DESIGN ANALYSIS REPORT
FINAL REVIEW DRAFT

Water Treatment Plant / Washeteria Upgrades, Kongiganak, Alaska

September 2019

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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)

1. Executive Summary

1.1. Scope

The Kongiganak Water Treatment Plant / 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. In 2018, a Preliminary Engineering Report was completed by Summit Consulting Services, Inc. that addressed the aging sanitation systems and noted deficiencies in the lagoon, and Water Treatment Plant / Washeteria. However, the scope of Summit's initial site inspections did not include the water treatment systems, and did not include a structural evaluation of the Water Treatment Plant / Washeteria building and foundation, or the mechanical/electrical systems serving the building. An additional engineering design study was recommended.

This Design Analysis Report provides additional detail on the WTP / Washeteria, including an evaluation of the existing systems and recommendations to address noted deficiencies. Two site inspections were conducted to provide needed information. A structural / geotechnical field inspection was conducted by Bristol Engineering Company LLC, and Golder Inc. on June 20-21, 2019 to evaluate the structural loadings under the current WTP / Washeteria use, as well as the impact of warming subsurface temperatures on the load bearing capacity of support pilings, and to evaluate the reuse of the old pilings that had supported the original Water Storage Tank. A second site inspection was conducted by Bristol Engineering Company LLC, and EDC Inc., on July 23, 2019, to evaluate the civil, mechanical, and electrical aspects of the WTP / Washeteria and collect water samples. Findings of these inspections are included in this report. The full field reports have been provided under a separate cover.

Water treatment processes, structural/geotechnical components, and electrical and mechanical systems are addressed in this report. Wastewater generated during the water treatment process must be safely discharged without damaging existing wastewater systems, or exceeding any operational or design limitations. Therefore, estimations of the wastewater generated in the water treatment process are included, along with a brief discussion of associated wastewater disposal concerns that could potentially impact existing systems. A full discussion of wastewater system and washeteria equipment, including deficiencies and recommendations, is covered in the recent PER (*Preliminary Engineering Report, Summit Consulting Services, Inc., June 12, 2018).*

This Design Analysis Report is not intended to duplicate the subject matter of the 2018 PER completed by Summit, although there are some limited areas of overlap with added detail.

1.2. Findings

The existing WTP/Washeteria is in an extremely poor state of repair due to age, changes in use that have resulted in structural deficiencies, and overuse, due to the limited facilities available to the community. These deteriorated systems are not correctable by routine maintenance.

Specifically:

- The WTP is at risk of catastrophic structural failure putting the safety of the public at risk, as well as putting the community at risk of losing their public water system and access to treated drinking water.
- The water treatment systems do not meet minimum Surface Water Treatment rule requirements, and do not provide pH adjustment to address the highly aggressive water quality and associated high copper levels in the system. The system is not in compliance with the Lead and Copper Rule.
- The existing treated water storage is not sufficient to simultaneously meet community demand, effective filter backwash requirements, and disinfection contact time. The current treated water tank system has areas that never receive any chlorination, and are experiencing issues with algae accumulation.
- The raw water has high organic levels. If the filtration system is not sufficiently effective at removing the organics, the final water quality will be subject to disinfection by-product issues, if an effective chlorination system is implemented.
- There are multiple issues increasing the cross-connection risk within the system, which is particularly problematic because of the ineffective chlorination system. These issues include the poor condition of the building plumbing, and the need to prime the transfer pump from the raw water storage tank using treated water storage.
- The Washeteria has experienced significant failure of its domestic water piping system due to aggressive water chemistry. This leakage has led to having only two operating water closets and two operating showers to serve the entire community. Both operating showers have holes in their surrounds which increases the possibility of mold and rotting of structural components.
- Two of the original three phase powered clothes washers were replaced with 120 volt units. Extension cords are hung through the facility in a wet environment to serve these two units. This is a hazardous installation.

1.3. Recommendations

This section provides an overview of recommendations which are discussed in more detail in Sections 7 and 8.

1.3.1. Existing WTP/Washeteria – Short Term Modifications

Little can be done to address the significant water treatment deficiencies without substantial new equipment. However, there are some opportunities to improve public health and safety with the existing system. The following modifications are listed in order of priority.

1. Immediately stabilize the structure of the system to prevent a critical failure.
2. Replace the domestic water piping system serving the Washeteria restroom and shower areas and provide all new plumbing fixtures in the Washeteria.
3. Re-implement pH adjustment (Soda Ash).
4. Have 120 volt circuits extended to new clothes washers to remove the unsafe extension cord installation.
5. Add a mesh strainer on the raw water transmission line to help control organics in the raw WST.
6. Although not an infrastructure modification, it is recommended that a fresh supply of calcium hypochlorite be obtained for the system.

1.3.2. WTP/Washeteria Modifications to Address System Deficiencies

The existing water treatment equipment is obsolete and undersized for the current population and associated design flow rates. The existing system is not capable of making a sufficient supply of water to meet the daily needs of the current population, and is not sufficient to meet the needs of a future population.

The following modifications would be needed to fully address the water treatment deficiencies, and provide adequate minimal Washeteria / Water Haul services to the community. These services assume no expanded water demand that would be associated with a much needed Washeteria expansion.

