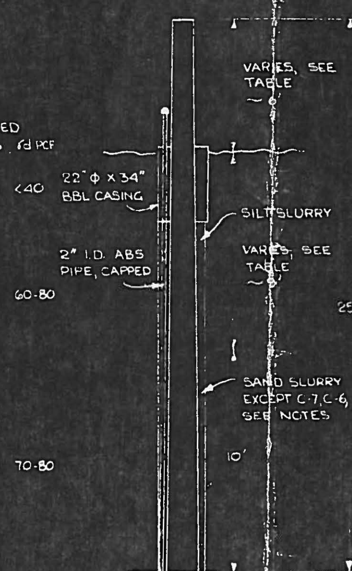
3) THE AVERAGE BUTT SIZE FOR VSWF PILES WAS 15.2" WHILE THE AVERAGE TIP IS 10.9".

ELEVATIONS BASED ON ASSUMPTION OF 20.00. AT PLAY DECK ADD 80.0 TO MATCH OTHER ELEVATIONS.



DESCRIPTION	ESTIMATED USC	W/C %	γd PCF
PEAT	Pt	>200	<40
BROWN ORG. SILT Nbe, V_r	ML	~100	60-80
GREY-GREEN FINE, SANDY SILT WITH SOME CLAY Nbn	ML	~50	70-80

GENERALIZED SOIL PROFILE



TYPICAL FUEL STORAGE PILE

SCALE: 1" = 4'

PILE	DATE SET	ORIG LENGTH	ELEV. OF TOP	ELEV. OF GROUND	DIAM. OF TOP	TOTAL EMBED.	SAND BACKFILL
A-1	10/7/76	25'	16.27	~ 12.0	~ 11.5'	21'	~
B-1	10/6	25'	14.69	~ 12.0	~ 11.5'		
C-1	10/4	25'	15.35	~ 12.0	~ 11.5'		~ 11'
D-1	10/3	25'	16.37	~ 12.0	~ 11.5'	19'	10'
A-2	10/7	25'	16.49	~ 12.0	~ 11.5'		
B-2	10/6	25'	16.08	~ 12.0	~ 11.5'		
C-2	10/5	25'	16.11	~ 12.0	~ 11.5'		
D-2	10/4	25'	15.50	~ 12.0	~ 11.5'		~ 11'
A-3	10/8	25'	16.89	~ 12.0	~ 11.5'		
B-3	10/7	25'	16.91	~ 12.0	~ 11.6'		
C-3	10/5	25'	15.80	~ 12.0	~ 11.5'		~ 11'
D-3	10/4	25'	15.85	~ 12.0	~ 11.5'		
A-4	10/8	25'	16.61	~ 12.0	~ 11.5'		
B-4	10/8	25'	16.05	~ 12.0	~ 11.5'		
C-4	10/8	25'	17.70	~ 12.0	~ 11.5'		
D-4	10/9	25'	16.15	~ 12.0	~ 11.5'		

NOTE:

1) THE AVERAGE BUTT SIZE FOR FUEL DEPOT PILES WAS 15.4" WHILE THE AVERAGE TIP SIZE WAS 11.5"

DAYS AFTER SETTING TEMP. °F — ADDITIONAL READINGS

PILE	THERMISTOR DEPTH BELOW GROUND	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	12/3/76 DATE	2/16/77 DATE	DATE
D 1	0	33.3	33.1	34.2		33.7			31.5	31.9		33.2											32.0												
	2	31.6	31.8	31.8		31.7			31.7	31.9		32.0											31.7												
	5	32.0	31.9	31.9		31.8			31.8	32.1		32.1											31.5												
	8	32.1	32.0	32.0		31.9			31.8	32.1		32.0											31.0												
	13	32.0	31.9	31.9		31.6			30.9	30.9		30.7											30.0												
	18	32.1	31.9	31.8		31.4			30.1	30.1		29.9											29.5												
D 9	8	32.1		32.0	32.2					31.8							31.3							30.6								30.2	30.6	28.2	
	23	32.1		32.0	32.0					30.7							28.6							28.3								28.0	28.6	28.8	
D 5	8	33.9				31.7							31.4							30.6												30.2	30.5	28.9	
	23	31.9				31.4							28.7							28.1												28.0	28.4	28.6	
A 8	8	32.1				31.9							31.7							31.2												30.4	30.8	29.9	
	23	31.7				31.8							29.8							28.9												28.6	29.0	30.1	
A 5	8				32.4							31.9							30.9												30.1		30.4	28.6	
	23				31.8							29.5							28.4												28.1		28.6	29.1	
B 7	9																	31.9												30.3			30.3	30.3	
	24																	31.1												28.7			28.8	29.0	
C 7	7				31.9												31.0																30.6	30.2	
	22				31.4												28.5																28.6	28.9	

TEMPERATURE DATA

AS BUILT

OCTOBER 1976

GENERAL NOTES:

1) ALL PILES WERE INSTALLED IN HOLES PREDRILLED WITH AN 18" AUGER. DUE TO WOBBLING IN THE HOLE, HOWEVER, THE ACTUAL SIZE OF THE HOLE WAS APPROXIMATELY 20".

2) THE SAND USED TO BACKFILL THE LOWER PORTIONS OF ALL PILES WAS IMPORTED MATERIAL WITH 100% PASSING THE #40 SIEVE AND 20% PASSING THE #200 SIEVE.

3) THE SAND SLURRY WAS AT A WATER CONTENT OF APPROXIMATELY 20% AND VIBRATED IN PLACE WITH A CONCRETE PROBE VIBRATOR.

4) A 2" I.D. ABS PIPE WAS CAST IN PLACE IN EACH HOLE FOR SUBSEQUENT USE EITHER FOR TEMPERATURE MONITORING OR FREEZEBACK.

5) THE UPPER PORTIONS OF EACH PILE WERE BACKFILLED WITH A SATURATED SILT SELECTED FROM THE HOLE CUTTINGS.

6) THERMISTORS USED WERE YELLOW SPRING INSTRUMENT COMPANY #401, GENERAL PURPOSE PROBES. WITHIN A RANGE OF 10°F OF FREEZING, THE RELATIONSHIP BETWEEN RESISTANCE AND TEMPERATURE IS $Y = ae^{-bx}$ WHERE Y IS THE TEMPERATURE IN DEGREES FAHRENHEIT, a IS A CONSTANT EQUAL TO 97.57, b IS A CONSTANT EQUAL TO 1.5157×10^{-4} AND X IS THE THERMISTOR RESISTENCE IN OHMS.

STATE OF ALASKA 49TH — Jon A. Bendz 3606-E

STATE OF ALASKA 49TH — Calvin E. Wood No. 2183-E

	BY
DESIGNED	J.A.B.
DRAWN	P.J.B.
CHECKED	J.A.B.

NO.	DATE	REVISION	BY
1	4-78	APRIL 1978 REVISED DESIGN	C.E.W.

QUADRA Engineering

Anchorage, Alaska

KONGIGANAK VSW

PILING AS BUILT

KONGIGANAK, ALASKA

DATE: 7 MAY 1977

S-1

SHEET 9 OF 24

ES74001W-9/22-1

77-16

Appendix E – Cost Estimates

HMS Capital Cost Estimate

NPV Cost Estimate

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Appendix F – Treatability Reports

Jar Testing Treatability Study - June 2019

SGS Lab Test Results Summary – July 2019

Disinfection By-Product Assessment

Corrosion Control Assessment

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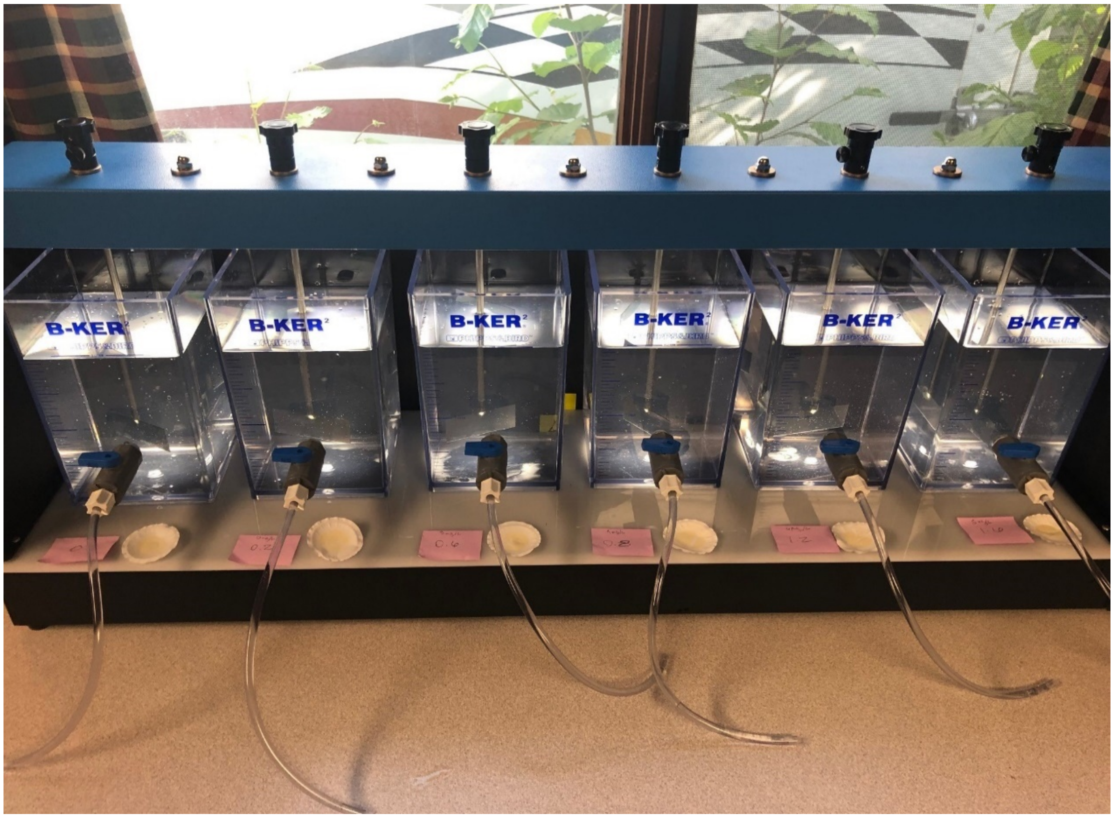
Technical Memorandum: Bench Scale Testing

July 2019

Kongiganak Public Water System, Native Village of Kongiganak, Alaska



Prepared For:

NATIVE VILLAGE OF KONGIGANAK
KONGIGANAK, AK 99545

and

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
VILLAGE SAFE WATER PROGRAM
(PROJECT 19-VSW-KKH-014)
555 CORDOVA ST., ANCHORAGE, AK 99501

Prepared By:

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111 W. 16 AVE, 3RD FLOOR, ANCHORAGE, AK 99501

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INTRODUCTION

Bristol Engineering Services Company, LLC (Bristol) was contracted through the State of Alaska, Village Safe Water Program (VSW), on behalf of the Native Village of Kongiganak (Village) to assess the treatability of the raw water in Kongiganak, Alaska.

Raw water samples were collected during a site inspection completed on July 23, 2019. Samples were collected in the Water Treatment Plant (WTP), from the raw water line from the raw Water Storage Tank (WST). The raw WST had been filled from Contractor's Lake the prior week. Bench scale jar testing and water modeling were performed July 25-26, 2019 to evaluate coagulation and corrosion control processes for the proposed Water Treatment Plant (WTP) update.

OBJECTIVES

The objectives of this report are to:

- Identify the optimum coagulant and the estimated dosage for both particulate removal (turbidity reduction) and organic reduction to minimize Disinfection By-Product (DBP) formation potential, based on a jar testing of Kongiganak' s raw water;
- Evaluate the DBP potential and corrosion potential based on raw water characteristics and the results of water modeling (Water!Pro™, 2019); and
- Estimate the optimum corrosion control method and dosage based on raw water characteristics and the results of water modeling (Water!Pro™, 2019).

SYSTEM DESCRIPTION

Kongiganak is a boardwalk community. Homes in Kongiganak do not have piped water or wastewater services. Residents individually haul their own drinking water and wastewater using private owned all-terrain vehicles. The only piped water and wastewater systems at this time serve the Water Treatment Plant (WTP) / Washeteria (with exterior community watering point), the new health clinic, and the school. The school relies on the 1.2 million gallon (MG) raw WST owned and operated by the Village. The Ayagina'ar Elitnaurvik School currently owns and operates a separate water treatment system (PWSID 271245).

Kongiganak Raw water is obtained annually, from Contractor's Lake. Raw water is stored throughout the winter, until the source and raw water transmission line are thawed and accessible in the late spring – early summer. Raw water is treated using direct filtration (Nalco 8105), followed by disinfection using calcium hypochlorite. At the time of the 2019 inspection the treated water did not meet current Surface Water Treatment Rule (SWTR) requirements for *Giardia* disinfection. There is no history of DBP exceedances. However, this may be due to the absence of chlorine in the storage containers.

Source Water Quantity and Quality

Contractor's Lake is approximately 5.2 acres is area and averages 4 feet deep (Quadra, 1981). There have been concerns that the Lake will provide sufficient water to meet an expanded demand. The Village currently has water rights for the use of 3,600 gallons per day (gpd), or 1.3 MG per year. The 1.2 MG raw WST has not had sufficient volume to meet meet community demand during the time that the system was operating off of stored water, and the source was inaccessible.

The lake was chosen as a source in 1981 (Quadra, 1981) because it has higher quality than the surrounding surface water and groundwater sources, and because it is less impacted by flooding and saltwater intrusion. A summary of raw water quality is provided in Table 1, with a full set of laboratory results attached in Appendix A.

Exhibit 1: Contractor's Lake (2010)

Table 1: Raw Water Quality Summary (Sampled July 2019)

	SGS[1]		Field Analysis[2]	
Calcium	282	ug/L		
Iron	750	ug/L		
Mn	9.96	ug/L		
Color	70	PCU		
pH	5.8		6.2	
TDS	27	mg/L		
Nitrate	0.185	mg/L		
TOC	7.22	mg/L		
DOC	5.96	mg/L		
UVA	0.35	cm-1		
Temp			67.5	F
Hardness			40	mg/L
Alkalinity			0	mg/L
Iron			0.9	mg/L
Turbidity			1.07	NTU
UV Absorbance			0.389	cm-1
Conductivity			21.7	µS/m
Total Dissolved Solids			16.3	mg/L
Salinity			0	

1. SGS laboratory analysis report, August 9, 2019.
2. Analyzed at time of sample collection, using field instruments.

In general, the water had relatively low turbidity, low hardness, and low pH, with high levels of organics. This indicates that limiting the potential for DBP formation and corrosion control will be important treatment objectives.

POTENTIAL REGULATORY COMPLIANCE CONCERNS

Long Term 2 (LT2) Surface Water Treatment Rule (SWTR)

The SWTR has been updated multiple times since its original promulgation in 1989. The main objective of the rule is to protect the public from microbial contaminants that cause acute illnesses. Required treatment is achieved through a combination of filtration (using turbidity as a measure of effectiveness), and inactivation (most commonly chlorine disinfection).

Maximum Combined Filter Effluent Turbidity: 0.30 NTU

A direct filtration system must have a representative filtered water turbidity less than or equal to 0.3 nephelometer turbidity units (NTU) in at least 95% of the monthly measurements . The current treatment system appeared to be meeting this requirement at the time of the inspection in 2019.

Disinfectants and Disinfection-By-Product (DBP) Rule

EPA began regulating DBPs in 1979, and updated the rule in 1998 and 2006. This rule is intended to optimize disinfection practices to reduce public exposure to DBPs. DBPs form when disinfectants react with naturally occurring organics in the water. Current federal regulatory limits for DBPs include Total Trihalomethanes (TTHMs), and five Haloacetic Acids (HAAs). There are current proposals to increase the regulated DBPs to include:

- Bromochloroacetic Acid, a sixth HAA. This is currently a regulated DBP in Canada.
- Chloral hydrate (CH), Canada has established a health-based value of 0.2 mg/L. The World Health Organization (WHO) has set a provisional guideline value of 0.1 mg/L (WHO, 2017).
  CH is being evaluated by EPA for regulatory oversight. In addition to the above chlorination by-products, there is also growing scrutiny on chlorates, which are formed from the slow decomposition of hypochlorite solutions. As chlorine residuals drop over long-term storage, and increased dosages are needed to maintain a desired residual,

increased chlorate concentrates in the water. Chlorate formation has been particularly noted when using chlorine dioxide, sodium hypochlorite, or electrochlorination processes (like Miox). Chlorate is on the EPA Third Chemical Contaminant List and has been evaluated as a candidate for regulation. Currently EPA lists a chlorate health reference level of 0.21 mg/L, while Canada regulates chlorate at a maximum level of 1.0 mg/L, and the World Health Organization recommends a chlorate limit of 0.7 mg/L. Water age, and associated chlorate formation was considered during the water treatment process evaluation and is included in the DBP modeling.

Current regulatory limits for DBPs (based on a running annual average of quarterly results):

80 µg/L (parts per billion) of Trihalomethanes (TTHMs)

60 µg/L (parts per billion) of five Halo acetic acids (HAA5s)

Test results for DBPs posted on the DEC Water Watch website indicate 2019 DBP levels for the current system indicate that

There have been no reported DBP exceedances with the existing system. However, the DBP samples results could be affected by the inefficiencies in the current chlorination system. DBP formation potential would need to be considered in system upgrades due to the high level of organics (approx. 6 mg/L) in the raw water.

Lead / Copper Rule (LCR)

The LCR was first issued in 1991 to address corrosive water, aging piping, and lead solder. Multiple updates to LCR rule have refined the definition of "lead free", modified sampling methods, and defined steps that must be taken if regulatory action levels are exceeded.

The current LCR action levels are:

0.015 mg/L for lead (Pb)

1.3 mg/L for copper (Cu)

The most recent test results for copper (2011) on ADEC's Water Watch website indicate that the system is exceeding the action level for copper (1.39 mg/L). There was observable corrosion in the interior piping systems.

SAMPLE COLLECTION

Four 7-gallon sample jugs were used to collect the samples used for jar testing. These jugs were manufacturer certified as compliant with Food and Drug Administration Food Grade standards. The jugs were rinsed and filled by Bristol at a spigot inside the WTP building on July 23, 2019, just prior to treatment. The jugs were flown back to Anchorage that day, and maintained overnight in a refrigerated facility at the airport.

The water jugs were picked up on July 24, 2019 and transported to the Bristol lab where they were left overnight at room temperature to allow the temperature to stabilize prior to testing (to prevent temperature changes during the test). Tests were conducted on July 25-26, 2019.

The jar tests were performed on water that was approximately 10-15 degrees Fahrenheit warmer than the temperature of the water when it was collected. Prior to filling the beakers, the jugs were gently swirled to ensure any particulates were distributed in the water. All beakers were filled from the same 7-gallon sample jug for a set of jar test.

TESTING EQUIPMENT AND PROCEDURES

The jar test was performed using a Phipps&Bird (7790-910) six-paddle stirrer with 2-liter square beakers. This jar test equipment was designed to meet ASTM standard method D 2035 (Standard Method for Coagulation -Flocculation Jar Test of Water).

The following test equipment was used to measure the water quality during the jar tests:

- Hach Pocket Pro + Multi 1 Multimeter (calibrated prior to the jar test).
- Hach 2100 Q Turbidimeter (calibrated with current standards prior to the jar test).
- RealTech UV254 Portable Meter (calibrated prior to the jar test)
- Hach Test Strips (pH, Hardness, Total Alkalinity, Iron) were used to estimate associated water quality values (all strips were within stated expiration dates).

The jar testing procedures include:

- 6 2-liter beakers were filled with raw water
- Stock solution (1 %) of coagulant was mixed (approximately 100 ml of 1% solution).
- Coagulant was piped into 5 of the 6 jars (Jar 1 was used for control, with no added coagulant)

- Rapid mixing and in-line flocculation (direct filtration) were simulated by
    - Stirring at 300 rpm for 1 minute to simulate static mixing
    - Stirring at 20 rpm for 10 minutes to simulate flocculation and direct filtration
- Jars were allowed to settle for 30 minutes.
    - Settled water turbidity and UVA were measured
- Approximately 100 ml of settled water was filtered using a 0.45 micron vacuum filter disc and electric lab filtration pump.
    - Filtered water turbidity and UVA were measured

Coagulants Evaluated

The coagulants evaluated for the jar tests are listed in Table 2. All coagulants were obtained a few months prior to the test, stored in a cool area, out of direct sunlight. All coagulants were NSF 60 approved and were within the 1-year expiration recommended by the manufacturer.

Table 2: Coagulants Evaluated

TRADE DESIGNATION	CHEMICAL	MANUFACTURER
NALCOLYTE® 8105 **(currently in use in WTP)**	Polyamine (PY)	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563 708-305-1000
ULTRION® 8185	Aluminum Chloride Hydroxide / Polyaluminum Chloride (PAC) Polyamine (PY) Polymer blend	
ULTRION® 8186	Aluminum Chloride Hydroxide / Polyaluminum Chloride (PAC)	

A summary of the jar tests completed for the Kongiganak source water is provided in Table 3.

Table 3: Jar Tests Process Summary

Parameter	Test 1	Test 2	Test 3	Test 4
Test Variables				
Coagulant	NALCO 8185	NALCO 8186	NALCO 8105	NALCO 8105
Test Date	7/25/2019	7/26/2019	7/26/2019	7/26/2019
Test Time	2:00 PM	8:00 AM	10:00 AM	2:00 PM
Time of rapid mix @ 300 rpm (min)	1	1	1	1
Time of slow mix @ 20 rpm (min)	10	10	10	10
Settling time (min) (no mixing)	30	30	30	30

Exhibit 2: Bench Testing Equipment

PARTICULATE (TURBIDITY) AND ORGANIC REDUCTION

Jar Test Results Summary

A comparison of results for the different coagulants is provided in Table 4, and shown graphically in Exhibit 3. The recommended coagulant and dosage is based on the reduction of both turbidity and UVA (as a surrogate for organics).

The bench scale study indicates that 7 mg/L dose of NALCO 8105 would provide an approximate reduction in turbidity of approximately 89% and a reduction of UVA of 75%. This represents the optimum dosage of the tested coagulants for simultaneous particulate and organic removal. NALCO 8105 is an NSF 60 approved polyamine, with a maximum dosage of 20 mg/L.

The exact relationship between UVA and organics depends on the types of organics present. If the 75% reduction in UVA (after filtration) is similar to the reductions in organic levels, then the resulting concentration of organics in the filtered water should be less than the 2 mg/L goal which typically represents a lower risk of DBP formation potential.

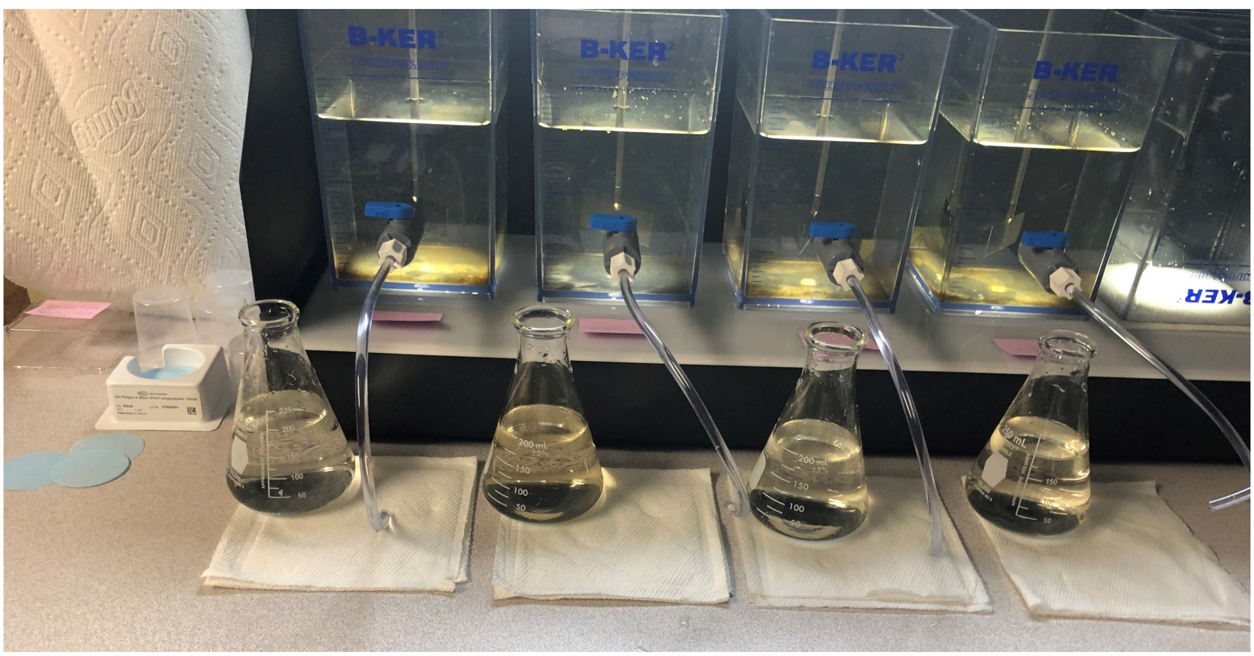


Exhibit 3: Kongiganak Jar Testing (Nalco 8105)

Table 4: Kongiganak Jar Test Results

Test No.	1	2	3	4	1	2	3	4
COAG	8185	8186	8105	8105	8185	8186	8105	8105
Dosage	Settled Water Turbidity				Filtered Water Turbidity (NTU)			
0 mg/L	1.19	1.14	1.08	0.00	0.43	0.12	0.11	0.00
1 mg/L	1.28	1.14	1.40	0.00	0.40	0.12	0.13	0.00
3 mg/L	1.91	1.29	1.86	0.00	0.14	0.17	0.10	0.00
4 mg/L	1.68	1.62	1.66	0.00	0.14	0.13	0.15	0.00
6 mg/L	1.88	1.60	0.80	0.00	0.17	0.13	0.10	0.00
8 mg/L	1.19	1.86	0.63	0.58	0.13	0.65	0.15	0.10
10 mg/L	0.00	0.00	0.00	1.95	0.00	0.00	0.00	0.09
12 mg/L	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.10
14 mg/L	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.01
Dosage	Settled Water UVA				Filtered Water UVA			
0 mg/L	0.381	0.387	0.386	0.000	0.325	0.337	0.325	0.000
1 mg/L	0.383	0.310	0.387	0.000	0.242	0.310	0.228	0.000
3 mg/L	0.382	0.259	0.387	0.000	0.156	0.259	0.159	0.000
4 mg/L	0.384	0.240	0.323	0.000	0.179	0.240	0.145	0.000
6 mg/L	0.382	0.187	0.160	0.000	0.159	0.187	0.104	0.000
8 mg/L	0.230	0.226	0.125	0.123	0.123	0.226	0.091	0.090
10 mg/L	0.000	0.000	0.000	0.318	0.000	0.000	0.000	0.080
12 mg/L	0.000	0.000	0.000	0.176	0.000	0.000	0.000	0.116
14 mg/L	0.000	0.000	0.000	0.190	0.000	0.000	0.000	0.088

REDUCTION SUMMARY			
8185	8186	8105	8105
% Reduction IFE = [1-(Filt/Raw)]*100			
63.46	89.80	90.65	
66.01	89.80	88.95	
88.10	85.55	91.50	
88.10	88.95	87.25	
85.55	88.95	91.50	
88.95	44.76	87.25	91.50
			92.35
			91.50
			99.15
% Reduction UVA = [1-(Filt/Raw)]*100			
14.85	11.70	14.85	
36.59	18.78	40.26	
59.13	32.14	58.34	
53.10	37.12	62.01	
58.34	51.00	72.75	
67.77	40.79	76.16	76.42
			79.04
			69.61
			76.94

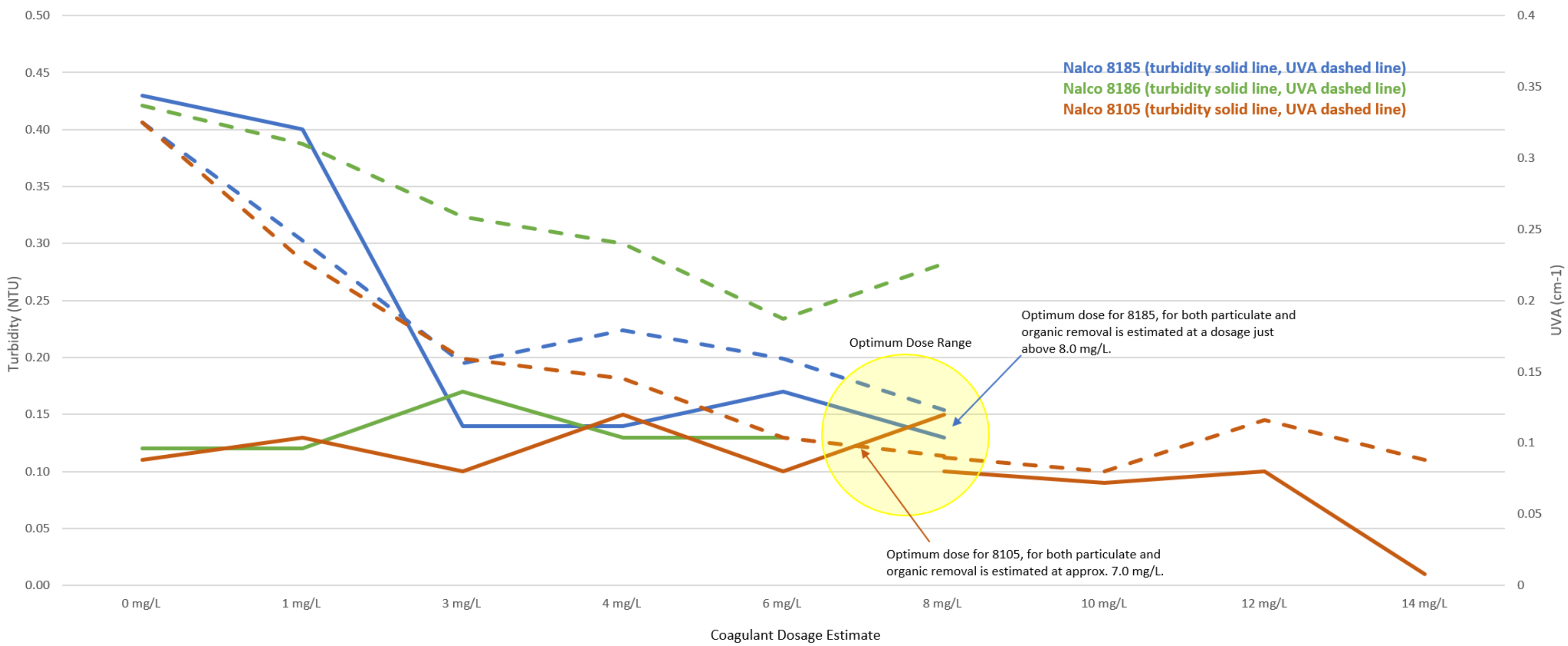


Exhibit 4: Kongiganak Filtered Water Quality

DISINFECTION BY-PRODUCT MODELING

Preliminary design calculation are based on the following disinfection parameters:

- Chlorine residual for Giardia disinfection: 0.4 mg/L

(pH =7.5, Peak Hourly Flow=28 gpm, Baffle Factor=0.1, Temperature=5C)

- Chlorine dosage to meet the required residual for *Giardia* inactivation = 4.2 mg/L.
- Treated WST Maximum Water Age (days, assuming WSTs full): 6.5 days (156 hours)
- Raw Water DOC: 5.96 mg/L (July 2019)
- Settled Water DOC: 1.5 mg/L (based on 75% reduction based on jar test results)

DBP modeling was completed using WaterPro™ (version 6.75). The predicted estimates are summarized in Table 5.

Table 5: Predictive Models for TTHM, HAA, and CH

DISINFECTION BY-PRODUCT	PREDICTED CONCENTRATION (µg/L)	REGULATORY MAXIMUM LIMIT[1] (µg/L)
Total Trihalomethanes (TTHM)	73.4	80
Total Halo acetic Acids[2] (HAA)	39.6	60
Chloral Hydrate[3] (CH)	7.4	100 - 200

1. Based on a Locational Running Annual Average (LRAA) of test results.
2. Six halo acetic acids were included in the predictive model.
3. There is currently no published EPA limit. The limit shown for CH is based on the current recommended limits by the WHO and by Canada.

These results indicate that a single coagulant (Nalco 8105) prior to filtration results in predicted TTHM levels that are just below the MCL. Pre-oxidation using potassium permanganate (KMnO4), and / or an additional polishing filtration step will likely be needed.

The levels of organics in the raw WST may be adjusted by managing the following"

- Timing of development - with respect to rainfall / runoff events;

- Method of source development - the depth of the intake hose with respect to the bottom Contractor's Lake and the rate of pumping; and
- The length of storage in the raw WST – longer storage periods could lead to increased organics.

CORROSION MODELING

Soda Ash would be used to increase the pH of the naturally occurring, low pH water, to a pH of approximately 7.2. Predicted dosages based on Water!Pro™ modeling results for Potash and Soda Ash, are provided in Table 6.

Table 6: Corrosion Control Dose Estimate

CORROSION CONTROL CHEMICAL	PREDICTED DOSE (mg/L)
Potash (to achieve pH = 7.2)	45
Soda Ash (to achieve pH = 7.2)	35

The predicted corrosion indices following pH adjustment, are summarized in Table 7.

Table 7: Corrosion Indices[1]

INDEX	CALCULATED VALUE	COMMENTS	RECOMMENDED
Aggressive Index (AI) =	8.6	Extremely aggressive conditions for asbestos cement piping	>12
Ryznar Index (RI) =	13.63	Tendency to dissolve CaCO3 (for steel piping)	6.5-7.0
Langelier Index, Calcite =	-3.23	Tendency to dissolve CaCO3 (for steel and cast iron piping)	>0
CCPP =	-16.9	mg/L as CaCO3, Calcium Carbonate Precipitation Potential	4-10 mg/L

1. Estimated based on corrosion modeling using Water!Pro™ (version 6.75, Schott Engineering, 2021).

The predicted results for lead copper reduction are shown in Exhibit 6: Corrosion Control Predictions Using Soda Ash and Exhibit 7: Corrosion Control Predictions Using Potash.

Water!Pro TM

Corrosion Control Modeling Program

Step 1 Enter Characteristics of Water to be Treated

System Name:	Kong WTP	Copy WaterPro		
Source Point:	Contractor's Lake			
Date of Sample:	July 1, 2019			
TDS =	27	mg/L		
pH =	5.80	field pH is recommended		
Total Alkalinity =	5.0	mg/L as $CaCO_3$		
Calcium (total) =	0.3	mg/L Ca^{2+}	0.75	mg/L as $CaCO_3$
Water Temperature =	10.0	^oC (temp. at which pH was analyzed)		
Field Water Temperature =	10.0	^oC (operating temperature at facility)		
Cl^- =	4.2	mg/L	0.0	mg/L as $CaCO_3$
SO_4^{2-} =	0.6	mg/L	0.0	mg/L as $CaCO_3$
Mg^{2+} =	0	mg/L	0.0	mg/L as $CaCO_3$

Step 2 Chemical Selection & Constraints

Select Corrosion Control Chemical: Soda Ash (Na2CO3)

Enter Constraints:		
Upper limit dose to plot:	60.0	mg/L
Upper Bound pH:	8.0	

Step 3 Enter PO_4^{3-} dose if added with chemical from Step 2

Orthophosphate as PO_4^{3-}	0.0	mg/L

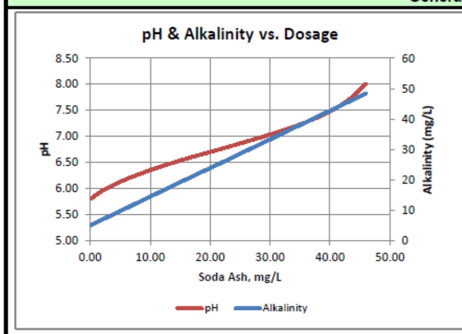
Step 4 Plot Data

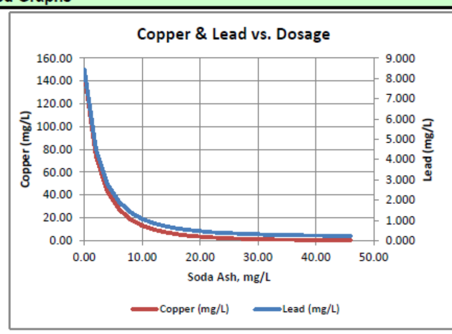
Activate button "*Plot Data*" to plot any new data entered in Steps 1 to 3.

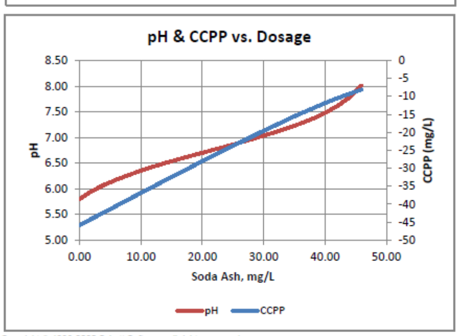
Plotting Points for Graphs

Dose mg/L	Ortho-phosphate mg/L	pH at Field Temp.	Alkalinity as $CaCO_3$ mg/L	DIC mg/L C	Langelier Index LI	CCPP as $CaCO_3$ mg/L	Copper II at 25°C mg/L	Lead II at 25°C mg/L	Buffer Intensity mM/pH	CO_2 mg/L	Aggressive Index AI	Ryznar Index RI
0.00	0	5.80	5.00	6.68	-5.46	-45.86	146.000	8.429	0.195	20.00	6.37	16.72
2.00	0	5.95	6.89	6.91	-5.17	-44.06	73.600	4.494	0.245	19.20	6.67	16.29
4.00	0	6.08	8.78	7.13	-4.94	-42.25	42.800	2.786	0.287	18.40	6.89	15.96
6.00	0	6.18	10.67	7.36	-4.76	-40.46	27.300	1.903	0.322	17.60	7.08	15.69
8.00	0	6.27	12.55	7.59	-4.59	-38.66	18.500	1.391	0.350	16.70	7.24	15.46
10.00	0	6.35	14.44	7.81	-4.45	-36.87	13.100	1.071	0.371	15.90	7.39	15.26
12.00	0	6.43	16.33	8.04	-4.32	-35.09	9.630	0.858	0.386	15.10	7.52	15.07
14.00	0	6.50	18.22	8.27	-4.20	-33.31	7.270	0.709	0.396	14.30	7.64	14.91
16.00	0	6.57	20.11	8.49	-4.09	-31.54	5.610	0.603	0.400	13.40	7.75	14.75
18.00	0	6.64	22.00	8.72	-3.99	-29.78	4.400	0.523	0.400	12.60	7.85	14.61
20.00	0	6.70	23.89	8.95	-3.89	-28.03	3.500	0.463	0.395	11.80	7.95	14.47
22.00	0	6.77	25.78	9.17	-3.79	-26.30	2.820	0.416	0.387	10.90	8.05	14.34
24.00	0	6.83	27.66	9.40	-3.69	-24.58	2.290	0.380	0.374	10.10	8.15	14.22
26.00	0	6.90	29.55	9.63	-3.60	-22.87	1.870	0.350	0.359	9.29	8.24	14.10
28.00	0	6.97	31.44	9.85	-3.50	-21.19	1.530	0.326	0.340	8.46	8.33	13.97
30.00	0	7.03	33.33	10.08	-3.41	-19.53	1.260	0.307	0.318	7.63	8.43	13.85
32.00	0	7.11	35.22	10.31	-3.31	-17.91	1.030	0.291	0.293	6.80	8.53	13.73
34.00	0	7.19	37.11	10.53	-3.21	-16.31	0.839	0.277	0.266	5.98	8.63	13.61
36.00	0	7.27	39.00	10.76	-3.10	-14.77	0.675	0.266	0.236	5.15	8.74	13.48
38.00	0	7.37	40.88	10.99	-2.99	-13.27	0.534	0.256	0.204	4.33	8.85	13.34
40.00	0	7.48	42.77	11.21	-2.86	-11.84	0.411	0.248	0.171	3.51	8.98	13.20
42.00	0	7.61	44.66	11.44	-2.71	-10.49	0.303	0.241	0.136	2.70	9.13	13.03
44.00	0	7.78	46.55	11.67	-2.52	-9.23	0.207	0.236	0.101	1.90	9.32	12.82
46.00	0	8.02	48.44	11.89	-2.27	-8.06	0.124	0.232	0.069	1.15	9.57	12.56

Generated Graphs







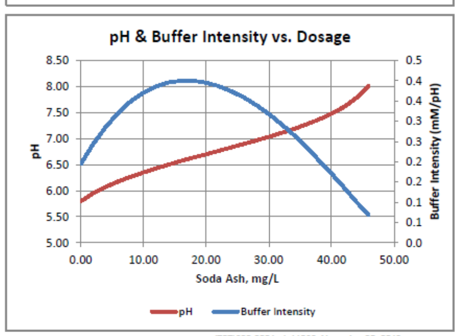


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Exhibit 5: Corrosion Control Predictions Using Soda Ash

Water!Pro TM

Corrosion Control Modeling Program

Step 1 Enter Characteristics of Water to be Treated

System Name: Kong WTP
Source Point: Contractor's Lake
Date of Sample: July 1, 2019

Copy WaterPro

TDS =	27	mg/L		
pH =	5.80	field pH is recommended		
Total Alkalinity =	5.0	mg/L as $CaCO_3$		
Calcium (total) =	0.3	mg/L Ca^{2+}	0.75	mg/L as $CaCO_3$
Water Temperature =	10.0	°C (temp. at which pH was analyzed)		
Field Water Temperature =	10.0	°C (operating temperature at facility)		
Cl^- =	4.2	mg/L	0.0	mg/L as $CaCO_3$
SO_4^{2-} =	0.6	mg/L	0.0	mg/L as $CaCO_3$
Mg^{2+} =	0	mg/L	0.0	mg/L as $CaCO_3$

Step 2 Chemical Selection & Constraints

Select Corrosion Control Chemical: Potash (K2CO3)

Enter Constraints:

Upper limit dose to plot:	60.0	mg/L
Upper Bound pH:	8.0	

Step 3 Enter PO_4^{3-} dose if added with chemical from Step 2

Orthophosphate as PO_4^{3-}	0.0	mg/L

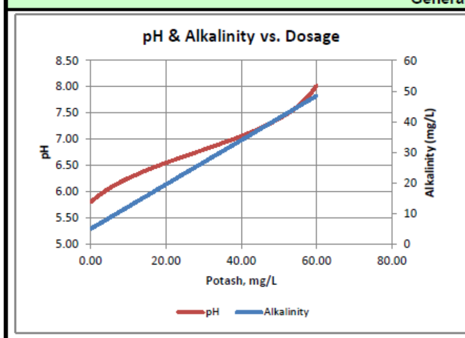
Step 4 Plot Data

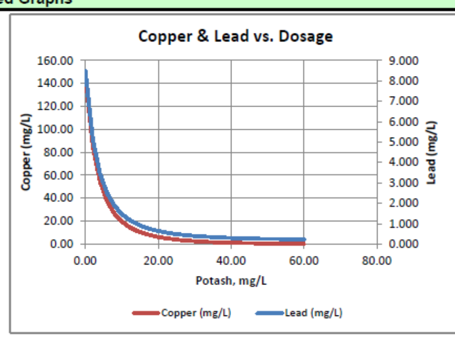
Activate button "*Plot Data*" to plot any new data entered in Steps 1 to 3.