- Use the existing pilings, from the old WST, to support a new modular WTP addition and treated water storage tank(s) that would include:
  - (1) 25,000-gallon treated water storage tank (if operating in batch mode), supported by the existing piers; or
  - (2) 25,000-gallon treated water storage tanks (if operating in continuous mode), supported by the existing piers; and
  - (2) 48-inch diameter media filters housed in a 14’ x 45’ modular building, supported by existing piers; and
  - New chemical mixing / injection equipment (chlorine, coagulant); and

- New online monitoring and process control equipment (including turbidimeters and streaming current detectors).

2. Introduction

2.1. 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).

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 Water Treatment Plant (WTP) / Washeteria and the school. The WTP provides treated drinking water to the community watering point, as well as to laundry and shower facilities. 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 Water Storage Tank (WST), but owns and operates their own water treatment system.

The community WTP building has undergone multiple renovations since its construction in 1978. 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 raw WST (572,000 gallons) with the construction of a new raw WST (1.2 million gallons, completed in 2008). An enclosed, coin operated, community watering point was added to the WTP building exterior in 2009.

Exhibit 2-1: Kongiganak WST, WTP/Washeteria, and old WST pilings (2019).

2.2. 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. The 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 (Kongnignanohk) River.

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 Exhibit 2-2), west of the airport.

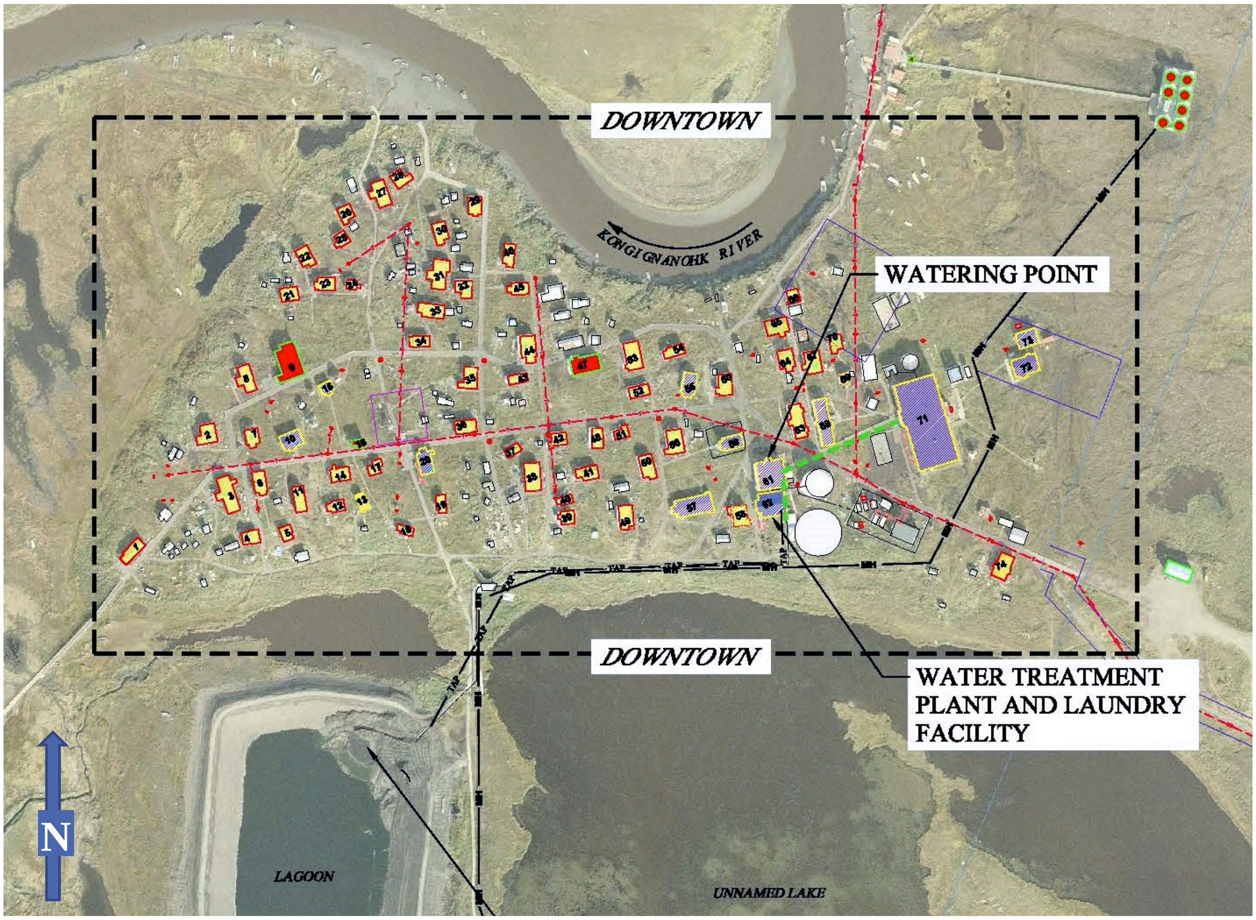


Exhibit 2-2: Kongiganak WTP/Washeteria Location (*Preliminary Engineering Report Final Draft, Kongiganak AK, Summit Consulting Services, Inc., June 12, 2018*).

2.3. 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 (http://www.usa.com/kongiganak-ak-weather.htm).

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 community is at risk from 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.

2.4. 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, which was the basis for the 20-year design population of 613 people (using a 0.9% growth rate). 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 2038 population (approximately 20-year design life), of 644 people, based on a 0.9% growth rate.

2.5. Sanitation Facilities

2.5.1. Drinking Water

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. As discussed in this report, this system is not in compliance with surface water treatment requirements and does not provide water that meets minimum safe drinking water standards.
- Ayagina'ar Elitnaurvik School WTP (PWSID 271245) – This is a non-transient non-community public water system which provides treated water for the school. 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.

2.5.2. Wastewater

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 (*Preliminary Engineering Report Final Draft, Kongiganak AK, Summit Consulting Services, Inc., June 12, 2018*).

2.5.3. Solid Waste

There is no permitted solid waste facility in Kongiganak. An unpermitted dumpsite is located northwest of the community.

3. Regulations

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.

3.1. 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 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 include the following.

3.1.1. 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).

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.

3.1.2. 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 generated through the use of sodium or calcium hypochlorite disinfection 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 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 (approx. 7 mg/L) in the raw water.

3.1.3. 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 ADECs Water Watch website indicate that the system is exceeding the action level for copper (1.39 mg/L).

3.2. 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 1: 1-30 points

Water Treatment 2: 31-55 points

Water Treatment 3: 56-75 points

Water Treatment 4: 76 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. Existing Conditions – Source Water

4.1. Summary

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 (*Design Report, Water Supply and Storage Project, Kongiganak VSW Facility, Kongiganak, Alaska, QUADRA Engineering, Inc., November, 1981*). Four lakes, located with approximately 0.5 miles of 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.

4.2. Source Water

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 (DNR) to withdraw 3,600 gallons per day (issued 2004, LAS 23946, see Appendix B).

Exhibit 4-1: Contractor's Lake (2010)

An Alaska Native Tribal Health Consortium (ANTHC) report (*A Sanitation Facilities Improvement* Project, Project Nos. AN94-A43 & AN99-MO9, 2004) noted that Contractor's Lake did not provide a sufficient volume of raw water, requiring the community and the school to supplement raw water supplies with rain water catchment. The report went on further to state: *"Additional water supply will be needed for the ultimate long-term water needs of the community."* The community population at the time of this report was estimated at 294 people (ANTHC, 2004). The current population is 539, with a 20-year design population of 644 people.

Enhancing the storage volume of Contractor's Lake through dredging and diking has been proposed. The installation of vertical infiltration galleries could also be investigated, for increased seasonal access to raw water, and improved water quality.

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.

4.3. 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. Flow estimates based on the plumbed appliances which were operable during the July 2019 site visit, correlate with operational reports. Flow estimates are fully detailed in Appendix D.

Table 4-1: Kongiganak Washeteria Current 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**

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.

Peak flow for the existing system was estimated as follows.

Average Flow = Daily Flow (gpd) / Washeteria Hours (hours/day) / 60 (minutes/hour)
= 2,724 gpd / 12 hours / 60 minutes
= 4 gpm
Peak Flow = Average Flow * 4 Peaking Factor
= 16 gpm

This peak flow represents the current flows for partially operational appliances. Flow rates for a fully operational system, with improved water quality, would be higher. Future flow estimates, based on water system improvements, are discussed in Section 7.

4.4. Water Quality

The following table provides a summary of water quality test results from samples taken during the July 2019 site visit (lab test results are provided in Appendix C). These results represent a snapshot in time. Water quality would vary with seasons and with time in storage.

Table 4-2: 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
UV 254 Absorption (UVA)	0.350		cm-1
Specific UV Absorbance (SUVA)	5.87		(L/mg)-M
Raw Water Turbidity[1]	1.07		NTU

1. Based on field tests and jar testing in Anchorage lab. Samples taken July 2019. Key contaminants highlighted.
2. Undetected.

The raw water sample results indicate the following.

- The source water is aggressive, with high color and high organics, but relatively low turbidity. 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, enhancing corrosion potential.
- The relatively low level of minerals (iron, manganese) indicates that there would be limited mineral interference for the coagulation process.
- 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.

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.

4.4.1. 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 current coagulant), 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 a slightly higher dosages. Nalco 8185 is less expensive than the Nalco 8105, which could support the use Nalco 8185. The cost savings would depend on water production.

Table 4-3: 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

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.

4.4.2. Chlorination / Disinfection By-Product Assessment

A chlorination assessment was conducted assuming the continued use of calcium hypochlorite (Appendix C). The current chlorine dosage is measured in the initial tank that is being chlorinated. The dosage level would need to be increased in a new chlorination system to a minimum of approximately 2.2 mg/L. This minimal level was used to model disinfection by-product formation, with a worse case time in contact of 8 hours. The filtered water organic concentration was based on the measured reduction in UV Absorbance (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.

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

	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**	72.7 µg/L	12.1 µg/L

1. A pH adjustment was assumed, resulting in a pH of 7.5 for the chlorinated water.
2. The by-product formation model included Bromochloroacetic Acid.

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.

4.4.3. 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.

Table 4-5: Corrosion Control Summary

Raw Water pH (adjusted for temperature)	6.6
Raw Water Dissolved Inorganic Carbon (DIC)	33 mg/L
Soda Ash (Sodium Carbonate, Na2CO3) Dose	38 mg/L
Treated Water pH Estimate	7.58

This system has a 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, because of the deteriorated condition of the piping. However, it would protect appurtenances and better meet minimum drinking water standards which require a pH of 6.5-7.5.