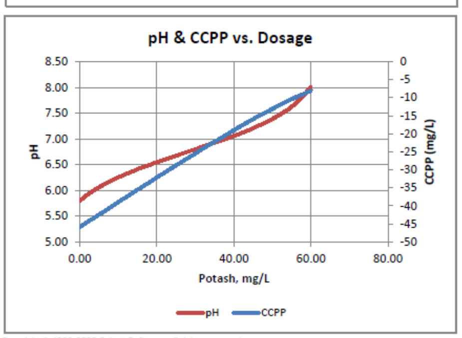
Plotting Points for Graphs

Dose mg/L	Ortho-phosphate mg/L	pH at Field Temp.	Alkalinity as $CaCO_3$ mg/L	DIC mg/L C	Langelier Index LI	CCPP as $CaCO_3$ mg/L	Copper II at 25°C mg/L	Lead II at 25°C mg/L	Buffer Intensity mM/pH	CO_2 mg/L	Aggressive Index AI	Ryznar Index RI
0.00	0	5.80	5.00	6.68	-5.46	-45.86	146.000	8.481	0.195	20.00	6.37	16.72
2.00	0	5.92	6.45	6.85	-5.23	-44.48	85.100	5.150	0.234	19.40	6.60	16.38
4.00	0	6.02	7.90	7.03	-5.04	-43.09	54.400	3.451	0.269	18.80	6.79	16.11
6.00	0	6.11	9.35	7.20	-4.88	-41.71	37.100	2.477	0.299	18.10	6.95	15.88
8.00	0	6.19	10.79	7.38	-4.74	-40.33	26.500	1.870	0.324	17.50	7.09	15.68
10.00	0	6.26	12.24	7.55	-4.62	-38.96	19.600	1.467	0.346	16.90	7.22	15.50
12.00	0	6.32	13.69	7.72	-4.51	-37.58	15.000	1.188	0.363	16.20	7.33	15.34
14.00	0	6.38	15.14	7.90	-4.40	-36.21	11.700	0.987	0.377	15.60	7.44	15.19
16.00	0	6.44	16.59	8.07	-4.31	-34.85	9.260	0.838	0.388	15.00	7.53	15.05
18.00	0	6.50	18.04	8.24	-4.21	-33.48	7.470	0.725	0.395	14.30	7.62	14.92
20.00	0	6.55	19.48	8.42	-4.13	-32.13	6.100	0.637	0.399	13.70	7.71	14.80
22.00	0	6.60	20.93	8.59	-4.05	-30.77	5.030	0.567	0.401	13.10	7.79	14.69
24.00	0	6.65	22.38	8.77	-3.97	-29.43	4.200	0.511	0.399	12.40	7.87	14.58
26.00	0	6.70	23.83	8.94	-3.89	-28.09	3.530	0.466	0.396	11.80	7.95	14.48
28.00	0	6.75	25.28	9.11	-3.81	-26.75	2.980	0.429	0.389	11.20	8.03	14.38
30.00	0	6.80	26.73	9.29	-3.74	-25.43	2.540	0.398	0.381	10.50	8.10	14.28
32.00	0	6.85	28.17	9.46	-3.67	-24.11	2.170	0.372	0.371	9.89	8.17	14.19
34.00	0	6.90	29.62	9.64	-3.60	-22.81	1.860	0.350	0.358	9.26	8.24	14.09
36.00	0	6.95	31.07	9.81	-3.52	-21.52	1.590	0.331	0.344	8.62	8.32	14.00
38.00	0	7.00	32.52	9.98	-3.45	-20.24	1.370	0.315	0.327	7.99	8.39	13.91
40.00	0	7.06	33.97	10.16	-3.38	-18.98	1.180	0.301	0.310	7.35	8.46	13.81
42.00	0	7.12	35.42	10.33	-3.30	-17.74	1.010	0.289	0.290	6.72	8.54	13.72
44.00	0	7.18	36.86	10.50	-3.22	-16.52	0.862	0.279	0.269	6.09	8.61	13.63
46.00	0	7.24	38.31	10.68	-3.14	-15.32	0.732	0.270	0.247	5.45	8.70	13.53
48.00	0	7.31	39.76	10.85	-3.06	-14.16	0.616	0.262	0.223	4.82	8.78	13.43
50.00	0	7.39	41.21	11.03	-2.97	-13.02	0.512	0.255	0.199	4.19	8.87	13.32
52.00	0	7.47	42.66	11.20	-2.87	-11.93	0.418	0.249	0.173	3.56	8.97	13.21
54.00	0	7.57	44.11	11.37	-2.76	-10.88	0.333	0.243	0.146	2.94	9.09	13.08
56.00	0	7.69	45.55	11.55	-2.63	-9.88	0.256	0.239	0.119	2.32	9.22	12.94
58.00	0	7.83	47.00	11.72	-2.47	-8.94	0.186	0.235	0.093	1.72	9.37	12.77
60.00	0	8.02	48.45	11.89	-2.27	-8.06	0.124	0.232	0.068	1.14	9.57	12.56

Generated Graphs







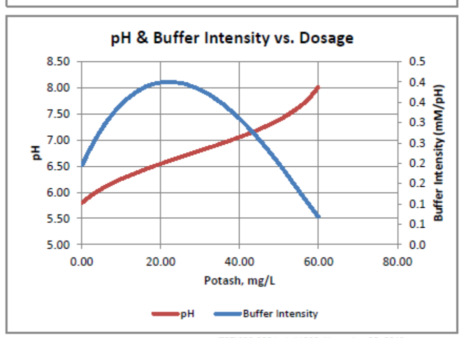


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Exhibit 6: Corrosion Control Predictions Using Potash

RESULTS AND DISCUSSION

The raw water for Kongiganak has a relatively low turbidity (1.1 NTU), and relatively high levels of dissolved organics (5.96 mg/L). A jar test was completed in July 2019 which indicated that Nalco 8105 would provide the best combination of particulate removal and organic removal, at a dose of approximately 7 mg/L. However, predicted results indicate that in order to reliably stay below regulated levels for DBPs, the addition of a pre-oxidation stage using KMnO4 and/or a polishing media filter may be needed.

Based on test results from the 2019 site visit, the raw water is highly aggressive with a low pH (5.8), relatively low TDS (16.3 mg/L), and a non-detectable level of alkalinity. Corrosion control treatment would first focus on pH adjustment to a pH of 7.2. Mitigation of ongoing corrosion of existing piping could be provided by the addition of orthophosphate. However, there is very little existing piping. There is no piped services to homes. The existing copper piping within the WTP and Washeteria are significantly corroded are planned to be replaced with plastic piping. Therefore, pH adjustment alone may be sufficient.

The KMnO4 would be injected at the beginning of the treatment process, followed by coagulation. Chlorine would be injected after filtration and prior to the treated WSTs. Another chlorination point may be needed at the entry point to distribution to maintain the required 0.2 mg/L chlorine residual. Corrosion control would also be injected at the entry point to distribution. The recommended injection point distance between chlorine and corrosion control inhibitor should be 1-ft of distance for each 1-inch diameter of piping (or 4 feet of separation distance for a 4 inch distribution pipe).

REFERENCES

ASTM, “Standard Practice for Coagulation-Flocculation Jar Test of Water”, ASTM D 2035.

ASTM, “Standard Practice for Performing Pressure In-Line Coagulation -Flocculation Filtration Test” ASTM D 4188.

EPA Revised Guidance Manual for Selecting Lead and Copper Control Strategies, 2003.

Health Canada, Guidance on Chloral Hydrate in Drinking Water, 2008.

World Health Organization, Guidelines for Drinking-water Quality, Fourth Edition, 2017.

APPENDIX A: RAW WATER TEST RESULTS

Laboratory Report of Analysis

To: Bristol Engineering Srvs
111 W.16th Avenue, Third Floor
Anchorage, AK 99501

Report Number: **1194055**

Client Project: **KONGIGANAK**

Dear Vanessa Wike,

Enclosed are the results of the analytical services performed under the referenced project for the received samples and associated QC as applicable. The samples are certified to meet the requirements of the National Environmental Laboratory Accreditation Conference Standards. Copies of this report and supporting data will be retained in our files for a period of ten years in the event they are required for future reference. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. Any samples submitted to our laboratory will be retained for a maximum of fourteen (14) days from the date of this report unless other archiving requirements were included in the quote.

If there are any questions about the report or services performed during this project, please call Jillian at (907) 562-2343. We will be happy to answer any questions or concerns which you may have.

Thank you for using SGS North America Inc. for your analytical services. We look forward to working with you again on any additional analytical needs.

Sincerely,
SGS North America Inc.

____

Jillian Janssen Date
Project Manager
Jillian.Janssen@sgs.com

SGS North America Inc. 200 West Potter Drive, Anchorage, AK 99518
t 907.562.2343 **f** 907.561.5301 www.us.sgs.com
Member of SGS Group

Case Narrative

SGS Client: **Bristol Engineering Srvs**
SGS Project: **1194055**
Project Name/Site: **KONGIGANAK**
Project Contact: **Vanessa Wike**

Refer to sample receipt form for information on sample condition.

Raw water Tap in WTP (1194055001) PS

UV254 was analyzed by ARS Analytical of Anchorage, AK.

1193920001MS (1521177) MS

4500NO3-F - Nitrate/Nitrite - MS recovery for Total Nitrate/Nitrite is outside of QC criteria. Refer to LCS for accuracy requirements.

1199540001MS (1521179) MS

4500NO3-F - Nitrate/Nitrite - MS recovery for Total Nitrate/Nitrite is outside of QC criteria. Refer to LCS for accuracy requirements.

1194084001MSD (1521175) MSD

4500NO3-F - Nitrate/Nitrite - MS recovery for Nitrite is outside of QC criteria. Refer to LCS for accuracy requirements.

1193920001MSD (1521178) MSD

4500NO3-F - Nitrate/Nitrite - MSD recovery for Total Nitrate/Nitrite is outside of QC criteria. Refer to LCS for accuracy requirements.

1199540001MSD (1521180) MSD

4500NO3-F - Nitrate/Nitrite - MSD recovery for Total Nitrate/Nitrite is outside of QC criteria. Refer to LCS for accuracy requirements.

*QC comments may be associated with the field samples found in this report. When applicable, comments will be applied to associated field samples.

Laboratory Qualifiers

Enclosed are the analytical results associated with the above work order. The results apply to the samples as received. All results are intended to be used in their entirety and SGS is not responsible for use of less than the complete report. This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indenmification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the context or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS maintains a formal Quality Assurance/Quality Control (QA/QC) program. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request. The laboratory certification numbers are AK00971 (DW Chemistry & Microbiology) & 17-021 (CS) for ADEC and 2944.01 for DOD ELAP/ISO17025 (RCRA methods: 1020B, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035A, 6020A, 7470A, 7471B, 8015C, 8021B, 8082A, 8260C, 8270D, 8270D-SIM, 9040C, 9045D, 9056A, 9060A, AK101 and AK102/103). SGS is only certified for the analytes listed on our Drinking Water Certification, and only those analytes will be reported to the State of Alaska for compliance. Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP and, when applicable, other regulatory authorities.

The following descriptors or qualifiers may be found in your report:

*	The analyte has exceeded allowable regulatory or control limits.
!	Surrogate out of control limits.
B	Indicates the analyte is found in a blank associated with the sample.
CCV/CVA/CVB	Continuing Calibration Verification
CCCV/CVC/CVCA/CVCB	Closing Continuing Calibration Verification
CL	Control Limit
DF	Analytical Dilution Factor
DL	Detection Limit (i.e., maximum method detection limit)
E	The analyte result is above the calibrated range.
GT	Greater Than
IB	Instrument Blank
ICV	Initial Calibration Verification
J	The quantitation is an estimation.
LCS(D)	Laboratory Control Spike (Duplicate)
LLQC/LLIQC	Low Level Quantitation Check
LOD	Limit of Detection (i.e., 1/2 of the LOQ)
LOQ	Limit of Quantitation (i.e., reporting or practical quantitation limit)
LT	Less Than
MB	Method Blank
MS(D)	Matrix Spike (Duplicate)
ND	Indicates the analyte is not detected.
RPD	Relative Percent Difference
U	Indicates the analyte was analyzed for but not detected.

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content. All DRO/RRO analyses are integrated per SOP.

SGS

Sample Summary

Client Sample ID	Lab Sample ID	Collected	Received	Matrix
Raw water Tap in WTP	1194055001	07/23/2019	07/24/2019	Drinking Water

Method	Method Description
SM21 2320B	Alkalinity as CaCO3 QC
SM21 2340B	Calcium Hardness by ICP-MS-Langlier
SM23 2120B	Color, True
SM 5310B	Dissolved Organic Carbon
SM2330B	Langlier Index by SM2330B
EP200.8	Metals in Water by ICP-MS
SM21 4500NO3-F	Nitrate/Nitrite Flow injection Pres.
SM21 4500-H B	pH Analysis
SM21 2540C	Total Dissolved Solids SM18 2540C
SM 5310B	Total Organic Carbon

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SGS

Detectable Results Summary

Client Sample ID: **Raw water Tap in WTP**
Lab Sample ID: 1194055001

	Parameter	Result	Units
Metals by ICP/MS	Calcium	282J	ug/L
	Iron	750	ug/L
	Manganese	9.96	ug/L
Waters Department	Color, True	70.0	PCU
	pH	5.8	pH units
	Total Dissolved Solids	27.0	mg/L
	Total Nitrate/Nitrite-N	0.185J	mg/L
	Total Organic Carbon	7.22	mg/L
	Total Organic Carbon,Dissolved	5.96	mg/L

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Results of **Raw water Tap in WTP**

Client Sample ID: **Raw water Tap in WTP**
Client Project ID: **KONGIGANAK**
Lab Sample ID: 1194055001
Lab Project ID: 1194055

Collection Date: 07/23/19 13:30
Received Date: 07/24/19 09:25
Matrix: Drinking Water
Solids (%):
Location:

Results by

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Langlier Index @ 50 degree F	-5.97				1		08/09/19 10:40

Batch Information

Analytical Batch: WAT11400
Analytical Method: SM2330B
Analyst: PLW
Analytical Date/Time: 08/09/19 10:40
Container ID: 1194055001-D

Results of **Raw water Tap in WTP**

Client Sample ID: **Raw water Tap in WTP**
Client Project ID: **KONGIGANAK**
Lab Sample ID: 1194055001
Lab Project ID: 1194055

Collection Date: 07/23/19 13:30
Received Date: 07/24/19 09:25
Matrix: Drinking Water
Solids (%):
Location:

Results by **Metals by ICP/MS**

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Arsenic	2.50 U	5.00	1.50	ug/L	1	(<10)	07/31/19 16:02
Calcium	282 J	500	150	ug/L	1		07/31/19 16:02
Iron	750	250	78.0	ug/L	1		07/31/19 16:02
Manganese	9.96	1.00	0.350	ug/L	1		07/31/19 16:02

Batch Information

Analytical Batch: MMS10579
Analytical Method: EP200.8
Analyst: DSH
Analytical Date/Time: 07/31/19 16:02
Container ID: 1194055001-E

Prep Batch: MXX32619
Prep Method: E200.2
Prep Date/Time: 07/30/19 09:13
Prep Initial Wt./Vol.: 20 mL
Prep Extract Vol: 50 mL

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Hardness (Ca Only)	5.00 U	5.00	5.00	mg/L	1		07/31/19 16:02

Batch Information

Analytical Batch: MMS10579
Analytical Method: SM21 2340B
Analyst: DSH
Analytical Date/Time: 07/31/19 16:02
Container ID: 1194055001-E

Prep Batch: MXX32619
Prep Method: E200.2
Prep Date/Time: 07/30/19 09:13
Prep Initial Wt./Vol.: 20 mL
Prep Extract Vol: 50 mL

Results of **Raw water Tap in WTP**

Client Sample ID: **Raw water Tap in WTP**
Client Project ID: **KONGIGANAK**
Lab Sample ID: 1194055001
Lab Project ID: 1194055

Collection Date: 07/23/19 13:30
Received Date: 07/24/19 09:25
Matrix: Drinking Water
Solids (%):
Location:

Results by **Waters Department**

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Organic Carbon	7.22	1.00	0.400	mg/L	1		07/25/19 20:45
Total Organic Carbon,Dissolved	5.96	1.00	0.400	mg/L	1		07/25/19 20:45

Batch Information

Analytical Batch: WTC2938
Analytical Method: SM 5310B
Analyst: BMZ
Analytical Date/Time: 07/25/19 20:45
Container ID: 1194055001-A

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Alkalinity	5.00 U	10.0	2.50	mg/L	1		07/24/19 14:43
CO3 Alkalinity	5.00 U	10.0	2.50	mg/L	1		07/24/19 14:43
HCO3 Alkalinity	5.00 U	10.0	2.50	mg/L	1		07/24/19 14:43
OH Alkalinity	5.00 U	10.0	2.50	mg/L	1		07/24/19 14:43

Batch Information

Analytical Batch: WTI5233
Analytical Method: SM21 2320B
Analyst: EWW
Analytical Date/Time: 07/24/19 14:43
Container ID: 1194055001-D

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Dissolved Solids	27.0	10.0	3.10	mg/L	1		07/24/19 16:57

Batch Information

Analytical Batch: STS6394
Analytical Method: SM21 2540C
Analyst: EWW
Analytical Date/Time: 07/24/19 16:57
Container ID: 1194055001-D

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
pH	5.8	0.100	0.100	pH units	1		07/24/19 14:43

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Results of **Raw water Tap in WTP**

Client Sample ID: **Raw water Tap in WTP**
Client Project ID: **KONGIGANAK**
Lab Sample ID: 1194055001
Lab Project ID: 1194055

Collection Date: 07/23/19 13:30
Received Date: 07/24/19 09:25
Matrix: Drinking Water
Solids (%):
Location:

Results by **Waters Department**

Batch Information

Analytical Batch: WTI5231
Analytical Method: SM21 4500-H B
Analyst: EWW
Analytical Date/Time: 07/24/19 14:43
Container ID: 1194055001-D

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Total Nitrate/Nitrite-N	0.185 J	0.200	0.0500	mg/L	2	(<10)	07/25/19 13:51

Batch Information

Analytical Batch: WFI2829
Analytical Method: SM21 4500NO3-F
Analyst: DMM
Analytical Date/Time: 07/25/19 13:51
Container ID: 1194055001-F

Parameter	Result Qual	LOQ/CL	DL	Units	DF	Allowable Limits	Date Analyzed
Color, True	70.0 *	10.0	10.0	PCU	2	(<15)	07/24/19 15:26

Batch Information

Analytical Batch: WAT11391
Analytical Method: SM23 2120B
Analyst: EWW
Analytical Date/Time: 07/24/19 15:26
Container ID: 1194055001-G

Print Date: 08/09/2019 12:25:26PM

J flagging is activated

Method Blank

Blank ID: MB for HBN 1797088 [MXX/32619]
Blank Lab ID: 1521968

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1194055001

Results by **EP200.8**

Parameter	Results	LOQ/CL	DL	Units
Arsenic	2.50U	5.00	1.50	ug/L
Calcium	250U	500	150	ug/L
Iron	125U	250	78.0	ug/L
Manganese	0.500U	1.00	0.350	ug/L

Batch Information

Analytical Batch: MMS10579
Analytical Method: EP200.8
Instrument: Perkin Elmer Nexlon P5
Analyst: DSH
Analytical Date/Time: 7/31/2019 3:47:46PM

Prep Batch: MXX32619
Prep Method: E200.2
Prep Date/Time: 7/30/2019 9:13:01AM
Prep Initial Wt./Vol.: 20 mL
Prep Extract Vol: 50 mL

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [MXX32619]
Blank Spike Lab ID: 1521969
Date Analyzed: 07/31/2019 15:50

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by **EP200.8**

Blank Spike (ug/L)

Parameter	Spike	Result	Rec (%)	CL
Arsenic	1000	1040	104	(85-115)
Calcium	10000	10200	102	(85-115)
Iron	5000	5050	101	(85-115)
Manganese	500	500	100	(85-115)

Batch Information

Analytical Batch: **MMS10579**
Analytical Method: **EP200.8**
Instrument: **Perkin Elmer Nexlon P5**
Analyst: **DSH**

Prep Batch: **MXX32619**
Prep Method: **E200.2**
Prep Date/Time: **07/30/2019 09:13**
Spike Init Wt./Vol.: 1000 ug/L Extract Vol: 50 mL
Dupe Init Wt./Vol.: Extract Vol:

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Matrix Spike Summary

Original Sample ID: 1521974
MS Sample ID: 1521975 MS
MSD Sample ID:

QC for Samples: 1194055001

Analysis Date: 07/31/2019 16:41
Analysis Date: 07/31/2019 16:44
Analysis Date:
Matrix: Water (Surface, Eff., Ground)

Results by **EP200.8**

		Matrix Spike (ug/L)			Spike Duplicate (ug/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Arsenic	2.50U	1000	1040	104				70-130		
Calcium	9980	10000	19800	98				70-130		
Iron	212J	5000	5500	106				70-130		
Manganese	25.8	500	540	103				70-130		

Batch Information

Analytical Batch: MMS10579
Analytical Method: EP200.8
Instrument: Perkin Elmer NexIon P5
Analyst: DSH
Analytical Date/Time: 7/31/2019 4:44:25PM

Prep Batch: MXX32619
Prep Method: DW Digest for Metals on ICP-MS
Prep Date/Time: 7/30/2019 9:13:01AM
Prep Initial Wt./Vol.: 20.00mL
Prep Extract Vol: 50.00mL

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Matrix Spike Summary

Original Sample ID: 1521972
MS Sample ID: 1521976 MS
MSD Sample ID:

Analysis Date: 07/31/2019 15:56
Analysis Date: 07/31/2019 15:59
Analysis Date:
Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by **EP200.8**

		Matrix Spike (ug/L)			Spike Duplicate (ug/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Arsenic	2.50U	1000	1030	103				70-130		
Calcium	10100	10000	20600	104				70-130		
Iron	206J	5000	5370	103				70-130		
Manganese	20.5	500	526	101				70-130		

Batch Information

Analytical Batch: MMS10579
Analytical Method: EP200.8
Instrument: Perkin Elmer NexIon P5
Analyst: DSH
Analytical Date/Time: 7/31/2019 3:59:41PM

Prep Batch: MXX32619
Prep Method: DW Digest for Metals on ICP-MS
Prep Date/Time: 7/30/2019 9:13:01AM
Prep Initial Wt./Vol.: 20.00mL
Prep Extract Vol: 50.00mL

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Method Blank

Blank ID: MB for HBN 1796838 [STS/6394]
Blank Lab ID: 1520892

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1194055001

Results by **SM21 2540C**

Parameter	Results	LOQ/CL	DL	Units
Total Dissolved Solids	5.00U	10.0	3.10	mg/L

Batch Information

Analytical Batch: STS6394
Analytical Method: SM21 2540C
Instrument:
Analyst: EWW
Analytical Date/Time: 7/24/2019 4:57:29PM

Duplicate Sample Summary

Original Sample ID: 1194050001
Duplicate Sample ID: 1520895

Analysis Date: 07/24/2019 16:57
Matrix: Drinking Water

QC for Samples:

1194055001

Results by **SM21 2540C**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Total Dissolved Solids	374	374	mg/L	0.00	(< 5)

Batch Information

Analytical Batch: STS6394
Analytical Method: SM21 2540C
Instrument:
Analyst: EWW

Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [STS6394]
Blank Spike Lab ID: 1520893
Date Analyzed: 07/24/2019 16:57

Spike Duplicate ID: LCSD for HBN 1194055 [STS6394]
Spike Duplicate Lab ID: 1520894
Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by **SM21 2540C**

	Blank Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Dissolved Solids	333	308	92	333	307	92	(75-125)	0.33	(< 5)

Batch Information

Analytical Batch: **STS6394**
Analytical Method: **SM21 2540C**
Instrument:
Analyst: **EWW**

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Method Blank

Blank ID: MB for HBN 1796920 [WAT/11391]
Blank Lab ID: 1521245

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1194055001

Results by **SM23 2120B**

Parameter	Results	LOQ/CL	DL	Units
Color, True	5.00U	5.00	5.00	PCU

Batch Information

Analytical Batch: WAT11391
Analytical Method: SM23 2120B
Instrument: Color Analyzer 2- 177-A1 OH
Analyst: EWW
Analytical Date/Time: 7/24/2019 3:26:00PM

Print Date: 08/09/2019 12:25:38PM

Duplicate Sample Summary

Original Sample ID: 1194055001
Duplicate Sample ID: 1521247

Analysis Date: 07/24/2019 15:26
Matrix: Drinking Water

QC for Samples:

1194055001

Results by **SM23 2120B**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Color, True	70.0	80.0	PCU	13.30	(< 20)

Batch Information

Analytical Batch: WAT11391
Analytical Method: SM23 2120B
Instrument: Color Analyzer 2- 177-A1 OH
Analyst: EWW

Print Date: 08/09/2019 12:25:39PM

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [WAT11391]
Blank Spike Lab ID: 1521246
Date Analyzed: 07/24/2019 15:26

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by **SM23 2120B**

	Blank Spike (PCU)			
Parameter	Spike	Result	Rec (%)	CL
Color, True	15	15.0	100	(86-113)

Batch Information

Analytical Batch: **WAT11391**
Analytical Method: **SM23 2120B**
Instrument: **Color Analyzer 2- 177-A1 OH**
Analyst: **EWW**

Method Blank

Blank ID: MB for HBN 1796913 (WFI/2829)
Blank Lab ID: 1521217

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1194055001

Results by **SM21 4500NO3-F**

Parameter	Results	LOQ/CL	DL	Units
Nitrate-N	0.100U	0.200	0.0500	mg/L
Nitrite-N	0.100U	0.200	0.0500	mg/L
Total Nitrate/Nitrite-N	0.100U	0.200	0.0500	mg/L

Batch Information

Analytical Batch: WFI2829
Analytical Method: SM21 4500NO3-F
Instrument: Discrete Analyzer 2
Analyst: DMM
Analytical Date/Time: 7/25/2019 12:20:59PM

Method Blank

Blank ID: MB for HBN 1796913 (WFI/2829)
Blank Lab ID: 1521219

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1194055001

Results by **SM21 4500NO3-F**

Parameter	Results	LOQ/CL	DL	Units
Nitrate-N	0.100U	0.200	0.0500	mg/L
Nitrite-N	0.100U	0.200	0.0500	mg/L
Total Nitrate/Nitrite-N	0.100U	0.200	0.0500	mg/L

Batch Information

Analytical Batch: WFI2829
Analytical Method: SM21 4500NO3-F
Instrument: Discrete Analyzer 2
Analyst: DMM
Analytical Date/Time: 7/25/2019 1:59:55PM

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Method Blank

Blank ID: MB for HBN 1796913 (WFI/2829)
Blank Lab ID: 1521221

Matrix: Water (Surface, Eff., Ground)

QC for Samples:

Results by **SM21 4500NO3-F**

Parameter	Results	LOQ/CL	DL	Units
Nitrate-N	0.100U	0.200	0.0500	mg/L
Nitrite-N	0.100U	0.200	0.0500	mg/L
Total Nitrate/Nitrite-N	0.100U	0.200	0.0500	mg/L

Batch Information

Analytical Batch: WFI2829
Analytical Method: SM21 4500NO3-F
Instrument: Discrete Analyzer 2
Analyst: DMM
Analytical Date/Time: 7/25/2019 3:04:59PM

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [WFI2829]
Blank Spike Lab ID: 1521216
Date Analyzed: 07/25/2019 12:19

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by **SM21 4500NO3-F**

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Nitrate-N	2.5	2.78	111	(70-130)
Nitrite-N	2.5	2.56	102	(90-110)
Total Nitrate/Nitrite-N	5	5.34	107	(90-110)

Batch Information

Analytical Batch: **WFI2829**
Analytical Method: **SM21 4500NO3-F**
Instrument: **Discrete Analyzer 2**
Analyst: **DMM**

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [WFI2829]
Blank Spike Lab ID: 1521218
Date Analyzed: 07/25/2019 13:58

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by SM21 4500NO3-F

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Nitrate-N	2.5	2.60	104	(70-130)
Nitrite-N	2.5	2.51	100	(90-110)
Total Nitrate/Nitrite-N	5	5.11	102	(90-110)

Batch Information

Analytical Batch: **WFI2829**
Analytical Method: **SM21 4500NO3-F**
Instrument: **Discrete Analyzer 2**
Analyst: **DMM**

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Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [WFI2829]
Blank Spike Lab ID: 1521220
Date Analyzed: 07/25/2019 15:03

Matrix: Water (Surface, Eff., Ground)

QC for Samples:

Results by **SM21 4500NO3-F**

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Nitrate-N	2.5	2.59	104	(70-130)
Nitrite-N	2.5	2.62	105	(90-110)
Total Nitrate/Nitrite-N	5	5.21	104	(90-110)

Batch Information

Analytical Batch: **WFI2829**
Analytical Method: **SM21 4500NO3-F**
Instrument: **Discrete Analyzer 2**
Analyst: **DMM**

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Matrix Spike Summary

Original Sample ID: 1194084001
MS Sample ID: 1521174 MS
MSD Sample ID: 1521175 MSD

QC for Samples:

Analysis Date: 07/25/2019 11:40
Analysis Date: 07/25/2019 11:42
Analysis Date: 07/25/2019 11:44
Matrix: Water (Surface, Eff., Ground)

Results by **SM21 4500NO3-F**

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)						
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)		CL	RPD (%)	RPD CL
Nitrate-N	0.100U	2.50	2.39	96	2.50	2.27	91		70-130	5.20	(< 25)
Nitrite-N	0.100U	2.50	2.44	98	2.50	2.23	89	*	90-110	9.00	(< 25)

Batch Information

Analytical Batch: WFI2829
Analytical Method: SM21 4500NO3-F
Instrument: Discrete Analyzer 2
Analyst: DMM
Analytical Date/Time: 7/25/2019 11:42:29AM

Matrix Spike Summary

Original Sample ID: 1193920001
MS Sample ID: 1521177 MS
MSD Sample ID: 1521178 MSD

QC for Samples: 1194055001

Analysis Date: 07/25/2019 13:17
Analysis Date: 07/25/2019 13:19
Analysis Date: 07/25/2019 13:21
Matrix: Drinking Water

Results by **SM21 4500NO3-F**

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Nitrate/Nitrite-N	0.200U	5.00	7.26	145 *	5.00	6.30	126 *	90-110	14.30	(< 25)

Batch Information

Analytical Batch: WFI2829
Analytical Method: SM21 4500NO3-F
Instrument: Discrete Analyzer 2
Analyst: DMM
Analytical Date/Time: 7/25/2019 1:19:39PM

Matrix Spike Summary

Original Sample ID: 1199540001
MS Sample ID: 1521179 MS
MSD Sample ID: 1521180 MSD

QC for Samples: 1194055001

Analysis Date: 07/25/2019 14:26
Analysis Date: 07/25/2019 14:28
Analysis Date: 07/25/2019 14:29
Matrix: Water (Surface, Eff., Ground)

Results by **SM21 4500NO3-F**

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Nitrate/Nitrite-N	0.584	5.00	7.06	130 *	5.00	6.98	128 *	90-110	1.20	(< 25)

Batch Information

Analytical Batch: WFI2829
Analytical Method: SM21 4500NO3-F
Instrument: Discrete Analyzer 2
Analyst: DMM
Analytical Date/Time: 7/25/2019 2:28:13PM

Print Date: 08/09/2019 12:25:47PM

Method Blank

Blank ID: MB for HBN 1796917 [WTC/2938]
Blank Lab ID: 1521225

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1194055001

Results by **SM 5310B**

Parameter	Results	LOQ/CL	DL	Units
Total Organic Carbon	0.500U	1.00	0.400	mg/L

Batch Information

Analytical Batch: WTC2938
Analytical Method: SM 5310B
Instrument: TOC Analyzer
Analyst: BMZ
Analytical Date/Time: 7/25/2019 4:52:34PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [WTC2938]
Blank Spike Lab ID: 1521223
Date Analyzed: 07/25/2019 16:35

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by **SM 5310B**

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Total Organic Carbon	75	72.0	96	(80-120)

Batch Information

Analytical Batch: **WTC2938**
Analytical Method: **SM 5310B**
Instrument: **TOC Analyzer**
Analyst: **BMZ**

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Matrix Spike Summary

Original Sample ID: 1193992001
MS Sample ID: 1521231 MS
MSD Sample ID: 1521232 MSD

QC for Samples: 1194055001

Analysis Date: 07/25/2019 17:38
Analysis Date: 07/25/2019 17:54
Analysis Date: 07/25/2019 18:11
Matrix: Water (Surface, Eff., Ground)

Results by **SM 5310B**

		Matrix Spike (mg/L)			Spike Duplicate (mg/L)					
Parameter	Sample	Spike	Result	Rec (%)	Spike	Result	Rec (%)	CL	RPD (%)	RPD CL
Total Organic Carbon	1.00U	10.0	10.9	109	10.0	9.67	97	75-125	12.10	(< 25)

Batch Information

Analytical Batch: WTC2938
Analytical Method: SM 5310B
Instrument: TOC Analyzer
Analyst: BMZ
Analytical Date/Time: 7/25/2019 5:54:37PM

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Duplicate Sample Summary

Original Sample ID: 1193955001
Duplicate Sample ID: 1521251

Analysis Date: 07/24/2019 13:15
Matrix: Drinking Water

QC for Samples:

1194055001

Results by **SM21 4500-H B**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
pH	8.6	8.50	pH units	1.20	(< 5)

Batch Information

Analytical Batch: WTI5231
Analytical Method: SM21 4500-H B
Instrument: Titration
Analyst: EWW

Print Date: 08/09/2019 12:25:55PM

Duplicate Sample Summary

Original Sample ID: 1194076001
Duplicate Sample ID: 1521252

Analysis Date: 07/24/2019 16:39
Matrix: Drinking Water

QC for Samples:

1194055001

Results by **SM21 4500-H B**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
pH	7.1	7.10	pH units	0.00	(< 5)

Batch Information

Analytical Batch: WTI5231
Analytical Method: SM21 4500-H B
Instrument: Titration
Analyst: EWW

Print Date: 08/09/2019 12:25:55PM

Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [WTI5231]
Blank Spike Lab ID: 1521248
Date Analyzed: 07/24/2019 12:09

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by **SM21 4500-H B**

Parameter	Spike	Result	Rec (%)	CL
	Blank Spike (pH units)			
pH	6.98	7.02	101	(99-101)

Batch Information

Analytical Batch: **WTI5231**
Analytical Method: **SM21 4500-H B**
Instrument: **Titration**
Analyst: **EWW**

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Method Blank

Blank ID: MB for HBN 1796923 [WTI/5233]
Blank Lab ID: 1521258

Matrix: Water (Surface, Eff., Ground)

QC for Samples:
1194055001

Results by **SM21 2320B**

Parameter	Results	LOQ/CL	DL	Units
Alkalinity	3.14J	10.0	2.50	mg/L

Batch Information

Analytical Batch: WTI5233
Analytical Method: SM21 2320B
Instrument: Titration
Analyst: EWW
Analytical Date/Time: 7/24/2019 12:37:00PM

Duplicate Sample Summary

Original Sample ID: 1193955001
Duplicate Sample ID: 1521260

Analysis Date: 07/24/2019 13:15
Matrix: Drinking Water

QC for Samples:

1194055001

Results by **SM21 2320B**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Alkalinity	117	117	mg/L	0.03	(< 25)

Batch Information

Analytical Batch: WTI5233
Analytical Method: SM21 2320B
Instrument: Titration
Analyst: EWW

Print Date: 08/09/2019 12:25:58PM

Duplicate Sample Summary

Original Sample ID: 1194076001
Duplicate Sample ID: 1521261

Analysis Date: 07/24/2019 16:39
Matrix: Drinking Water

QC for Samples:

1194055001

Results by **SM21 2320B**

NAME	Original	Duplicate	Units	RPD (%)	RPD CL
Alkalinity	101	100	mg/L	0.16	(< 25)

Batch Information

Analytical Batch: WTI5233
Analytical Method: SM21 2320B
Instrument: Titration
Analyst: EWW

Print Date: 08/09/2019 12:25:58PM

SGS

Blank Spike Summary

Blank Spike ID: LCS for HBN 1194055 [WTI5233]
Blank Spike Lab ID: 1521259
Date Analyzed: 07/24/2019 12:45

Matrix: Water (Surface, Eff., Ground)

QC for Samples: 1194055001

Results by **SM21 2320B**

	Blank Spike (mg/L)			
Parameter	Spike	Result	Rec (%)	CL
Alkalinity	250	236	94	(85-115)

Batch Information

Analytical Batch: **WTI5233**
Analytical Method: **SM21 2320B**
Instrument: **Titration**
Analyst: **EWW**

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PWSID sampling for submittal

1194055

Locations Nationwide

Alaska | Maryland
New Jersey | New York
North Carolina | Florida

www.us.sgs.com

Section 1

CLIENT: VANESSA WIKE, BRISTOL 9073064507

CONTACT: PHONE #:

PROJECT NAME: KONGIGANAK PROJECT/ PERMIT#:

REPORTS TO: V. WIKE E-MAIL: VWIKE@bristol-companies.com Profile #:

INVOICE TO: QUOTE #: P.O. #:

Instructions: Sections 1 - 5 must be filled out. Omissions may delay the onset of analysis.

Page ____ of ____

Section 3 | Preservative

Info Required for ADEC Submittal - Missing or incorrect info may result in a delay. Information may be found on your ADEC Monitoring Summary.

Section 2

RESERVED for lab use	Sample Location	Date of Collection	Time of Collection	# CONTAINERS	Comp Grab	Analysis				PWSID#	FAC ID #	Sample Pt. ID
① A-G	RAW WATER TAP IN WTP	7/23/19	1:00pm									raw water tap in wTP
			1:30PM									
	all		1:50PM									

Section 5

Relinquished By: (1)	Date	Time	Received By:
VBWike	7/24/19	9:16	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date	Time	Received For Laboratory By:
	07/24/19	09:15	Alexander Gl

Section 4

Cooler ID: ____________

Data Deliverable Requirements:

Requested Turnaround Time and/or Special Instructions:

Cooler temp. 5.0° #D50 GM

Temp Blank °C: 6.9 D50
or Ambient [ ]

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT

Delivery Method: Hand Delivery [X] Commerical Delivery [ ]

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F083-Blank_COC_DWLong_20190104

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200 W. Potter Dr.. 3180 Peger Rd. Ste. 190, Fairbanks, AK 99709 (ph) 907-474-8656

Sample Kit Request

☐ Client pickup Date: 7/19/2019 Time: 10:00

Be sure to ask if client will ship by ground (DOT) or air carrier (IATA)

Does a Profile exist in LIMS? If not, please send a request for new profile build.

1194055

Client Name: Bristol Engineering
Ordered By: Vanessa Wike **Phone #:** 907-743-9302
Email:
Project Name: Kongiganak **Project/Permit#:**
Quote #: **Profile #:**
Delivery Address:

☐ **Deliver to client:**
Ship by/Air Carrier:
Airbill Number:
Date to ship by:
Notes:
Kit request taken by: JKJ **Date:** July 15, 2019
Kit prepared by: R.F **Date:** 7/18/19
Kit *(including lid tightness for pres'd bottles)* checked by: A.L **Date:** 7/18/19
Kit packed & shipped by: R.F **Date:** 7/18/19

Filename: SKIT_Bristol Engineering_Kongiganak_2019-07-15 *Required Items

No. Samples	Matrix	Analysis	Container Size	& Type	Pres.	Bottle Lot #	Preservative Lot #	Hold Time	# QC Bottles	Total Bottles
✓ 1	DW	TOC	1 x 125-mL	amber glass	HCl			28 days		1
✓ 1	DW	DOC (Lab Filter)	1 x 125-mL	amber glass				28 days		1
✓ 1	DW	UV 254 <REF LAB>	1 x 250-mL	amber glass				48 hours		1
✓ 1	DW	Alkalinity, TDS, pH (Langlier Index)	1 x 500-ml	HDPE				7 days		1
✓ 1	DW	Calcium Hardness (Langlier Index)	1 x 250-mL	HDPE	HNO3			180 days		1
✓ 1	DW	Metals (EPA 200.8): As, Fe, Mn								
✓ 1	DW	Nitrate+Nitrite Pres	1 x 60-mL	HDPE	H2SO4			28 days		1
✓ 1	DW	Color	1 x 250-mL	HDPE				48 hours		1

- ☐ Pack for Shipping via ***ground*** (DOT)
- ☑ Pack for Shipping via ***air carrier*** (IATA)
- ☑ Temperature Blank (***circle one:*** 120-ml OR 500-ml)
- ☐ Soil VOA Trip Blank - Lot#:
- ☐ Water VOA Trip Blank - Lot#:
- ☐ 524 VOA Trip Blank - Lot#:
- ☐ Low Level Mercury Trip Blank- Lot#:
- ☑ Coolers
- ☑ Gel Ice
- ☑ Bubble Wrap
- ☑ Labels
- ☑ Custody Seals
- ☑ SGS COCs - ***Circle req'd format:*** ☐ BI ☐ DW COC ☐ COC initiated by PM (attached)
- ☐ Send additional instructions/documents (***Note to PM:*** *Be sure to attach copy of requested form.)*

- ☐ Total # includes bottles for % Solids
- ☐ Track all Lot#? (Required for DOD)
- ☐ Foreign Soil

Other Notes/Reminders for Kit Prep:

Attention Client/Sampler:

1. Do not rinse container; be aware of any acid preservative in container.
2. Fill container, but do not overfill (except volatile waters).
3. Label the container with your sample ID as well as the date/time of collection.
4. Fill out the Chain of Custody.
5. Add frozen gel packs or ice to your cooler & pack to prevent breakage.

Charges may be invoiced for bottles which are unused or improperly used.
If you have any questions concerning this sample kit, please contact your Project Manager for assistance. ***Thank you.***

***This will email a copy of this form for confirmation to the client email and save the form to the network. This should not be used outside of SGS.**

e-Sample Receipt Form

SGS Workorder #: **1194055**

1 1 9 4 0 5 5

Review Criteria	Condition (Yes, No, N/A)	Exceptions Noted below
Chain of Custody / Temperature Requirements		Yes — Exemption permitted if sampler hand carries/delivers.
Were Custody Seals intact? Note # & location	N/A	HD
COC accompanied samples?	Yes	
DOD: Were samples received in COC corresponding coolers?		
		**Exemption permitted if chilled & collected <8 hours ago, or for samples where chilling is not required
Temperature blank compliant* (i.e., 0-6 °C after CF)?	Yes	Cooler ID: 1 @ 5.0 °C Therm. ID: D50
		Cooler ID: @ °C Therm. ID:
If samples received without a temperature blank, the "cooler temperature" will be documented instead & "COOLER TEMP" will be noted to the right. "ambient" or "chilled" will be noted if neither is available.		Cooler ID: @ °C Therm. ID:
		Cooler ID: @ °C Therm. ID:
		Cooler ID: @ °C Therm. ID:
**If >6°C, were samples collected <8 hours ago?*	N/A	
If <0°C, were sample containers ice free?	N/A	
Note: Identify containers received at non-compliant temperature . Use form FS-0029 if more space is needed.		
Holding Time / Documentation / Sample Condition Requirements		Note: Refer to form F-083 "Sample Guide" for specific holding times.
Were samples received within holding time?	Yes	
Do samples **match COC**** (i.e.,sample IDs,dates/times collected)? **Note: If times differ <1hr, record details & login per COC. ***Note: If sample information on containers differs from COC, SGS will default to COC information	No	COC Not filled out login per kit request
Were analytical requests clear? (i.e., method is specified for analyses with multiple option for analysis (Ex: BTEX, Metals)	Yes	
		***Exemption permitted for metals (e.g,200.8/6020A).
Were proper containers (type/mass/volume/preservative***)used?	Yes	
Volatile / LL-Hg Requirements		
Were Trip Blanks (i.e., VOAs, LL-Hg) in cooler with samples?	N/A	
Were all water VOA vials free of headspace (i.e., bubbles ≤ 6mm)?	N/A	
Were all soil VOAs field extracted with MeOH+BFB?	N/A	

Note to Client: Any "No", answer above indicates non-compliance with standard procedures and may impact data quality.

Additional notes (if applicable):

Sample Containers and Preservatives

Container Id	Preservative	Container Condition	Container Id	Preservative	Container Condition
1194055001-A	HCL to pH < 2	OK			
1194055001-B	No Preservative Required	OK			
1194055001-C	No Preservative Required	OK			
1194055001-D	No Preservative Required	OK			
1194055001-E	HNO3 to pH < 2	OK			
1194055001-F	H2SO4 to pH < 2	OK			
1194055001-G	No Preservative Required	OK			

Container Condition Glossary

Containers for bacteriological, low level mercury and VOA vials are not opened prior to analysis and will be assigned condition code OK unless evidence indicates than an inappropriate container was submitted.

OK - The container was received at an acceptable pH for the analysis requested.
BU - The container was received with headspace greater than 6mm.
DM - The container was received damaged.
FR - The container was received frozen and not usable for Bacteria or BOD analyses.
IC - The container provided for microbiology analysis was not a laboratory-supplied, pre-sterilized container and therefore was not suitable for analysis.
NC- The container provided was not preserved or was under-preserved. The method does not allow for additional preservative added after collection.
PA - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt and the container is now at the correct pH. See the Sample Receipt Form for details on the amount and lot # of the preservative added.
PH - The container was received outside of the acceptable pH for the analysis requested. Preservative was added upon receipt, but was insufficient to bring the container to the correct pH for the analysis requested. See the Sample Receipt Form for details on the amount and lot # of the preservative added.