5. Existing Conditions – Water Treatment Plant

5.1. Summary

The following is a description of existing systems, based on the recent site inspections, historical documentation, and information from community representatives (Joseph Mute, Tribal Administrator, and Paul Paul, WTP Operator).

5.2. 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 (provided under a separate cover) includes the following.

- 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 on 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.

Area at risk of catastrophic failure due to second floor filtration equipment.

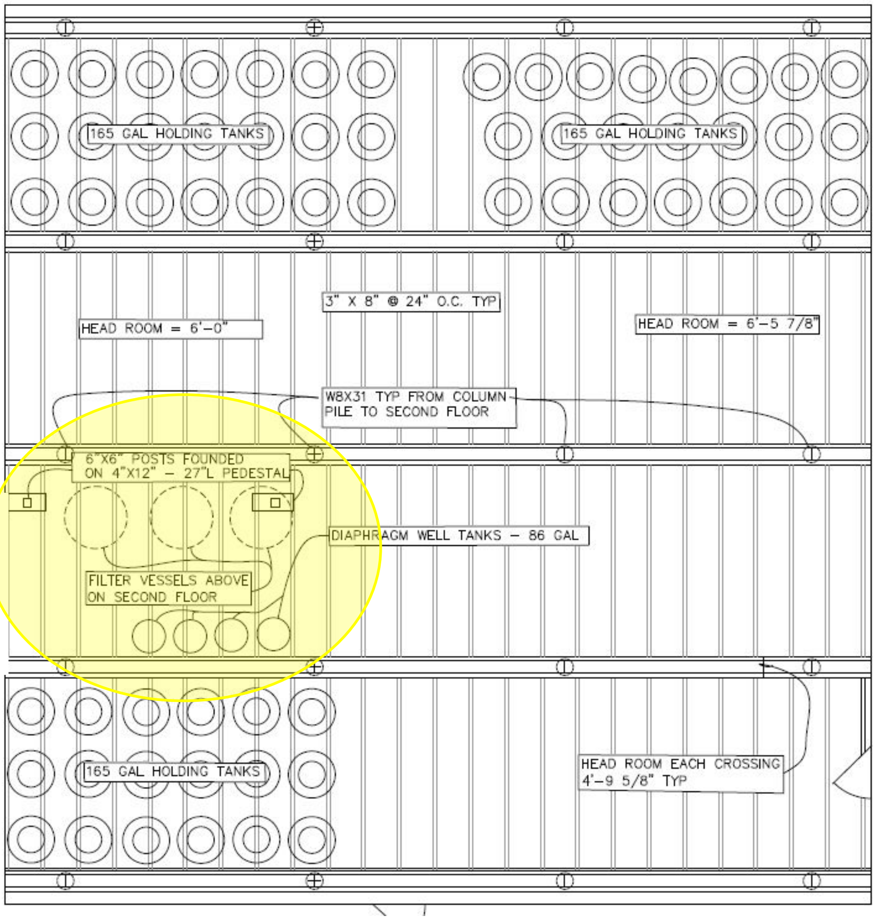


Exhibit 5-1: WTP Loading (plan view)
(Kongiganak Water Treatment Plant and Washeteria, Structural Condition Report, June 2019)

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. The design of a bracing system is currently underway that will 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. These systems need to be moved to an appropriately designed building.

5.3. Water Treatment Systems

A schematic of the existing treatment system is presented on Figure 1 – Existing Water Treatment Process Schematic located 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.

5.3.1. Raw Water

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 million gallon, (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 fire flow 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 an 4-inch high density polyethylene (HDPE) pipe, uninsulated, laying on the surface of the ground. This line is only operational during non-frozen months. This could become more of a concern as water demand increases.

Raw Water Storage

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 water rated pumps, piped in a primary/back-up configuration, divert the raw water through the heat exchanger.

5.3.2. Surface Water Treatment

The WTP building houses all of the water treatment equipment on the second floor of the building. The pressure pumps, 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 is 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 between a treated water system and the raw WST.

Pre-Filters (bags)

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 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 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 seems low, particularly since there is no air scour process. The system is at risk of mudball formation.

The site glasses are installed on the bottom of the filters. 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 primary concern associated with the filters is the lack of adequate structural support in their existing location (as discussed in Section 5.2.), putting the system at risk of critical failure. System failure represents a risk to any people in the building, as well as a loss of community access to treated drinking water.

Protozoa Filters (bags)

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 Surface Water Treatment Rule).

Chlorination

A calcium hypochlorite solution is injected into a single 165-gallon container. 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 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.

5.3.3. 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 5-2: Current Treated Water Storage

The filtered, chlorinated water is added to one of the tanks, which is part of three storage tank groupings (see Figure 1 in Appendix A). The current piping sends the 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 (as compared to the filtration vessels located on the second floor).

5.3.4. Drinking Water Distribution

Service Pumps and Pressure Tanks

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 models WX-252) .

Community Watering Point

The community added a coin operated watering point, accessible in an exterior, drive thru area. The community self-hauls water on privately owned ATVs using individual holding tanks.

5.3.5. WTP Wastewater

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.

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, as discussed in the recent PER (*Preliminary Engineering Report, Summit Consulting Services, Inc., June 12, 2018*). The current water systems generates approximately 1,000 gallons per backwash (which covers both filters).