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Anchorage, AK 99517
(907) 258-2155 | Fax (907) 258-6634

ARS Aleut Analytical, LLC

Laboratory Analytical Report

ARS3-19-02251

SGS Environmental Services
Julie Shumway
200 W. Potter Drive
Anchorage, AK 99523
907-550-3215
Julie.Shumway@sgs.com

PO Number: **1194055**
Job Number: **SGS#1194055**
Project Name: **SGS Environmental**

Questions regarding this analytical report should be addressed to ARS project manager, Jennifer Roberts, who can be reached by phone at 907-258-2155 or email at datareporting@amrad.com.

I certify that the test results presented in this report (in either hardcopy or electronic file (EDD)) meet the requirements of the laboratory's certifications and other applicable contract terms and conditions. Any exceptions to the certification or contract will be noted within the case narratives presented in the report. Any subcontracted sample results will be identified within the case narratives presented in the report. In the event this report is an amendment to a previously released report, the case narrative will clearly identify the original report as well as the reason(s) for reissuance. A statement of uncertainty for each analysis is available upon request. I authorize release and issuance of this report on the date signed below.

Signature	Date	Title
		Laboratory Management, ARS Aleut Analytical

This report provides analytical results of the requested analysis and does not include any opinions or interpretations. ARS Aleut Analytical, LLC assumes no liability for the use or interpretation of analytical results. Results relate only to items tested. A partial reproduction of this test report is prohibited. Reproduction of this report in full requires the written approval of the laboratory.

Alaska Laboratory# AK00969

ARS Aleut Analytical
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ARS Aleut Analytical, LLC
Analytical Reports

for

SGS Environmental Services

Case Narrative

ARS Aleut Analytical
3710 Woodland Dr. Suite 900 ● Anchorage, AK 99517
(907) 258-2155 ● Fax (907) 258-6634

PROJECT SAMPLE IDENTIFICATION CROSS-REFERENCE
TO ARS SAMPLE LABORATORY IDs

Client Sample ID	ARS Aleut Analytical Sample ID
Raw Water Tap in WTP **Raw Water Tap in WTP**	**ARS3-19-02251-001**

Sample	Date Collected	Date Received	Analysis	Prep Date/Time	Analysis Date/Time
001	07/23/19 13:30	07/24/19	WCH-UV254-AQ	07/25/19 11:52	07/25/19 11:52

SAMPLE RECEIPT/PREP

The samples arrived in good condition. Turnaround time was set at 10 work days.

Sample 001 Comment:
SGS #1194055001

ANALYTICAL METHODS

UV 254 analysis was performed using **ARS-WCH-024, "UV254 (SM5910B)".**

ANALYTICAL RESULTS

**No QC failures or CRDL failures found.

For batch ARS3-B19-01248, sample “Raw Water Tap in WTP” (ARS3-19-02251-001) was used as the Sample Duplicate and sample “Raw Water Tap in WTP” (ARS3-19-02251-001) was designated as the Matrix Spike.

Notes (Case Narrative):

General Comments:

1.0) Soil and Sludge analysis are reported on a wet basis or an as received basis unless otherwise indicated.
2.0) Modified analysis procedures are procedures that are modified to meet the certain specifications. An example may be the use of a water method to analyze a solid matrix due to the lack of an officially recognized procedure for the analysis of the solid matrix. Modified analyses are indicated by the subsequent addition of "m" to the procedure number (i.e. 900.0M).
3.0) All NIOSH method results are reported without blank corrections applied.

Radiochemistry Comments:

1.0) All MDA/MDC values are calculated on a sample specific basis.
2.0) Data in this report are within the limits of uncertainty specified in the reference method unless otherwise specified.
3.0) Total activity is actually total gamma activity and is determined utilizing the prominent gamma emitters from the naturally occurring radioactive decay chains and other prominent radioactive nuclides. Total activity may be lower than the actual total activity due to the extent of secular equilibrium achieved in the various decay chains at the time of analysis. The total activity is not representative of nuclides that emit solely alpha or beta particles.
4.0) Ra-228 is determined via secular equilibrium with its daughter, Actinium 228 (Gamma Spectroscopy only).
5.0) U-238 is determined via secular equilibrium with its daughter, Thorium 234 (Gamma Spectroscopy only).
6.0) All gamma spectroscopy was performed utilizing high purity germanium detectors (**HPGe**).
7.0) ARS makes every attempt to match sample density to calibrated density; however, in some cases, it is not practical or possible to do so and data results may be affected (Gamma Spectroscopy only).
8.0) Gamma spectroscopy results are calculated values based on the **ORTEC**® GammaVision ENV32 Analysis Engine.
9.0) ACLASS DOD and ISO 17025 certification applies only to the following analytes and methods: Gross Alpha and Gross Beta (EPA 900, SM7110B&C, SW846 9310); Radium 226 (EPA 903, EPA 903.1, SM 7500 Ra-B, SW846 9315); Radium 228 (EPA 904, SM 7500 Ra-B SW846 9320); Iodine-131(EPA 901.1); Uranium by ICPMS (EPA 200.8); Strontium 89/90 (EPA 905, Eichrom SRW01, HASL 300 Sr-03-RC); Tritium (EPA 906, EPA 906M); Gamma Emitters (EPA 901.1, SM7120B, HASL 300 Ga-01-R); Americium-241, Curium 242/244, Plutonium 239/240 and 241, Thorium 228/230/232, Uranium 234/233 and 238 (Eichrom ACW03 VBS); Lead 210 (HASL 300 Pb-01-RC, Eichrom OTW01); Polonium 210 (HASL 300 Po-01-RC, HASL 300 Po-02-RC); Technetium-99 (Eichrom TCW02, Eichrom TCS01M).

Definitions:

CRDL	Contract Required Detection Limit
CSU	Combined Standard Uncertainty
DLC	Decision Level Concentration (ANSI N42.23) or critical level
DO	Duplicate Original
DUP	Method Duplicate
LCS/LCSD	Laboratory Control Sample/Laboratory Control Sample Duplicate
MDA	Minimum Detectable Activity
MDC	(Minimum Detectable Concentration) minimum concentration of the analyte that ARS can detect utilizing the specific analysis
MBL	Method Blank
MS/MSD	Matrix Spike/Matrix Spike Duplicate
N/A	Not Applicable
NP	Not Provided
NR	Not Referenced
LOD	Limit of Detection
LOQ	Limit of Quantitation
MCL	Maximum Contaminant Level

Data Qualifiers:

B	The activity of both the method blank and the target sample are above the MDL.
D	Sample analysis accomplished through dilution.
J	The reported result is an estimated value above the LOD but below the LOQ.
Q	The LCS and LCSD percent recoveries are out of range.
U	Activity is below the MDC, MDA, MDL, or LOD
N	The analyte is a tentatively identified compound using mass spectrometry or any non-customer requested compounds that are tentatively identified.
*****	LCS/LCSD or Sample DUP fails one or more Duplicate criteria.
S	Spike
SC	Subcontracted out to another qualified laboratory
H	Holding time exceeded
E	Exceeds MCL
******	Reporting Limit is higher than MCL; Target cannot be detected

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ARS Aleut Analytical, LLC
Analytical Reports

for

SGS Environmental Services

Analytical Results

ARS Aleut Analytical
3710 Woodland Dr. Suite 900 • Anchorage, AK 99517
907-258-2155 • FAX 907-258-6634

ARS Sample Delivery Group: ARS3-19-02251
Client Sample ID: Raw Water Tap in WTP
Sample Collection Date: 07/23/19 13:30
Sample Matrix: Drinking Water
Percent Solids: N/A

Request or PO Number: 1194055
ARS Sample ID: ARS3-19-02251-001
Date Received: 07/24/19
Report Date: 08/07/19

Inorganics

Analysis Description	Analysis Results	MDL	LOQ	MCL	Analysis Units	Method	Analysis Date/Time	Analysis Technician
UV 254 Ultraviolet Absorption	0.350	0.00200	0.0100	N/A	cm-1	ARS-WCH-024/SM5910B	07/25/19 11:52	EHENDERSON

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ARS Aleut Analytical, LLC
Analytical Reports

for

SGS Environmental Services

Sample Management Records

SGS North America Inc.
CHAIN OF CUSTODY RECORD

Locations Nationwide

Alaska | Florida
New Jersey | Colorado
Texas | North Carolina
Virginia | Louisiana

www.us.sgs.com

CLIENT:	SGS North America Inc. - Alaska Division		
CONTACT:	Julie Shumway	PHONE NO:	(907) 562-2343
PROJECT NAME:	1194055	PWSID#:	
		NPDL#:	
REPORTS TO: Julie Shumway		E-MAIL:	Julie.Shumway@sgs.com Env.Alaska.RefLabTeam@sgs.com
INVOICE TO: SGS - Alaska		QUOTE #:	
		P.O. #:	1194055

SGS Reference: **ARS Anchorage**

Page 1 of 1

Additional Comments: All soils report out in dry weight unless

RESERVED for lab use	SAMPLE IDENTIFICATION	DATE mm/dd/yy	TIME HHMM	MATRIX/ MATRIX CODE	# CONTAINERS	Preservative Used: / TYPE C = COMP G = GRAB MI = Multi Incremental Soils	NONE / UV 254				MS	MSD	SGS lab #	Location ID
	Raw water Tap in WTP	07/23/2019	13:30	DW	1	G =	X						1194055001	

Relinquished By: (1)	Date	Time	Received By:
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4) J Shumway	Date 7/24/19	Time 1133	Received For Laboratory By: Derek Paleny 7-24-17 13:10

DOD Project?	NO	Data Deliverable Requirements:
Report to DL (J Flags)? If J- Report as DL/LOD/LOQ.	NO	Level 1
Cooler ID:		

Requested Turnaround Time and-or Special Instructions:

Temp Blank °C: 0.4

or Ambient [ ]

Chain of Custody Seal: (Circle)

INTACT BROKEN ABSENT

[X] 200 W. Potter Drive Anchorage, AK 99518 Tel: (907) 562-2343 Fax: (907) 561-5301
[ ] 5500 Business Drive Wilmington, NC 28405 Tel: (910) 350-1903 Fax: (910) 350-1557

http://www.sgs.com/terms_and_conditions.htm

Water!Pro TM

Corrosion Control Modeling Program

Step 1 Enter Characteristics of Water to be Treated

System Name:	Kong WTP	Copy WaterPro		
Source Point:	Contractor's Lake			
Date of Sample:	July 1, 2019			
TDS =	27	mg/L		
pH =	5.80	field pH is recommended		
Total Alkalinity =	5.0	mg/L as $CaCO_3$		
Calcium (total) =	0.3	mg/L Ca^{2+}	0.75	mg/L as $CaCO_3$
Water Temperature =	10.0	°C (temp. at which pH was analyzed)		
Field Water Temperature =	10.0	°C (operating temperature at facility)		
Cl^- =	4.2	mg/L	0.0	mg/L as $CaCO_3$
SO_4^{2-} =	0.6	mg/L	0.0	mg/L as $CaCO_3$
Mg^{2+} =	0	mg/L	0.0	mg/L as $CaCO_3$

Step 2 Chemical Selection & Constraints

Select Corrosion Control Chemical	Potash (K2CO3)	
Enter Constraints:		
Upper limit dose to plot:	60.0	mg/L
Upper Bound pH:	8.0	

Step 3 Enter PO_4^{3-} dose if added with chemical from Step 2

Orthophosphate as PO_4^{3-}	0.0	mg/L

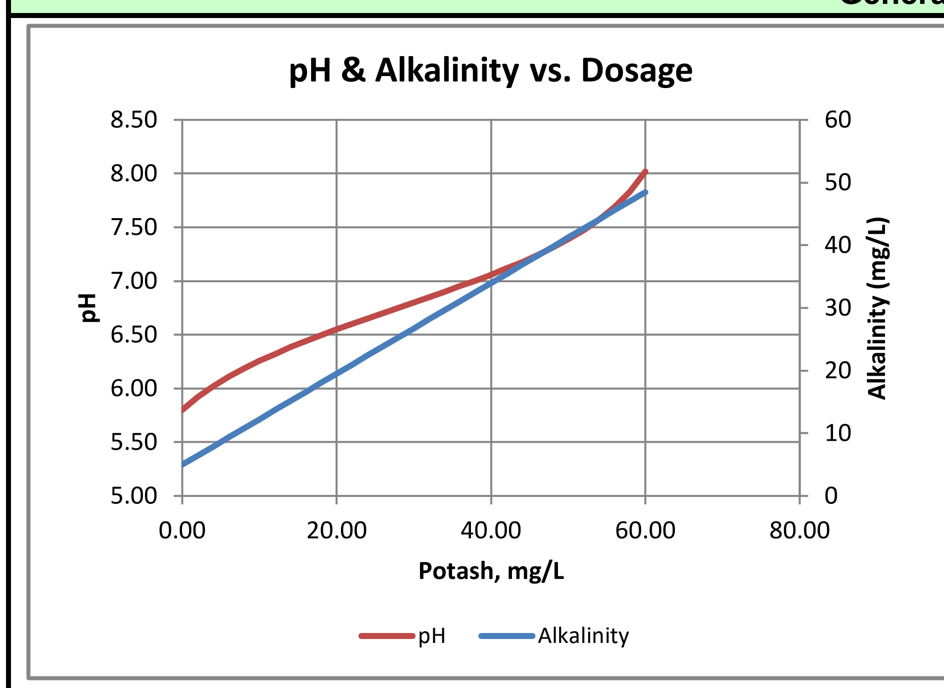
Step 4 Plot Data

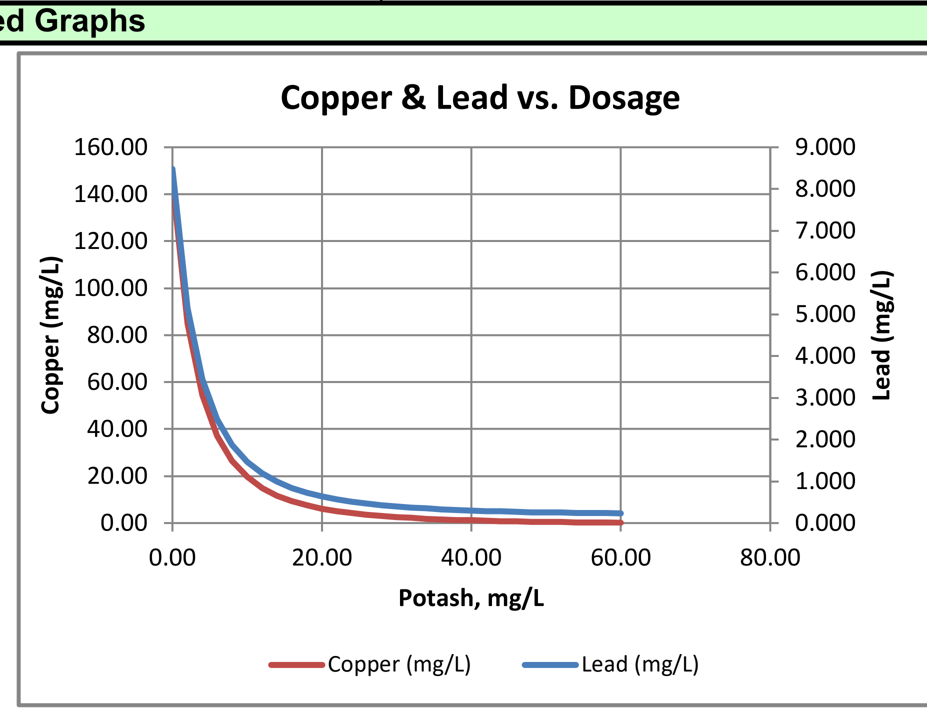
Activate button "***Plot Data***" to plot any new data entered in Steps 1 to 3.

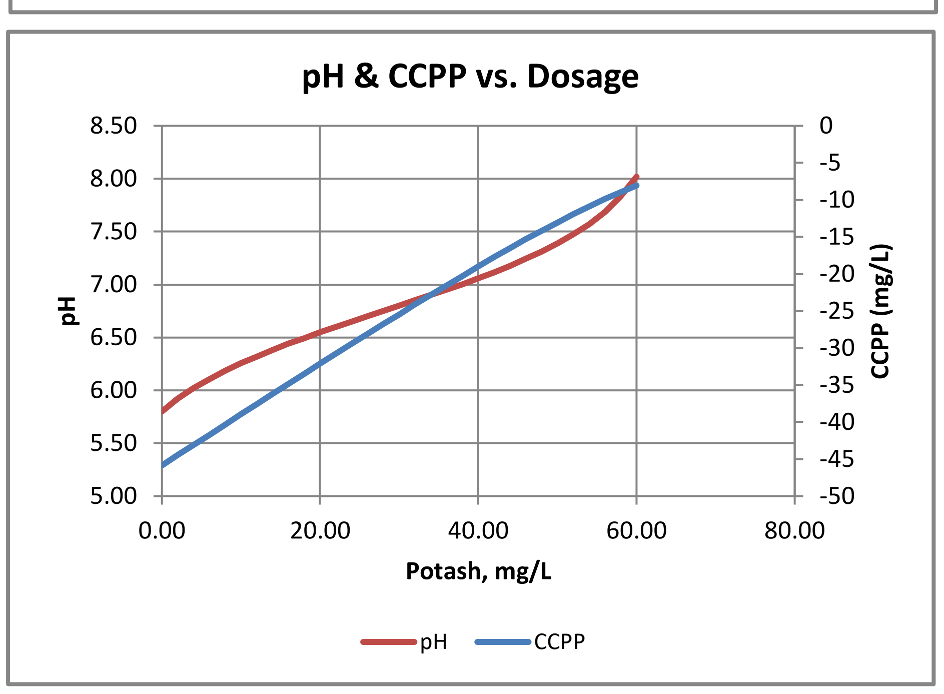
Plotting Points for Graphs

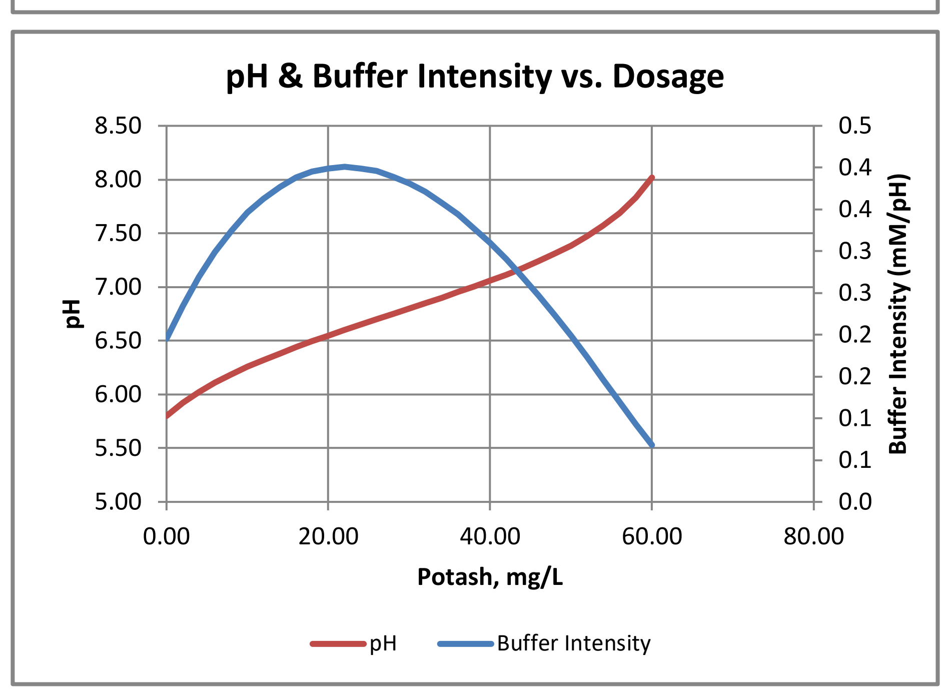
Dose mg/L	Ortho-phosphate mg/L	pH at Field Temp.	Alkalinity as $CaCO_3$ mg/L	DIC mg/L C	Langelier Index LI	CCPP as $CaCO_3$ mg/L	Copper II at 25°C mg/L	Lead II at 25°C mg/L	Buffer Intensity mM/pH	CO_2 mg/L	Aggressive Index AI	Ryznar Index RI
0.00	0	5.80	5.00	6.68	-5.46	-45.86	146.000	8.481	0.195	20.00	6.37	16.72
2.00	0	5.92	6.45	6.85	-5.23	-44.48	85.100	5.150	0.234	19.40	6.60	16.38
4.00	0	6.02	7.90	7.03	-5.04	-43.09	54.400	3.451	0.269	18.80	6.79	16.11
6.00	0	6.11	9.35	7.20	-4.88	-41.71	37.100	2.477	0.299	18.10	6.95	15.88
8.00	0	6.19	10.79	7.38	-4.74	-40.33	26.500	1.870	0.324	17.50	7.09	15.68
10.00	0	6.26	12.24	7.55	-4.62	-38.96	19.600	1.467	0.346	16.90	7.22	15.50
12.00	0	6.32	13.69	7.72	-4.51	-37.58	15.000	1.188	0.363	16.20	7.33	15.34
14.00	0	6.38	15.14	7.90	-4.40	-36.21	11.700	0.987	0.377	15.60	7.44	15.19
16.00	0	6.44	16.59	8.07	-4.31	-34.85	9.260	0.838	0.388	15.00	7.53	15.05
18.00	0	6.50	18.04	8.24	-4.21	-33.48	7.470	0.725	0.395	14.30	7.62	14.92
20.00	0	6.55	19.48	8.42	-4.13	-32.13	6.100	0.637	0.399	13.70	7.71	14.80
22.00	0	6.60	20.93	8.59	-4.05	-30.77	5.030	0.567	0.401	13.10	7.79	14.69
24.00	0	6.65	22.38	8.77	-3.97	-29.43	4.200	0.511	0.399	12.40	7.87	14.58
26.00	0	6.70	23.83	8.94	-3.89	-28.09	3.530	0.466	0.396	11.80	7.95	14.48
28.00	0	6.75	25.28	9.11	-3.81	-26.75	2.980	0.429	0.389	11.20	8.03	14.38
30.00	0	6.80	26.73	9.29	-3.74	-25.43	2.540	0.398	0.381	10.50	8.10	14.28
32.00	0	6.85	28.17	9.46	-3.67	-24.11	2.170	0.372	0.371	9.89	8.17	14.19
34.00	0	6.90	29.62	9.64	-3.60	-22.81	1.860	0.350	0.358	9.26	8.24	14.09
36.00	0	6.95	31.07	9.81	-3.52	-21.52	1.590	0.331	0.344	8.62	8.32	14.00
38.00	0	7.00	32.52	9.98	-3.45	-20.24	1.370	0.315	0.327	7.99	8.39	13.91
40.00	0	7.06	33.97	10.16	-3.38	-18.98	1.180	0.301	0.310	7.35	8.46	13.81
42.00	0	7.12	35.42	10.33	-3.30	-17.74	1.010	0.289	0.290	6.72	8.54	13.72
44.00	0	7.18	36.86	10.50	-3.22	-16.52	0.862	0.279	0.269	6.09	8.61	13.63
46.00	0	7.24	38.31	10.68	-3.14	-15.32	0.732	0.270	0.247	5.45	8.70	13.53
48.00	0	7.31	39.76	10.85	-3.06	-14.16	0.616	0.262	0.223	4.82	8.78	13.43
50.00	0	7.39	41.21	11.03	-2.97	-13.02	0.512	0.255	0.199	4.19	8.87	13.32
52.00	0	7.47	42.66	11.20	-2.87	-11.93	0.418	0.249	0.173	3.56	8.97	13.21
54.00	0	7.57	44.11	11.37	-2.76	-10.88	0.333	0.243	0.146	2.94	9.09	13.08
56.00	0	7.69	45.55	11.55	-2.63	-9.88	0.256	0.239	0.119	2.32	9.22	12.94
58.00	0	7.83	47.00	11.72	-2.47	-8.94	0.186	0.235	0.093	1.72	9.37	12.77
60.00	0	8.02	48.45	11.89	-2.27	-8.06	0.124	0.232	0.068	1.14	9.57	12.56

Generated Graphs









(707)322-2001;p/n11068; November 25, 2019

Water!Pro TM

Corrosion Control Modeling Program

Step 1 **Enter Characteristics of Water to be Treated**

System Name:	Kong WTP			
Source Point:	Contractor's Lake	**Copy WaterPro**		
Date of Sample:	July 1, 2019			
TDS =	27	mg/L		
pH =	5.80	field pH is recommended		
Total Alkalinity =	5.0	mg/L as $CaCO_3$		
Calcium (total) =	0.3	mg/L Ca^{2+}	0.75	mg/L as $CaCO_3$
Water Temperature =	10.0	^oC (temp. at which pH was analyzed)		
Field Water Temperature =	10.0	^oC (operating temperature at facility)		
Cl^- =	4.2	mg/L	0.0	mg/L as $CaCO_3$
SO_4^{2-} =	0.6	mg/L	0.0	mg/L as $CaCO_3$
Mg^{2+} =	0	mg/L	0.0	mg/L as $CaCO_3$

Step 2 **Chemical Selection & Constraints**

Select Corrosion Control Chemical Soda Ash (Na2CO3)

Enter Constraints:

Upper limit dose to plot:	60.0	mg/L
Upper Bound pH:	8.0	

Step 3 **Enter PO_4^{3-} dose if added with chemical from Step 2**

Orthophosphate as PO_4^{3-}	0.0	mg/L

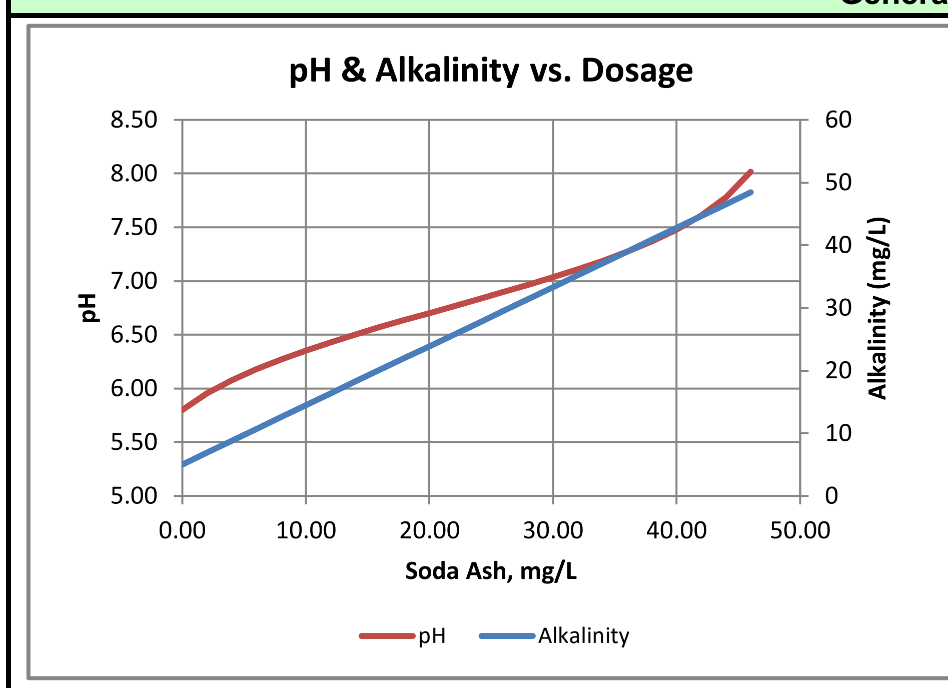
Step 4 **Plot Data**

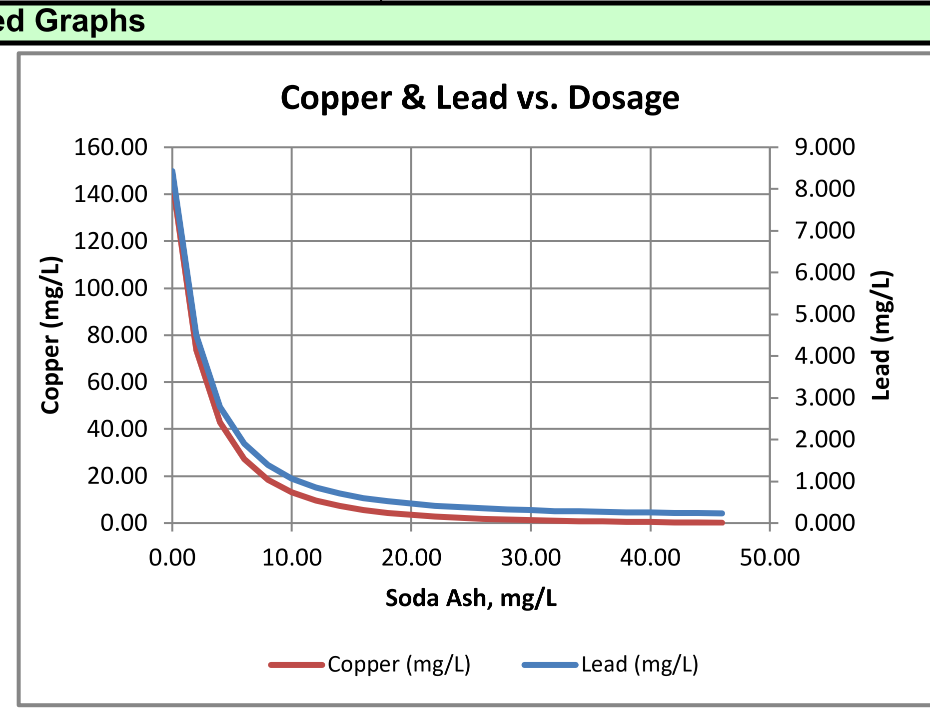
Activate button "***Plot Data***" to plot any new data entered in Steps 1 to 3.

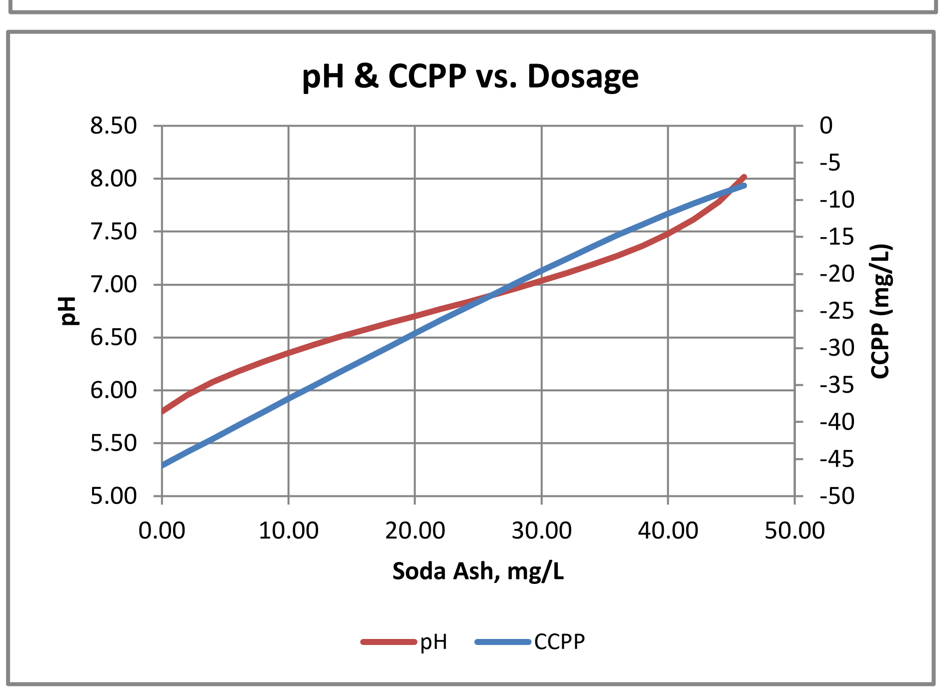
Plotting Points for Graphs

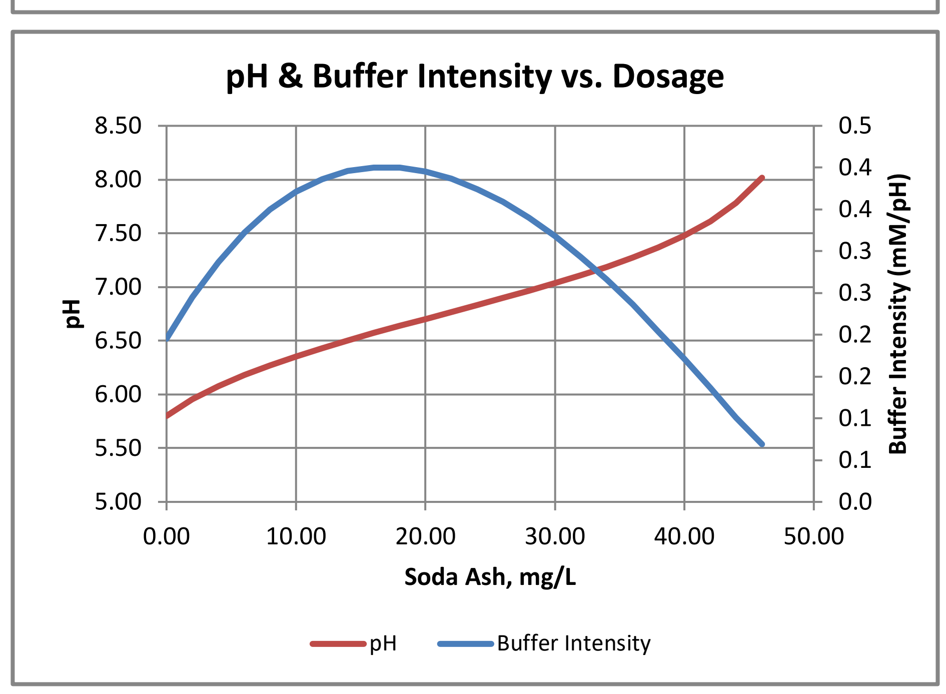
Dose mg/L	Ortho-phosphate mg/L	pH at Field Temp.	Alkalinity as $CaCO_3$ mg/L	DIC mg/L C	Langelier Index LI	CCPP as $CaCO_3$ mg/L	Copper II at 25^oC mg/L	Lead II at 25^oC mg/L	Buffer Intensity mM/pH	CO_2 mg/L	Aggressive Index AI	Ryznar Index RI
0.00	0	5.80	5.00	6.68	-5.46	-45.86	146.000	8.429	0.195	20.00	6.37	16.72
2.00	0	5.95	6.89	6.91	-5.17	-44.06	73.600	4.494	0.245	19.20	6.67	16.29
4.00	0	6.08	8.78	7.13	-4.94	-42.25	42.800	2.786	0.287	18.40	6.89	15.96
6.00	0	6.18	10.67	7.36	-4.76	-40.46	27.300	1.903	0.322	17.60	7.08	15.69
8.00	0	6.27	12.55	7.59	-4.59	-38.66	18.500	1.391	0.350	16.70	7.24	15.46
10.00	0	6.35	14.44	7.81	-4.45	-36.87	13.100	1.071	0.371	15.90	7.39	15.26
12.00	0	6.43	16.33	8.04	-4.32	-35.09	9.630	0.858	0.386	15.10	7.52	15.07
14.00	0	6.50	18.22	8.27	-4.20	-33.31	7.270	0.709	0.396	14.30	7.64	14.91
16.00	0	6.57	20.11	8.49	-4.09	-31.54	5.610	0.603	0.400	13.40	7.75	14.75
18.00	0	6.64	22.00	8.72	-3.99	-29.78	4.400	0.523	0.400	12.60	7.85	14.61
20.00	0	6.70	23.89	8.95	-3.89	-28.03	3.500	0.463	0.395	11.80	7.95	14.47
22.00	0	6.77	25.78	9.17	-3.79	-26.30	2.820	0.416	0.387	10.90	8.05	14.34
24.00	0	6.83	27.66	9.40	-3.69	-24.58	2.290	0.380	0.374	10.10	8.15	14.22
26.00	0	6.90	29.55	9.63	-3.60	-22.87	1.870	0.350	0.359	9.29	8.24	14.10
28.00	0	6.97	31.44	9.85	-3.50	-21.19	1.530	0.326	0.340	8.46	8.33	13.97
30.00	0	7.03	33.33	10.08	-3.41	-19.53	1.260	0.307	0.318	7.63	8.43	13.85
32.00	0	7.11	35.22	10.31	-3.31	-17.91	1.030	0.291	0.293	6.80	8.53	13.73
34.00	0	7.19	37.11	10.53	-3.21	-16.31	0.839	0.277	0.266	5.98	8.63	13.61
36.00	0	7.27	39.00	10.76	-3.10	-14.77	0.675	0.266	0.236	5.15	8.74	13.48
38.00	0	7.37	40.88	10.99	-2.99	-13.27	0.534	0.256	0.204	4.33	8.85	13.34
40.00	0	7.48	42.77	11.21	-2.86	-11.84	0.411	0.248	0.171	3.51	8.98	13.20
42.00	0	7.61	44.66	11.44	-2.71	-10.49	0.303	0.241	0.136	2.70	9.13	13.03
44.00	0	7.78	46.55	11.67	-2.52	-9.23	0.207	0.236	0.101	1.90	9.32	12.82
46.00	0	8.02	48.44	11.89	-2.27	-8.06	0.124	0.232	0.069	1.15	9.57	12.56

Generated Graphs









(707)322-2001;p/n11068; November 25, 2019

Appendix G – Trip Reports

July 2019 - Civil / Mechanical / Electrical

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Bristol
ENGINEERING
SERVICES COMPANY, LLC

111 W. 16th Avenue, Third Floor
Anchorage, AK 99501
(907) 563-0013 • Phone
(907) 563-6713 • Fax

Site Inspection Trip Report
Native Village of Kongiganak, Water Treatment Plant and Washeteria

This trip report summarizes a site visit completed July 23, 2018, to Kongiganak, AK. Findings from this report will be incorporated into a Design Analysis Report (DAR) detailing needed upgrades to the Water Treatment Plant and Washeteria

ITINERARY

REPORT DATE:	Monday Aug 26, 2019
INSPECTION DATE:	Tuesday July 22 – Wednesday July 23, 2019
PROJECT:	Kongiganak WTP / Washeteria, Bristol # 32190078
LOCATION:	Kongiganak, AK
VSW PROJECT LEAD:	Susan Randlett, PE, VSW
PERFORMED BY:	Vanessa Wike, PE; David Beiswenger; PE, John Pepe, PE; Craig Fredeen, PE
OTHERS PRESENT	Joseph Mute, Paul Paul
WEATHER:	Overcast, 55 °

Monday 22 July 2019

05:00 pm Arrive at Anchorage International Airport.
06:45 pm Depart Anchorage for Bethel on AK Air.
08:00 pm Arrive Nome. Overnight at the Long House Hotel (543-4613).

Tuesday 23 July 2019

09:00 am Arrive Ravn Air Terminal
10:15 am Leave Bethel (two separate Ravn flights were needed to transport team)
10:45 am Arrive Kongiganak
05:15 pm Leave Kongiganak Ravn Air
06:00 pm Arrive Bethel, proceed to AK Air Terminal
08:55 pm Leave Bethel AK Air
10:00 pm Arrive Anchorage

SCOPE

Bristol Engineering Services Company, LLC (Bristol) was contracted through the State of Alaska, Village Safe Water Program (VSW) to develop a design for needed upgrades to the Water Treatment Plant (WTP) and Washeteria serving the Native Village of Kongiganak. A site inspection was conducted to evaluate the processes and equipment in the WTP and Washeteria, and provided needed information for the DAR. This inspection (conducted July 23, 2019) follows a June 20-21, 2019 inspection which addressed the structural and geotechnical aspects of the facilities.

TRAVEL

The team arrived in Bethel, overnighted, and proceeded the next morning to the Ravn air terminal. Two flights (one leaving approximately 30 minutes after the first) were needed to transport all team members to Kongiganak. We met Joseph Mute (Native Village of Kongiganak Tribal Chief) and Paul Paul (WTP Operator) onsite. Team members conducted the site inspection and flew out on the afternoon Ravn flight. In Bethel, team members proceeded to the Alaska Air terminal for the flight back to Anchorage.

INSPECTION

The following findings address the water treatment equipment and processes. Information specific to the electrical and mechanical inspections is included in the field trip reports provided by EDC (attached).

System Information

At the time of the site visit the system had completed filling the 1.2 million gallon raw water storage tank from Contractor's Lake within the last week. The filling process took approximately 2 weeks (running 24/7). The system was actively treating water (coagulation, flocculation tank, media filtration, and chlorination. Treated water is stored in 61, 150-gallon, plastic tanks, cumulatively providing approximately 7,500 gallons of storage. The water treatment process is summarized in the attached schematic.

System Operations

The operator (Paul Paul) was new to the system, having started earlier in the summer. He was well organized, took careful operational notes, and was knowledgeable of the system. The Remote Maintenance Worker for the area (Allan Paukan) had trained Mr. Paul on system operations.

The following summarizes observed system operations.

- The water treatment processes are located on the second floor of the WTP. During filter inspection, there appeared to be a deflection in the floor under the pressure filters.
- The pre-filter systems were not in use (the housings showed zero pressure differential).
- The media filters had no air scour system and limited ability to backwash. It is expected that the limited backwash could result in mud balls and rapid media plugging. The media filters have limited head room over the access hatches, which would could make routine maintenance and media inspection/replacement very difficult.
- The post treatment filtration system (presumably for protozoa) was not in use (housings showed zero pressure differential).
- The soda ash pH adjustment system was not in use.

- The chlorination system was operational. Chlorine was injected into a single tank, within a group of tanks on the first floor of the treatment plant. The operator had been taking the residual chlorine measurement in this first tank. This chlorine measurement would not be reflective of the chlorine content in the remainder of the treated water storage. Many treated water storage containers are located in areas that with little to no hydraulic connection to the chlorination point, and likely have no measurable chlorine residual.
- The online turbidimeters were obsolete (Hach 1720C-1720D models), as were the controllers for the units.

The current water treatment system is not providing sufficient disinfection of the filtered water to meet the requirements of the Surface Water Treatment Rule. The current configuration of treated water storage tanks results in ineffective chlorination and areas of water storage that have limited to no flow (and would therefore receive not chlorination). Algae was observed in multiple treated water storage tanks. At the time of the site visit the operator was isolating and cleaning the tanks to remove accumulated biogrowth. Due to the piping, each tank had to be disconnected from the system to complete the cleaning (with chlorine solution) and rinsing.

Unfortunately, there is limited opportunity to improve the existing treatment system due to the limitations of the existing treatment equipment and the structure.

- The coagulation / flocculation process cannot be improved, because it would increase the sediment load on the media filters, which have a limited backwash process (with no air scour).
  - There is no effective way to improve the backwash rate (limited treated water storage).
- The pre-filter system had no bags installed. Pre-treatment bags (NSF 61 approved) could help control sediment in the system.
- The post filter system had no bags installed. Post treatment 1 micron bags (NSF 61 approved) could help remove protozoa. However, there are no DEC approved protozoa filter system that would fit the existing post filter housings. So although tighter bags would improve filtration, the lack of 3rd party verification of the filtration effectiveness would prevent any regulatory approval of protozoa removal for the system.
- Due to the arrangement of the treated water storage tanks, there is no reasonable way to maintain any level of chlorine residual throughout all 61 tanks. A separate treated water storage tank, located outside the WTP, would be needed to meet system disinfection requirements.

The above items will be discussed in detail in the Design Analysis Report (DAR) for the drinking water treatment system.

Water Testing

During the site visit raw water was tested using field equipment, samples were taken for laboratory analysis (see attached results), and approximately 25 gallons of water was collected for jar testing in Anchorage. The jar test results will be provided in the DAR, with a discussion of the coagulation/filtration treatment processes. The DAR will also include a discussion of corrosivity.

The following is a summary of raw water tests results.

Table 1: Raw Water Quality

Arsenic	ND	
Calcium	282	ug/L
Iron	750	ug/L
Manganese	9.96	ug/L
Color, True	70	PCU
pH	5.8	
Total Dissolved Solids	27	mg/L
Total Nitrate/Nitrite	0.185	mg/L
Total Organic Carbon	7.22	mg/L
Dissolved Organic Carbon	5.96	mg/L
Langelier Index	-5.97	
Alkalinity	ND	
Hardness	ND	

SUMMARY / RECOMMENDATIONS

The WTP equipment is outdated and cannot be safely supported by the WTP structure. There is no reasonable way to bring the water treatment system into compliance with the existing equipment, within the existing structure, within a short period of time. However, there are steps that can be taken within a short period of time to minimize health and safety risks for the public.