Exhibit 5-3: Community Watering Point

5.4. 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 results in Water Treatment Level II operator requirements. 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 1 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 of 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 manual controls. The system disinfects filtered water using a solution of calcium hypochlorite.

5.5. Mechanical Systems

5.5.1. 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. Per the Uniform Plumbing Code, all plumbing fixtures in the WTP should have labels stating, “CAUTION: NON-POTABLE WATER, DO NOT DRINK”.

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 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 fresh 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.

5.5.2. High Demand / Fire 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.

5.5.3. 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 strokes 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 add-heat 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.

5.5.4. Ventilation System

The ventilation system for the WTP plant consists of two ventilation systems, each with manually set dampers that mixed 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.

5.5.5. 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.

5.6. Electrical Systems

5.6.1. Building Service

The existing electrical service consists of a 208Y/120 volts, 3-phase overhead utility drop from 25kVA pole mounted transformers. The service equipment, located on the northwest corner of the building, consists of a Current Transformer cabinet with integral meter (meter# 045 0000003) and 400 amp rated service disconnect with 200-amp fuses.

5.6.2 Building Power Distribution

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, 81 amps 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 high flow during times of fire demand. Panel B supports mainly the water treatment system loads including injection pumps, turbidimeters, mixers, etc. The MDP, in addition to panel sub-feeds, 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.

6. Existing Conditions – Washeteria

6.1. Summary

The Washeteria is in a decrepit condition with failing architectural finishes, leaking piping, and broken laundry equipment. 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.

6.2. Operations

The existing facilities are not capable of meeting community demand. If all of the fixtures are repaired and are fully functional, the community would have to share 6 washers (approximately 90 people sharing a single washer), and 4 showers/toilets/sinks (approximately 135 people sharing a single bathroom). A wait list is maintained for washing machines, with limits on loads of laundry. The community is left to find other means to supplement their sanitation needs.

6.3. 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 appears to have been 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.

6.4. Architectural Finishes

Several areas of the resin floor system have failed, 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.

6.5. Mechanical Systems

6.5.1. Domestic Plumbing System

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

As noted under the WTP Mechanical Existing Conditions section, 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.

- The water heater was set at 165 degrees. 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.
- Copper is 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 convert 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 was 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:

- There are 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 are operational, one of those is leaking at the tank seal. The other two were abandoned due to leaking pipes and have been cannibalized for parts.
- All four lavatories are 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 come out that requires ASSE 1070 tempering valves be installed at each public lavatory. The existing fixtures met code at the time of installation.

It was noted in the PER that sewer gases were present in the Washeteria. That was not noticed during our inspection but we 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.

6.5.2. 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 appeared to be in operable condition. Thermostats have been replaced or modified over time and several of them were loose from the wall.

The Washeteria has its original construction, cast iron boiler in its 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-psi pressure relief valve which requires that the expansion tank on the system be ASME rated, which it is not. The boiler flue is fairly sooted. This can be an indicator for 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. 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.

6.5.3. 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.

6.5.4. 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.

6.6. Electrical Systems

6.6.1. Building Service

The existing electrical service consists of a 208Y/120 volts, 3-phase overhead utility drop from the same 25kVA pole mounted transformers that feed the Water Treatment Building. There is an intermediate support pole that raises the incoming conductors to the required height above grade. The service equipment, located on the northeast corner of the building, consists of a 200-amp rated meter base (meter# 045 0000001) with integral 200-amp main circuit breaker.

6.6.2. Building Power Distribution

The service is then fed to a 225-amp rated Main Distribution Panel (MDP) located in the connecting utilidor between the washeteria and water treatment building. The MDP sub-feeds two branch circuit panelboards 'A' and 'B'. The loads supported by panel A are exclusively the washers and dryers within the facility. Panel B supports mainly the general-use receptacles within the washeteria and offices. The MDP, in addition to panel sub-feeds, supports the boiler and dryer circulation pumps, lift station pumps and controls, diesel-fired water heater and dryer exhaust circulation fans. The MDP has no backup connection from a standby power system and therefore these systems will not be functional during an outage.

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

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, currently connected using an extension cord.

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.

7. Water Treatment Plant Recommendations

7.1. Summary

The original WTP building was constructed in 1978 and has repeatedly undergone incremental updates, including the added Washeteria expansion in 2002. None of these updates increased the ability of the system to meet the demand of the community. Some renovations were intended to be temporary when they were constructed almost two decades ago, with the intent to complete reconstruction in the future. The net effect is water treatment systems that are obsolete and undersized, that produce water that doesn't meet minimum safe drinking water standards, and that overload the WTP structure to the point that it is at risk of catastrophic failure.

Although the WTP and Washeteria components are intricately linked, they have different challenges. Therefore, recommendations are discussed separately, with the WTP recommendations provided in this section, and the Washeteria recommendations provided in Section 8.

7.2. Structural Recommendations

7.2.1. Existing System Improvements

The most immediate need for the WTP/Washeteria is to stabilize the existing WTP structure to protect the community from potential building collapse, and to ensure that the community has a functioning source of drinking water. An amendment for this needed improvement has been finalized. This stabilization will provide immediate, short-term relief, but is not a permanent solution to the structural issues at the WTP.

7.2.2. Long Term Solution / New System

New finished water storage tanks and filters cannot safely be supported by the existing WTP. New treatment systems would be placed in a new, small, modular structure that would be supported on the piers that originally supported the old WST, immediately behind the existing WTP. A heated walkway would connect the existing WTP and the new WTP addition. This walkway would house piping and electrical connections. The WTP addition would consist of a standard 14-foot-wide by 45-foot-long, insulated, modular unit. The WTP addition would be heated with waste heat. The roof area over the filters may need to be raised/modified to provide adequate access.

7.3. Water Treatment System Recommendations

Design assumptions, including estimates of increased water system demand, and associated calculations are provided in Appendix D and summarized below.

Table 7-1: General System Design Summary

WTP / Washeteria	1978-2002	System construction
2000 Design Population	360 people	From Montgomery Watson, 2000
2019 Population	539 people	Based on 2018 DCCED certified population.
2019 Daily Demand	1,000-3,000 gpd	Operator reports, with Washeteria facilities in poor repair (low flow).
2038 Design Population	644 people	Estimate, assumes a 0.9% growth rate.
2000 Treated WST	20,000 gallons	Design volume, from Montgomery Watson, 2000
2002 Treated WST	9,150 gallons	Installed volume (61 150-gallon tanks)

7.3.1. Existing System Improvements

The majority of the components in the existing water treatment system cannot be reasonably updated to meet current water treatment standards. An inventory list of primary system components, and calculated estimates of the current system operational parameters, are provided in Appendix D.

- **The existing filtration system needs to be replaced and air scour should be provided.**
  The existing filtration system appears to be producing water that meets turbidity removal requirements, treating 1,000 – 3,000 gpd. However, this is an under-represented demand, due to broken piping, inoperable Washeteria appliances, and limited backwash rates. Filtration loading rates would have to be increased above recommended levels to produce sufficient water to meet an increased demand. This would be particularly problematic due to the high levels of organics in the raw water. The existing filters do not include air scour for effective backwash, which further limits the ability of these filters to operate under increased loading.
- **The existing housings for bag/cartridge filters are not approved for filtration credit and cannot be used.**
  Housings exist for bag/cartridge filters (both pre-filtration and post filtration). These housings are not part of any regulatory approved surface water treatment filtration system.
- **Modern online monitoring equipment is needed to comply with current treatment standards.**
  Many components of the existing online monitoring equipment are not functioning; those that are are obsolete.
- **A new treated water storage system is required to meet demand and to provide required chlorine contact time.**
  The storage tanks currently in use provide inadequate capacity to meet community demand (assuming repaired/replaced Washeteria systems), and needed backwash volumes. The current

plumbing of the 61 tanks in use do not provide adequate chlorination and disinfection. These tanks could not be reasonably plumbed to provide the needed disinfection. However, if a new treated water storage tank is provided, these tanks could be distributed to the community, to provide home storage of hauled water. The storage tanks currently in use provide inadequate capacity to meet community demand

- **The pumps for the raw WST add-heat system are not potable-water compliant.**
  Both add-heat pumps should be replaced with stainless or bronze construction pumps to minimize corrosion and improve service life. Though these pumps are on the non-treated side of the system, the use of NSF rated pumps is recommended.
- **The use of treated water to prime the Treatment/Filter pump should be addressed to eliminate a cross-contamination potential.**
  The existing installation and Treatment/Filter pump cannot remove the bottom six feet of water from the raw WST. This is likely due to a low NSPSH rating of the existing pump. A piping connection from the treated water side is made to the raw water system to help remove more water from the tank, creating a cross-connection concern. There are a couple options available to eliminate the cross-contamination:
  - Replace the existing Treatment/Filter Pump with a unit that has a negative NSPSH rating so that the pump can pull water from the bottom of the storage tank. This is the recommended solution.
  - Install a reduced pressure principle backflow preventer assembly between the treated water system and the raw water system. This type of valve is supposed to be inspected and tested annually so it has long-term maintenance implications.
  - Relocating the existing pump to a heated enclosure at the base of the storage tank would increase the suction head and allow the pump to empty more of the tank. This solution would be costly (extension of heat and power) and still not allow complete emptying of the storage tank.
- **The non-functioning low-flow distribution pump should be replaced.**
  The low-flow distribution pump was not operational during our site visit. The high-flow pump was being used and cycling excessively. This will lead to a premature failure of the high-flow pump. Based on the current distribution system, it may be better to replace both of these pumps with two same sized pumps, piped in parallel and connected to variable frequency drives, and be staged as required to meet water demand.

The current opportunities for improved water treatment, using the existing system components include the following.

Corrosion Control / Soda Ash

The system originally included pH adjustment using soda ash. This treatment process could be reinstalled to offset the corrosive nature of the water. The corrosion on the pipes is so advanced at this point, reinstalling the process may not provide a substantial benefit to the pipes. However, it may help ensure a longer life of replacement fixtures and appliances, and compliance with pH water quality standards.

Transmission Line Pre-screening

A mesh strainer / roughing filter should be added between Contractor's Lake and the raw WST to inhibit larger organic materials from entering the WST.

7.3.2. Long Term Solution / New System

New treatment units are needed to meet minimum safe drinking water standards. A new water treatment system design is proposed that considers operational alternatives, increased demand to support improved facilities and population growth, and raw water quality. In addition, operator certification requirements were considered. The options below are based on a required Water Treatment Level 1 Operator Certification Level (estimate scoring calculation provided in Appendix B).

Operational Options

Three operational options were considered for the new water treatment system design. The associated treatment processes needed to meet these operational options are provided next, and summarized in Table 7-2. Support calculations are provided in Appendix D.