The following recommendations for immediate improvements are provided in order of priority.

IMMEDIATE REPAIR ITEMS:

1. **Stabilize existing structure:** As detailed in the structural trip report (June 20-21, 2019), and discussed during the July 22, 2019 site visit, the existing water treatment equipment cannot be safely supported by the existing water treatment plant structure. This poses a safety risk to anyone in the WTP building. Structural failure would not only present a dangerous risk to humans in the immediate area, but would also leave the community without drinking water. An estimate has been provided separately that addresses the immediate need for structural reinforcement. The importance of this cannot be over-stated.

2. **Labeling Fixtures:** The potable water from the fixtures does not meet minimum treatment standards and is not safe to drink. The public should be informed of the status of the drinking water in this public facility (EDC Site Inspection Report, page 4). DEC Drinking Water Program can provide more guidance for public notification.

3. **Water Heater:** The water heater needs to be immediately turned down to 120 degrees and have an ASSE 1017 certified tempering valve be located immediately above the water heater. Both actions are recommended (EDC Site Inspection Report, page 5).

4. **Piping / Plumbing Repair:** The existing piping/plumbing in the Washeteria showers is broken and leaking. This broken piping represents a contamination risk to the drinking water system due to breaks, loss of pressure, and potential for cross connection (EDC Site Inspection Report, page 5).

    a. It is recommended that the corroded copper pipe be replaced with PEX piping.
    b. The walls of the showers should be patched to prevent water from going into the walls.
    c. Three new water closets should be installed.

5. **Electrical Outlet Repair:** The original washing machines used 240 volt outlets. Replacement washing machines require 110 volt supply. Extension cords are used to provide power to the washing machines. This presents an electrical risk to the public, as well as a risk to the WTP, in the event of a short circuit or associated fire (EDC Site Inspection Report, page 6).

6. **Treatment Pump Replacement:** The pump that transmits water from the raw water storage tank through the treatment system is not effective at pumping the bottom 6 feet of the tank. A new pump would allow full access to the bottom portion of the tank. Alternatively, if the existing pump is used to connect the treated water to prime the pump, a backflow prevention device could be used to prevent contamination of the treated water (EDC Site Inspection Report, page 4).

Most of these items are could be completed by worker under the supervision of a skilled supervisor (such as a Remote Maintenance Worker). The electric repair would require a licensed electrician. The structural repairs would be completed according to structural engineering plans.

A full listing of electrical/mechanical recommendations is provided in the accompanying field report from EDC. Longer term repair/replacement items will be addressed in the Design Analysis Report.

Appendix H – Technical Design Reports

2019 Structural Condition Report

2020 WTP Vessel Support, Design Considerations

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KONGIGANAK WATER TREATMENT PLANT
VESSEL SUPPORT
RECOMMENDED WORK CONSIDERATIONS
KONGIGANAK, ALASKA

DECEMBER 2019

CONSTRUCTION RECOMMENDATIONS

Prepared by:

Bristol
ENGINEERING SERVICES COMPANY, LLC

Prepared for:

Alaska Department of Environmental Conservation
DIVISION OF WATER

VILLAGE SAFE WATER

CONTENTS

REPORT CONTACTS

Project Management	Bristol Engineering Services Company 111 W. 16th Avenue, Third Floor Anchorage, AK 99501-5109	Vanessa Wike, P.E. Senior Civil Engineer Tel: 907-563-0013 Email: vwike@bristol-companies.com
Structural Engineering	Bristol Engineering Services Company 111 W. 16th Avenue, Third Floor Anchorage, AK 99501-5109	Kraig Hughes, P.E., S.E., P.L.S Senior Structural Engineer Tel: 907-563-0013 Email: khughes@bristol-companies.com

1.0 PURPOSE AND SCOPE

1.1 BACKGROUND

The State of Alaska, Department of Environmental Conservation (ADEC), Division of Water, through the Village Safe Water (VSW) Program, has requested that Bristol Engineering Services Company, LLC (Bristol) provide construction recommendations for implementing the temporary structural enhancements for the existing Kongiganak Water Treatment Plant (WTP). The enhancements were recommended after a structural inspection performed by Bristol on June 20th and June 21st of 2019.

1.2 SAFETY DISCLAMER

This report is presented to the client to allow their Contractor to plan and implement their construction efforts in a safe and efficient manner. Bristol is not responsible for the safety of the Contractor's personnel in any manner. Construction activities under heavy loads can be inherently dangerous and the Contractor should plan all construction and inspection activities accordingly. The Contractor is responsible for their work plan, including all safety of their personnel. The recommendations included in this report and on the plans are meant only to assist the Contractor in planning their construction activities.

2.0 RECOMMENDATIONS

2.1 Suggested Construction Steps

The following list is offered only as suggestions. The Contractor may find field conditions which warrant changes in order of priority or methods used. See Section 1.2 for the safety disclaimer in planning the work.

1) Provide adequate notice of impending work to the Village residents to allow them to store adequate water during the water supply outage. Provide them with a date and time when water will be turned off and for how long it will be unavailable. We suggest that at least one week of advanced notice be provided with flyers delivered to every home in the village and posted in the school, churches, washeteria and both stores.

2) Clean up all debris under the building in the area of construction. Remove all snow and ice in the construction area. If possible, try to level out the ground as best as possible.

3) Clean up all debris on the first floor of the WTP in the area of construction.

4) Construct the pea gravel retaining bins, cut the cribbing timbers, cut the insulation and make sure the pea gravel is dry and thawed.

5) Get everything ready and in location near where construction activities will take place. Leave pea gravel inside in a warm dry location until ready to place.

6) Shut water off at the indicated date and time provided in the notice and drain the vessels on the second floor to reduce their weight.

7) Perform all construction activities, starting under the building first.

8) Place the pea gravel retaining bins on the ground, under the building, at the correct locations in line with existing and new frame bent, outside columns on first floor. The centerline of the bins should be in line with the center of the outside columns on the frame bents on the first floor. Only one bent currently exists and the other bent will be constructed offset from the existing bent by 20 inches to the south (to be confirmed in the field).

9) Place dry, thawed pea gravel in the bins to provide for an even and level surface from which to start the construction of the cribbing. Make sure there are no voids and that the gravel is compacted and level.

10) Place the 4" deep 60 psi insulation on top of the gravel.

11) Place the first layer of cribbing, within the bins, fully across the bottom (four pieces in plank position) with even gaps between the timbers.

12) Start the second level of cribbing (two pieces) and so on until the desired height is reached. Use four planks at the top level (continuous across the top). Adequate fastening shall be provided at

all intersections and junctions of wood structural members to ensure a well-integrated structure capable of withstanding the load imposed.

13) Construct the second crib in similar manner. Ensure that they are relatively at the same elevation and remain level.

14) Once both cribs are fully constructed and secured in place, install the four beams between the top of the two cribs. These beams are to be installed in with major axis in bending (long axis up and down).

15) Ensure that the beams are held firmly to the bottom of the building. The top of each beam should be snug to the bottom of the bottom floor sheathing throughout the length of each beam. The beams should be fully shimmed at each crib to provide this condition. Shimming should be continuous across the beam along the full support of each crib.

16) Provide a continuous 2x12 blocking (rim joist) at the end of each crib across the four perpendicular beams. Also, provide 2x12 blocking between each beam at the inside edge of each crib. Also provide 2x12 blocking evenly spaced between the beams at a maximum spacing of 4'-0" between span between the cribs.

17) Once the under-building support has been fully constructed, start construction on the first floor.

18) Start by installing a supplemental vertical column post adjacent to the existing post on the east side of the existing frame bent. The column connection to the beam and pad should be similar to the existing condition.

19) Place an additional column support at the center of the existing beam, half way between the far right and far left existing columns. Use a similar pad and similar connection details as the existing columns. The pad should be 32" in length.

20) Remove the newly constructed frame bent.

21) Install additional joists between the existing joists as shown on the plans. Block under the joists at the beam and end supports. Ensure that adequate end bearing is achieved (2.5" minimum). If sufficient room is not available, the joists can be cut so that they meet at one or the other frame bent (existing or one to be newly constructed).

22) Install the new frame bent 20" on center from the existing frame bent. This frame bent should be similar with three columns, three pads, similar connections and a beam at the top with diagonal bracing similar to the existing bent.

23) Upon completion of construction, turn the water back on and refill the vessels.

24) Inspection of the area, including the under-building supports, should take place monthly and shims should be provided for any gaps. If heaving is witnessed, then notify the engineer immediately. Any large movement or noticeable new gaps or cracks in the wooden members should be recorded and reported to the engineer immediately.

Appendix A – PHOTO LOG

Photo Log

From

June 20-21, 2019

Site Visit

Kongiganak, Alaska

Photo 1 – East side existing support frame bent on first floor

Photo 2 – Typical pile support bracket and pile under WTP

Photo 3 – Under WTP. Note Debris.

Photo 4 – Existing frame bent on first floor

Photo 5 – East column on existing frame bent on first floor

Photo 6 – Large vessels on second floor above the frame bent below

Photo 7 – Existing frame bent showing top connection and diagonal supports

Photo 8 – Support Column, east side of support bent on first floor. Note cracking

Photo 9 – Top end of east support column on existing support bent – first floor.

Photo 10 – Bottom of column on east side of existing support bent on first floor.

Photo 11 – Joist framing above support frame for second floor. Note sistering of existing joists.

Photo 12 – Second floor joists above support bent. Note longitudinal crack at top of utility cutout. Also, not sister joist.

Photo 13 – Sister joists on south end from photo 12. Not minimal bearing distance and longitudinal crack.

Photo 14, Frame for Vessels – west end.

Photo 15, Frame Beam and Second Floor, Floor Joists.

Photo 16 – Cribbing, similar to support idea in area under vessels.

Photo 17 – Rick Mitchells under WTP taking temperature readings. Note debris.

END OF PHOTOS

KONGIGANAK WATER TREATMENT PLANT & WASHETERIA

KONGIGANAK, ALASKA

JUNE 2019

Structural Condition Report

Prepared by: **Prepared for:**

VILLAGE SAFE WATER

CONTENTS

REPORT CONTACTS

Project Management	Bristol Engineering Services Company 111 W. 16th Avenue, Third Floor Anchorage, AK 99501-5109	Vanessa Wike, P.E. Senior Civil Engineer Tel: 907-563-0013 Email: Vwike@bristol-companies.com
Structural Engineering	Bristol Engineering Services Company 111 W. 16th Avenue, Third Floor Anchorage, AK 99501-5109	Kraig Hughes, P.E., S.E., P.L.S Senior Structural Engineer Tel: 907-563-0013 Email: khughes@bristol-companies.com
Geotechnical Engineering	Golder Associates, Inc. 2121 Abbott Road, Suite 100 Anchorage, AK 99507	Richard Mitchells, P.E. Principal, Senior Geotechnical Engineer Tel: 907-344-6001 Email: rmitchells@golder.com

1.0 PURPOSE AND SCOPE

1.1 BACKGROUND

The State of Alaska, Department of Environmental Conservation (ADEC), Division of Water through the of Village Safe Water (VSW) program has requested that Bristol Engineering Services Company, LLC (Bristol) to perform a field inspection and evaluation of the existing Kongiganak Water Treatment Plant (WTP), Washeteria building and piling from the former water storage tank location. This was accomplished on June 20th and June 21st of 2019.

1.2 SCOPE

The scope of the work is to investigate the existing building conditions for both the Water Treatment Plant and the Washeteria and the piling conditions at the former water storage tank location. The scope requires determination of load capacity of the existing structure and evaluation as to ability to have additional loading applied in the WTP. There are currently three vertically standing water filtration vessels on the second floor of the WTP and additional water vessels filters are going to be needed. One likely spot for their placement would be the second floor. This inspection was conducted to ascertain the ability of the existing structure to sustain these additional loadings.

Secondly, there is reported vibration failure associated with the use of the washers/dryers in the washeteria. These appliances are located on the bottom floor of this building. This report investigated the as-built conditions of the washeteria and the existing vibration condition.

Finally, the existing wood piling that remain where the former water storage tank existed in the near vicinity of the WTP were to be inspected for possible reuse to support a future structure.

2.0 INSPECTION SUMMARY AND REPORT

2.1 Location

Kongiganak is an unincorporated traditional Yup'ik Eskimo village located approximately 2.5 miles inland to the north from the seacoast Kuskokwim Bay, approximately five miles southwest of the Kuskokwim River and approximately 70 miles southwest of Bethel. Kongiganak is also located within the Yukon Delta National Wildlife Refuge. The community was established on a shallow permafrost bluff along the Kongnignanohk River (Preliminary Engineering Report, Page 1).

The Water Treatment Plant building and the Washeteria Building sites are located in Kogniganak at approximately 59° 57' 34" North Latitude and 162° 53' 21" West Longitude (WGS 84, Google Earth), within the United States Geological Survey Quad Map Kuskokwim Bay, D-3 and more specifically within Township 2 South, Range 79 West, Section 32, Seward Meridian. The buildings are located adjacent to each other on the southeast side of the village, west of the airport.

2.2 Pertinent Codes:

ASCE 7-10	Minimum Design Loads for Buildings and Other Structures
2012 IBC	International Building Code
NCS 2005	National Design Specification for Wood Construction

2.3 Code Evaluation:

From a structural evaluation standpoint, The ASCE 7-10 (Minimum Design Loads for Buildings and Other Structures) indicates the following risk category and load parameters for these buildings:

Risk Category: III Buildings and other structures, the failure of which could pose a substantial risk to human life. Table 1.5-1. Importance Factors listed below are from Table 1.5-2.

Snow Importance:	Is = 1.10
Ice Importance:	Ii = 1.25
Ice Importance-Wind:	Iw = 1.00
Seismic Importance:	Ie = 1.25, Seismic design parameters are provided in Appendix G.

Live Load:	LL = 100 psf No specific category listed in Table 4.1 or IBC Table 1607.1
Dead Load:	DL = Actual (Operational loads for vessels) + Minimal collateral loads
Snow Load:	SL (Pg) = 40 psf (based on Table 7-1, using Bethel's load designation)
Wind Velocity:	160 MPH 3-second gust. ASCE 7-10 Figure 26.5-1B

Calculations are provided in Appendix F – Estimated Existing and Proposed Loads on the Buildings.

2.3 Topography

The site topography is generally flat with slight rolling hills and a gentle slope toward the river that wraps around the town on the south, west and north side of the Village as shown in Figure 1, below:

Figure 1: Village of Kongiganak

3.0 STRUCTURAL

3.1 Introduction

A site investigation was performed on June 20th and June 21, 2019. Bristol's Senior Structural Engineer, Kraig Hughes, PE, SE, PLS, flew to Kongiganak, Alaska in the morning of June 20th via Rav'n Alaska Airways through Bethel. Departure time in Anchorage was approximately 9:30 AM and arrival time in Kongiganak was approximately 2:20 PM. Kraig was accompanied by Richard Mitchells, PE, Senior Geotechnical Engineer, with Golder Associates, Inc. Kongiganak is a village of about 500 people on the Kuskokwim Bay, southwest of the mouth of the Kuskokwim River in Southwest Alaska.

The purpose of the inspection was to evaluate the condition of the existing water treatment plant (WTP), washeteria building and piling on the former water tank location. There are four specific areas of concern:

1) Capacity of the existing floor framing on first and second floor and evaluation of load path to pile foundations.
2) Piling capacity at the Washeteria and WTP.
3) Vibrational failure associated with use of the washers and dryers in the Washeteria.
4) Potential use of the pilings for support of a new structure at the old water storage tank (WST) location.

4.0 WTP EXISTING CONDITIONS

The WTP was constructed in 1978. This building is founded on wood piling installed in permafrost conditions. Reference the technical memorandum from Golder Associates, Inc and dated July 02, 2019 found in Appendix B.

4.1 WTP First Floor Framing

The WTP building is founded on 20 each wood piling as described in the Golder Report. The first floor is founded on top of these piling approximately 4'-0" above the ground surface (varies). The building was built in four 12' 0" long (nominally south to north) sections running approximately 50 feet wide from east to west. There are overhangs on each end and a 14' X 20' – 6" garage on the north side. The exterior building dimensions are approximately 50.15 feet in the nominal east-west direction and 52.29 feet in the north-south direction. The floor joists on the first floor were not visually confirmed, but the total floor thickness was determined to be 8 ¼" deep from top of sheathing on top to bottom of bottom sheathing. The bottom sheathing is ¼" plywood with the top sheathing being 3/4" T&G plywood. It is assumed that the joists are 2 ½"x 7" treated lumber (3" X 8" nominal) at 24" on center. This is based on like joists being used on the second floor, the available depth in the floor cavity and screw patterns in the floor sheathing. This should be confirmed, especially in heavy loaded locations. The joists span between steel channels (C12x25 or C12x20.7) that span between the pilings in the east-west direction. A framing layout is shown in Figure 1. Larger version found in Appendix C.

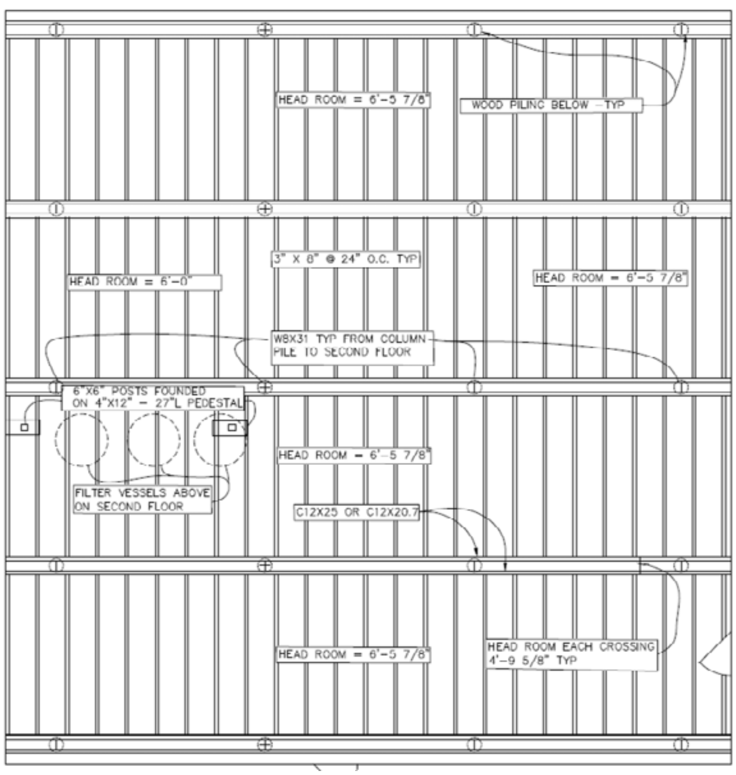


Figure 1. WTP First Floor - Framing plan.

The first floor was heavily loaded with multiple 165 gallon storage tanks, see Figure 2.

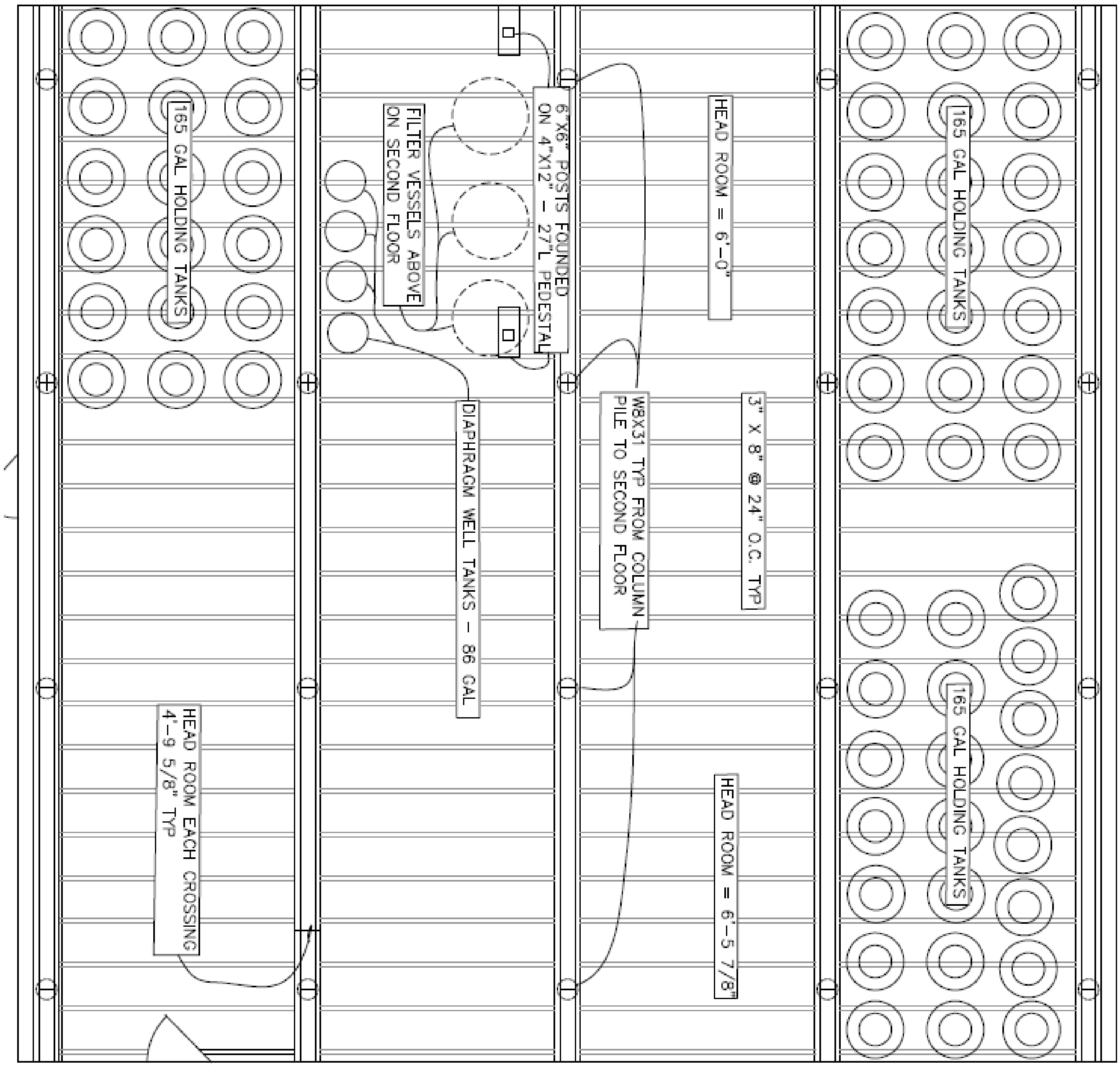


Figure 2. WTP First Floor - Loading.

As is clearly shown, there is excessive loading on the first floor. Each 165 gallon tank can weigh as much as 1,375 pounds. They are reported to never exceed 150 gallons, but that is still 1,250 pounds per tank. The Well-X-Trol WX-252 diaphragm well tanks weigh in the neighborhood of 830 pounds each, see the specification sheet in Appendix E. The vertical vessel tanks on the second floor are estimated to have an operational weight in the neighborhood of 7,500 pounds each when in operation. Their weight is transferred to the first floor through a wooden frame erected directly underneath the tanks and through the walls from the floor joist load path. Considering the support frame underneath the tanks, there are two nominal 6"x6" (5 ½" x 5 ½" actual) treated wood columns (5'-3" high) supporting a 4"x12" (3 ¼" x 11 ¾") treated wood beam that spans at the top of the columns. The columns are supported at the first floor level on 27" long 4"x12" treated wood footings above the 1" tongue and groove plywood sheathing and wood joists of unknown layout. The span on that beam is approximately 13' 5 ½" inside the column edges. The frame is diagonally braced with 2"x4"s.

4.2 First Floor Structural Analysis

The ENERCALC Structural calculations for the first floor wooden joists indicate excessive bending moment, shear and deflection for these joists in bays holding the 165 gallon holding tanks. This assumes the joists are 3"x8" at 24" on center. At the time of the inspection, the water in these tanks had all been depleted and was only partially filled by the time of departure, less than 30 gallons each. When the tanks are in a normal operating condition, it is assumed that excessive deflection would be very apparent. The floor condition in these bays must have been modified from the 24" on center spacing, otherwise failure would have been imminent a long time ago. However, even with 12" on center spacing, they still don't have adequate capacity. If there was failure of this floor, in the bays where the 165 gallon tanks are stored, the failure would likely not be catastrophic for the structure but could cause human harm if anybody was underneath or on the tanks. Depending on time of year, this type of failure could be very inconvenient for the community and would be very harmful under most conditions. For example, having people under the building could be a potentially hazardous situation and immediate cautions should be implemented to eliminated or reduce personnel from working under the building.

Analysis of the steel C channel at each end of the joists indicate adequate sizing and capacity for holding these floor loads.

4.3 Analysis of the bay holding the large vessel loads from the second floor

Assuming the operational total vessels weight is approximately 7,500 pounds each (calculations in Appendix D) and assuming the layout shown on the drawing is accurate, the beam on the support frame is severely overloaded - see photo 22 – 27 & 29. Additionally, the floor joists in this bay, supporting the columns for this frame, are also severely overloaded if they are 3"x8" joists at 24" on center, or even 12" on center. Furthermore, the stress on these components are so much overloaded, that an engineering solution for intermittent support, from the ground, should be strongly considered for immediate implementation. Temporary cribbing could be built up from the ground to the bottom of the floor joists in this vicinity, then the first floor system could be more carefully investigated. It is strongly suggested that the vessels on the second floor be emptied prior to supporting and investigating this area further. An engineered solution should be developed in the near future to perform a careful determination of the floor structural system. Failure of the second floor or first floor in this area could be catastrophic and potentially harmful or fatal to any personnel in the vicinity. Furthermore, it would take the WTP out of service for a significant amount of time and cause significant hardship to the community. The bay directly under the second floor vessels, on the first floor should be warned off to occupancy until a solution can be designed and implemented.

4.4 Second floor framing analysis

The floor joists for the second floor are readily visible from the first floor and vary from bay to bay. Most bays have 2"x12" wood joists spaced at 12" on center and supported on each end by multi-ply timber trusses and or wooden beams at the walkway that are supported by the steel columns directly above each foundation pile. The top floor is sheathed with three layers of plywood consisting of a top 1/2 " layer, then ¾" layer and a bottom layer of ½" plywood.

The area of immediate concern is under the area supporting the three vessels on the second floor. This area is denoted as "bay 2" of the building. The layout of the second floor joists in this vicinity are not consistent, several joists are split and sistered for added support. Again, the second floor framing is inadequate to safely carry the operating load of the vessels above in this bay. Additional framing support under the tanks, leading to ground, should be added immediately. Figure 3 shows the existing condition for framing of west side of Bay 2. Additionally, the tank's support leg pads should all be supported on a channel similar to the center vessel. These tanks should also be adequately anchorage to resist seismic loading considerations. Design for this anchoring is outside of the scope for this report.

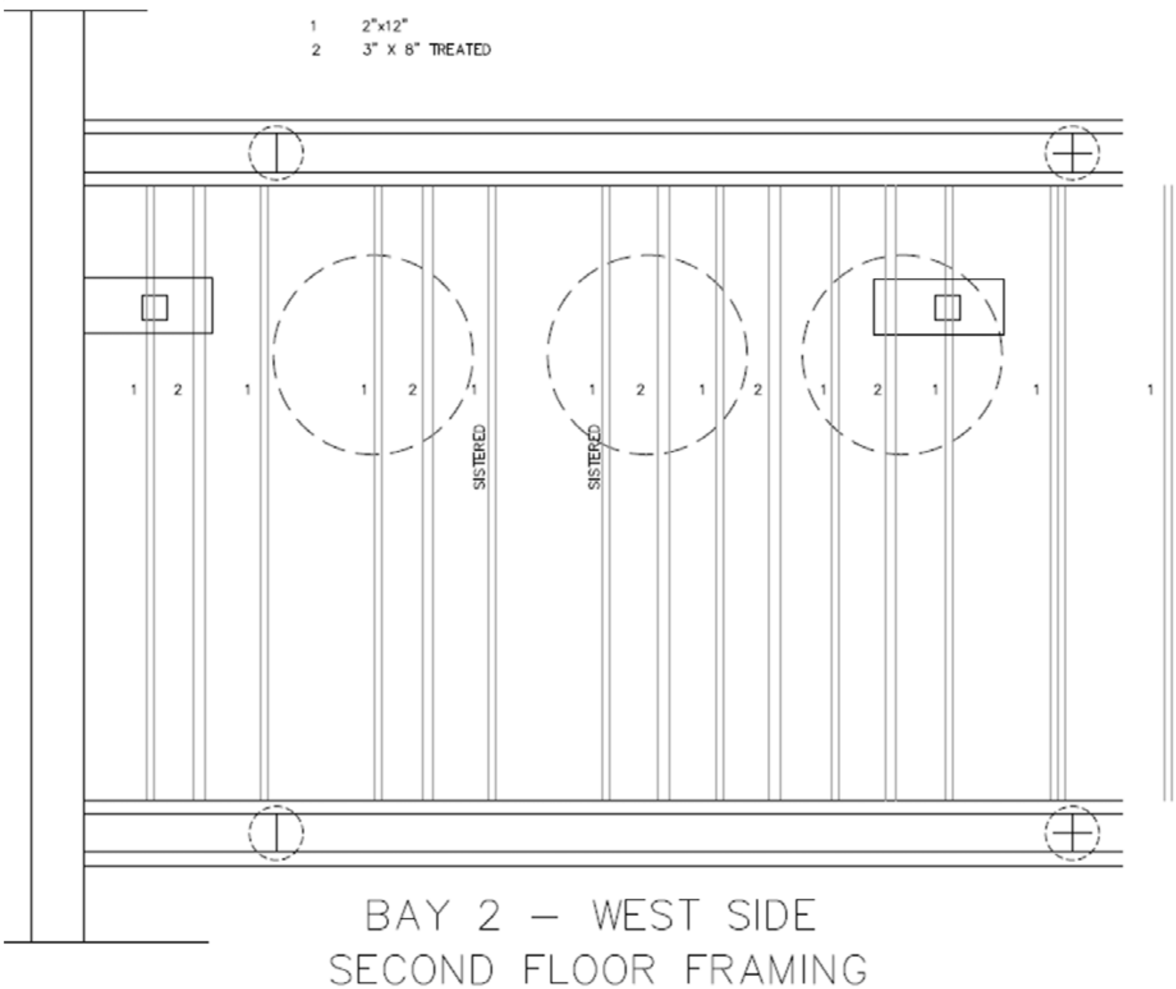


Figure 3. Second Floor Framing Plan West Side of Bay 2

4.5 WTP Pile Loading Review:

There are twenty piles supporting the WTP Building. These piles are shown in figure 4, below.

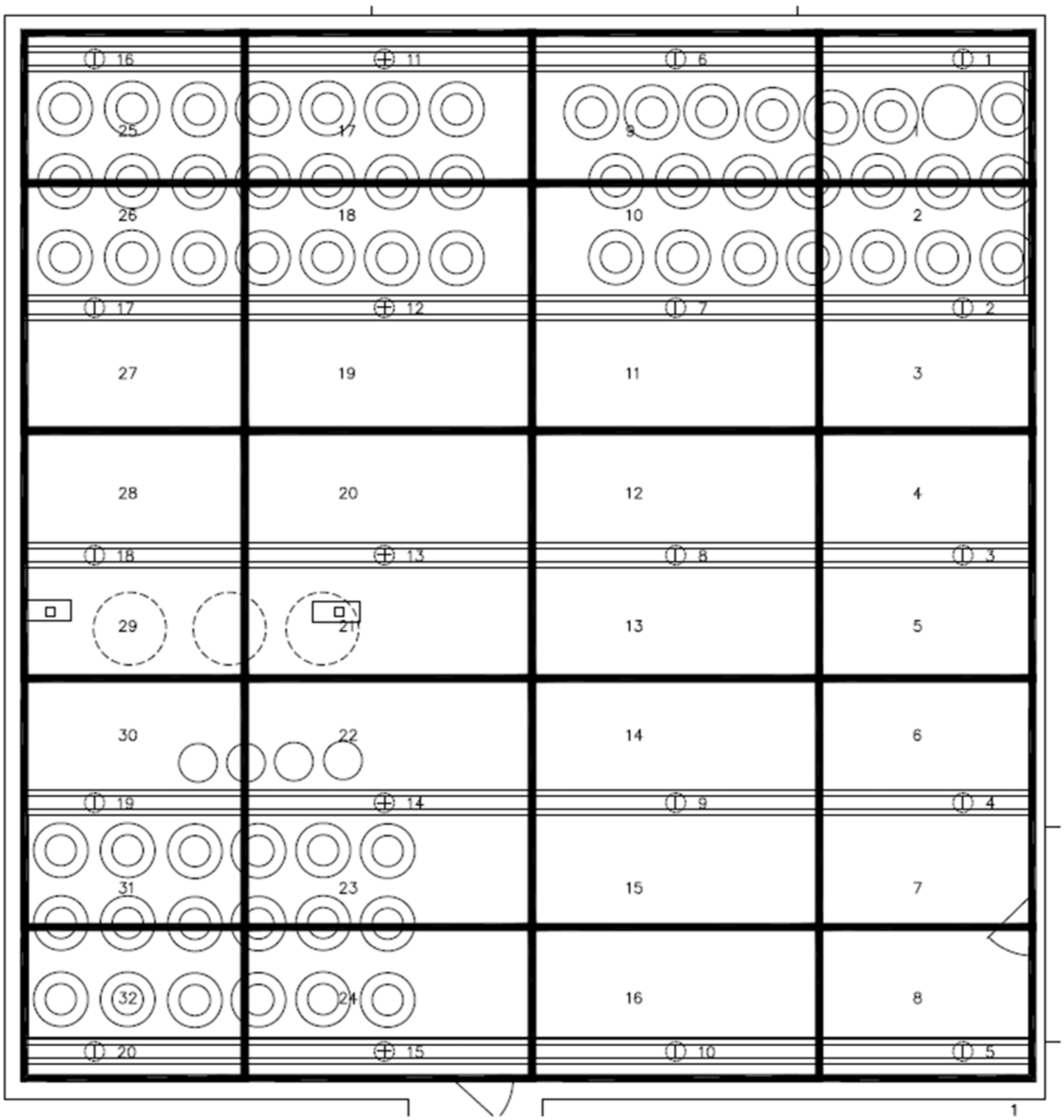


Figure 4. WTP Tributary Areas and Piling Numbers

Using ASCE 7-10 Axial Loading requirements listed above, loads for each pile were determined using the tributary area assigned to each pile. Table 1, shown below, illustrates the area for each pile, the sections that make up that area, the calculated maximum load using IBC load combinations for dead load, live load, and snow load. Lateral loads were not considered in this calculation.

Kongiganak					
Pile	Sections		Area		Pile Load
			SF		Pounds
1	1		74.50		16,763
2	2-3		122.67		27,600
3	4-5		122.67		27,600
4	6-7		123.31		27,745
5	8		74.93		16,859
6	9		100.37		22,583
7	10-11		165.26		37,183
8	12-13		165.26		37,183
9	14-15		166.13		37,378
10	16		100.94		22,713
11	17		100.37		22,583
12	18-19		165.26		37,183
13	20-21		165.26		37,183
14	22-23		166.13		37,378
15	24		100.94		22,713
16	25		76.99		17,323
17	26-27		126.77		28,523
18	28-29		126.77		28,523
19	30-31		127.44		28,673
20	32		77.44		17,423

Table 1. Axial Compressive Loads on WTP Piling

Many of these loads exceed the current estimated <u>ultimate</u> axial compression capacity cited in the geotechnical report as "…. in the range of 25 kips per pile." Ultimate axial compression capacity is the theoretical maximum load that can be supported without failure. Allowable compression capacity is the ultimate capacity divided by a safety factor, as high as 3.0 for piling in this case as shown in figure 5.

Method of Determining Capacity	Loading Condition	Minimum Factor of Safety Compression	Minimum Factor of Safety Tension
Theoretical or empirical prediction to be verified by pile load test	Usual	2.0	2.0
	Unusual	1.5	1.5
	Extreme	1.15	1.15
Theoretical or empirical prediction to be verified by pile driving analyzer as described in Paragraph 5-4a	Usual	2.5	3.0
	Unusual	1.9	2.25
	Extreme	1.4	1.7
Theoretical or empirical prediction not verified by load test	Usual	3.0	3.0
	Unusual	2.25	2.25
	Extreme	1.7	1.7

Figure 5. Piling Safety Factors (Design of Pile Foundations, Gilbert Gedeon, P.E., Course No. G10-001, CED engineering.com, page 4-2)

Failure in this case is likely not catastrophic, but more like differential settlement. There are no signs of differential settlement at this time. Golder indicates that the ultimate axial capacity is that it is based, in part, on a 1-inch creep related settlement over the next 20 years. This also includes an estimate of reasonably anticipated forecast climate impacts to the permafrost over the next 20 years and no additional ground thermal stabilization measures.

5.0 STAIRCASE AND LANDING – SECOND FLOOR WEST ENTRANCE

During the inspection of the WTP facility, it was noted that the staircase and landing on the west side of the building at the second floor had insufficient vertical support. It is recommended that two helical anchors be placed at the outside landing area in line with the vertical posts and support this landing from the ground. The following photo illustrates the existing condition.

Photo of WTP Second Floor West Entrance.

6.0 WASHETERIA VIBRATIONAL FAILURE CONDITION

The village laundry facility was not in operation and water was not available on the first day of the inspection. This was due to the water level in the water storage tank reaching a level that prohibited the pumps from replenishing the water system. This level is reported to be 5 feet of water in the water storage tank. The water was only reestablished in the late that evening. Regardless, Mr. Joseph Mute, Native Village of Kongiganak Tribal Chief, provided background information. Apparently the Laundry Facility had large washers in the past and these washers did produce a large vibrational impact on the building when improperly loaded. However, these washers have all broken down and are no longer in use. Only smaller washers are in use in this facility and this has greatly decreased vibrations. Laundry operations were being performed on the day of our departure and no vibration was felt. See photo 38 & 39 for the laundry area. This issue appears to be moot.

7.0 PILING FOR FORMER WATER STORAGE TANK

The exposed wooden piling that were used from the previous water storage tank were inspected for possible use as support for a new structure. The piling were inspected and appear to be in acceptable condition. There are 88 each piling spaced approximately 5'-6" apart in a matrix that has an approximate circular diameter of 50 feet.

Photo of wooden piling for previous water storage tank.

We concur with the geotechnical report that indicates "the exposed portions of the timber piles at this location appeared to be in decent condition with no significant rot or damage. The exposed tops of the timber piles have experienced weathering and their structural integrity will need to be confirmed."

8.0 REPORT LIMITATIONS AND EXCLUSIONS

The site inspections included only visible areas of the exterior and interior of the buildings. Destructive testing was not conducted during the site inspections. Unseen deficiencies may exist in the walls or in the substructure.

No inspection or condition report can entirely eliminate the uncertainty regarding the presence of physical deficiencies. This report is to be used as a guide completed as art of the due diligence process, and is intended to reduce the potential for unanticipated system failures and/or unexpected costs.

Not include in the scope of work was the implementation of corrective actions. Before any corrective action is made appropriate design, engineering, and permitting documents must be prepared.

9. APPENDICES

Appendix A – PHOTO LOG

Photo Log

June 20-21, 2019

Site Visit

Kongiganak, Alaska

Photo 1 – East side of Washeteria & WTP w/ Previous WST Piling in Forground

Photo 2 – Typical WTP Piling Bracket

Photo 3 – Under WTP. Not Debris

Photo 4 – C Channel at each end of floor joists, first floor WTP

Photo 5 – Typical Header Beam at Walkway and truss layout. First floor WTP

Photo 6 – Header at walkway, first floor WTP. Also showing staircase to second floor

Photo 7 - First Floor WTP, Bay 3. Showing typical truss layout for support of second floor joists.

Photo 8 – Support Column, First Floor. Columns extend vertically at each pile to second floor

Photo 9 – Typical wall truss support for second floor at column.

Photo 10 – Typical Wall Truss at each bay. Trusses run east-west. Also note floor joists for second floor.

Photo 11 – Typical connection detail at truss column connection.

Photo 12 – Typical header beam and truss connecting to column.

Photo 13 – Typical truss connection at column

Photo 14 – Pressure Vessels on First Floor, Bay 2

Photo 15 – Typical Tank Loading in Bay 1 (West side only, Bay 4 both sides).

Photo 16 – 165 Gallon Tank Loading, WTP First Floor

Photo 17 – Typical 165 Gallon Tank Layout

Photo 18 – Typical 165 Gallon Tank Layout, First Floor WTP

Photo 19 – Three Filter Vessels on Second Floor.

Photo 20 – Vertical Supports for Vessels on 2nd floor. Channel is under legs on middle vessel only.

Photo 21 – Vertical Supports for Vessels on 2nd floor. Channel is under legs on middle vessel only.

Photo 22 – Framing under vessels. First Floor, Bay 2, North side.

Photo 23 – Cracks in east column on frame for vessel supports.

Photo 24, Frame for Vessels – west end.

Photo 25, Frame Beam and Second Floor, Floor Joists.

Photo 25 – longitudinal crack on second floor, floor joists – directly under vessels.

Photo 26, Sistered joists in vicinity of vessels above. Note lack of bearing distance.

 Photo 27 – Frame under Vesssels. First Floor, Bay 2, North End.	 Photo 28 – Typical 2" x 12" Framing. Bay 1, 3, 4. Not Bay 2.
 Photo 29 – Frame Column showing cracks	 Photo 30 – Typcial hearder connection to column at walkways.

 Photo 31 – Typical Sheathing on Second Floor	 Photo 32- Raised Ceiling at Vessels on Second Floor. Head Room = 10'-1", Typical Second Floor Head Room = 7'-11"
 Photo 33 – Roof Trusses over raised ceiling area. Note trusses – 2x6 top and bottom chords. Tursses Spliced – 3 piece trusses.	 Photo 34 - – Roof Trusses over raised ceiling area. Note Blocking and craming.

Photo 35 - Roof Trusses over raised ceiling area. Note Blocking and craming.

Photo 36 – Rick Mitchells under WTP taking temperature readings. Note debris.

Photo 37 – Cribbing, similar to support idea in area under vessels.

Photo 38 – Washeteria - washers

 Photo 39 – Washeteria – Dryers.	 Photo 40 – Previous Water Storage Tank, 88 piles.
 Photo 41 – Piling	 Photo 42 - Piling

Photo 43 – Under Washeteria. Note bent angles

Photo 44 - Under Washeteria. Note bent angles

Photo 45 - Under Washeteria. Note broken angle

Photo 46 – Rick Mitchells

 Photo 47 – Multiple ply trusses at each wall section on first floor.	 Photo 48 - Multiple ply trusses at each wall section on first floor.
 Photo 49 – West side of WTP, Washeteria, WST Piling and new Waster Storage Tank	 Photo 50 – Departing flight on 6/21/19.

END OF PHOTOS

Appendix B – Geotechnical Report

TECHNICAL MEMORANDUM

DATE 02 July 2019 19126567

TO Vanessa Wike, PE, Bristol Engineering Services Company

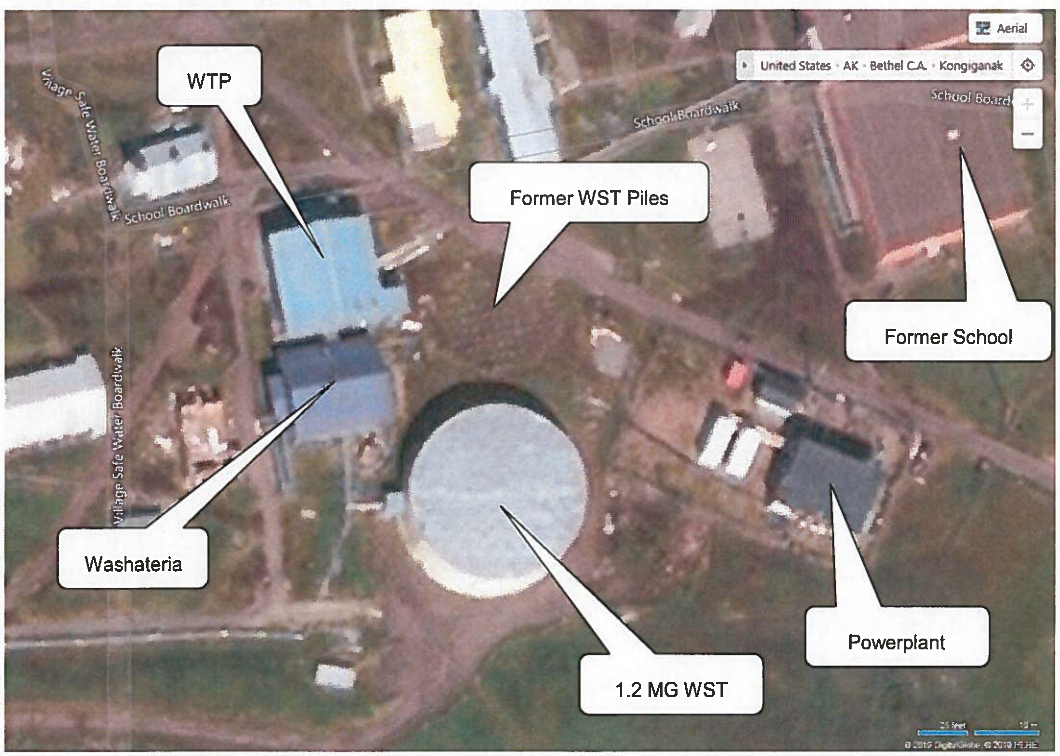
CC Kraig Hughes, SE, PE

FROM Richard Mitchells, PE RAM **EMAIL** rmitchells@golder.com

KONGIGANAK WTP GEOTECHNICAL RECONNAISSANCE FINDINGS

Richard Mitchells and Kraig Hughes travelled to Kongiganak, Alaska June 20-21, 2019 to conduct a brief structural and geotechnical reconnaissance of the existing Water Treatment Plant (WTP) building and adjacent Washateria/Laundromat. The purpose of the reconnaissance was to ascertain the current structural and foundation condition of the facility in light of proposed improvements that may induce additional design loads on the structure. During the WTP reconnaissance, we also conducted visual assessments of the foundations for the adjacent 1.2-MG at-grade Water Storage Tank (WST) and the existing timber piles that supported the now demolished nominal 0.5 MG-WST.

The general locations of the key structures are noted in the following Bing image.



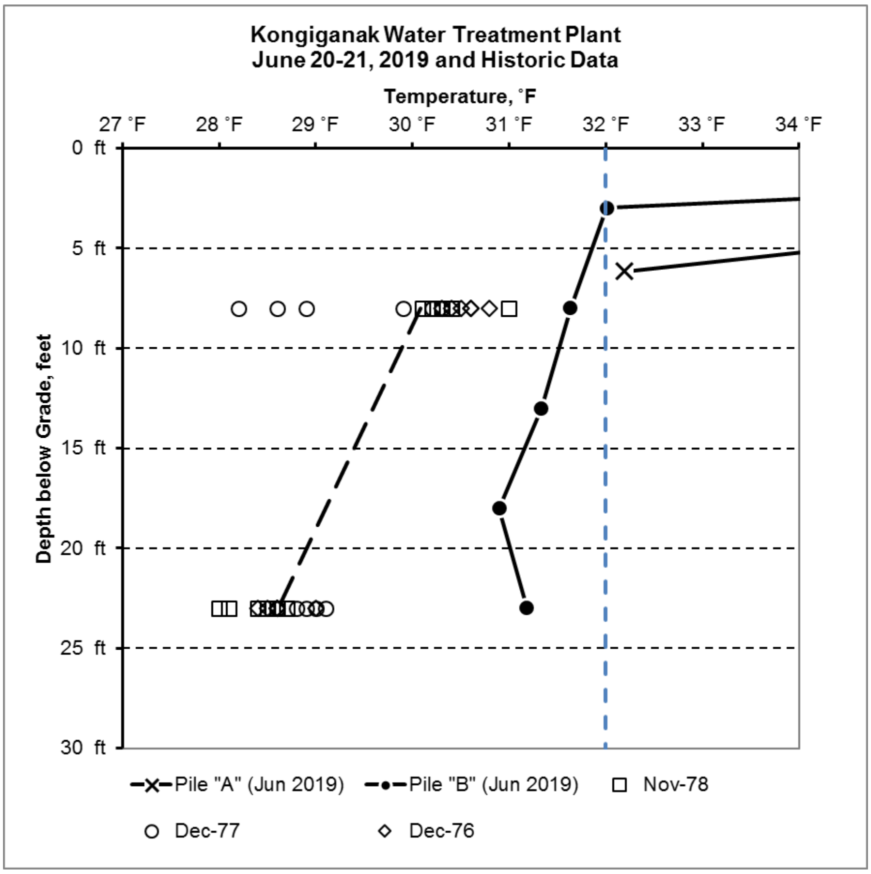
Existing WTP

The existing WTP was constructed in 1978 as a water or wastewater treatment facility. The facility is founded on 20 round timber piles installed using drill and slurry methods. The foundations piles appeared to be treated, at least on their exposed surfaces. The foundation piles are inferred to be adfreeze-type piles. We have assumed the original pile foundation design did not include significant end bearing contribution. Rigid insulation was not observed in the soil underlying the WTP footprint and none was reported with the reviewed as-built data. A summary as-built record of the WTP timber piles is attached for reference.

While there is a considerable amount of building debris under the structure, the exposed portions of the WTP timber piles appeared to be in decent condition with no obvious signs of rot or deterioration. An elevation survey of the pile caps was not conducted during the June 2019 reconnaissance, but no visual indications of excessive pile settlement or heave were noted.

During original installation, a 2-inch diameter ABS standpipe was installed in the borehole annular space adjacent to each timber pile. All but one of these ABS standpipes were either damaged or infilled with material or ice at the time of our June field effort. Ground temperatures were measured in the one accessible ABS standpipe. The location of temperature measured pile is noted on the attached sketch.

Ground temperatures from June 2019 and historic ground temperature data provided with the as-built records are summarized in the following plot. As noted, ground temperatures have warmed significantly since original installation, as expected for this area.



We used the as-built ground temperature data from the late 1970s to derive an estimated ultimate axial capacity at the time of initial installation. The estimated ultimate axial capacity is predicated on a timber pile installed with drill and slurry methods using a non-cohesive mineral soil and potable water slurry and a creep-related settlement of 1-inch over 20 years (approximately year 2000 service life). We also assumed negligible pore water salinity impacts along the piles. We also derived a current estimated ultimate axial capacity for similar conditions based on the June 2019 ground temperature data, ignoring any potential end bearing contribution. For a 22 to 23-foot embedment below existing grade, estimated ultimate axial compression capacity of approximately 65 kips was derived for the initial installation period. The estimated ultimate axial compression capacity is reduced from the initial installation capacities due primarily to ground warming since installation. We estimated current ultimate axial compression capacities in the range of 25 kips per pile.

Additional considerations for current axial capacities include:

- Perimeter piles should be expected to have lower current axial capacities relative to interior piles due to solar gain, runoff water, tundra damage, snow drifts, and albedo impacts along the building perimeter.
- The current facility discharges a considerable amount of water through the floor, particularly along the southeasts corner of the WTP during water pumping. This discharged water is expected to accelerate permafrost degradation in this area.
- The debris under the structure can impede unrestricted air flow under the structure and capture snow drifting. Both may impact colder winter air cooling under and around the structure.
- Climate impacts are expected to continue to further warm the area permafrost and increase the depth of surface thaw. Warming ground will further reduce foundation pile axial capacities and/or increase creep-related settlement rates. Deepening surface thaw will lower the point of fixity along the foundation piles with attendant adverse impacts to lateral capacity and behaviour.

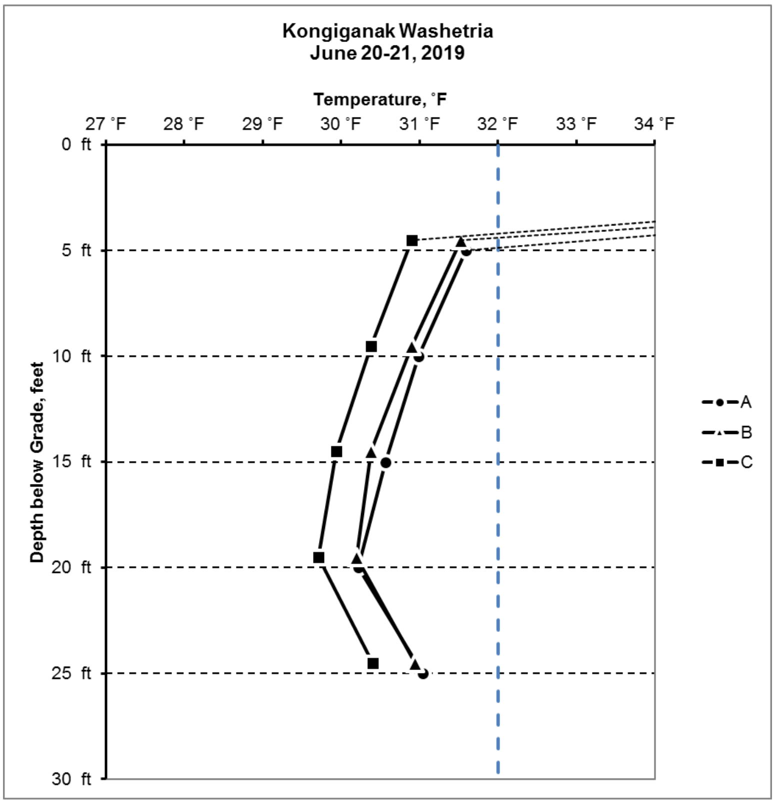
The WTP foundations are considered well beyond their originally intended service life. The current ground temperatures have reduced the estimated axial capacities of these piles. Since only one foundation pile had an accessible ground temperature standpipe, the measured ground temperatures may not accurately reflect ground temperatures along other foundation piles. Select other standpipes that are currently blocked should be opened to determine accurate ground temperatures in other areas of the WTP foundation. We can assist the design team with options for accessing currently blocked ground temperature standpipes.

Assuming the ground temperatures measured on the single standpipe are representative of the site ground thermal states, continued use of the existing WTP foundation pile will almost certainly require geotechnical augmentation for extended use as foundation members under certain loading conditions. Geotechnical augmentation may include installation of rigid insulation and/or use of subgrade cooling around the foundation piles. Redirecting the water discharge through the floor away from the building foundation is also needed.

Existing Washateria

The existing Washateria is founded on 18 each, 6-inch nominal diameter steel Arctic Foundations Inc. (AFI) Thermohelix piles. Pile embedment are estimated to be similar to the WTP foundations, 22 to 23 feet below grade. The foundation piles were installed using drill and slurry methods, assuming a non-cohesive mineral soil and potable water slurry backfill. Rigid insulation was not observed in the soil underlying the structure. Each pile has 2 or 3 steel angle lateral support brackets attached to the structural glulam beam and the base of the pile. Many of the steel lateral supports are damaged, apparently due to frost-related action.

Each foundation pile included a ¾-inch dimeter PVC standpipe assumed installed to the pile embedment depth. Several of the PVC standpipes are damaged or otherwise inaccessible, but an equal number appeared accessible. Of the accessible PVC standpipes, three standpipes along a cross-building transect were accessed for ground temperature measurements, reference the following plot and attached sketch. The Thermohelix piles are apparently cooling the ground around the measured piles within reasonable expectations for their age and assumed as-built conditions.



During our site reconnaissance, local personnel familiar with the facility operations since original construction indicated the Washateria has experienced settlements, reportedly on the order of 8 to 12 inches vertically. There is some evidence supporting differential movements, possibly settlement related, due to select exterior door misalignment. However, widespread evidence of larger differential movements was not visibly supported throughout most of the facility. Also, at the measured ground temperatures referenced above, we would not anticipate foundation differential movements in excess of geotechnical design tolerances, provided the measured ground temperatures reflect the ground thermal regime throughout the entire building footprint.

1.2-MG Water Storage Tank

The current 1.2-MG WST is founded at-grade using 16 AFI Thermoprobes with nominal condenser size of 70 square feet. This WST was installed around 2000 and reliable design and as-built records should be available for the WST. No significant geotechnical issues were observed at the WST. A thermistor reader is located inside the WTP fabricated to provide temperatures for 32 temperature sensors. Temperature measurements for the 32 reader positions are summarized below. We do not have as-built records for the locations of the individual temperature data points, but they are assumed to be located at strategic areas under the WST below a rigid insulation layer installed under and around the WST perimeter.

While temperature data at the Washateria and 12-MG WST indicate the passive subgrade cooling systems are operational, it would be prudent to have AFI conduct a survey of each passive cooling unit to verity their operational status relative to their original basis of design.

Kongiganak 1.2- MG Water Tank
Temperatures (assumed °F)
21-Jun-19

Switch	A	B
1	27.94	27.46
2	28.13	26.96
3	27.76	26.81
4	27.95	27.31
5	28.29	28.37
6	27.42	28.26
7	27.82	28.04
8	28.06	28.06
9	28.42	27.62
10	28.13	28.13
11	27.86	27.42
12	28.04	27.76
13	28.77	28.22
14	29.23	28.40
15	27.76	28.06
16	28.07	28.51

Former WST Foundation Piles

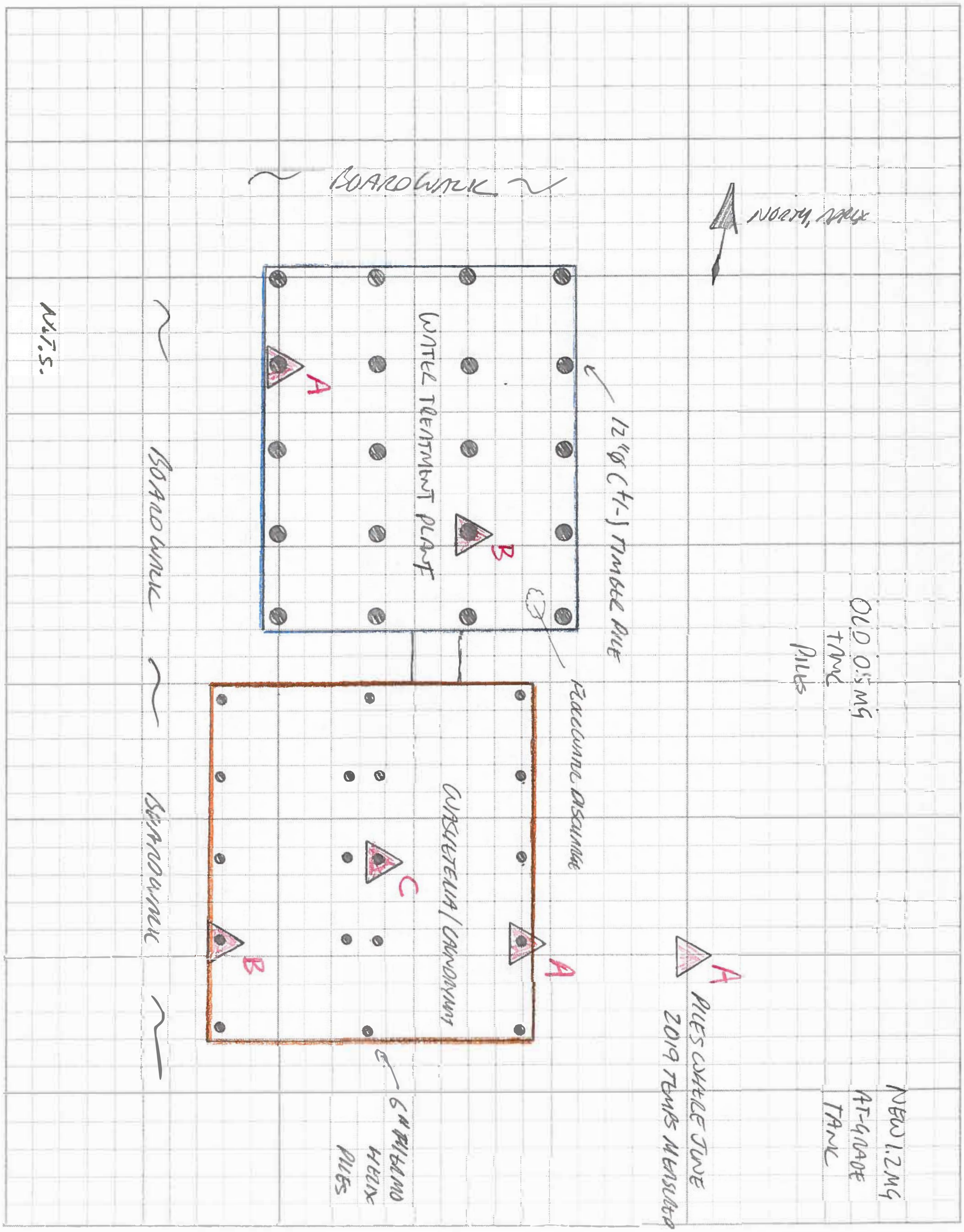
The former WST was founded on 88 timber piles installed on a nominal 5.5-foot rectangular grid. The former WST was demolished concurrent with the 1.2-MG WST project; however, the foundation piles were left in-place. We were unable to locate reliable design or as-built records for these foundation piles. However, it is reasonable to assume they were installed roughly similar to the WTP foundation system. A series of 1-inch diameter PVC standpipes were randomly located throughout the tank foundation footprint. These PVC standpipes were apparently not installed concurrent with original WST pile foundation installation. They may have been installed as part of WST shell post-demolition effort. Only two (2) of the PVC standpipes had caps in place; the remaining PVC standpipes were broken and infilled with soil or ice. The two intact standpipes were both infilled or iced at about 5.5 feet below grade. Reliable ground temperatures were not available from either PVC standpipe.

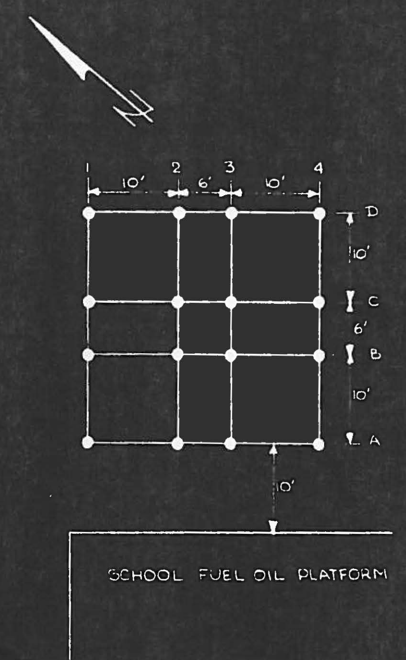
The exposed portions of the timber piles at this location appeared to be in decent condition with no significant rot or damage. The exposed tops of the timber piles have experienced weathering and their structural integrity will need to be confirmed.

If these piles are being considered for new loading, additional geotechnical assessment will be required to estimate their axial and lateral capacities. However, for preliminary considerations, it may be reasonable to assume their current axial capacities could be similar to the WTP foundation piles discussed above, provided both the former WST and WTP foundation piles are of similar design and installation means and methods. Pending the results of a site-specific geotechnical evaluation, reuse of the former WST foundation piles will almost certainly require rigid insulation under and around load bearing piles and possibly subgrade cooling.

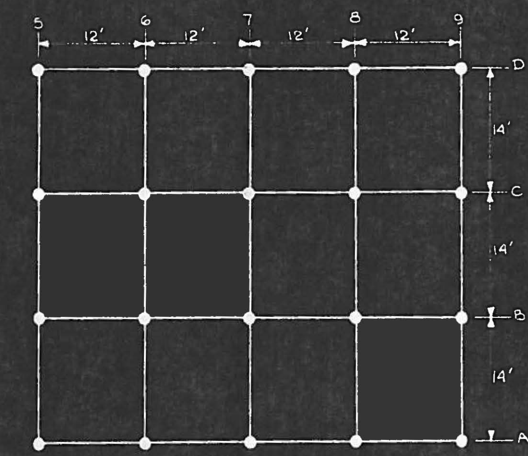
Golder Associates

SUBJECT KONG WTP & WASHETERIA FOUNDATION SCHEMATIC		
Job No. NOT TO SCALE	Made by RAM	Date 6-24-19
	Reviewed MA	Sheet 1 of 1



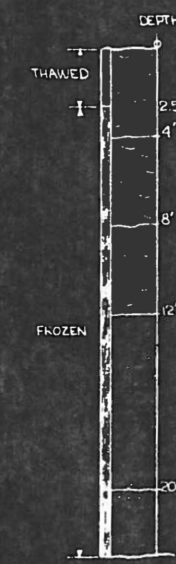


FUEL STORAGE

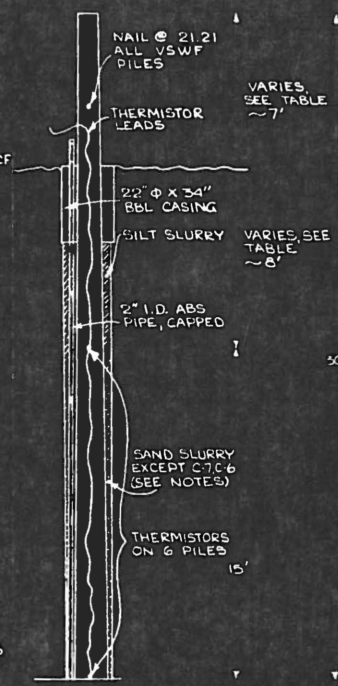


VSWF SITE

GENERALIZED SOIL PROFILE



DESCRIPTION	ESTIMATED USC	W/C %	γd PCF
BROWN ORGANICS ICE ~50% OVERALL AS V_x, V_R	Pt	7200	<40
BROWN ORG. SILT VIS. ICE ~30% AS V_R	OL	~100	
BROWN SILT WITH SOME ORGANICS N_{bN} & V_s	ML	~45	
GREY-GREEN SILT WITH SOME CLAY N_{bN}	ML	~40	
BROWN SILT WITH SOME CLAY, TRACE ORG. N_{bN}	ML-CL	~35	~85



TYPICAL VSWF PILE

SCALE: 1" = 4'

PILE	DATE SET	ORIG. LENGTH	ELEV. OF TOP	ELEV. OF GROUND	DIAM. OF TOP	TOTAL EMBED.	SAND BACKFILL
A5	10/14/76		23.7	16.9	11.8"	23.2	
B5	10/28	30'	25.3	17.3	10.7"	22.0	
C5	10/28	30'	25.4	17.4	11.3"	22.0	
P5	10/12	30'	24.5	17.1	11.9"	22.6	
A6	10/13	30'	24.2	17.1	12.1"	22.9	
B6	10/28	30'	25.3	17.5	13.0"	22.3	
C6	10/28	30'	24.0	17.2	11.5"	23.1	
D6	10/12	30'	24.7	17.2	13.4"	22.5	
A7	10/13	30'	23.1	16.5	10.9"	23.4	
B7	10/15	30'	22.8	16.9	10.8"	24.1	
C7	10/28	30'	24.5	16.8	10.7"	22.3	
D7	10/11	30'	25.2	17.9	11.8"	22.7	
A8	10/13	30'	23.7	16.5	10.4"	22.8	
B8	10/15	30'	22.4	16.7	13.5"	24.3	~ 15
C8	10/28	30'	22.9	17.2	12.0"	24.3	~ 15
D8	10/11	30'	25.0	17.6	12.4"	22.6	~ 15
A9	10/12	30'	23.3	16.7	10.7"	23.4	~ 15
B9	10/14	30'	23.6	16.8	11.9"	23.3	~ 15
C9	10/9	30'	23.5	17.2	10.7"	23.7	~ 15
D9	10/28	30'	24.8	17.7	11.5"	23'	~ 15

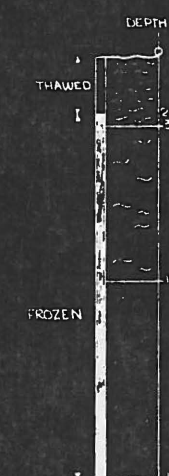
NOTE:

1) PILE C-7 WAS BACKFILLED ENTIRELY WITH A SILT SLURRY.

2) PILE C-6 WAS BACKFILLED IN THE LOWER 5 FEET WITH SILT AND THE NEXT 15 FEET WITH SAND AND THE REMAINDER WITH SILT.

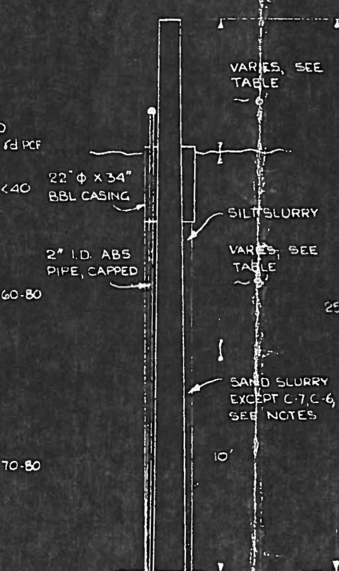
3) THE AVERAGE BUTT SIZE FOR VSWF PILES WAS 15.2" WHILE THE AVERAGE TIP IS 10.9".

ELEVATIONS BASED ON ASSUMPTION OF 20.00. AT PLAY DECK
ADD 80.0 TO MATCH OTHER ELEVATIONS.



DESCRIPTION	ESTIMATED USC	W/C %	γd PCF
PEAT	Pt	7200	<40
BROWN ORG. SILT Nbe, V_R	ML	~100	60-80
GREY-GREEN FINE, SANDY SILT WITH SOME CLAY Nbn	ML	~50	70-80

GENERALIZED SOIL PROFILE



TYPICAL FUEL STORAGE PILE

SCALE: 1" = 4'

PILE	DATE SET	ORIG LENGTH	ELEV. OF TOP	ELEV. OF GROUND	DIAM. OF TOP	TOTAL EMBED.	SAND BACKFILL
A-1	10/7/76	25'	16.27	~ 12.0	~ 11.5'	21'	~
B-1	10/6	25'	14.69	~ 12.0	~ 11.5'		
C-1	10/4	25'	15.35	~ 12.0	~ 11.5'		~ 11'
D-1	10/3	25'	16.37	~ 12.0	~ 11.5'	19'	10'
A-2	10/7	25'	16.49	~ 12.0	~ 11.5'		
B-2	10/6	25'	16.08	~ 12.0	~ 11.5'		
C-2	10/5	25'	16.11	~ 12.0	~ 11.5'		
D-2	10/4	25'	15.50	~ 12.0	~ 11.5'		~ 11'
A-3	10/8	25'	16.89	~ 12.0	~ 11.5'		
B-3	10/7	25'	16.91	~ 12.0	~ 11.5'		
C-3	10/5	25'	15.80	~ 12.0	~ 11.5'		~ 11'
D-3	10/4	25'	15.85	~ 12.0	~ 11.5'		
A-4	10/8	25'	16.61	~ 12.0	~ 11.5'		
B-4	10/8	25'	16.05	~ 12.0	~ 11.5'		
C-4	10/8	25'	17.70	~ 12.0	~ 11.5'		
D-4	10/9	25'	16.15	~ 12.0	~ 11.5'		

NOTE:

1) THE AVERAGE BUTT SIZE FOR FUEL DEPOT PILES WAS 15.4" WHILE THE AVERAGE TIP SIZE WAS 11.5"

DAYS AFTER SETTING TEMP. °F — ADDITIONAL READINGS

PILE	THERMISTOR DEPTH BELOW GROUND	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	12/3/76 DATE	2/16/77 DATE	DATE
D1	0	33.3	33.1	34.2		33.7			31.5	31.9		33.2											32.0												
	2	31.8	31.8	31.8		31.7			31.7	31.9		32.0											31.7												
	5	32.0	31.9	31.9		31.8			31.8	32.1		32.1											31.5												
	8	32.1	32.0	32.0		31.9			31.8	32.1		32.0											31.0												
	13	32.0	31.9	31.9		31.6			30.9	30.9		30.7											30.0												
	18	32.1	31.9	31.8		31.4			30.1	30.1		29.9											29.5												
D9	8	32.1		32.0	32.2					31.8							31.3							30.6								30.2	30.6	28.2	
	23	32.1		32.0	32.0					30.7							28.6							28.3								28.0	28.6	28.8	
D5	8	33.9				31.7							31.4							30.6												30.2	30.5	28.9	
	23	31.9				31.4							28.7							28.1												28.0	28.4	28.6	
A8	8	32.1				31.9							31.7							31.2												30.4	30.8	29.9	
	23	31.7				31.8							29.8							28.9												28.6	29.0	30.1	
A5	8				32.4							31.9							30.9												30.1		30.4	28.6	
	23				31.8							29.5							28.4												28.1		28.6	29.1	
B7	9																	31.9												30.3			30.3	30.3	
	24																	31.1												28.7			28.8	29.0	
C7	7				31.9												31.0																30.6	30.2	
	22				31.4												28.5																28.6	28.9	

TEMPERATURE DATA

AS BUILT
OCTOBER 1976

GENERAL NOTES:

1) ALL PILES WERE INSTALLED IN HOLES PREDRILLED WITH AN 18" AUGER. DUE TO WOBBLING IN THE HOLE, HOWEVER, THE ACTUAL SIZE OF THE HOLE WAS APPROXIMATELY 20".

2) THE SAND USED TO BACKFILL THE LOWER PORTIONS OF ALL PILES WAS IMPORTED MATERIAL WITH 100% PASSING THE #40 SIEVE AND 20% PASSING THE #200 SIEVE.

3) THE SAND SLURRY WAS AT A WATER CONTENT OF APPROXIMATELY 20% AND VIBRATED IN PLACE WITH A CONCRETE PROBE VIBRATOR.

4) A 2" I.D. ABS PIPE WAS CAST IN PLACE IN EACH HOLE FOR SUBSEQUENT USE EITHER FOR TEMPERATURE MONITORING OR FREEZEBACK.

5) THE UPPER PORTIONS OF EACH PILE WERE BACKFILLED WITH A SATURATED SILT SELECTED FROM THE HOLE CUTTINGS.

6) THERMISTORS USED WERE YELLOW SPRING INSTRUMENT COMPANY #401, GENERAL PURPOSE PROBES. WITHIN A RANGE OF 10°F OF FREEZING, THE RELATIONSHIP BETWEEN RESISTANCE AND TEMPERATURE IS $Y = ae^{-bx}$ WHERE Y IS THE TEMPERATURE IN DEGREES FAHRENHEIT, a IS A CONSTANT EQUAL TO 97.57, b IS A CONSTANT EQUAL TO 1.5157×10^{-4} AND X IS THE THERMISTOR RESISTENCE IN OHMS.

STATE OF ALASKA 49TH Jon A. Bendz 3606-E

STATE OF ALASKA 49TH Calvin E. Wood NO. 2183-E

	BY
DESIGNED	J.A.B.
DRAWN	P.J.B.
CHECKED	J.A.B.

NO.	DATE	REVISION	BY
1	4-78	APRIL 1978 REVISED DESIGN	C.E.W.

QUADRA Engineering
Anchorage, Alaska

KONGIGANAK VSW
PILING AS BUILT
KONGIGANAK, ALASKA

DATE: 7 MAY 1977

S-1

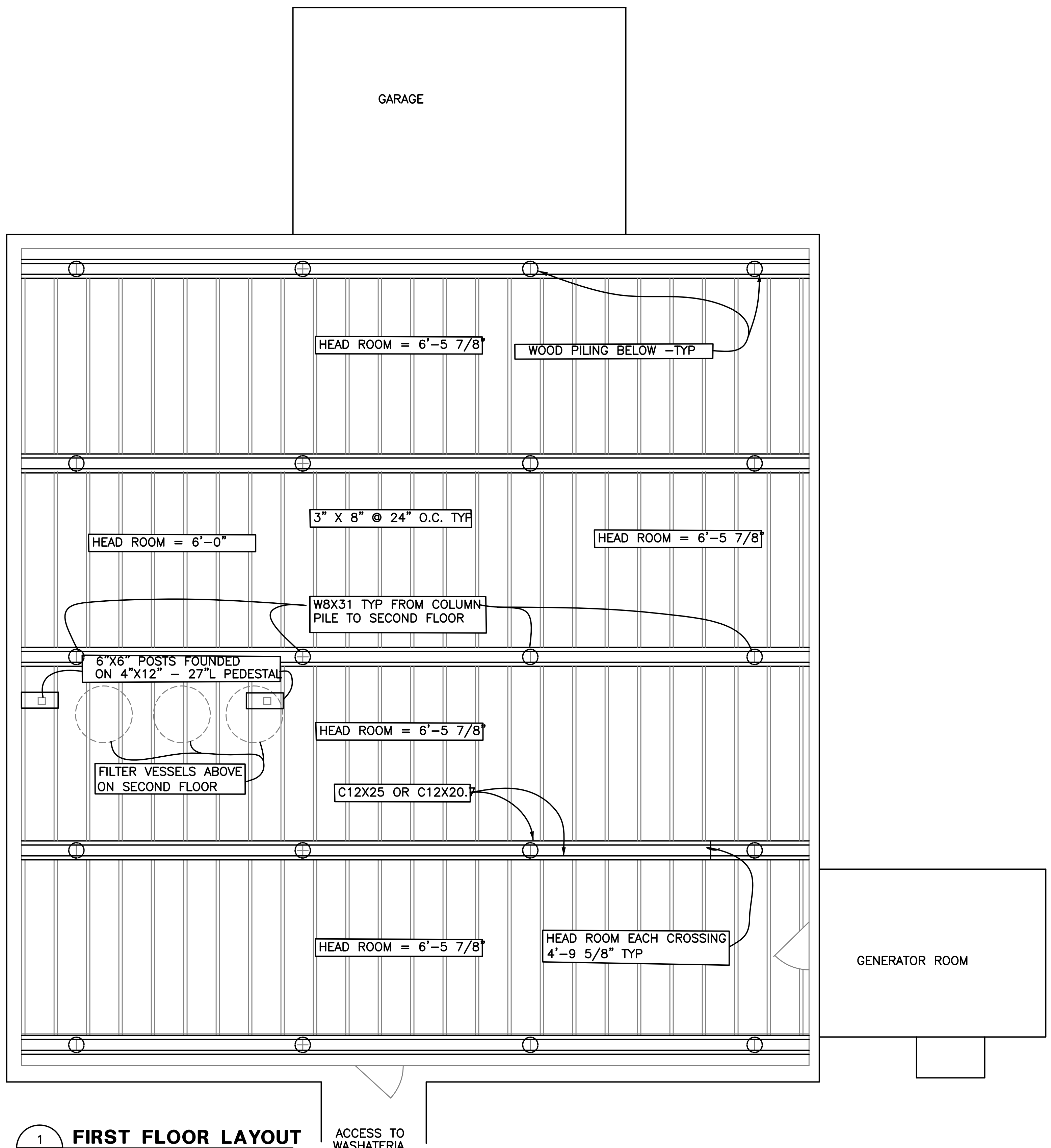
SHEET 9 OF 24

ES74001W-9/22-1

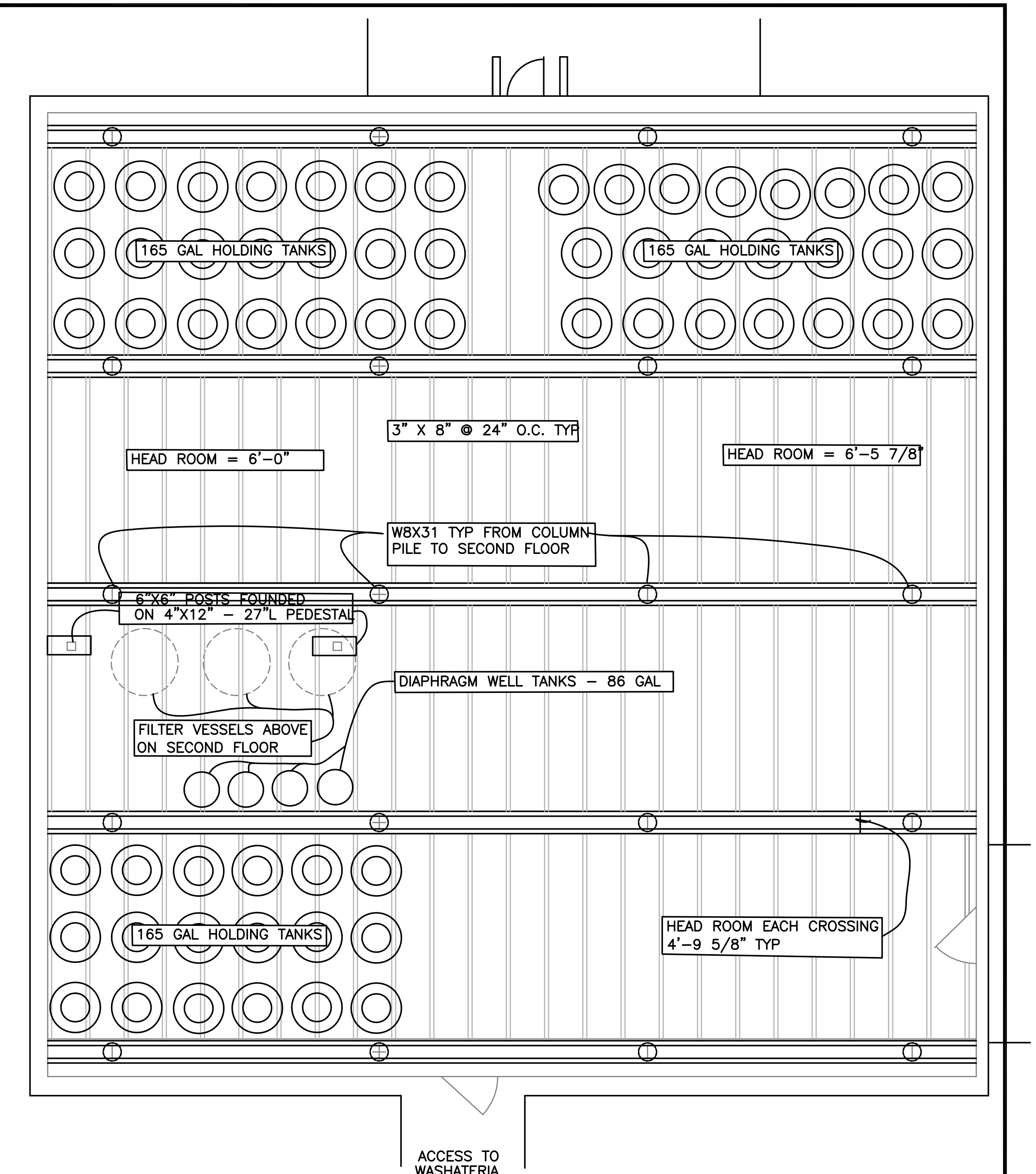
77-16

Appendix C – Framing Drawings

User: KHUGHES Jul 18, 2019 – 4:26pm
Drawing: K:\JOBS\32190078 KONGIGANAK VSW\ACAD-DESIGN\STRUCTURAL\32190078_STRUCTURAL.DWG – Layout: FOUNDATION PLAN
Xrefs: (DIESEL evaluation failed) – Images: None



1 S-1 **FIRST FLOOR LAYOUT**
SCALE: 1/4"=1'



2 S-1 **FIRST FLOOR LOADING DIAGRAM**
SCALE: 1/4"=1'

NOT FOR CONSTRUCTION

REVISIONS

NO.	DATE	BY	DESCRIPTION

REVISIONS

NO.	DATE	BY	DESCRIPTION

Project No. 32190078

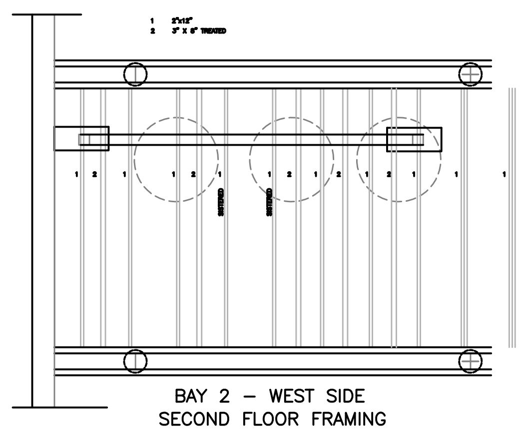
Bristol
ENGINEERING SEVICES COMPANY, LLC
Phone (907) 563-0013 Fax (907) 563-6713

KONGIGANAK WTP
KONGIGANAK, ALASKA
WATER TREATMENT PLANT
TRIP INSPECTION

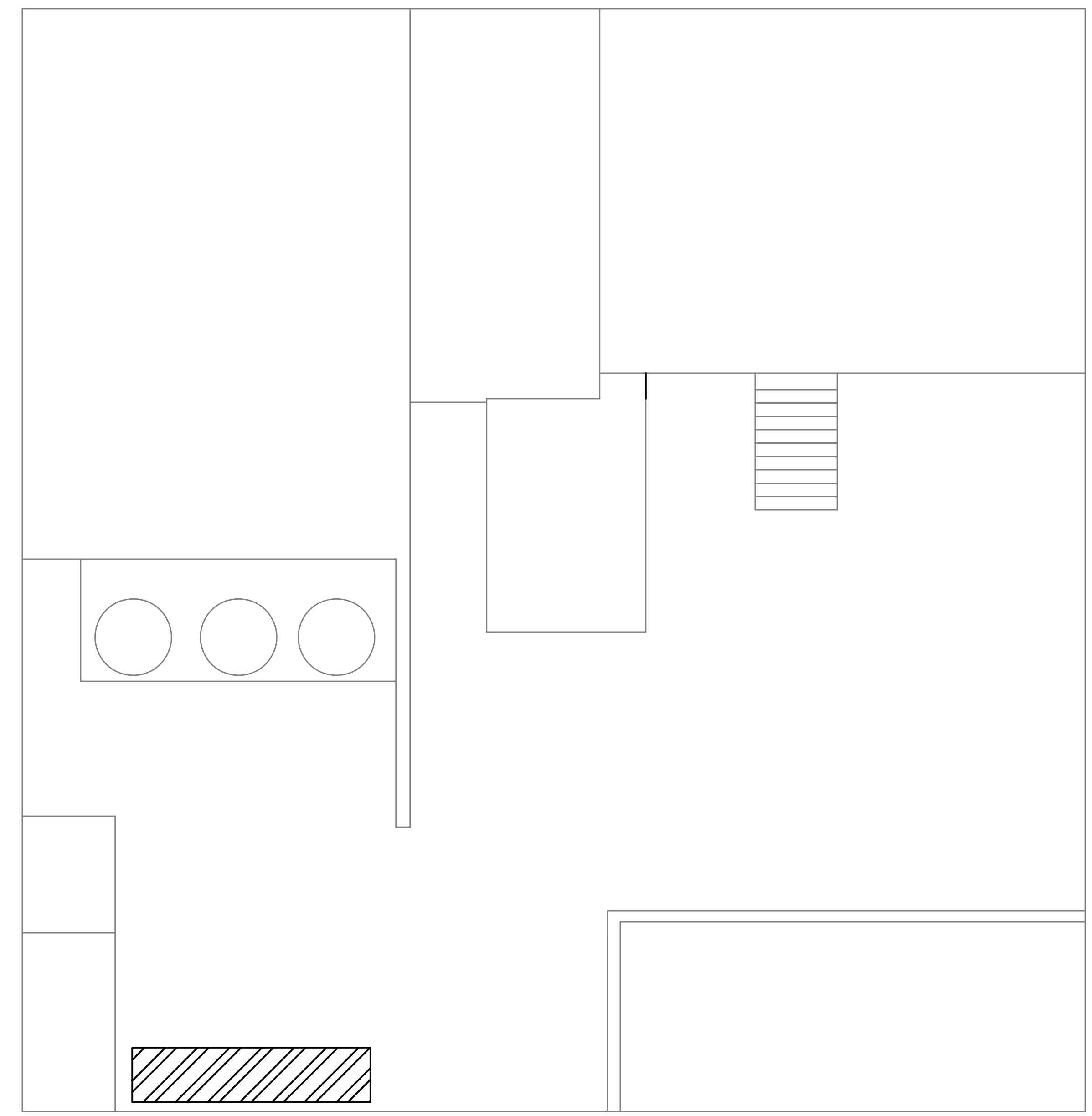
SHEET NO. **S-1**

SCALE: NOTED | DESIGNED: N/A | CHECKED: N/A | DRAWN: KRH | DATE: 07/18/19 | SHEET **1** OF **2**

User: KHUGHES Jul 19, 2019 - 10:59am
Drawing: K:\JOBS\32190078 KONGIGANAK VSW\ACAD-DESIGN\STRUCTURAL\32190078_STRUCTURAL.DWG - Layout: FOUNDATION PLAN (2)
Xrefs: (DIESEL evaluation failed) - Images: None



1 / S-2 **SECOND FLOOR FRAMING**
SCALE: 1/4"=1'



2 / S-2 **SECOND FLOOR LAYOUT**
SCALE: 1/4"=1'