Option 1: Batch Treatment

The system would treat water when the Washeteria and community watering point are offline. The limited hours of community access would also limit the daily system demand. Batch treatment operations would minimize the need for treated water and disinfection contact time storage, but would require filters that could process sufficient water to meet the daily demand in approximately 3-4 hours, to allow approximately 3-4 hours for disinfection. Batch treatment would minimize the need for treated water storage, but would require more time to recover in the event that all treated water storage was lost.

> Option 1 would require a new WTP addition (14 feet x45 feet) which includes (2) 48-inch media filters, chemical addition, process monitoring and control equipment, and (1) 25,000-gallon WST (providing disinfection contact time and 3 days of treated water storage).
>
> Option 1 would supply approximately 4,500 gpd of treated water, with 12 hour per day access to plumbed facilities.

Option 2: Continuous Treatment

Providing continuous operations of the WTP would also allow expanded service hours to the community, which would help relieve the demand on the Washeteria systems, and would result in a modest increase in daily demand. Providing disinfection contact time in a falling head reservoir tank is inefficient, resulting in the need for approximately twice the storage as a system operating in batch treatment mode. Since a continuous treatment system could process water faster, it would be easier to recover from a total loss of treated water.

Option 2 would require a new WTP addition (14 feet x45 feet) which includes (2) 48-inch media filters, chemical addition, process monitoring and control equipment, and (2) 25,000-gallon WSTs (providing disinfection contact time and 3 days of treated water storage).

Option 2 would supply approximately 6,300 gpd of treated water, with 20 hour per day access to plumbed facilities. A modification of the existing DNR Water Rights Permit would be needed.

Option 3: Expanded Water Production

A rough estimate of the ability of a treatment system to meet a more substantial increase in demand (approximately 50 gallons per capita per day) was also considered. This estimate indicates the same filtration systems included under a batch treat / continuous treat scenario could potentially be used to meet a more substantial water system demand. However, the size of the treated water storage tank would have to be significantly increased. In this scenario, the smaller water storage tanks (25,000 gallon each) could be used as dedicated disinfection contact time tanks (2 in series, providing a 0.2 baffle factor), to optimize the chlorination processes. The expanded demand in this option would require more raw water than is currently provided by the existing raw water storage tank. Modifications in the raw water system would be needed (upgraded storage at Contractor's Lake, or the development of additional sources).

Option 3 would require a new WTP addition (14x45) which includes (2) 48-inch media filters, chemical addition, process monitoring and control equipment, and (2) 25,000-gallon chlorine contact tanks (connected in series, with a baffle factor of 0.2), and a 250,000-gallon treated water storage reservoir tank (providing 5 days of treated water storage).

Option 3 would supply approximately 30,000 gpd of treated water.

Option 3 would require improved access to the raw water source, or development of an additional source, to meet the increase in water demand. A modification of the existing DNR Water Rights Permit would be needed.

Treatment Processes and New Building

New direct filtration treatment processes would be housed in a modular building (approximately 14' x 45') on the existing pile foundation (left from the old WST). The existing pile foundation would require some updates to provide thermal stabilization and prevent problems associated with warming permafrost. Heat for the new building and add-heat systems for the water storage tank would come from the existing WTP heating plant so that waste heat could be utilized.

The new treatment module would be connected to the WTP through a heated walkway that would also house piping/electrical connection. The filters would be located under the ridge line of the new modular building, to provide adequate vertical access (an extension above the filters may be needed depending on final grade of wastewater piping and final system design). The treatment processes would be capable of being expanded to provide an increased production capacity.

A schematic showing the recommended treatment system is shown in Appendix A. Treatment assessments based on raw water quality (coagulation, DBP formation, and corrosion control) are provided in Appendix C. The following treatment components result in a Level 1 Water Treatment Operator requirement (calculation provided in Appendix B).

The two dominant aspects of the system treatment design are organic content and access to raw water.

- The system has a relatively high level of organics. Coagulant dosage and optimized organic removal are important to prevent DBP formation. Typically, a Streaming Current Detector (SCD) assists the operator in maintaining turbidity and organic removal in situations where there is changing raw water quality. In this instance, Kongiganak operates off of 1.2 MG of stored raw water. The quality of the raw water could change between fill operations. However, once filled, the WST water quality should not vary significantly. Organic removal is important, but an SCD may not provide substantial benefit to the system.
- 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 recommended, with automated valves, to carefully manage the water used in the backwash / filter cleaning processes, and optimize system efficiencies. New backwash pump(s) would be housed in the new addition and a new filter to waste line will be connected to the WTP/Washeteria lagoon discharge line (reference Proposed Water Treatment Process Schematic).

Table 7-2: New Treatment Components

PROCESS	COMPONENT	OBJECTIVE
Media Filters	(2) 48-inch diameter media filters operated in parallel. Expansion area for (2) additional 48-inch media filters.	Particulate (2 log *Giardia*, 4 log virus) and organic removal. Provide additional polishing and organic removal if needed.[1]
Coagulation	Polymer (Nalco 8105)	Particulate and organic removal, could be supported with the use of a SCD system, but limited variation in raw water expected. Backwash process control could be supported with the use of automated valves and a PLC system.
Chlorination	Calcium Hypochlorite	Flow paced disinfection (1 log).
pH Adjustment	Soda Ash	Flow paced corrosion control (7.5 pH).
Water Storage	25,000 gallon (batch treatment); 50,000 gallon (continuous treatment) 250,000 (expanded production)	Treated water storage reservoir to meet community demand to meet disinfection contact time. Storage reservoir needed for 5 days treated water storage at 30,000 gpd. Disinfection contact time would be met in (2) 25,000-gallon tanks.