NOT FOR CONSTRUCTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

Project No. 32190078

Bristol
ENGINEERING
SEVICES COMPANY, LLC
Phone (907) 563-0013 Fax (907) 563-6713

KONGIGANAK WTP
KONGIGANAK, ALASKA
WATER TREATMENT PLANT
TRIP INSPECTION

SHEET NO. **S-2**

SCALE: NOTED | DESIGNED: N/A | CHECKED: N/A | DRAWN: KRH | DATE: 07/18/19 | SHEET **2** OF **2**

Appendix D – Structural Calculations

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Wood Beam

Description : First Floor Joists

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

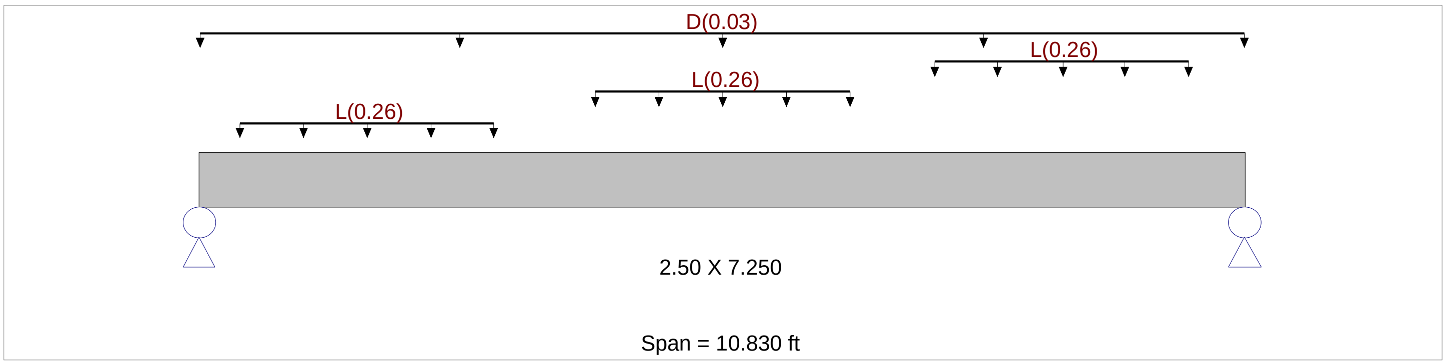
Wood Species :
Wood Grade :

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,000.0	psi
Fb - Compr	1,000.0	psi
Fc - Prll	1,000.0	psi
Fc - Perp	1,000.0	psi
Fv	65.0	psi
Ft	65.0	psi

E : Modulus of Elasticity
Ebend- xx 1,300.0 ksi
Eminbend - xx 1,300.0 ksi

Density 34.0 pcf
Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 0.260 k/ft, Extent = 0.430 -->> 3.060 ft, Tributary Width = 1.0 ft, (165 Gallon Tanks)
Uniform Load : L = 0.260 k/ft, Extent = 4.110 -->> 6.740 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : L = 0.260 k/ft, Extent = 7.620 -->> 10.250 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	**1.849** : 1	Maximum Shear Stress Ratio	=	**1.500** : 1
Section used for this span		**2.50 X 7.250**	Section used for this span		**2.50 X 7.250**
fb : Actual	=	1,848.60 psi	fv : Actual	=	97.49 psi
FB : Allowable	=	1,000.00 psi	Fv : Allowable	=	65.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	5.469 ft	Location of maximum on span	=	10.234 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.587 in	Ratio =	221 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.691 in	Ratio =	188
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 10.830 ft	1	0.275	0.210	1.000	1.000	1.000	1.000	1.000	1.000	0.50	275.37	1000.00	0.17	13.67	65.00
+D+L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.849	1.500	1.000	1.000	1.000	1.000	1.000	1.000	3.37	1,848.60	1000.00	1.18	97.49	65.00
+D+0.750Lr+0.750L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750Lr+0.750L+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 18 JUL 2019, 2:26PM

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : First Floor Joists

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750Lr+0.750L+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.6908	5.469		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.220	1.202
D Only	0.186	0.186
L Only	1.035	1.017
D+L	1.220	1.202

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 16 JUL 2019, 9:46AM

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : First Floor Joists

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

Wood Species : Douglas Fir - Larch (North)
Wood Grade : No. 1 & Btr

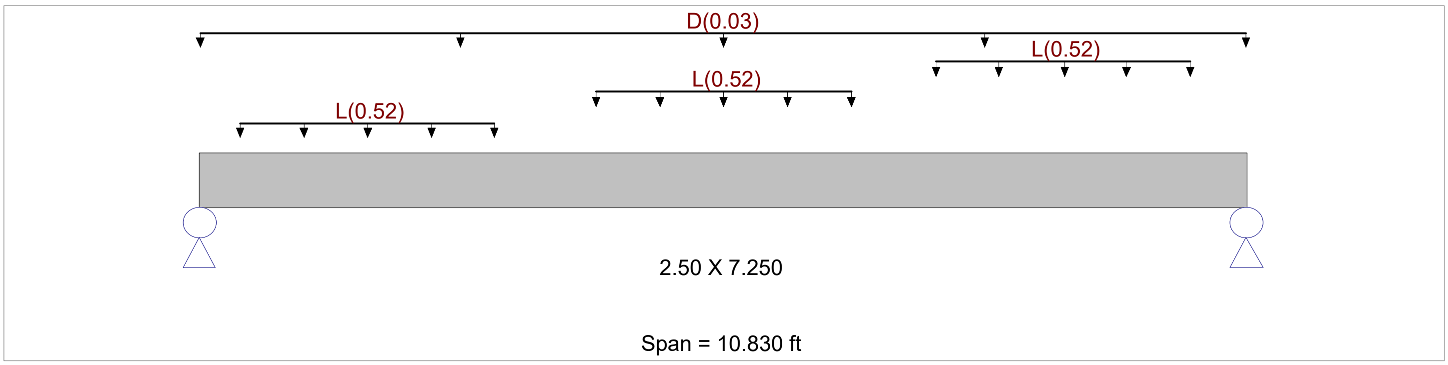
Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1150	psi
Fb - Compr	1150	psi
Fc - Prll	1800	psi
Fc - Perp	625	psi
Fv	180	psi
Ft	750	psi

E : Modulus of Elasticity

Ebend- xx	1800	ksi
Eminbend - xx	660	ksi
Density	31.57	pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 0.520 k/ft, Extent = 0.430 -->> 3.060 ft, Tributary Width = 1.0 ft, (165 Gallon Tanks)
Uniform Load : L = 0.520 k/ft, Extent = 4.110 -->> 6.740 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : L = 0.520 k/ft, Extent = 7.620 -->> 10.250 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	2.973: 1	Maximum Shear Stress Ratio	=	1.007 : 1
Section used for this span		**2.50 X 7.250**	Section used for this span		**2.50 X 7.250**
fb : Actual	=	3,419.40 psi	fv : Actual	=	181.18 psi
FB : Allowable	=	1,150.00 psi	Fv : Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	5.469 ft	Location of maximum on span	=	10.234 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.848 in	Ratio =	153 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.922 in	Ratio =	140 <180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 10.830 ft	1	0.237	0.075	1.000	1.000	1.000	1.000	1.000	1.000	0.50	272.91	1150.00	0.16	13.55	180.00
+D+L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.973	1.007	1.000	1.000	1.000	1.000	1.000	1.000	6.24	3,419.40	1150.00	2.19	181.18	180.00
+D+0.750Lr+0.750L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00
+D+0.750L+0.750S+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00
+D+0.750Lr+0.750L+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00

Wood Beam

Description : First Floor Joists

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	C d	C F/V	C r	C m	C t	C L	Moment Values M	fb	Fb	Shear Values V	fv	Fv
+D+0.750L+0.750S+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00
+D+0.750Lr+0.750L+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	2.289	0.774	1.000	1.000	1.000	1.000	1.000	1.000	4.81	2,632.77	1150.00	1.68	139.28	180.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.9223	5.469		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.253	2.218
D Only	0.184	0.184
L Only	2.069	2.034
D+L	2.253	2.218

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 16 JUL 2019, 5:15PM

Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : Frame Beam

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

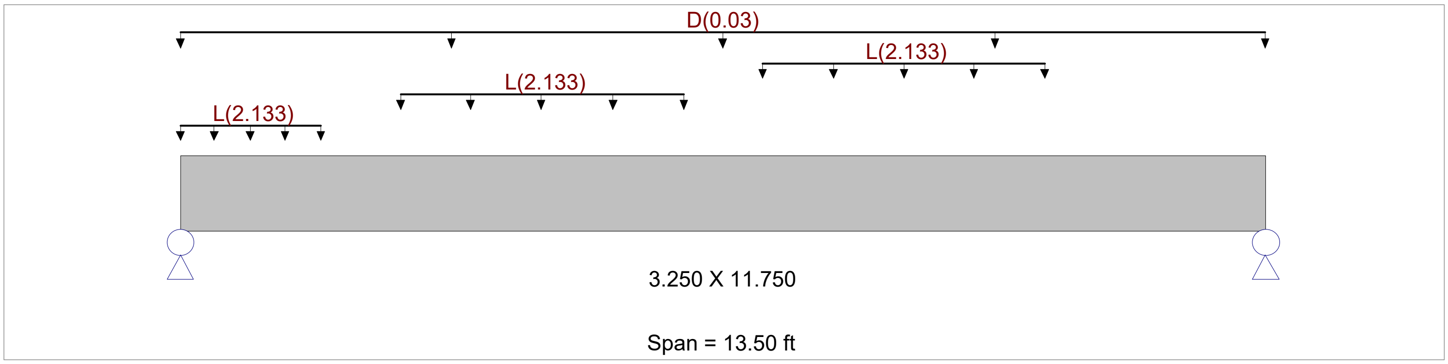
Wood Species : Douglas Fir - Larch (North)
Wood Grade : No. 1 & Btr

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,150.0	psi
Fb - Compr	1,150.0	psi
Fc - Prll	1,800.0	psi
Fc - Perp	625.0	psi
Fv	180.0	psi
Ft	750.0	psi

E : Modulus of Elasticity
Ebend- xx 1,800.0 ksi
Eminbend - xx 660.0 ksi

Density 31.570 pcf
Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 2.133 k/ft, Extent = 0.0 -->> 1.750 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : L = 2.133 k/ft, Extent = 2.750 -->> 6.250 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : L = 2.133 k/ft, Extent = 7.250 -->> 10.750 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	**3.996** : 1	Maximum Shear Stress Ratio	=	**2.000** : 1
Section used for this span		**3.250 X 11.750**	Section used for this span		**3.250 X 11.750**
fb : Actual	=	5,813.48 psi	fv : Actual	=	359.94 psi
FB : Allowable	=	1,454.75 psi	Fv : Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	6.143 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	1.479 in	Ratio =	109 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	1.516 in	Ratio =	106 <180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 13.50 ft	1	0.096	0.049	1.000	1.100	1.150	1.000	1.000	1.000	0.87	140.27	1454.75	0.22	8.75	180.00
+D+L+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.996	2.000	1.000	1.100	1.150	1.000	1.000	1.000	36.23	5,813.48	1454.75	9.16	359.94	180.00
+D+0.750Lr+0.750L+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750Lr+0.750L+0.750W+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Wood Beam

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : Frame Beam

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	Moment Values M	fb	Fb	Shear Values V	fv	Fv
+D+0.750L+0.750S+0.750W+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750Lr+0.750L+0.5250E+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+0.5250E+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	1.5159	6.750		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	11.215	7.966
D Only	0.259	0.259
L Only	10.956	7.707
D+L	11.215	7.966

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

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Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporatior**

Description : First Floor Joists

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-0!

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

Wood Species :
Wood Grade :

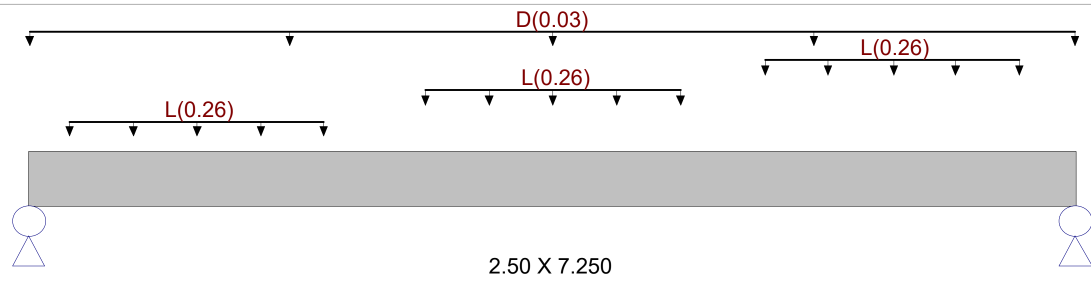
Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,000.0	psi
Fb - Compr	1,000.0	psi
Fc - Prll	1,000.0	psi
Fc - Perp	1,000.0	psi
Fv	65.0	psi
Ft	65.0	psi

E : Modulus of Elasticity

Ebend- xx	1,300.0	ksi
Eminbend - xx	1,300.0	ksi
Density	34.0	pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculatior

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 0.260 k/ft, Extent = 0.430 -->> 3.060 ft, Tributary Width = 1.0 ft, (165 Gallon Tanks)
Uniform Load : L = 0.260 k/ft, Extent = 4.110 -->> 6.740 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : L = 0.260 k/ft, Extent = 7.620 -->> 10.250 ft, Tributary Width = 1.0 ft, (165 Gallon Tank)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	**1.849**: 1	
Section used for this span		**2.50 X 7.250**	
fb : Actual	=	1,848.60	psi
FB : Allowable	=	1,000.00	psi
Load Combination		+D+L+H	
Location of maximum on span	=	5.469	ft
Span # where maximum occurs	=	Span # 1	

Maximum Shear Stress Ratio	=	**1.500** : 1	
Section used for this span		**2.50 X 7.250**	
fv : Actual	=	97.49	psi
Fv : Allowable	=	65.00	psi
Load Combination		+D+L+H	
Location of maximum on span	=	10.234	ft
Span # where maximum occurs	=	Span # 1	

Maximum Deflection

Max Downward L+Lr+S Deflection	0.587	in	Ratio =	221 <360
Max Upward L+Lr+S Deflection	0.000	in	Ratio =	0 <360
Max Downward Total Deflection	0.691	in	Ratio =	188
Max Upward Total Deflection	0.000	in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 10.830 ft	1	0.275	0.210	1.000	1.000	1.000	1.000	1.000	1.000	0.50	275.37	1000.00	0.17	13.67	65.00
+D+L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.849	1.500	1.000	1.000	1.000	1.000	1.000	1.000	3.37	1,848.60	1000.00	1.18	97.49	65.00
+D+0.750Lr+0.750L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750Lr+0.750L+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

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Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : First Floor Joists

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	Moment Values M	fb	Fb	Shear Values V	fv	Fv
+D+0.750L+0.750S+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750Lr+0.750L+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 10.830 ft	1	1.455	1.177	1.000	1.000	1.000	1.000	1.000	1.000	2.66	1,455.29	1000.00	0.92	76.54	65.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	0.6908	5.469		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.220	1.202
D Only	0.186	0.186
L Only	1.035	1.017
D+L	1.220	1.202

Wood Beam

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : --None--

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

Wood Species :
Wood Grade :

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,000.0	psi
Fb - Compr	1,000.0	psi
Fc - Prll	1,000.0	psi
Fc - Perp	1,000.0	psi
Fv	65.0	psi
Ft	65.0	psi

E : Modulus of Elasticity

Ebend- xx	1,300.0	ksi
Eminbend - xx	1,300.0	ksi
Density	34.0	pcf

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0: 1	**Maximum Shear Stress Ratio**	=	0 : 1
Section used for this span			Section used for this span		
fb : Actual	=	psi	fv : Actual	=	psi
FB : Allowable	=	psi	Fv : Allowable	=	psi
Load Combination			Load Combination		
Location of maximum on span	=	0ft	Location of maximum on span	=	0 ft
Span # where maximum occurs	=	1	Span # where maximum occurs	=	1

Maximum Deflection

Max Downward L+Lr+S Deflection	in	Ratio =	<360
Max Upward L+Lr+S Deflection	in	Ratio =	<360
Max Downward Total Deflection	in	Ratio =	<180
Max Upward Total Deflection	in	Ratio =	<180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2

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111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

Printed: 15 JUL 2019, 4:32PM

Steel Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

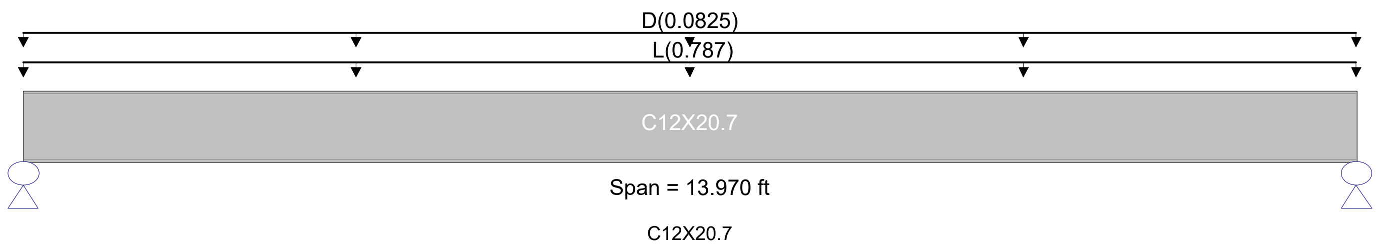
Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : Steel Floor Channel.

Material Properties

Calculations per AISC 360-05, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method :	Allowable Stress Design	Fy : Steel Yield :	36.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		
Load Combination	2006 IBC & ASCE 7-05		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Uniform Load : L = 0.7870 k/ft, Tributary Width = 1.0 ft, (165 Gallon Tanks - Assume 8 per)
Uniform Load : D = 0.0150 ksf, Tributary Width = 5.50 ft, (Dead Load)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.472** : 1	Maximum Shear Stress Ratio =	**0.142** : 1
Section used for this span	**C12X20.7**	Section used for this span	**C12X20.7**
Mu : Applied	21.717 k-ft	Vu : Applied	6.218 k
Mn / Omega : Allowable	45.988 k-ft	Vn/Omega : Allowable	43.769 k
Load Combination	+D+L+H	Load Combination	+D+L+H
Location of maximum on span	6.985 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.182 in	Ratio =	922
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.206 in	Ratio =	815
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
+D													
Dsgn. L = 13.97 ft	1	0.055	0.016	2.52		2.52	76.80	45.99	1.00	1.00	0.72	73.09	43.77
+D+L+H													
Dsgn. L = 13.97 ft	1	0.472	0.142	21.72		21.72	76.80	45.99	1.00	1.00	6.22	73.09	43.77
+D+0.750Lr+0.750L+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750Lr+0.750L+0.750W+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+0.750W+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750Lr+0.750L+0.5250E+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+0.5250E+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	6.218	6.218
D Only	0.721	0.721
L Only	5.497	5.497
D+L	6.218	6.218

Wood Column

Description : 6x6 Frame Column

General Information

Calculations per 2005 NDS, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
End Fixities Top & Bottom Pinned
Overall Column Height 5.240 ft
(Used for non-slender calculations)
Wood Species Douglas Fir - Larch (North)
Wood Grade No. 1 & Btr

Fb - Tension	1150 psi	Fv	180 psi
Fb - Compr	1150 psi	Ft	750 psi
Fc - Prll	1800 psi	Density	31.57 pcf
Fc - Perp	625 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1800	1800	1800 ksi
Minimum	660	660	

Load Combination 2006 IBC & ASCE 7-05

Wood Section Name 6x6
Wood Grading/Manuf. Graded Lumber
Wood Member Type Sawn

Exact Width	5.50 in
Exact Depth	5.50 in
Area	30.250 in^2
Ix	76.255 in^4
Iy	76.255 in^4

Allowable Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compression	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Factor	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 NDS 15.3.2
Use Cr : Repetitive ?	No (non-glb only)

Brace condition for deflection (buckling) along columns
X-X (width) axis : Unbraced Length for X-X Axis buckling = 5.24 ft, K = 1.0
Y-Y (depth) axis : Fully braced against buckling along Y-Y Axis

Applied Loads

Service loads entered. Load Factors will be applied for calculation

Column self weight included : 34.751 lbs * Dead Load Factor
AXIAL LOADS . . .
From Beam - Vessels: Axial Load at 5.240 ft, D = 0.240, L = 12.440 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.2629** : 1
	Load Combination	+D+L+H
	Governing NDS Formla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are . . .	
	Applied Axial	12.715 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	1,598.54 psi
PASS	Maximum Shear Stress Ratio =	**0.0** : 1
	Load Combination	+D+0.750L+0.750S+0.5250E+H
	Location of max.above base	5.240 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	180.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .
Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension
Cf or Cv : Size based factors	1.000	1.000	

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
+D	0.005682	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+L+H	0.2629	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+0.750W+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+0.750W+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+0.5250E+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+0.5250E+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft

Maximum Reactions - Unfactored

Note: Only non-zero reactions are listed

Load Combination	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base
D Only		k		k	0.275 k
L Only		k		k	12.440 k
D+L		k		k	12.715 k

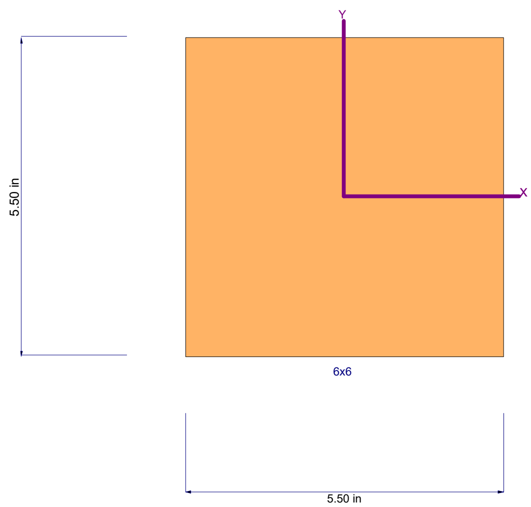
Wood Column

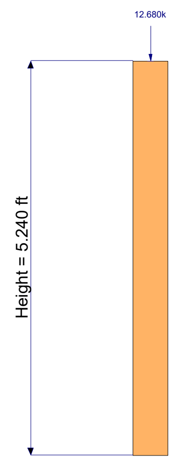
Description : 6x6 Frame Column

Maximum Deflections for Load Combinations - Unfactored Loads

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
D+L	0.0000 in	0.000 ft	0.000 in	0.000 ft

Sketches





Loads are total entered value. Arrows do not reflect absolute direction.

Bristol Engineering Services Comp.
111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

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File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Steel Beam

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

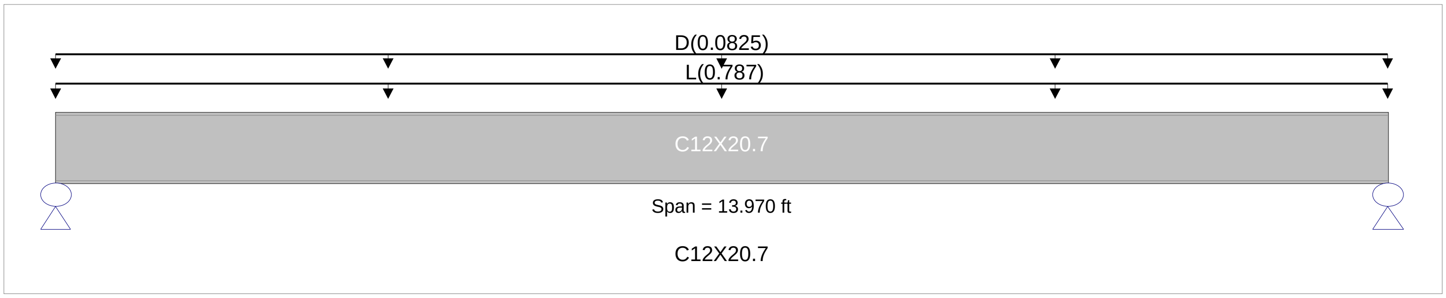
Description : Steel Floor Channel.

Material Properties

Calculations per AISC 360-05, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending
Load Combination 2006 IBC & ASCE 7-05

Fy : Steel Yield : 36.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Uniform Load : L = 0.7870 k/ft, Tributary Width = 1.0 ft, (165 Gallon Tanks - Assume 8 per)
Uniform Load : D = 0.0150 ksf, Tributary Width = 5.50 ft, (Dead Load)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.472** : 1	Maximum Shear Stress Ratio =	**0.142** : 1
Section used for this span	**C12X20.7**	Section used for this span	**C12X20.7**
Mu : Applied	21.717 k-ft	Vu : Applied	6.218 k
Mn / Omega : Allowable	45.988 k-ft	Vn/Omega : Allowable	43.769 k
Load Combination	+D+L+H	Load Combination	+D+L+H
Location of maximum on span	6.985 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.182 in	Ratio =	922
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.206 in	Ratio =	815
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination Segment Length	Span #	Max Stress Ratios M	V	Summary of Moment Values Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega	Cb	Rm	Summary of Shear Values Va Max	Vnx	Vnx/Omega
+D													
Dsgn. L = 13.97 ft	1	0.055	0.016	2.52		2.52	76.80	45.99	1.00	1.00	0.72	73.09	43.77
+D+L+H													
Dsgn. L = 13.97 ft	1	0.472	0.142	21.72		21.72	76.80	45.99	1.00	1.00	6.22	73.09	43.77
+D+0.750Lr+0.750L+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750Lr+0.750L+0.750W+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+0.750W+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750Lr+0.750L+0.5250E+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77
+D+0.750L+0.750S+0.5250E+H													
Dsgn. L = 13.97 ft	1	0.368	0.111	16.92		16.92	76.80	45.99	1.00	1.00	4.84	73.09	43.77

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
	1	0.0000	0.000		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	6.218	6.218
D Only	0.721	0.721
L Only	5.497	5.497
D+L	6.218	6.218

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Title :
Engineer:
Project Desc.:

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Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : Frame Beam

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
Load Combination 2006 IBC & ASCE 7-05

Wood Species : Douglas Fir - Larch (North)
Wood Grade : No. 1 & Btr

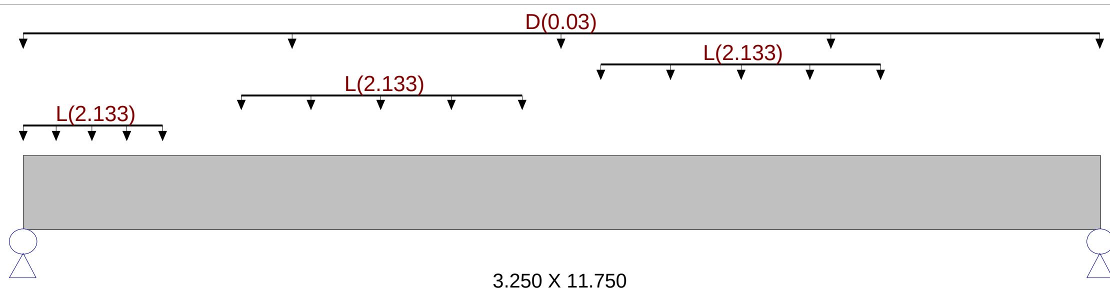
Beam Bracing : Beam is Fully Braced against lateral-torsion buckling

Fb - Tension	1,150.0	psi
Fb - Compr	1,150.0	psi
Fc - Prll	1,800.0	psi
Fc - Perp	625.0	psi
Fv	180.0	psi
Ft	750.0	psi

E : Modulus of Elasticity

Ebend- xx	1,800.0	ksi
Eminbend - xx	660.0	ksi
Density	31.570	pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Load for Span Number 1
Uniform Load : L = 2.133 k/ft, Extent = 0.0 -->> 1.750 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : L = 2.133 k/ft, Extent = 2.750 -->> 6.250 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : L = 2.133 k/ft, Extent = 7.250 -->> 10.750 ft, Tributary Width = 1.0 ft, (2nd Floor Vessel)
Uniform Load : D = 0.0150 ksf, Tributary Width = 2.0 ft, (Dead Load)

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	**3.996** : 1	Maximum Shear Stress Ratio	=	**2.000** : 1
Section used for this span		**3.250 X 11.750**	Section used for this span		**3.250 X 11.750**
fb : Actual	=	5,813.48 psi	fv : Actual	=	359.94 psi
FB : Allowable	=	1,454.75 psi	Fv : Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	6.143 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	1.479 in	Ratio =	109 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	1.516 in	Ratio =	106 <180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 13.50 ft	1	0.096	0.049	1.000	1.100	1.150	1.000	1.000	1.000	0.87	140.27	1454.75	0.22	8.75	180.00
+D+L+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.996	2.000	1.000	1.100	1.150	1.000	1.000	1.000	36.23	5,813.48	1454.75	9.16	359.94	180.00
+D+0.750Lr+0.750L+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750Lr+0.750L+0.750W+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+0.750W+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00

Wood Beam

Description : Frame Beam

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750Lr+0.750L+0.5250E+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00
+D+0.750L+0.750S+0.5250E+H					1.100	1.150	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	3.021	1.512	1.000	1.100	1.150	1.000	1.000	1.000	27.39	4,394.90	1454.75	6.93	272.14	180.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D+L	1	1.5159	6.750		0.0000	0.000

Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	11.215	7.966
D Only	0.259	0.259
L Only	10.956	7.707
D+L	11.215	7.966

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111 W. 16th Ave
Anchorage, AK 99501
907 563-0013

Title :
Engineer:
Project Desc.:

Project Notes :

Job #

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Wood Column

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

Description : 6x6 Frame Column

General Information

Calculations per 2005 NDS, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method : Allowable Stress Design
End Fixities Top & Bottom Pinned
Overall Column Height 5.240 ft
(Used for non-slender calculations)
Wood Species Douglas Fir - Larch (North)
Wood Grade No. 1 & Btr

Fb - Tension	1,150.0 psi	Fv	180.0 psi
Fb - Compr	1,150.0 psi	Ft	750.0 psi
Fc - Prll	1,800.0 psi	Density	31.570 pcf
Fc - Perp	625.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,800.0	1,800.0	1,800.0 ksi
Minimum	660.0	660.0	

Load Combination 2006 IBC & ASCE 7-05

Wood Section Name 6x6
Wood Grading/Manuf. Graded Lumber
Wood Member Type Sawn

Exact Width	5.50 in
Exact Depth	5.50 in
Area	30.250 in^2
Ix	76.255 in^4
Iy	76.255 in^4

Allowable Stress Modification Factors

Cf or Cv for Bending	1.0
Cf or Cv for Compression	1.0
Cf or Cv for Tension	1.0
Cm : Wet Use Factor	1.0
Ct : Temperature Factor	1.0
Cfu : Flat Use Factor	1.0
Kf : Built-up columns	1.0 *NDS 15.3.2*
Use Cr : Repetitive ?	No *(non-glb only)*

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for X-X Axis buckling = 5.24 ft, K = 1.0
Y-Y (depth) axis : Fully braced against buckling along Y-Y Axis

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 34.751 lbs * Dead Load Factor
AXIAL LOADS . . .
From Beam - Vessels: Axial Load at 5.240 ft, D = 0.240, L = 12.440 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS	Max. Axial+Bending Stress Ratio =	**0.2629** : 1
	Load Combination	+D+L+H
	Governing NDS Formla	Comp Only, fc/Fc'
	Location of max.above base	0.0 ft
	At maximum location values are . . .	
	Applied Axial	12.715 k
	Applied Mx	0.0 k-ft
	Applied My	0.0 k-ft
	Fc : Allowable	1,598.54 psi
PASS	Maximum Shear Stress Ratio =	**0.0** : 1
	Load Combination	+D+0.750L+0.750S+0.5250E+H
	Location of max.above base	5.240 ft
	Applied Design Shear	0.0 psi
	Allowable Shear	180.0 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .
Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension
Cf or Cv : Size based factors	1.000	1.000	

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Maximum Shear Ratios: Stress Ratio	Status	Location
+D	0.005682	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+L+H	0.2629	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+0.750W+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+0.750W+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750Lr+0.750L+0.5250E+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft
+D+0.750L+0.750S+0.5250E+H	0.1986	PASS	0.0 ft	0.0	PASS	5.240 ft

Maximum Reactions - Unfactored

Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Axial Reaction @ Base
D Only		k		k	0.275 k
L Only		k		k	12.440 k
D+L		k		k	12.715 k

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111 W. 16th Ave
Anchorage, AK 99501
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Title :
Engineer:
Project Desc.:

Project Notes :

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Wood Column

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ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

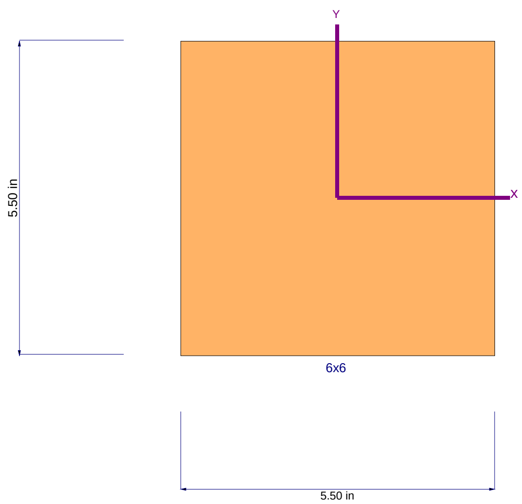
Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

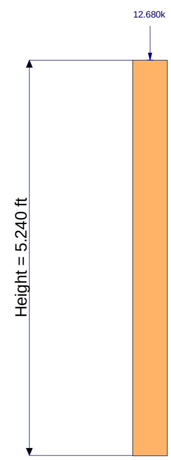
Description : 6x6 Frame Column

Maximum Deflections for Load Combinations - Unfactored Loads

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
L Only	0.0000 in	0.000 ft	0.000 in	0.000 ft
D+L	0.0000 in	0.000 ft	0.000 in	0.000 ft

Sketches





Loads are total entered value. Arrows do not reflect absolute direction.

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Title :
Engineer:
Project Desc.:

Project Notes :

Job #

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Wood Beam

File: c:\Users\khughes\Documents\ENERCALC Data Files\kongiganak wtp.ec6
ENERCALC, INC. 1983-2011, Build:6.12.01.12, Ver:6.14.7.31

Lic. # : KW-06009554 **Licensee : Bristol Engineering Services Corporation**

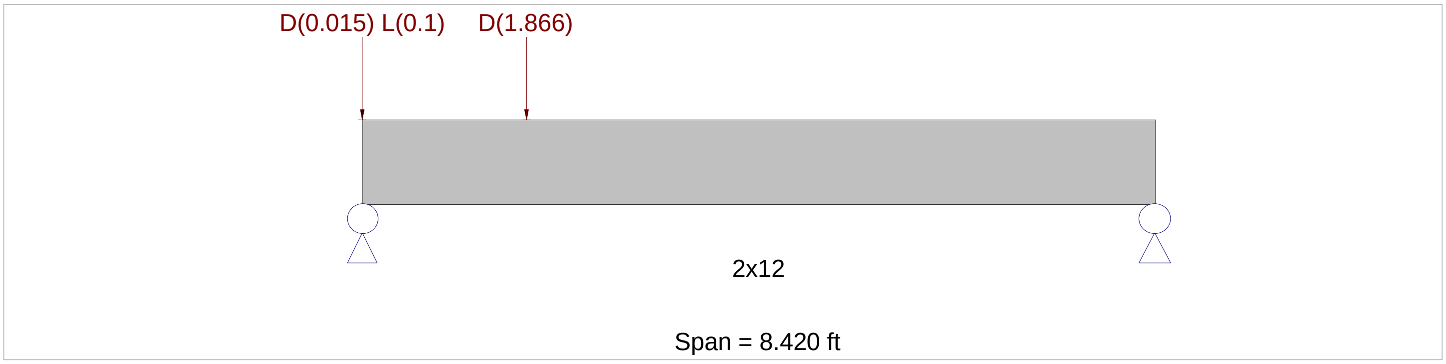
Description : Second Floor Framing Check

Material Properties

Calculations per NDS 2005, IBC 2009, CBC 2010, ASCE 7-05

Analysis Method :	Allowable Stress Design	Fb - Tension	1,000.0 psi	*E : Modulus of Elasticity*	
Load Combination	2006 IBC & ASCE 7-05	Fb - Compr	1,000.0 psi	Ebend- xx	1,300.0 ksi
		Fc - Prll	1,000.0 psi	Eminbend - xx	1,300.0 ksi
Wood Species	:	Fc - Perp	1,000.0 psi		
Wood Grade	:	Fv	65.0 psi		
		Ft	65.0 psi	Density	34.0 pcf

Beam Bracing : Beam is Fully Braced against lateral-torsion buckling



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Point Load : D = 0.0150, L = 0.10 k @ 0.0 ft, (Normal Code Loading)
Point Load : D = 1.866 k @ 1.750 ft

DESIGN SUMMARY

Design N.G.

Maximum Bending Stress Ratio	=	0.978 : 1	Maximum Shear Stress Ratio	=	2.021 : 1
Section used for this span		**2x12**	Section used for this span		**2x12**
fb : Actual	=	978.39 psi	fv : Actual	=	131.39 psi
FB : Allowable	=	1,000.00 psi	Fv : Allowable	=	65.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	1.768 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Upward L+Lr+S Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.105 in	Ratio =	963
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
+D												0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750Lr+0.750L+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750L+0.750S+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750Lr+0.750L+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750L+0.750S+0.750W+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750Lr+0.750L+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	0.00
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00
+D+0.750L+0.750S+0.5250E+H					1.000	1.000	1.000	1.000	1.000			0.00	0.00	0.00	

Wood Beam

Description : Second Floor Framing Check

Load Combination		Max Stress Ratios								Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_r	C_m	C_t	C_L	M	fb	Fb	V	fv	Fv
Length = 8.420 ft	1	0.978	2.021	1.000	1.000	1.000	1.000	1.000	1.000	2.58	978.39	1000.00	1.48	131.39	65.00

Overall Maximum Deflections - Unfactored Loads

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
D Only	1	0.1048	3.705		0.0000	0.000

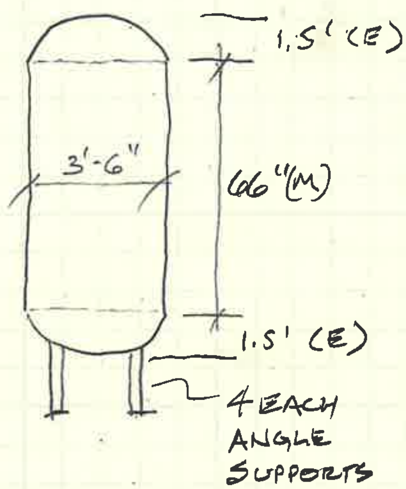
Vertical Reactions - Unfactored

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.593	0.388
D Only	1.493	0.388
L Only	0.100	0.000
D+L	1.593	0.388

ESTIMATED SECOND FLOOR VESSEL WEIGHT

E = ESTIMATED
M = MEASURED



$$V_{TD} = \frac{\pi}{6} \cdot h\left(3c^2 + h^2\right)$$

$$= \frac{\pi}{6} \cdot 1.5\left(3 \cdot 1.75^2 + 1.5^2\right)$$

$$= \frac{\pi}{6} 1.5\left(3 \cdot 3.06 + 2.25\right)$$

$$= \frac{\pi}{6}\ 1.5(11.44)$$

$$= 0.52 \cdot 17.16$$

$$= 8.98 \text{ cf}$$

$$A_{MID} = \frac{\pi d^2}{4} = \frac{\pi\, 3.5'^2}{4} = 9.62 \text{ SF}$$

$$V_M = 9.62 \text{ SF} \times 66''/12''/' = 52.92 \text{ CF}$$

$$V_{BOT} = \frac{\pi}{6} \cdot 1.5\left(3 \cdot 1.75^2 + 1.5^2\right)$$

$$= 8.98 \text{ CF}$$

$$\Sigma V_{OL} = 8.98 + 8.98 + 52.92 \text{ CF}$$

$$= 70.88 \text{ CF}$$

ASSUME 1/2 WATER / 1/2 MEDIUM

$$= 70.88/2 = 35.44 \text{ CF} \times 120\ \#/\text{CF}$$

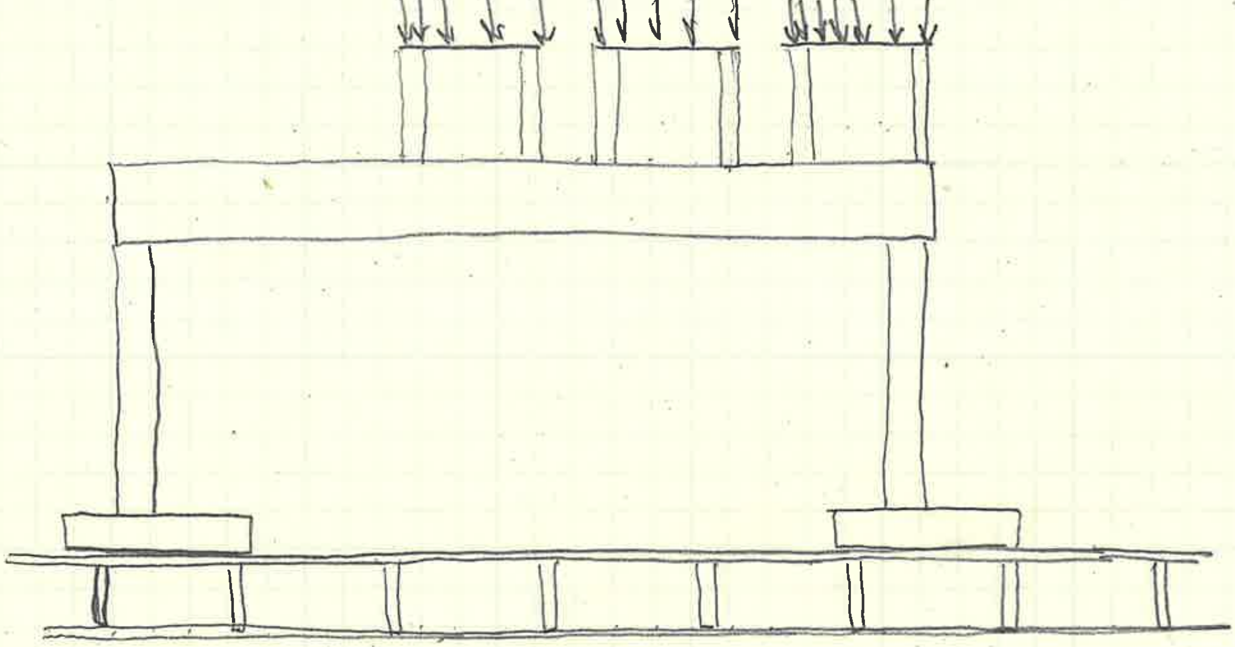
$$= 4,252.80\ \#$$

$$+ \quad 70.88/2 \times 62.4\ \#/\text{CF} = 2,211\#$$

$$+ \text{ DL OF VESSEL} \sim 1,000\ \# +/-$$

$$\text{TOTAL LOAD} = 4,253 + 2,211 + 1,000 = 7,464\ \# +/-$$

VESSEL LOAD ON SUPPORT FRAME BEAM.



7,464#/3.5' = 2,132.64 #/LF ~ LIVE LOAD
(NOT CONSERVATIVE)

PER ENERCALC

MAXIMUM BENDING STRESS RATIO = 3.886:1

MAXIMUM SHEAR STRESS RATIO = 2.00:1

DOWNWARD DEFLECTION = 109 < 360

Appendix E – Pressure Vessel Tank Specifications

AMTROL

WELL-X-TROL®

Diaphragm Well Tanks: WX-100, 200 and 300 Series

150 PSIG Working Pressure

Construction

Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator™
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Performance

Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7 Year

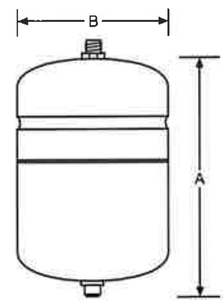
Application

- Controls pump cycling in residential well water systems.
- Can be installed indoors or outdoors.

In-Line Models

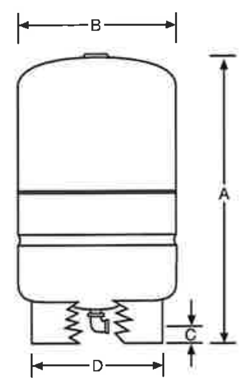
Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Diameter		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-101	2.0	8	0.45	13	330	8	203	¾	5	2
WX-102	4.4	17	0.55	15	381	11	279	¾	9	4
WX-103	7.6	29	0.43	22	559	11	279	¾	15	7
WX-104	10.3	39	1.00	18	457	15	381	1	20	9
WX-200	14.0	53	0.81	22	559	15	381	1	22	10

Available in gray. Use suffix G.



Stand Models

Model Number	Tank Volume		Max. Accept. Factor	A Tank Height		B Tank Diameter		C Sys. Conn. Centerline		D Stand Diameter		System Conn. (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	mm	In	mm	In	Lbs	Kg
WX-201	14.0	53	0.81	25	635	15	381	1 19/32	40	12	304	1	25	11
WX-202	20.0	76	0.57	32	813	15	381	1 19/32	40	12	304	1	33	15
WX-202XL	26.0	98	0.44	39	991	15	381	1 19/32	40	12	304	1	36	16
WX-203	32.0	121	0.35	47	1194	15	381	1 19/32	40	12	304	1	43	20
WX-205	34.0	129	1.00	30	762	22	559	1 15/16	49	20½	521	1¼	61	28
WX-250	44.0	167	0.77	36	914	22	559	1 15/16	49	20½	521	1¼	69	31
WX-251	62.0	235	0.55	47	1194	22	559	1 15/16	49	20½	521	1¼	92	42
WX-255	81.0	306	0.41	57	1448	22	559	1 15/16	49	20½	521	1¼	103	47
WX-252*	86.0	326	0.39	62	1575	22	559	1 15/16	49	20½	521	1¼	114	52
WX-302	86.0	326	0.54	47	1194	26	660	2 1/16	52	20½	521	1¼	123	56
WX-350	119.0	450	0.39	62	1575	26	660	2 1/16	52	20½	521	1¼	166	75



*WX-252: Maximum Working Pressure: 100 PSIG. Available in Blue only. Available in Tan and Gray. Use suffix T or G.

All dimensions and weights are approximate.

Job Name ______________________ Notes ______________________

Engineer ______________________ ______________________

Contractor ______________________ ______________________

P.O. No. ______________________ ______________________

Sales Rep. ______________________ ______________________

Model No. ______________________ ______________________

NSF CERTIFIED TO NSF/ANSI 61

ISO 9001:2008 REGISTERED

MADE IN USA

LOW-LEAD IAPMO R&T

ANTIMICROBIAL PROTECTION

TURBULATOR

Amtrol Inc., 1400 Division Road, West Warwick, RI 02893 USA T: 401.884.6300 **www.amtrol.com**

MC 4400 (01/15)

WELL-X-TROL®

Diaphragm Well Tanks: WX-100, 200 and 300 Series with DuraBase®

AMTROL

150 PSIG Working Pressure

Construction

Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator™
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Performance

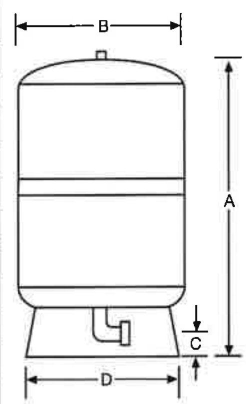
Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7 Year

Application

- Controls pump cycling in residential well water systems.
- Can be installed indoors or outdoors.
- DuraBase stand is rugged and will never corrode. Patent Pending.

Stand Models

Model Number	Tank Volume		Max. Accept. Factor	A Tank Height		B Tank Diameter		C Sys. Conn. Centerline		D Stand Diameter		System Conn. (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	mm	In	mm	In	Lbs	Kg
WX-201D	14.0	53	0.81	25	635	15	381	1 11/16	43	15 3/8	391	1	25	11
WX-202D	20.0	76	.057	32	813	15	381	1 11/16	43	15 3/8	391	1	33	15
WX-202XLD	26.0	98	0.44	39	991	15	381	1 11/16	43	15 3/8	391	1	36	16
WX-203D	32.0	121	0.35	47	1194	15	381	1 11/16	43	15 3/8	391	1	43	20
WX-205D	34.0	129	1.00	30	762	22	559	2	51	22	559	1 1/4	61	28
WX-250D	44.0	167	0.77	36	914	22	559	2	51	22	559	1 1/4	69	31
WX-251D	62.0	235	0.55	47	1194	22	559	2	51	22	559	1 1/4	92	42
WX-255D	81.0	306	0.41	57	1448	22	559	2	51	22	559	1 1/4	103	47
WX-302D	86.0	326	0.54	47	1194	26	660	2	51	22	559	1 1/4	123	56
WX-350D	119.0	450	0.39	62	1575	26	660	2	51	22	559	1 1/4	166	75



Available in Tan and Gray. Use suffix T or G.

All dimensions and weights are approximate.

Job Name ______________________ Notes ______________________

Engineer ______________________ ______________________

Contractor ______________________ ______________________

P.O. No. ______________________ ______________________

Sales Rep. ______________________ ______________________

Model No. ______________________ ______________________

CERTIFIED TO NSF/ANSI 61

MADE IN USA

LOW-LEAD IAPMO R&T

ANTIMICROBIAL PROTECTION™

TURBULATOR

WELL-X-TROL®

Diaphragm Well Tanks: Underground, Wall Hung and Pump Stand Series

AMTROL®

150 PSIG Working Pressure

Construction

Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator™
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Performance

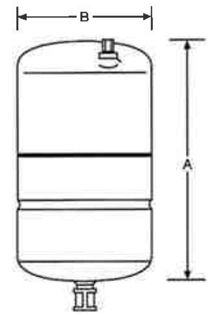
Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7 Year

Application

• Controls pump cycling in residential well water systems.

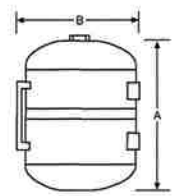
Undergound Models (BLACK)

Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Diameter		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-200UG	14	53	0.81	23	584	15	381	1	22	10
WX-202UG	20	76	0.57	30	762	15	381	1	30	14
WX-250UG	44	167	0.77	33	838	22	559	1¼	60	27
WX-251UG	62	235	0.55	44	1118	22	559	1¼	83	38



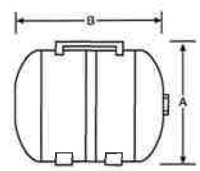
Wall Hung Model for VFD Systems

Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Diameter		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-102VFD	4.4	17	0.55	15	381	12	305	¾	13	6



Pump Stand Models

Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Width		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-102PS	4.4	17	0.55	12	305	15	381	¾	13	6
WX-105PS	5.3	20	0.80	12	305	18	457	¾	15	7
WX-110PS	7.4	28	0.56	12	305	23	584	¾	18	8
WX-200PS	14.0	53	0.81	16	406	22	559	1	29	13
WX-202PS	20.0	76	0.57	16	406	30	762	1	35	16
WX-202H	20.0	76	0.57	16	406	30	762	1	33	15



All dimensions and weights are approximate.

Job Name ____________ Notes ____________

Engineer ____________

Contractor ____________

P.O. No. ____________

Sales Rep. ____________

Model No. ____________

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MADE IN USA

LOW-LEAD

ANTIMICROBIAL PROTECTION

Amtrol Inc., 1400 Division Road, West Warwick, RI 02893 USA T: 401.884.6300 **www.amtrol.com**

MC 4400 (01/15)

AMTROL

WELL-X-TROL®

Diaphragm Well Tanks: WX-200PA and WX-300PA Series with PRO ACCESS®

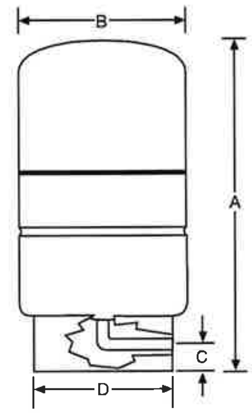
150 PSIG Working Pressure

Construction

Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel NPTF
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator™
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Application

- Controls pump cycling in residential well water systems.
- Can be installed indoors or outdoors.
- PRO ACCESS provides piped to stand convenience for faster installation.



Performance

Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7 Year

Stand Models

Model Number	Tank Volume		Max. Accept. Factor	A Tank Height		B Tank Diameter		C Sys. Conn. Centerline		D Stand Diameter		System Conn. (NPTF)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	mm	In	mm	In	Lbs	Kg
WX-202PA	20.0	76	0.57	32	813	15	381	1 19/32	40	12	304	1	33	15
WX-202XLPA	26.0	98	0.44	39	991	15	381	1 19/32	40	12	304	1	36	16
WX-203PA	32.0	121	0.35	47	1194	15	381	1 19/32	40	12	304	1	43	20
WX-205PA	34.0	129	1.00	30	762	22	559	1 15/16	49	12	304	1¼	61	28
WX-250PA	44.0	167	0.77	36	914	22	559	1 15/16	49	20½	521	1¼	69	31
WX-251PA	62.0	235	0.55	47	1194	22	559	1 15/16	49	20½	521	1¼	92	42
WX-255PA	81.0	306	0.41	57	1448	22	559	1 15/16	49	20½	521	1¼	103	47
WX-302PA	86.0	326	0.54	47	1194	26	660	2 1/16	52	20½	521	1¼	123	56
WX-350PA	119.0	450	0.39	62	1575	26	660	2 1/16	52	20½	521	1¼	166	75

Available in Tan and Gray. Use suffix T or G.

All dimensions and weights are approximate.

Job Name ____________________ Notes ____________________

Engineer ____________________

Contractor ____________________

P.O. No. ____________________

Sales Rep. ____________________

Model No. ____________________

NSF CERTIFIED TO NSF/ANSI 61

MADE IN USA

LOW-LEAD

ANTIMICROBIAL PROTECTION

Amtrol Inc., 1400 Division Road, West Warwick, RI 02893 USA T: 401.884.6300 **www.amtrol.com**

Appendix F – Vessel Tank Weight Calculations

Kongiganak

Pile	Sections	Area SF	Pile Load Pounds
1	1	74.50	16,763
2	2-3	122.67	27,600
3	4-5	122.67	27,600
4	6-7	123.31	27,745
5	8	74.93	16,859
6	9	100.37	22,583
7	10-11	165.26	37,183
8	12-13	165.26	37,183
9	14-15	166.13	37,378
10	16	100.94	22,713
11	17	100.37	22,583
12	18-19	165.26	37,183
13	20-21	165.26	37,183
14	22-23	166.13	37,378
15	24	100.94	22,713
16	25	76.99	17,323
17	26-27	126.77	28,523
18	28-29	126.77	28,523
19	30-31	127.44	28,673
20	32	77.44	17,423
			37,378

IBC ASD Load Combinations

			INPUT
DEAD LOAD	D	=	45
LIVE LOAD	L	=	200
ROOF LL	Lr	=	20
EARTH LOAD	H	=	
FLUID LOAD	F	=	
SNOW LOAD	S	=	40
SEISMIC LOAD	E	=	
WIND LOAD	W	=	-
THERMAL	T	=	
RAIN LOAD	R	=	

Bristol
ENGINEERING SERVICES CORPORATION

IBC - ASD - LOAD COMBINATIONS.XSLS
PW: Kraig2015

1605.3.1 Basic Load Combinations

MAX = 225

16-8	D	45
16-9	D + H + F + T	45
16-10	D + H + F + Lr	65
	D + H + F + SL	85
	D + H + F + R	45
16-13	D + H + F + .75 (W) + 0.75 (L) + 0.75 (Lr)	210
	D + H + F + .75 (W) + 0.75 (L) + 0.75 (S)	225
	D + H + F + .75 (W) + 0.75 (L) + 0.75 (R)	195
	D + H + F + .75 (0.7 E) + 0.75 (L) + 0.75 (Lr)	210
	D + H + F + .75 (0.7 E) + 0.75 (L) + 0.75 (S)	225
	D + H + F + .75 (0.7 E) + 0.75 (L) + 0.75 (R)	195
16-14	0.6D + W + H	27
16-15	0.6D + 0.7E + H	27

1605.3.2 Alternative Basic Load Combinations

MAX = 285

16-16	D + L + Lr	265
	D + L + S	285
	D + L + R	245
16-17	D + L + (ωW)	245
16-18	D + L + (ωW) + S/2	265
16-19	D + L + S + ωW/2	245
16-20	D + L + S + E/1.4	285
16-21	0.9D + E/1.4	45

Appendix G – Seismic Design Parameters

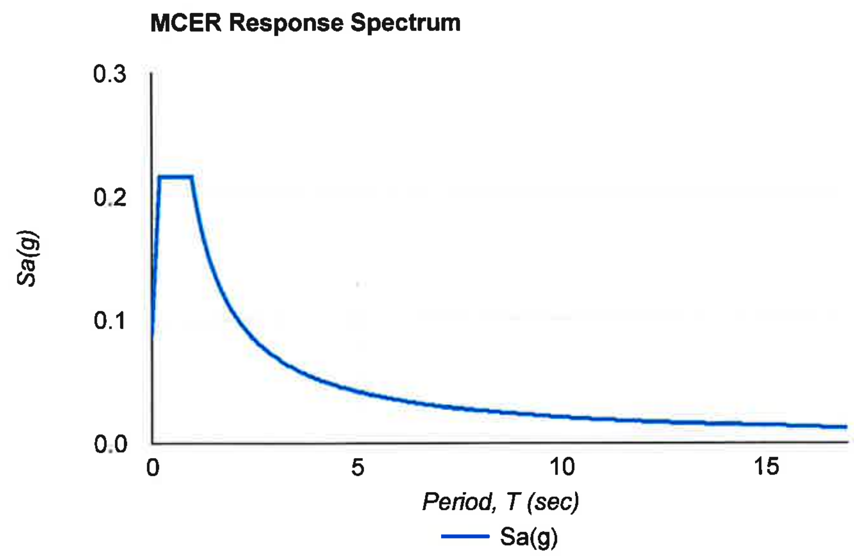
OSHPD

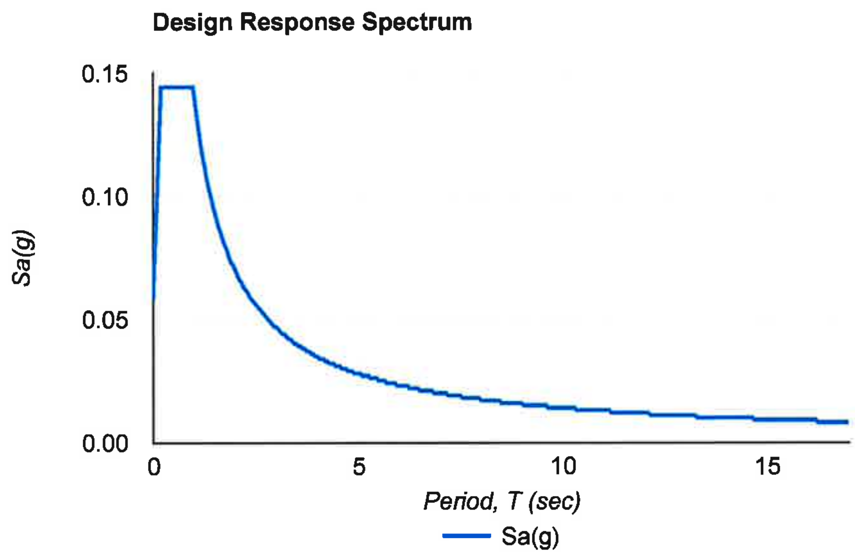
Latitude, Longitude: 59.959630556, -162.888272222

Date	6/19/2019, 4:25:47 PM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	0.135	MCE_R ground motion. (for 0.2 second period)
S_1	0.087	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.216	Site-modified spectral acceleration value
S_{M1}	0.209	Site-modified spectral acceleration value
S_{DS}	0.144	Numeric seismic design value at 0.2 second SA
S_{D1}	0.14	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	C	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.052	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.084	Site modified peak ground acceleration
T_L	16	Long-period transition period in seconds
SsRT	0.135	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.133	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.087	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.088	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	1.02	Mapped value of the risk coefficient at short periods
C_{R1}	0.992	Mapped value of the risk coefficient at a period of 1 s





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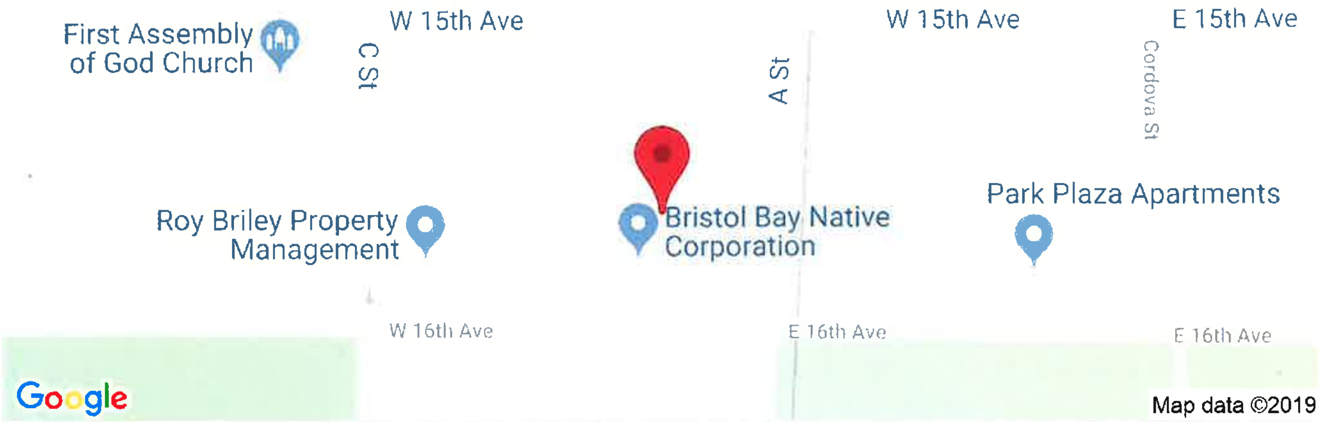
OSHPD

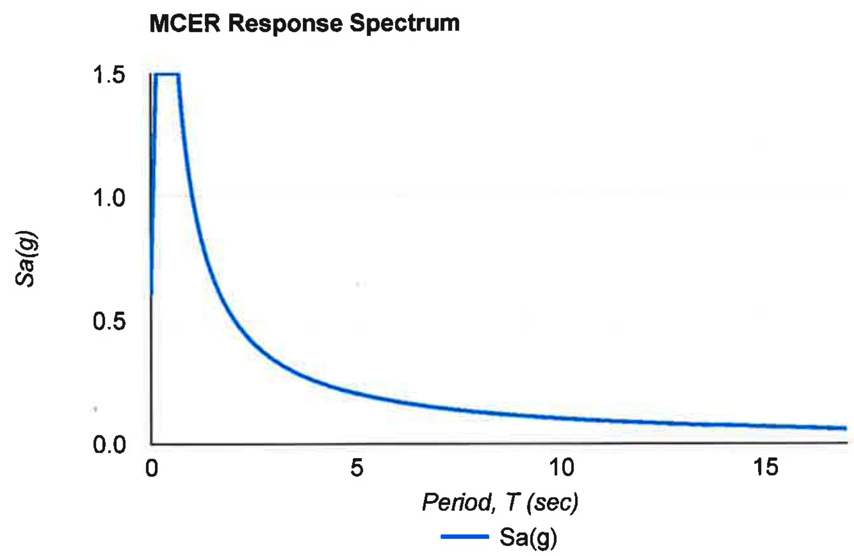
Latitude, Longitude: 61.206730556, -149.88432222



Date	6/19/2019, 4:30:57 PM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.5	MCE_R ground motion. (for 0.2 second period)
S_1	0.677	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.5	Site-modified spectral acceleration value
S_{M1}	1.015	Site-modified spectral acceleration value
S_{DS}	1	Numeric seismic design value at 0.2 second SA
S_{D1}	0.677	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	1.5	Site amplification factor at 1.0 second
PGA	0.5	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.5	Site modified peak ground acceleration
T_L	16	Long-period transition period in seconds
SsRT	1.894	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.703	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.832	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.801	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.677	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	1.113	Mapped value of the risk coefficient at short periods
C_{R1}	1.038	Mapped value of the risk coefficient at a period of 1 s


MCER Response Spectrum
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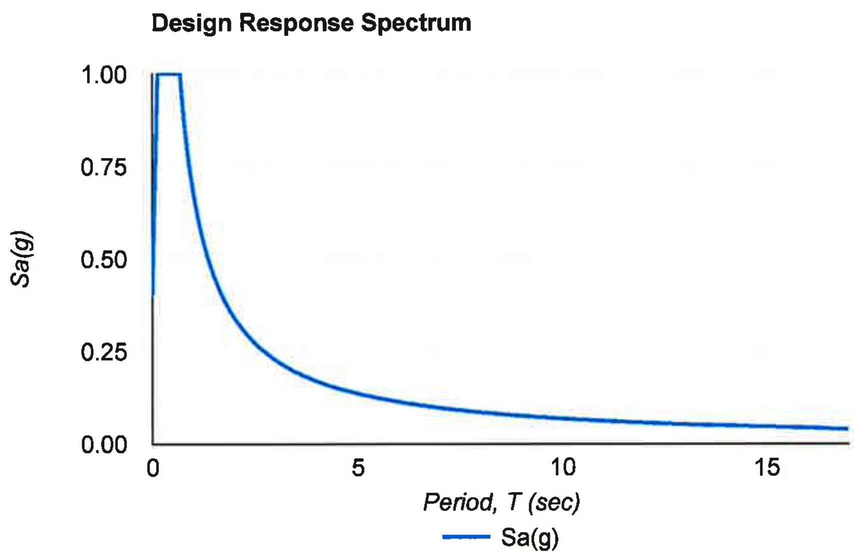
1.0
0.5
0.0
Sa(g)
0
5
10
15
Period, T (sec)
Sa(g)


Design Response Spectrum
1.00
0.75
0.50
0.25
0.00
Sa(g)
0
5
10
15
Period, T (sec)
Sa(g)

Appendix I: Regulatory Compliance

ADEC Drinking Water Compliance Summary

ADEC Operator Certification Estimates

ADNR Water Rights

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Monitoring Summary for KONGIGANAK WATER SYSTEM

Public water system ID#AK2271025 **Population: 539** **March 11, 2019**

Community Water System, Surface water

	Requirement	Sample Point ID	Required Sampling Frequency	Last Sample	Next Sample
	Sanitary Survey		Every 3 years	10/10/2017	2020
DISTRIBUTION SYSTEM W/ COIN OP FILL SITE (Facility ID:DS001)					
	COLIFORM (TCR)	SPDS001TCR	1 sample(s) monthly	01/31/2019	Monthly, according to Sample Siting Plan
	TTHM & HAA5 (DBP2)	-See below-	1 sample(s) annually	12/13/2018	See stage 2 sampling detail information below
INTAKE - LAKE (ALSO FOR PWS 271245) (Facility ID:IN001)					
	E. COLI	SPIN001	2 sample(s) monthly		Sample according to approved LT2 source sampling plan
DIRECT TREATMENT W/ CHLORINATION (Facility ID:TP001)					
	SOC	SPTP001	1 sample(s) quarterly	11/07/2003	Quarterly, until complete SOC waiver request and fee is submitted and approved
	VOC	SPTP001	1 sample(s) annually	08/11/2015	Overdue; Collect ASAP
	NITRATE	SPTP001	1 sample(s) annually	12/13/2018	2019
	TOTAL GROSS ALPHA	SPTP001	1 sample(s) per 9 year cycle	06/08/2007	Overdue; Collect ASAP
	ARSENIC - SINGLE	SPTP001	1 sample(s) per 9 year cycle	12/05/2008	Between 2011 and 2019
	INORGANICS	SPTP001	1 sample(s) per 9 year cycle	04/11/2013	Between 2020 and 2022 (Sample in first period of each 9 year cycle)
	RADIUM 226 AND 228	SPTP001	1 sample(s) per 9 year cycle	12/13/2018	Between 2026 and 2034

Stage 2 Sampling Detail Information - Sample frequency listed in requirements above				
Contaminant	**Sample Pt. ID**	**Location**	**Sample Count**	**Sample Dates**
DBP2	SPDS1DBP2-1	WATERING POINT	1	December 2019

Operator Report				
Requirement	**Location**	**Sampling Frequency**	**Last Report**	
TURBIDITY	After Filters	Monitor continuously record results every 4 h on the hour mark N when not filtering	10/01/2016	Test and record daily. Send reports to ADEC on the last day of the month (before the 10th day of the following month).
CHLORINE	Distribution System	Same time/place as routine TCR sample, record results on report	01/01/2019	
CHLORINE	Entry Point	2 samples daily, when making water, keep chlorine above 0.2 mg/L	10/01/2016	

Compliance Schedules			
		Due	Comments
Emergency Preparedness Regulation			
	EPR-PMP CERTIFICATION	08/20/2013	CWS serving population of less than 1,000 persons, required to complete a Priority Measures Plan (PMP).
Lead/Copper Exceedance Schedule			
	PBCU EXC SCHED - ST DESIGNATE OPT WQP		
	PBCU EXC SCHED - STATE DESIGNATE OCCT		
	ENF-PUB NOTICE SUBMITTAL	05/31/2013	Need Tier 2 PN within 30 days after the system learns of Copper Action Level violation.
	PBCU EXC SCHED - WQP TESTING	06/30/2013	
	PBCU EXC SCHED - SOU WATER TESTING	06/30/2013	
	PBCU EXC SCHED - TT REC/DESK TOP STUDY	12/31/2013	Within 6 months of copper exceedance, need to submit treatment recommendation/desktop study.
Public Notice			
	PN-MAIL/HAND DELIVER NOTICE TO CONSUMERS	07/01/2014	Notify consumers with Tier 3 PN (CCR in 2014) regarding NOV issued to PWS due to failure to monitor regulated contaminants. Also, include date of closure of NOV upon achieving NOV monitoring requirements. - LVS
Consumer Confidence Report			
	CCR - SUBMITTAL	06/30/2019	
	CCR - CERTIFICATION PAGE	09/30/2019	

**NSF = No sample found

1) Periods are three years in length. The current period is 1/1/2017 - 12/31/2019 and the next period will be 1/1/2020 - 12/31/2022. Cycles are nine years in length. The current cycle is from 1/1/2011 - 12/31/2019 and the next cycle is 1/1/2020 - 12/31/2028.
2) Periods for radionuclides (gross alpha, radium 226/228, and uranium) are three or six years in length. The current 6 year period is 01/01/2014 - 12/31/2019, the next 6 year period will be 01/01/2020 - 12/31/2025. Cycles for radionuclides are nine years in length. The current cycle is from 01/01/2017 - 12/31/2025 and the next cycle is 01/01/2026 - 12/31/2034.
3) WL (well) or TP (treatment plant) is the entry point to the distribution system, except for raw water samples and WL (well) is the raw water tap. DS (distribution system) is the home and buildings that receive water from a piped water system.
4) Water quality parameters are tested in order to conduct a corrosion control study. Please contact your engineer, health corporation, or certified laboratories for assistance.
5) Lead/Copper samples on an annual or 3 year schedule should be collected in month of warmest water temperature.
6) Water systems with multiple water sources that do not combine before entering the distribution must take one sample from each entry point to the distribution and may do a composite sample according to 18AAC80.325(17), 18AAC80.315(4).
7) SOC waiver renewal forms are due every three year period. SOC waiver, new and renewal, forms can be found at http://www.dec.alaska.gov/eh/dw/publications/forms.html.
8) Each public water system is required to have a water operator (or operators) certified at or above the drinking water treatment and drinking water distribution level assigned to the system. To check on current level of certification for your water operator please see the Alaska Certified Water/Wastewater Operator Database maintained by the Division of Water: https://dec.alaska.gov/Applications/Water/OpCert/Home.aspx?p=OperatorSearch. If you have questions regarding the water system level or the operator certification level please contact Operator Certification at 907-465-1139 or at dec.water.fco.opcert@alaska.gov.

Monitoring summaries reflect sampling information the Drinking Water Program receives from certified laboratories and public water systems. If you notice any errors in this data, please contact your local ADEC Drinking Water Program office. Public water systems are responsible for compliance with monitoring requirements.

Monitoring summary completed by , Environmental Program Specialist/ADEC. If you have any questions please contact ADEC at (907) 269-7518 or 1-866-956-7656 Email: Fax: (907) 269-7650.

Sincerely,

Environmental Program Specialist

SYSTEM DESIGN CALCULATIONS: DRINKING WATER

OPERATOR CERTIFICATION LEVEL ESTIMATE

Based on 18 AAC 74 (11/26/16) - Contact DEC Op Cert for official determination.

Treatment Certification Level Required

Small Untreated	No Chemicals Added	*Not identified by point sum below.*
Small Treated	1 Chemical Only	*Not identified by point sum below.*
Water Treatment 1:	1-30 points	
Water Treatment 2:	31-55 points	
Water Treatment 3:	56-75 points	
Water Treatment 4:	76 points +	

SYSTEM: Kong (no pretreatment, pH adjustment)

DATE: 9/9/2019

PROCESS TYPE	PROCESS VALUE	POINTS	COMMENTS
Delete or add duplicate lines for processes as needed:			
Size/Peak Day Capacity (gpd)	less than 10,000	1	3,000 gpd in 2018 PER
Water Supply Source	SW	6	
Pretreatment	None	0	Assume no pre-filter bags
Corrosion Control	None	0	No pH adjustment at this time
Sorption	None	0	
Activated Carbon	None	0	
Chemical Oxidation	None	0	
Coagulation	Coagulant/floc/filter aid	3	
Rapid Mix Units	In-line static mixers	0	
Flocculation	None or Inline	0	Count tank as wide pipe
Sedimentation/Clarification	None	0	
Package Plant (coag/mix/floc/sedt)	None	0	
Filtration	Granular Media	8	
Fluoridation	None	0	
Disinfection	Liquid/powdered hypochlorites	3	
Finished Water Storage	Water storage tank for CT	3	
WTP Wastewater/Residuals	WW-Sewer/Offsite Connection	0	
Other	Pressure tanks	0	
	Total WTP Point Estimate:	**24**	**Water Treatment Level 1**

SYSTEM DESIGN CALCULATIONS: DRINKING WATER

OPERATOR CERTIFICATION LEVEL ESTIMATE

Based on 18 AAC 74 (11/26/16) - Contact DEC Op Cert for official determination.

Treatment Certification Level Required

Small Untreated	No Chemicals Added	*Not identified by point sum below.*
Small Treated	1 Chemical Only	*Not identified by point sum below.*
Water Treatment 1:	1-30 points	
Water Treatment 2:	31-55 points	
Water Treatment 3:	56-75 points	
Water Treatment 4:	76 points +	

SYSTEM: Kong with pretreatment and pH adjustment

DATE: 9/9/2019

PROCESS TYPE	PROCESS VALUE	POINTS	COMMENTS
Delete or add duplicate lines for processes as needed:			
Size/Peak Day Capacity (gpd)	less than 10,000	1	3,000 gpd in 2018 PER
Water Supply Source	SW	6	
Pretreatment	RF - Cartridge	2	Roughing Filters
Corrosion Control	pH Adjustment	3	pH adjustment for corrosion control
Sorption	None	0	
Activated Carbon	None	0	
Chemical Oxidation	None	0	
Coagulation	Coagulant/floc/filter aid	3	
Rapid Mix Units	In-line static mixers	0	
Flocculation	None or Inline	0	Count tank as wide pipe
Sedimentation/Clarification	None	0	
Package Plant (coag/mix/floc/sedt)	None	0	
Filtration	Granular Media	8	
Fluoridation	None	0	
Disinfection	Liquid/powdered hypochlorites	3	
Finished Water Storage	Water storage tank for CT	3	
WTP Wastewater/Residuals	WW-Sewer/Offsite Connection	0	
Other	Pressure tanks	0	
	Total WTP Point Estimate:	**29**	**Water Treatment Level 1**

Results - Case File Abstract

Summary

File: LAS 23946

Customer: 000041396 KONGIGANAK VILLAGE OF
PO BOX 5069
KONGIGANAK AK 995595069

Case Type: 801 WATER RIGHTS **DNR Unit:** 800 WATER

File Location: WANC WATER MGT-ANCHORAGE

Case Status: 36 CERTIFICATE ISSUED **Status Date:** 11/22/2004

Total Acres: 0.000 **Date Initiated:** 08/20/2002

Office of Primary Responsibility: WANC WATER MGT-ANCHORAGE

Last Transaction Date: 02/24/2009 **Case Subtype:** SUR SURFACE

Last Transaction: CHGSTCD CASE STATUS CODE CHANGED

Land Records

Meridian: S **Township:** 002S **Range:** 079W **Section:** 27 **Section Acres:** 0

Case Actions

08-20-2002 **APPLICATION RECEIVED**

STATUS 10	10	APLN RECEIVED
DATA ENTERED BY	KKL	

USE OF 3,600 GPD FOR 90 UNPLUMBED HOMES, VILLAGE OF KONGIGANAK, SM, T3S, R80W, SEC32.

12-30-2002 **STATUS CODE STANDARDIZED**

STATUS CODE	11	APLN/INITIAL STATUS

****** STATUS CODE STANDARDIZATION ******
STATUS CODE CHANGED BY BATCH UPDATE

04-14-2003 **SUMMARY RECORD DATA CHANGED/CORRECTED**

OFF PRIM RESPONS	WANC	WATER MGT-ANCHORAGE

CHANGED THE OFFICE OF PRIMARY RESPONSIBILITY TO NEW CODES

10-26-2004 **ADD LAND SECTIONS TO CASE**

THIS LAND IS	Y	PART OF ORIGINAL CAS

INITIAL LOCATION INCORRECT. THIS IS CORRECT LOCATION

10-26-2004 **ADD LAND SECTIONS TO CASE**

THIS LAND IS	Y	PART OF ORIGINAL CAS

10-26-2004 **STATUS PLAT UPDATE REQUESTED**

ATTACHMENTS SENT (Y,N):	N	NO

CORRECTED WATER TAKE POINT ON 26 OCTOBER 2004

11-22-2004 **ISSUE/APPROVE/ACTIVE AUTHORIZATION**

EFFECTIVE DATE	11-22-2004	
STATUS 35	35	ISS/APPRV/ACTV AUTH

AUTHORIZATION TYPE	CERT	WTR RGHT CERTIFICATE
PERMIT AND CERTIFICATE OF APPROPRIATION ISSUED.		

***11-24-2004* STATUS PLAT UPDATE REQUESTED**

ATTACHMENTS SENT (Y,N):	N	NO
CERTIFICATE ISSUED		

***05-16-2005* STATUS PLAT UPDATED**

REQUESTED TRANSACTION:	SPU	STATUS PLAT UPDATED
ACTION TAKEN:	C	COMPLETED

***05-16-2005* STATUS PLAT UPDATED**

REQUESTED TRANSACTION:	SPU	STATUS PLAT UPDATED
ACTION TAKEN:	C	COMPLETED

***02-24-2009* CASE STATUS CODE CHANGED**

STATUS CODE:	36	CERTIFICATE ISSUED
FIXED STATUS CODE THAT WAS CHANGED DURING STATUS CODE STANDARDIZED		

Legal Description

THE LOCATION TO WHICH THIS WATER RIGHT IS APPURTENANT: KONGIGANAK PUBLIC WATER SUPPY AND DISTRIBUTION SYSTEM, LOCATED WITHIN E1/2 SECTION 32 AND W1/2 SECTION 33, TOWNSHIP 2 SOUTH, RANGE 79 WEST, SEWARD MERIDIAN, OF THE BELOW-DESCRIBED PARCEL OF LAND:
INTERIM CONVEYANCE NO. 451, DATED NOVEMBER 20, 1981, PURSUANT TO SECTION 14(A) AND 22(J) OF THE ALASKA NATIVE CLAIMS SETTLEMENT ACT OF DECEMBER 18, 1971 (43 U.S.C. 1601, 1613(A), 1621(J)), BETHEL RECORDING DISTRICT, STATE OF ALASKA, SUBJECT TO RESERVATIONS AND EXCEPTIONS OF RECORD.

Appendix J – Calculations

Assumptions and Design Calculations

Major Unit Process Evaluation

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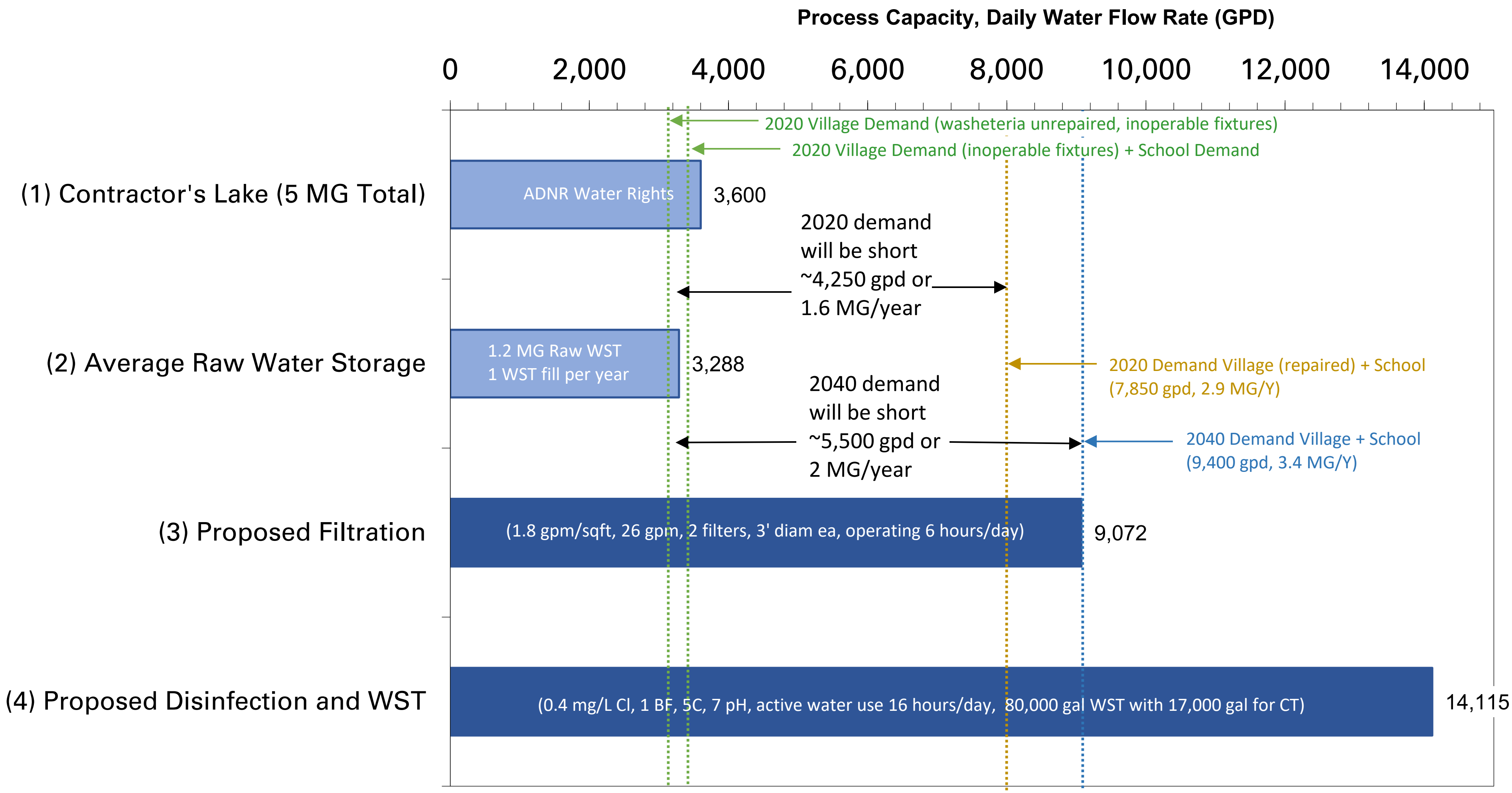
Major Unit Process Evaluation - Kongiganak Water System



The School and Village currently rely on Contractor's Lake for raw water.
Current ADNR Water Rights allow a use rate of 3,600 GPD = 1.3 MG per year, out of a total estimated lake volume of 5 MG.
Raw water storage is 1.2 MG in the Village and another 90,000 gal at the school. Raw water is only accessible seasonally, when raw water line is unfrozen.
The current (2020) Village use rate with unrepaired, inoperable fixtures is 3,500 gpd (1.28 MG/year), and 1,500 gpd for the school (270,000 gal /180 day school year).

NATIVE VILLAGE OF KONGIGANAK WATER TREATMENT SYSTEM DESIGN ANALYSIS REPORT

PROJECT SCOPE

THIS PROJECT PROVIDES THE PRELIMINARY DESIGN OF WATER TREATMENT SYSTEM UPGRADES WHICH ARE NEEDED TO BRING THE SYSTEM INTO COMPLIANCE WITH THE SURFACE WATER TREATMENT RULE (SWTR) AS WELL AS THE LEAD COPPER RULE. THIS REPORT FOLLOWS A 2018 PRELIMINARY ENGINEERING REPORT BY SUMMIT CONSTRUCTION.

A NEW WATER TREATMENT SYSTEM WILL BE PROVIDED THAT MEETS THE SWTR REQUIREMENTS FOR FILTRATION AND DISINFECTION. PH ADJUSTMENT WILL BE INCLUDED TO BRING THE PH UP TO 7. PLASTIC PIPING WILL BE USED IN ALL NEW PIPING. THE EXISTING WATER TREATMENT EQUIPMENT AND WATER STORAGE CONTAINERS WILL BE DEMOLISHED AND REMOVED FROM THE ORIGINAL WTP. A NEW WTP ANNEX HOUSING NEW TREATMENT EQUIPMENT AND (2) NEW TREATED WATER STORAGE TANKS (40,000 GALLONS EACH) WILL BE CONSTRUCTED ON EXISTING PILINGS LOCATED ADJACENT TO THE WTP WHICH WERE LEFT FROM THE OLD RAW WATER STORAGE TANK (538,000 GALLONS).

SITE DESCRIPTION

KONGIGANAK IS AN UNINCORPORATED, TRADITIONAL YUP'IK ESKIMO VILLAGE WITH A SUBSISTENCE LIFESTYLE AND CULTURE. THE RESIDENTS OF THE NATIVE VILLAGE OF KONGIGANAK (VILLAGE) ARE REPRESENTED BY THE KONGIGANAK TRADITIONAL COUNCIL. THE COMMUNITY IS WITHIN THE CALISTA REGIONAL NATIVE CORPORATION.

KONGIGANAK IS LOCATED ON THE KUSKOKWIM RIVER, APPROXIMATELY 2.5 MILES INLAND FROM KUSKOKWIM BAY AND 70 MILES SOUTHWEST OF BETHEL (LATITUDE: 59.9594 LONGITUDE: -162.8871), WITHIN THE YUKON DELTA NATIONAL WILDLIFE REFUGE.

KONGIGANAK IS IN A LOW RELIEF AREA, SURROUNDED BY MARSHY WETLANDS, PONDS, AND MEANDERING STREAMS. THE AREA IS AT RISK OF PERIODIC FLOODING WITH A BASE FLOOD ELEVATION OF 20.7 FEET MEAN LOWER LOW WATER (MLLW) AND A SURGE ELEVATION OF 18.4 FEET MLLW. THE SUBSURFACE CONSISTS OF FINE GRAINED, WARMING PERMAFROST. KONGIGANAK HAS AN ANNUAL AVERAGE TEMPERATURE OF 30.7 DEGREES FAHRENHEIT (F), AN ANNUAL AVERAGE PRECIPITATION OF 21.3 INCHES, AND AN ANNUAL AVERAGE WIND SPEED OF 19.2 MILES PER HOUR (USA.COM).

HOMES IN KONGIGANAK DO NOT HAVE INTERIOR PLUMBING FOR WATER OR WASTEWATER. RESIDENTS SELF-HAUL DRINKING WATER AND AND WASTES USING ALL TERRAIN VEHICLES (ATVS). BUILDINGS ARE GENERALLY CONSTRUCTED ON PILINGS. THERE ARE NO GRAVEL SOURCE AREAS IN KONGIGANAK, SO THERE ARE VERY FEW ROADWAYS. THE COMMUNITY PRIMARILY RELIES ON A BOARDWALK SYSTEM FOR PEDESTRIAN AND ATV TRAFFIC.

2021 KONGIGANAK COMMUNITY WATER SYSTEM

THE KONGIGANAK PUBLIC WATER SYSTEM (PWS) HAS BEEN DESIGNATED AS A COMMUNITY PUBLIC WATER SYSTEM BY THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION (ADEC) DRINKING WATER PROGRAM, WITH A PUBLIC WATER SYSTEM IDENTIFICATION (PWSID) NUMBER OF 271025.

WTP BUILDING

THE CURRENT WTP BUILDING HAS BEEN REPURPOSED AND UNDERGONE MULTIPLE RENOVATIONS SINCE THE BUILDING'S ORIGINAL CONSTRUCTION IN 1978. THE MOST RECENT WATER TREATMENT RENOVATION, COMPLETED IN 1999, INCLUDED A PARTIAL UPGRADE OF TREATMENT COMPONENTS. THE FILTERS WERE RELOCATED TO THE TOP FLOOR OF THE WTP, WITH TREATED WATER STORAGE CONTAINERS LOCATED ON THE FIRST FLOOR. A 2019 STRUCTURAL EVALUATION OF THE WTP (BRISTOL ENGINEERING) INDICATED THAT THE STRUCTURAL SUPPORTS FOR THE WTP ARE CARRYING LOADS THAT EXCEED ALLOWED CAPACITY.

RAW WATER

THE WATER SYSTEM OBTAINS RAW SURFACE WATER FROM CONTRACTOR'S LAKE.

RAW WATER IS TRANSFERRED VIA A SEASONAL TRANSMISSION LINE (9,400 LINEAR FEET, UNINSULATED, 4-INCH DIAMETER, HIGH DENSITY POLYETHYLENE PIPE) WHICH IS INSTALLED ON THE GROUND SURFACE. A 1.2 MILLION GALLON RAW WATER STORAGE TANK IS FILLED AS SOON AS THE TRANSMISSION LINE THAWS IN THE LATE SPRING, AND IS TYPICALLY TOPPED OFF BEFORE THE TRANSMISSION LINE FREEZES IN THE FALL. THE SYSTEM HAS TO OPERATE OFF OF STORED WATER FOR APPROXIMATELY 10-11 MONTHS.

AT THE END OF WINTER THERE IS OFTEN INSUFFICIENT STORED WATER TO MEET DEMAND. THE COMMUNITY HAS REPORTED WATER SHORTAGES AND HAVING TO RATION WATER.

TREATMENT PROCESSES

THE CURRENT TREATMENT SYSTEMS ARE IN POOR REPAIR, WITH MOST COMPONENTS WELL PAST THEIR DESIGN LIFE. THE DIRECT FILTRATION SYSTEM CURRENTLY FILTERS WATER AT 7 GALLONS PER MINUTE (GPM). FILTERED WATER IS STORED IN (61) 165-GALLON CONTAINERS THAT CONNECT TO A BASE MANIFOLD. CHLORINE IS INJECTED INTO A CENTRAL CONTAINER AND DOES NOT DISTRIBUTE THROUGH THE CONTAINERS. THE CURRENT SYSTEM DOES NOT MEET THE DISINFECTION REQUIREMENTS OF THE SWTR.

2021 SERVICE CONNECTIONS

THE KONGIGANAK PWS DOES NOT HAVE A PIPED DISTRIBUTION SYSTEM. WATER IS ONLY PROVIDED TO THE FOLLOWING FACILITIES.

WASHETERIA

RESIDENTS RELY ON THE WASHETERIA FOR ACCESS TO TREATED WATER. THE WASHETERIA IS ATTACHED TO THE WTP AND CONNECTED BY INTERIOR PLUMBING. THE HIGHLY CORROSIVE NATURE OF THE FINISHED WATER HAS CONTRIBUTED TO OBSERVABLE CORROSION IN THE COPPER PIPING IN THE WTP AND WASHETERIA. THE PLUMBED EQUIPMENT WITHIN THE WASHETERIA IS DETERIORATED AND IN POOR REPAIR. A LIMITED NUMBER OF WASHING MACHINES AND SHOWER ROOMS ARE OPERABLE.

RESIDENTS INDIVIDUALLY HAUL TREATED WATER TO THEIR HOMES FROM A COMMUNITY WATERING POINT LOCATED ON THE EXTERIOR OF THE WASHETERIA. WATER IS TYPICALLY HAULED IN 5-GALLON CONTAINERS USING 4-WHEEL ATVS.

OLD SCHOOL

A 3-INCH DIAMETER, HDPE SERVICE LINE WAS CONSTRUCTED BETWEEN THE WTP AND THE OLD SCHOOL. THE OLD SCHOOL CURRENTLY HAS LIMITED USE. HOWEVER THE COMMUNITY HAS PLANS FOR FUTURE, EXPANDED USE. THE NEW HEALTH CLINIC (2020), LOCATED ADJACENT TO THE OLD SCHOOL, IS CONNECTED TO THE EXISTING SCHOOL SERVICE LINE.

HEALTH CLINIC

A NEW HEALTH CLINIC WAS CONSTRUCTED IN 2020. THE CLINIC CONNECTED TO THE EXISTING WATER LINE SERVING THE OLD SCHOOL. THE CLINIC PROVIDES NO DIRECT COMMUNITY ACCESS TO TREATED WATER (NO WATER HAUL POINTS).

AYAGINA'AR ELITNAURVIK SCHOOL WATER SYSTEM

THE AUYAINA'AR ELITNAURVIK SCHOOL WAS CONSTRUCTED IN 2010. THE LOWER KUSKOKWIM SCHOOL DISTRICT (LKSD) CURRENTLY OWNS AND OPERATES A SEPARATE NON-TRANSIENT NON-COMMUNITY PWS (PWSID 271245) WHICH SERVES THE SCHOOL AND TEACHER HOUSING. THE VILLAGE PROVIDES RAW WATER TO THE SCHOOL WITH A RAW WATER TRANSMISSION LINE (4,600 FEET, ARCTIC PIPE). MEMBRANE TREATMENT MODULES (PCI FYNE, NANOFILTRATION) FILTER THE RAW WATER AT A RATE OF APPROXIMATELY 2,300 GPD. WATER IS CHLORINATED AND STORED IN (4) TANKS PROVIDING 2,600 GALLONS OF STORAGE EACH. TREATED WATER IS DISTRIBUTED TO THE SCHOOL AND TEACHER HOUSING.

THE LKSD REPORTS THAT THE 2020-2021 SCHOOL TREATED WATER DEMAND IS APPROXIMATELY 1,500 TO 1,600 GPD, HOWEVER THIS USE RATE MAY HAVE BEEN IMPACTED BY THE PANDEMIC.

2021 COMMUNITY WASTEWATER DISPOSAL LAGOON

A 5-ACRE COMMUNITY LAGOON WAS COMPLETED IN 2008. THE LAGOON RECEIVES PIPED WASTEWATER FROM THE WASHETERIA, OLD SCHOOL / CLINIC, AND NEW SCHOOL, AS WELL AS HAULED HONEY BUCKET WASTES FROM COMMUNITY MEMBERS. THE LAGOON WAS DESIGNED TO DISCHARGE PERIODICALLY (ALASKA GENERAL PERMIT AKG573008). HOWEVER NO DISCHARGES HAVE OCCURRED. IN 2018 MEASUREMENTS TAKEN BY SUMMIT ENGINEERING INDICATED THAT THE LAGOON WAS ABOVE THE MAXIMUM DESIGN OPERATING LEVEL.

2041 KONGIGANAK COMMUNITY WATER SYSTEM

RAW WATER

THE COMMUNITY WILL CONTINUE TO RELY ON CONTRACTOR'S LAKE FOR RAW WATER. THERE WILL BE NO CHANGE TO RAW WATER STORAGE.

TREATMENT PROCESSES

NEW TREATMENT PROCESSES WILL INCLUDE:

* COAGULATION - USING NALCO 8105 COAGULANT
* DIRECT FILTRATION - (2) 36 INCH DIAMETER PRESSURE FILTERS, OPERATED IN PARALLEL AT 24 GPM
* A POLISHING FILTER - (1) MEDIA FILTER, 36 INCH DIAMETER, FOLLOWING PRIMARY FILTRATION
* CHLORINATION - USING CALCIUM HYPOCHLORITE
* PH ADJUSTMENT - USING SODA ASH
* TREATED WATER STORAGE - PROVIDED IN (2) 40,000-GALLON, BOLTED STEEL (INSULATED) TANKS. WITH INLET AND OUTLET SEPARATED TO PROVIDE 0.1 BAFFLE FACTOR (BF)

2041 SERVICE CONNECTIONS

THIS PROJECT DOES NOT INCLUDE OR ASSUME ANY FUTURE EXPANSION OF THE LIMITED COMMUNITY DISTRIBUTION SYSTEM. HOWEVER, SOME CHANGES IN USAGE ARE ANTICIPATED.

WASHETERIA

THE WASHETERIA WILL CONTINUE TO BE THE COMMUNITY'S PRIMARY SOURCE FOR TREATED WATER. BASED ON COMMUNITY SURVEYS AND CURRENT WASHETERIA USE DATA, THE DEMAND FOR WASHETERIA SERVICES EXCEEDS THE CAPACITY OF OPERABLE FACILITIES. ONCE THE WASHERS AND SHOWERS ARE REPAIRED, IT IS EXPECT THAT USE WILL INCREASE TO MEET DEMAND.

OLD SCHOOL

IT IS EXPECTED THAT THE COMMUNITY USE OF THE OLD SCHOOL FOR A PRESCHOOL AND OFFICE AREA WILL CONTINUE. NO ADDITIONAL USES WERE IDENTIFIED OR INCLUDED.

HEALTH CLINIC

IT IS EXPECTED THAT THE NEW TREATMENT SYSTEM WILL CONTINUE TO PROVIDE TREATED WATER TO THE HEALTH CLINIC, AND THAT WATER USE WOULD INCREASE AT THE SAME RATE AS THE PROJECTED POPULATION INCREASE (0.9%, ADOL).

AYAGINA'AR ELITNAURVIK SCHOOL WATER SYSTEM

LKSD SCHOOL REPRESENTATIVES HAVE EXPRESSED INTEREST IN PURCHASING TREATED WATER FROM THE VILLAGE INSTEAD OF RAW WATER. THEREFORE, SCHOOL DEMAND WAS INCLUDED IN THE DEMAND ESTIMATES FOR THE NEW SYSTEM. THE POPULATION GROWTH RATE (0.9%, ADOL) WAS USED TO ESTIMATE THE 2041 SCHOOL POPULATION. A SCHOOL DEMAND OF 10 GPD PER PERSON WAS ASSUMED.

RAW WATER QUALITY (JULY 2019)

COLOR	70 PCU
PH	5.8
TOTAL NITRATE/NITRITE	0.185 MG/L
ARSENIC	BELOW DETECTION LIMIT
IRON	0.75 MG/L
MANGANESE	0.00996 MG/L
CALCIUM	0.282 MG/L
TOTAL DISSOLVED SOLIDS	27 MG/L
LANGELIER INDEX	-5.97 MG/L
HARDNESS	BELOW DETECTION LIMIT
ALKALINITY	BELOW DETECTION LIMIT
TOTAL ORGANIC CARBON	7.22 MG/L
DISSOLVED ORGANIC CARBON	5.96 MG/L
UV 254 ABSORPTION	0.350 CM-1
SPECIFIC UV ABSORBANCE	5.87 (L/MG)-M
RAW WATER TURBIDITY	1.07 NTU

DESIGN CRITERIA

SYSTEM:		
2021 COMMUNITY POPULATION (2018 DCCED CERTIFIED)	539	PEOPLE
POPULATION GROWTH RATE (ADOL)	0.9	%
2041 COMMUNITY POPULATION	645	PEOPLE
2041 SCHOOL POPULATION (STUDENTS AND STAFF)	232	PEOPLE
SOURCE WATER	CONTRACTOR'S LAKE	
ESTIMATED SOURCE WATER VOLUME AVAILABLE	4-5	MG
ADNR WATER RIGHTS (2002, LAS 23946)	3,600	GPD
RAW WATER STORAGE	1.20	MG
STORAGE INTERVAL	10-12	MONTHS
2041 AVERAGE TOTAL DAILY DEMAND	8,800	GPD
2041 MAX TOTAL DAILY DEMAND	10,100	GPD
FILTRATION:		
MINIMUM CRYPTOSPORIDIUM REMOVAL	2	LOG
MINIMUM GIARDIA REMOVAL	1	LOG
MINIMUM VIRUS REMOVAL	2	LOG
HOURS OF FILTER OPERATION PER DAY	6	HOURS
MINIMUM FILTRATION RATE (TOTAL)	24	GPM
NUMBER OF FILTERS	2	
FILTER DIAMETER	42	INCHES
FILTER LOADING RATE	1.70	GPM/SQFT
POLISHING MEDIA FILTER DIAMETER	42	INCHES
GENERATED WASTEWATER :		
BACKWASH (BW)		
NUMBER OF BACKWASHES PER FILTER	1	PER WEEK
FILTERS BACKWASHED (INCLUDING POLISHING FILTER)	3	
BACKWASH LOADING RATE	15	GPM/SQFT
BACKWASH RATE (EA)	106	GPM
BACKWASH INTERVAL (EA)	15	MINUTES
TOTAL BACKWASH VOLUME	4,771	GALLONS
AIR SCOUR LOADING RATE	4	CFM/SQFT
AIR SCOUR RATE (EA)	28	CFM
FILTER TO WASTE (FTW)		
MAXIMUM FTW CYCLES	1	PER WEEK
FILTER TO WASTE RATE (ALL FILTERS SIMULTANEOUSLY)	24	GPM

FILTER TO WASTE INTERVAL	20	MINUTES
FILTER TO WASTE VOLUME	489	GALLONS
TOTAL WASTEWATER GENERATED (BW+FTW)	5,260	GALLONS
CHLORINATION:		
MINIMUM GIARDIA DISINFECTION	1	LOG
MINIMUM VIRUS DISINFECTION	2	LOG
HOURS OF ACTIVE WATER USE	16	HOURS/DAY
PEAKING FACTOR	3	
PEAK HOURLY FLOW FOR CONTACT TIME	14	GPM
MINIMUM REQUIRED VOLUME FOR CONTACT TIME	17,000	GALLONS
GIARDIA DISINFECTION	1	LOG
CHLORINE FREE RESIDUAL	0.30	MG/L
PH	7	
TEMPERATURE	5	CELSIUS
BAFFLE FACTOR	0.10	
TREATED WATER STORAGE:		
DAYS OF TREATED WATER STORAGE	6.5	DAYS
TREATED WATER STORAGE (TOTAL)	80,000	GALLONS
NUMBER OF TANKS	2	
TANK VOLUME (EA)	40,000	GALLONS
TANK DIAMETER	20	FEET
TANK HEIGHT	17	FEET

KONGIGANAK - Water Use Estimates Based on Operator Records, Population, and Typical Use Rates

2021 (Current Estimates) and 2041 (Design Estimates)

(Variables shaded green)

1a. 2021 Domestic Use (Washeteria / Home Haul Water) Estimates, based on current population and operator records

Current Population (2018 DCCED Certified)	539	people	
Current Service Connections	2		New Clinic and Old School Community Center (Washeteria is direct plumbed in connected building)
Average Daily Demand	4,000	gpd	Based on operator info and washeteria calcs(assuming all fixtures repaired)
Calculated Average Demand Per person	7	gal/cap/day	Calculated use, based on use records and population (washeteria + home haul)
Max Daily Demand	5,500	gpd	Based on operator info and washeteria calcs (assuming all fixtures repaired)
Calculated Max Demand Per person	10	gal/cap/day	Calculated use, based on use records and population (washeteria + home haul)
Hours per Day of Water Use / Availability	12	hours	Washeteria hours (based on current system opertions)
Average Total Use Estimate	10.20	gal/cap/day	

1b. 2021 New Services Water Use (Clinic/Community Center/Preschool/Grocery Store) Estimates

Clinic:			Wolf Eye Center in Wasilla uses 350 gpd (32 max workers, 45 patients/day)
New Clinic Patient Population	14	patients	Clinic has waiting room seating for 10? Maybe one doctor / four nurse?
New Clinic Per Cap Demand	15	gal/cap/day	Clinic Estimate EPA: 10 gal/person (Seems low, doesn't take into account kitchen/laundry… morgue)
New Clinic - Total Daily Demand	210	gpd	
Community Center:			
Old School Community Center Pop	15	people	
Old School Community Center Demand	5	gal/cap/day	Visitor Center EPA: 5 gpd/visitor UPC Dance halls: 5 gpd/person
Old School - Community Center Total	75	gpd	
Preschool:			
Old School - Preschool Pop	20	kids+staff	School estimtate EPA: 10 gal/person (no cafeteria / no gym);
Old School - Preschool Per Cap Demand	10	gal/cap/day	School estimate from CRUM: 10 gpd/person
Old School - Preschool Total	200	gpd	
Grocery:			
Grocery Staff:	5	people	Assumes no bathroom use by public.
Grocery Per Cap Demand:	13	gal/cap/day	
Grocery Total	65	gpd	
New School:			
New School pop	194	kids+staff	Ayagina'ar Elitnaurvik, LKSD website:https://kongiganak.lksd.org/about (174 students, 27 total staff, but not all present at same time)
School Per Cap Demand	10	gal/cap/day	1,500-1,600 gpd average including teacher housing over week (wastewater adds another 20%) - relayed by VSW from LKSD
Estimated use based on pop and standard	1,940	gpd	
Metered Use (from LKSD)	1,550	gpd	1,500 - 1,600 gpd (during pandemic, less school use)

New School - Estimated Total	1,940	gpd	max of estimated vs metered
Total Additional Water Use	**2,490**	**gpd**	

Peak Hourly Flow (with additional water use)

Hours per day Active Water Use	12		washeteria currently open 8-10 hours per day, most days. Watering point has full access.
Total Avg Flow	6,490		Existing average use (1a) + New use (1b)
Peaking Factor	3		
Peak Hourly Flow	27.04	gpm	

2021 Total Max Water Use Estimate: Domestic (1a) + New Use (1b) - rounded:
8,000 GPD

2a. 2041 Domestic Use (Washeteria/Home Haul Water) Estimates with increases in daily water use (gpd), based on improved wq and repaired fixtures.

2040 Design Pop	645	people	0.9% growth rate (ADOL)
Estimated Avg Demand Per person	9	gal/cap/day	assume avg water use increases with improved access to washeteria and improved water quality.
Estimated Average Daily Demand	5,805	gpd	Equates to a ROUGH demand (for time estimates to fill tank) of 13 gpm or 770 gph, over 24 hrs.
Estimated Max Demand Per person	11	gal/cap/day	assume avg water use increases with improved access to washeteria and improved water quality.
Estimated Maximum Daily Demand	7,095	gpd	Rough estimate based on population and modest increases in water use (gpd).

2b. 2041 New Added Water Use (Clinic/Community Center/Preschool/School) Estimates based primarily on increased population

Clinic:			Wolf Eye Center in Wasilla uses 350 gpd (32 max workers, 45 patients/day)
New Clinic Patient Population	20	patients	Clinic has waiting room seating for 10? Maybe one doctor / four nurse?
New Clinic Per Cap Demand	15	gal/cap/day	Clinic Estimate EPA: 10 gal/person (Seems low, doesn't take into account kitchen/laundry… morgue)
New Clinic - Total Daily Demand	300	gpd	
Community Center:			
Old School Community Center Pop	20	people	
Old School Community Center Demand	5	gal/cap/day	Visitor Center EPA: 5 gpd/visitor UPC Dance halls: 5 gpd/person
Old School - Community Center Total	100	gpd	
Preschool:			
Old School - Preschool Pop	30	kids+staff	School estimtate EPA: 10 gal/person (no cafeteria / no gym);
Old School - Preschool Per Cap Demand	10	gal/cap/day	School estimate from CRUM: 10 gpd/person
Old School - Preschool Total	300	gpd	
Grocery:			
Grocery Staff:	5	people	Assumes no change
Grocery Per Cap Demand:	13	gal/cap/day	

Grocery Total	65	gpd	
New School:			
New School pop	232	kids+staff	Increase based on population increase of 0.9% over 20 years
School Per Cap Demand	10	gal/cap/day	
Estimated use based on pop*demand	2,320	gpd	
Total Additional Water Use	**3,020**	**gpd**	

Peak Hourly Flow (with additional water use)

Hours per Day of Water Use / Availability	16	hours	Expanded washeteria hours
Total Avg Flow	8,825		Existing average use (2a) + New use (2b)
Peaking Factor	3		
Peak Hourly Flow	27.58	gpm	Use peak hourly = 28 gpm

2041 Total Max Water Use Estimate: Domestic (2a) + New Use (2b) - rounded:
10,100 GPD

3. 2041 Domestic Use - assuming expanded production, providing approximately 40 gpd/capita, in addition to washeteria / school use.

2040 Design Pop	645	people	
Expanded Water Consumption	40	gpd/person	limited water use, with limited home plumbing
Total Estimated Per Cap Demand	25,800	gpd	based on design population
Washeteria (washing machines access)	5	gpd/person	assume each person requires 1 load (35 gal) of laundry per week, approx 5 gpd (showers at home)
Total Washeteria	3,225	gpd	
Possible Future Piped Demand Estimate	**29,025**	**gpd**	This matches well with original design estimate for piped systems (28,800 gpd), by Montg Watson

Peak Hourly Flow

Hours per Day of Water Use / Availability	20	hours	With home plumbing, water would be used over broader amount of time.
Total Avg Daily Flow	32,045	gpd	with piped homes and new added connections (2b)
Average Flow Rate	27	gpm	Approximately equal to design filtration rate. So would have to run continuously, or add another filter (reserve space in design)
Peaking Factor	3		
Peak Hourly Flow	80	gpm	Could still reasonably provide 1 log treatment if chlorinate at 0.7 mg/L, reserve 20,000 gal for CT.

Adequate raw water availability is the biggest limiting factor in the current system, at current demand estimates, as well as future demand estimates.

Kongiganak WTP - New Surface Water Treatment System

I. Direct filtration and chlorination, followed by treated water storage

Chemical dosage / storage and direct filtration system would be added in new WTP annex, behind existing WTP. Existing WTP would be used for office space, and continue to house pressure tanks and distribution pumps for system.
Treatment would consist of:

Coagulation (Nalco 8105) > Filtration (2 gpm/sqft max) > Polishing filter (organic removal) > WST (1 log Giardia Inactivation) > Service

2040 Avg Daily Demand	8,800	gpd	from demand estimates (includes village and new school)
2040 Max Daily Demand	10,100	gpd	

a. Direct Filtration

Filtration

Mininum Giardia Log Removal	1	log	Assumes 1 log from disinfection
Minimum Virus Log Removal	2	log	Assumes 2 log from disinfection
Filter Production Hours per Day	6	hours	Leave some time for filter maintenance, backwash etc, and replenishing WST
Min Filtration Rate (total)	24	gpm	Based on avg daily demand and hours of operation per day
Number of Filters	2		Split filter flow evenly across 2 filters, 3rd filter is a polishing filter
Filter Diameter	42	inches	
Filter Area	9.62	sq ft	
Resulting Filter Loading Rate	1.27	gpm/sqft	ANTHC recommends 1 gpm/sqft, engineering standards say 1-4 gpm/sqft. In this case high level of organic would favor lower rate. This assumes filters operated in parallel.

Backwash

Max Number backwashes per filter per day	1		filters and polishing tank backwashed in series, all in same day
Number of Filters	3		included polishing filter, which would also be backwashed
Backwash Rate (ea)	15	gpm/sqft	
	144	gpm	
Backwash Interval (ea)	15	min	each filter
Backwash Volume (per filter)	2,165	gallons	per filter
Backwash Volume (all filters)	6,494	gallons	for 2 filters and the polishing filter
Air Scour Rate	4	cfm/sqft	
	38	cfm	Include air scour in the polishing filter

Filter to Waste

Max FTW cycles per day	1		
Filter to Waste Rate	24	gpm	should be same as design flow, FTW in parallel
Filter to Waste Interval	20	min	
Filter to Waste Volume	489	gallons	

Total Wastewater Discharge Per Cleaning Cycle (BW+FTW)	6,983	gal	includes all fiters
Total Wastewater Discharge Interval Per Cycle	65	min	All wastewater would be generated within this time frame.

Number of Daily Cleaning Cycles per Week	1		To estimate treated water storage volume needed
BW Surge Tank			Backwash two filters. Wait if needed before next bw of polishing filter.
Volume	5,000	gal	
	668	cuft	
Height or Length	8	feet	to leave room for air gap and piping -- discharge into top of surge tank.
Unit Area	84	sqft	
Radius	5.16	feet	
Diameter	10.31	feet	
b. Oxidation of Organics with KMnO4			
Design Flow (from above)	24	gpm	total filter flow
Detention Time	14	minutes	for KMnO4 to dissolve
Volume Detention Needed	342	gallons	
	46	cuft	
Diameter of Detention Chamber	12	inches	
Unit Area	2	sqft	per foot of pipe
Needed Length of Detention Chamber	19	feet	
b. Chlorination for Giardia/Viruses			
Mininum Giardia Log Removal	1	log	Assumes 2 log from filtration
Minimum Virus Log Removal	2	log	Assumes 2 log from filtration
Typical Hours of Active Water Use	16	hours/day	Flow from treated water tank
Peaking Factor	3		
Peak Hourly Flow (for CT)	28	gpm	Avg flow * PF = (GPD/HoursPD/60Min)*PF
Minimum required contact volume (reserved for CT)	17,000	gal	From CT Calc tab (0.4 mg/L chlorine dosage, 7 pH, 5C, 1 log inactivation), this is worst case (pH was lower in field tests)
c. Treated Water Storage			
Days of finished water storage	6.5		ANTHC recommends 7-ish days, but have raw water storage to offset needs. Need at least 3 days storage so operators don't have to work weekends or holidays.
Min Treated water tank volume	80,000	gallons	= Rounded (Days*Max Demand + Pro-rated Backwash + CT Reserve)
Number of Tanks	2		Use multiple filters to spread load on old pilings
Tank Sizing (ea)			
Total Tank Volume Needed	40,000	gallons	
	5,348	cuft	
Tank Diameter	20	feet	
Area per foot of height	314	sqft	
Min height to achieve volume	17	feet	APPROX 2,350 GALL PER FOOT

Consider Fire Flow

			Check to see how fire flow compares to WST volume
Fire Flow Rate	500	gpm	Typical rural flow = 500, Typical urban flow = 1,500
Fire Duration	120	min	Typical fire suppression event = 120 min
Fire Flow Volume Needed	60,000	gallons	Is of same magnitude as treated water storage

Kongiganak WTP - CT Estimates

CT CALCULATOR *ENTER DATA IN SHADED CELLS*		CASE 1	CASE 2	CASE 3
(0 to 25° C)	**Water Temperature** (° C)	**5.0**	**5.0**	**5.0**
(6.5-8.5)	**pH**	**6.0**	**6.0**	**7.0**
(NLT .2)	**Free Chlorine Residual** (mg/l)	**0.30**	**0.30**	**0.40**
(0 to 3)	**Log Inactivation** Required	**1.0**	**1.0**	**1.0**
	CT = Log Inactivation* 5.057 * e$^{(a+b+c)}$			
	a = -0.0693 *temp	(0.35)	(0.35)	(0.35)
	b = 0.361* pH	2.17	2.17	2.53
	c = 0.113 * Free Cl Residual	0.03	0.03	0.05
	REQUIRED CT (min*(mg /liter))=	**32**	**32**	**47**
	Required Contact Time (min) = CT / (Free Cl Residual) =	**108**	**108**	**117**
	Achieved CT	36	NA	49
	Design Flow Rate (gpm)	**14**	**28**	**28**
	CT Storage Volume (gal)	**17,000**	**17,000**	**17,000**
	Baffle Factor (0.1 to 1.0)	**0.1**	**0.2**	**0.2**
Effective Storage (gal) = (Storage * Baffle Factor)		1,700	3,400	3,400
Storage Time (min) @ Flow Rate = Eff. Storage / Des Flow Rate		121	121	121
Excess contact time (mins) = (Storage Time - Contact Time)		14	14	4
Achieved Inactivation		1.13	1.13	1.04

Note: Excess Contact Time must be positive under all operating conditions!

Kongiganak WTP - Virus Inactivation Estimates

Case 1	Case 2	Case 3		
1,700	3,400	3,400	effective volume (gal)	Uses tank info from CT Calc tab
121.4	121.4	121.4	Contact Time (min)	
36.4	36.4	48.6	CT achieved (mg/L-min)	
10.0	10.0	10.0	CT required (mg/L-min)	From EPA SWTR Guidance Table below (4 log)
3.6	3.6	4.9	Inactivation ratio at 4-log	
14.6	14.6	19.4	Log Achieved virus inactivation (extrapolated)	Plenty of inactivation (need at least 4)

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TABLE E-7

CT VALUES FOR
INACTIVATION OF VIRUSES BY FREE CHLORINE(1)

	Log Inactivation					
	2.0		3.0		4.0	
	pH		pH		pH	
Temperature (C)	6-9	10	6-9	10	6-9	10
0.5	6	45	9	66	12	90
5	4	30	6	44	8	60
10	3	22	4	33	6	45
15	2	15	3	22	4	30
20	1	11	2	16	3	22
25	1	7	1	11	2	15

Population Growth

Beginning Year:	2021	
Begining Population:	539	
Years:	20	
Growth Rate (%):	0.009	growth rate / 100
End Year:	2041	
End Population:	645	= beginning pop * (1+rate of growth)^years

Appendix K – Supplemental Information

Water Treatment Plant Equipment Inventory

Existing Water Treatment Process Operator Instructions

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KONGIGANAK WATER SYSTEM EQUIPMENT INVENTORY
WATER TREATMENT EQUIPMENT

ITEM	NAME	LOCATION	DESCRIPTION	MAKE	MODEL	SIZE	STATUS	NOTES
WT1	Raw Water Intake Raft	Contractor Lake	Supports floating intake for raw water.	Wood			Active (seasonally)	
WT2	Raw Water Transfer Pump	Contractor Lake	Mobile pump, used at the lake during pumping. Stored in WTP when not in use.			120 GPM	Active (seasonally)	Portable, used seasonally to start flow from Contractors Lake (then Fire Pump is used for transfer).
WT3	Transfer Pump Generator/ Fuel Tank	Contractor Lake	Provides power to transfer pump.				Active (seasonally)	
WT4	Raw Water Transmission Line	Contractor Lake to WTP	Above ground, used seasonally (when line is thawed).	HDPE	4"	9,400 LF	Active (seasonally)	Transmission line between Contractor Lake and 1.2M-gal raw water storage tank.
WT5	Raw Water Storage Tank	WST	Bolted steel tank.			1.2M-GAL	Active	Provides raw water for treatment year-round, to Community and School. Filled seasonally from Contractor's Lake. Takes about 2 weeks to fill (runnining 24/7).
WT6	Raw Water Service Line to School	WTP to School	School maintains separate water treatment system.	HDPE with quick connect.			Active	Used year-round.
WT7	Roughing Bag Filter Housing System 1: 8-micron	WTP, 2nd Floor	Housing for 8-micron filter	Knight Corporation	RK Series		Housing only, no bag in use.	Roughing Filter System 1: 8 micron followed by 5 micron. System 1 in parallel with Filter System 2.
WT8	Roughing Bag Filter Housing System 1: 5- micron	WTP, 2nd Floor	Housing for 5-micron filter	Knight Corporation	RK Series, KHG 525 P2SSL		Housing only, no bag in use.	Roughing Filter System 1: 5 micron filter.
WT9	Roughing Bag Filter Housing System 2: 8-micron	WTP, 2nd Floor	Housing for 8-micron filter	Knight Corporation	RK Series		Housing only, no bag in use.	Roughing Filter System 2: 8 micron followed by 5 micron. System 1 in parallel with Roughing Filter System 2.
WT10	Roughing Bag Filter Housing System 2: 5-micron	WTP, 2nd Floor	Housing for 5-micron filter	Knight Corporation	RK Series, KHG 525 P2SSL		Housing only, no bag in use.	Roughing Filter System 2: 5 micron filter.
WT11	Floc Tank	WTP, 2nd Floor	Steel, coagulant contact tank / floc tank			3-FT DIA. X 5.5-FT	Active	immediately after coagulation, prior to media filtration.
WT12	Media Filter 1	WTP, 2nd Floor	Media Filter (1st in series).			3-FT DIA. X 5.5-FT, 7gpm Design Flow	Active	In series with Media Filter 2. Limited headspace for access for media replacement / maintenance. Windows at bottom of vessel. No air scour system.
WT13	Media Filter 2	WTP, 2nd Floor	Media Filter (2nd in series).			3-FT DIA. X 5.5-FT, 7gpm Design Flow	Active	In series with Media Filter 1. Limited headspace for access for media replacement / maintenance. Windows at bottom of vessel. No air scour system.
WT14	Finished Bag Filter Housing 1	WTP, 2nd Floor	Housings for 1-micron filters	RP Products (Ronninger-Petter) Phone:616-273-1612	Series HPM		Housing only, no bag in use. 5 micron bag specified in design.	Protozoa Filter (not rated for removal credit), in parallel with Finished Filter 2. Current SWTR rule requires 1 micron bag filter system, with 3rd party verification.
WT15	Finished Bag Filter Housing 2	WTP, 2nd Floor	Housings for 1-micron filters	RP Products (Ronninger-Petter) Phone:616-273-1612	Series HPM		Housing only, no bag in use. 5 micron bag specified in design	Protozoa Filter (not rated for removal credit), in parallel with Finished Filter 1. Current SWTR rule requires 1 micron bag filter system, with 3rd party verification.

WT16	Chemical Feed Pump 1: Polymer Injection	WTP, 2nd Floor	Dosage unknown.	Milton Roy LMI	B711-91S	1.6 gph	Active	No static mixer, in-line injection. Flow controlled to Flow Meter 1.
WT17	Polymer Tank Mixer	WTP, 2nd Floor	Nalco 8105	Neptune Chemical Pump Co	NO 7163-6819 Type 63	E46205	1550 RPM 1/20 HP P/N 100783	
WT18	Flow Meter 1	WTP, 2nd Floor	Raw water flow meter, connected to chemical injection pump 1 (coagulation system).	SeaMetrics	06001354 K: P26 ME-100-07		Active	
WT19	Chemical Feed Pump 2: Calcium Hypochlorite Solution	WTP, 2nd Floor	Dosage unknown. Pittclor, 65% calcium hypochorite	Milton Roy LMI	B711-86HV	1.6 gph	Active	No static mixer, in-line injection. Calcium hypochlorite appeared old/oxidized (had eaten through container). Flow controlled to Flow Meter 2.
WT20	Chlorine Tank Mixer	WTP, 2nd Floor		JL Wingert			Active	
WT21	Flow Meter 2	WTP, 2nd Floor	Finished water flow meter, connected to chemical injection pump 2 (chlorination).	SeaMetrics			Active	
WT22	Soda Ash Feed System	WTP, 2nd Floor	Injection pump, mix tank, not in use and disconnected.				Disconnected	Not in Use
WT23	Treated Water Storage Tanks	WTP, 1st Floor	61 EA - plastic	Norwesco (appear to be NSF 61 plastic tanks)		165-GAL	Active, Does not provide required disinfection contact time.	61 tanks total, approx 7,500 - 8,000 gallon total usable capacity. Issues with algae buildup in tanks.
WT24	Turbidimeter "A" with HACH PS1201 (power supply)	WTP, 2nd Floor	Coagulated water turbidity	HACH	1720D		Active, Obsolete, approx 20 years old, no longer supported by HACH	Appears to be recording coagulated water. Turbidimeter feed lines in closed conduit, so difficult to follow.
WT25	Turbidimeter "B" with HACH PS1201 (power supply)	WTP, 2nd Floor		HACH	1720D		In-Active, Obsolete, approx 20 years old, no longer supported by HACH	Not sure where this is reading from. Turbidimeter lines in closed conduit, so difficult to follow.
WT26	Turbidimeter "C" with HACH PS1201 (power supply)	WTP, 2nd Floor	Individual Filter Effluent turbidity	HACH	1720D		Active, Obsolete, approx 20 years old, no longer supported by HACH	Appears to be Filter Effluent reading after Filter 1 (IFE 1). Note, filters are operated in series, there is no CFE.
WT27	Turbidimeter "D" with controller	WTP, 2nd Floor	Not sure controller is operable	HACH	1720C		In-Active, Obsolete, approx 30 years old, no longer supported by HACH	According to labels on lines, this is connected to treated water after protozoa bags, immediately prior to chlorination. Conduit makes it difficult to confirm.
WT28	Turbidimeter "E" with controller	WTP, 2nd Floor	Not sure controller is operable	HACH	1720C		In-Active, Obsolete, approx 30 years old, no longer supported by HACH	According to labels on lines, this is connected to raw water feed, before roughing filters. Conduit makes it difficult to confirm.
WT29	AquaTrend Interface	WTP, 2nd Floor	Display/Controller for Turbidimeters A, B, C (could possible include D and E?)	HACH	AquaTrend / SOM		Active, Obsolete, approx 20 years old, no longer supported by HACH	
WT30	Heat Exchanger	WTP, 1st Floor	Raw Water	Doucette Industries, Inc.	CSZ2MI/IP-4SCC (F) HP		Presumed Operational	Unsure if single or double wall.

WT31	Heat Exchanger	WTP, 1st Floor	School Raw Water	Doucette Industries, Inc.	CSY3M1.51P-4-SCN(F) HP		Abandoned in place. Available for re-use.	Vented double wall, tube-in-tube construction.
WT32	Fire Pump	WTP, 1st Floor	Centrifugal Fire Pump	A-C Pump/ITT Industries	Type 1580	2.5X2.5X7F Inline TL 83, 150 GPM, 95 PSI	Presumed Operational	Also used to pump raw water from Contractors lake to WST when valved to be in series.
WT33	Treatment Pump	WTP, 1st Floor	Transmits water from raw WST through treatment system	Goulds Pump with Baldor Motor	3656S	1.5X2-8, 2 HP	Operational, insufficient at low tank levels	Pump has insufficient NPSH to operate correctly at WST levels below 8'. To pump at low tank levels connects treated water line to pump via hose bib to prime pump.
WT34	Backwash Pump	WTP, 1st Floor	Backwashes from treated water storage tanks. Typical backwash about 5-7 minutes (until water clears). Operator doesn't typically run a filter to waste rinse.	Goulds Pump with Baldor Motor	3BFK1	4.78" Impeller, 3 HP	Active	No blower/air scour system. Backwash performed on each filter (one at a time), when pressure differential gets close to 10 psi.
WT35	Pressure Pump 1	WTP, 1st Floor	Low flow distribution pump, 1.5 HP	Grundfos	CR4-30 U-G-A-AUUE	22 GPM, 110 FT HD	Inoperable	Pump was inoperable.
WT36	Pressure Pump 2	WTP, 1st Floor	High flow distribution pump, 3 HP	Grundfos	CR5-7 A-B-A-E-HQQE	30 GPM, 170 FTHD	Active	
WT37	Pressure Tank #1	WTP, 1st Floor	Water pressure tank	Amtrol	WX-252	86 gal	Active	
WT38	Pressure Tank #2	WTP, 1st Floor	Water pressure tank	Amtrol	WX-252	86 gal	Active	
WT39	Pressure Tank #3	WTP, 1st Floor	Water pressure tank	Amtrol	WX-252	86 gal	Active	
WT40	Pressure Tank #4	WTP, 1st Floor	Water pressure tank	Amtrol	WX-252	86 gal	Active	
WT41	Treated Water Service Line to Washeteria/Watering Point	WTP / Washeteria						WTP piping is copper, with significant corrosion observable. Community watering point with coin dispenser.

KONGIGANAK WATER SYSTEM EQUIPMENT INVENTORY
MECHANICAL EQUIPMENT

ITEM	NAME	LOCATION	DESCRIPTION	MAKE	MODEL	SIZE	STATUS	NOTES
M1	Domestic Hot Water Heater	Washeteria Mech Room	Oil fired, 68 gal, 199 MBH input hot water heater	Bock	72E	68 gal	Active	Temperature setpoint at 165 degrees. Should have tempering valve installed. Active corrosion occurring at piping connections.
M2	Washeteria Boiler	Washeteria Mech Room	Oil fired, 4.6 GPH input, cast iron boiler. Serves clothes dryers only.	Bryan	D650-W-FDO	2.10 GPH	Active	Sooted flue.
M3	Washeteria Boiler Expansion Tank	Washeteria Mech Room	Expansion tank for heating system.	Amtrol	SX90V		Active	Not ASME, which is required for the boiler's 45 psi PRV.
M4	Washeteria Boiler Pump	Washeteria Mech Room	Primary boiler heating loop pump.	Grundfos	UPS 32-160F, Speed 3		Active	
M5	Clothes Dryer Coil Pumps	Washeteria Dryer Access	Secondary loop pumps serving individual heating coils.	Grundfos	UP 26 64F		Active	Pump for Dryer 4 had field wiring and an extension cord.
M6	Dryer Make-up Air Unit Pumps	Washeteria Mech Room	Inline pumps	Grundfos	UP 26 64F		Active	Primary/Backup configuration. Manual switching.
M7	Washeteria Heating Terminal Unit Pumps	Washeteria Mech Room	Inline pumps	Grundfos	UPS 32-80F, Speed 3		Active	
M8	Dryer Make-Up Air Unit	Washeteria Mech Room	Hydronic make-up air unit	McQuay	CAH008FHAC		Active	
M9	WTP Boilers	WTP Mech Room	Oil fired, 2.10 GPH input, cast iron boiler. Space heating and add-heat system.	Burnham	PV77WT-GBWF2S	2.10 GPH	Active	
M10	WTP Boiler Pumps	WTP Mech Room	Boiler circuit pump	Grundfos	UP 26 99F		Active	
M11	WTP Boiler Expansion Tank	WTP Mech Room	Expansion tank for heating system.	Amtrol	SX-90 and 60		Active	Two of each tank model, for total of four tanks, attached to system.
M12	Day Tank	WTP Mech Room	Fuel oil storage tank for WTP boilers	Simplex	SST 25-C	25 gal	Active	
M13	Heat Exchanger	WTP Mech Room	Brazed plate heat exchanger for "waste" heat system.	Ameridex	Ser# 93211B		Active	
M14	WTP Heating Plant Distribution Pumps	WTP Mech Room	Duplex set of pumps in a primary/back-up configuration	Grundfos	UPS 32-80F, Speed 3		Active	
M15	Ventilation Fan Pump	WTP, 2nd Floor	Secondary loop pump that serves the ventilation fan unit	Grundfos	UPS 15-42F		Active	
M16	Ventilation Supply Fan	WTP, 2nd Floor	Provides ventilation and heat distributioin in WTP process area	Trane	T.3		Presumed Operational	One fan assembly had been removed.

TO MAKE WATER WITH FILTER TANKS IN SERIES

Repeat back when shut off.

1.) Check chemical levels, mix if necessary.
2.) Open valve #1
3.) ~~Open valve #2~~
4.) Open valve #3
5.) Open valve #5
6.) Open valve #11
7.) Open valve #13
8.) Open valve #16
9.) Turn on filter pump.
10.) Check turbidity.
11.) Test water and record.
12.) After water is made, close all valves.

TO MAKE WATER WITH FILTER TANKS IN PARALLEL

1.) Check chemical levels, mix if necessary.
2.) Open valve #1
3.) Open valve #2
4.) Open valve #3
5.) Open valve #7
6.) Open valve #11
7.) Open valve #4
8.) Open valve #13
9.) Open valve #16
10.) Turn on filter pump.
11.) Check turbidity.
12.) Test water and record.
13.) After water is made, close all valves.

TO BACKWASH FILTER TANK #1

1.) Check water level in storage tanks.
2.) Close valve #3 **(VERY IMPORTANT)**
3.) Close valve #16 **(VERY IMORTANT)**
4.) Open valve #10
5.) Open valve #8
6.) Open valve #6
7.) Turn on backwash pump.
8.) Run backwash until wastewater is **clear**. (Approx. 5-10 minutes)
9.) Turn off backwash pump.
10.) Rinse filter.

TO RINSE FILTER TANK #1

1.) Close valve #8
2.) Open valve #9
3.) Open valve #7
4.) Close valve #6
5.) Open valve #4
6.) Open valve #15
7.) Turn on backwash pump.
8.) Run pump until wastewater is **clear**. (Minimum rinse 5 minutes)
9.) Turn off backwash pump and close all valves.

TO BACKWASH FILTER #2

1.) Check water level in storage tanks.
2.) Close valve #3 **(VERY IMPORTANT)**
3.) Close valve #16 **(VERY IMPORTANT)**
4.) Open valve #10
5.) Open valve #12
6.) Open valve #14
7.) Turn on backwash pump.
8.) Run backwash until wastewater is **clear**. (Approx. 5-10 minutes)
9.) Turn off backwash pump.
10.) Rinse filter.

TO RINSE FILTER TANK #2

1.) Close valve #12
2.) Open valve #9
3.) Open valve #13
4.) Close valve #14
5.) Open valve #11
6.) Open valve #15
7.) Turn on backwash pump.
8.) Run pump until wastewater is **clear**. (Minimum rinse 5 minutes)
9.) Turn off backwash pump and close all valves. important