1. *Additional media filter could be installed in series, for final polishing. This may be needed depending on raw water organic content. Only one set of raw water organic test results are available. These may not represent worse case conditions.*

7.4. Mechanical Systems Recommendations

7.4.1. Existing System Improvements

Domestic Plumbing System

All domestic water outlets in the 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 PEX tubing. This includes the piping that serves the 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, that 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 DEC 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 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.

The existing heating plant appeared to be working adequately and there are no additional recommendations for the heating system in the WTP area.

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 for the fuel system that serves the WTP equipment was noted.

7.4.2. Long Term / New Treatment Mechanical System Improvements

The following recommendations assume a new water treatment addition, and new treated water storage tank(s) are constructed on the existing pilings from the old WST.

Domestic Plumbing System

Emergency eye and/or 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.

Requirements for the treated water and backwash piping distribution have been noted in previous sections. Water lines will be routed through the heated walkways so as to eliminate the need for heat tracing.

Heating System

The new addition and storage tanks would be heated from the existing WTP heating plant. Calculations would also be completed to verify the additional heat load that will be required to heat the addition as well as a new add-heat system for the new tanks. 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.

Space heat will be provided from hydronic unit heaters.

The new storage tank add-heat system will consist of a double-wall heat exchanger, either a tube-in-tube unit like the existing Doucette units or a brazed plate heat exchanger.

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. 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

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

Fuel System

The new addition and storage tanks will not impact the fuel system aside from additional fuel usage at the WTP heating plant.

7.5. Electrical Systems Recommendations

7.5.1. Existing System Improvements

The existing electrical distribution system for the treatment 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.

7.5.2. Longer Term Solution / New System

The longer-term electrical improvements for the water treatment plant include items to support the proposed new water treatment and distribution system. These will include the following:

1. Lighting, interior and exterior
2. Power distribution supporting the backwash, scour and feed pump systems. The treatment/filter and pressure pumps will also require modifications.
3. Control panel(s) and instrumentation for the process area.

8. Washeteria Recommendations

8.1. Summary

Improvements to the existing Washeteria are provided below. The existing Washeteria systems, fully repaired and operational, are not sufficient to reasonably meet the demand of the community. An expansion of the Washeteria facilities is needed, to meet both current and future estimated populations.

8.2. Architectural Finishes

It is recommended that a new floor finish be installed throughout the Washeteria to address the failed resin floor. This will mitigate potential mold and subfloor damage as well as tripping hazards for the public.

- It would be difficult to patch sections, so it is recommended to replace the entire floor covering.
- The failures seem to be focused at subfloor joints. It is unclear if post-construction settling of the systems caused the flooring gaps but a flexible flooring finish is recommended in case expansion/contraction is still an issue.

The failed shower stall finishes need immediate repair. The exposed wall structure may need to be remediated for potential mold prior to enclosing.

- Though temporary measures should be taken to cover up the holes in the surrounds, a long-term solution should be replacing the resin shower pan system with a new shower stall that includes a water-resistant subsurface and shower surround.
- The shower valve and water piping system serving the shower should be replaced as part of the facility-wide cross-linked polyethylene (PEX) tubing replacement while the wall is exposed for construction.

As water piping is replaced with PEX tubing, the existing plywood wall patches should be replaced with gypsum wall finishes. This may require the painting of all restroom walls in order to match surrounding surface finishes.

8.3. Structural Recommendations

The community reported issues with vibrational settling in the Washeteria associated with the use of high capacity industrial washers. However, the original industrial size washers have broken down and been replaced by smaller washing machines that do not appear to have vibrational issues.

The community also has reported settlement of 8 – 12 inches in the Washeteria foundation. There were some signs of settlement, but it appears to have been roughly uniform across the foundation.

8.4. Mechanical Systems Recommendations

8.4.1. Domestic Plumbing System

All domestic water outlets in the Washeteria should have non-potable water identification installed in accordance with the Uniform Plumbing Code until water treatment improvements are completed. Until then, the water to the drinking fountain should be immediately turned off.

For the water heater system, the following actions are recommended:

- Turn down the thermostat to a maximum of 120 degrees F. Adjust the existing tempering valve so that hot water of no more than 110 degrees F is provided to the Washeteria fixtures.
- Install American Society of Safety Engineers (ASSE) 1017 certified central tempering valve at the water heater to protect the public from scalding. This will also allow the storage water temperature to be raised above 120 degrees in the future if so desired. A thermometer should be located downstream of the valve so an operator can visually verify the temperature of the water being provided to the Washeteria.
- Install dielectric nipples and bronze unions at the water connections to mitigate galvanic corrosion.
- Install an expansion tank to address water expansion. Replace cold water feed piping that is leaking.
- Install seismic support system. Recommend installing Unistrut rack system connected to wall studs and providing double-strap system.

It is recommended that all of the domestic water distribution piping in the Washeteria and WTP be replaced with PEX tubing. Reference Section 8.2 for specific recommendations at plumbing fixtures and fixture groups.

Very few plumbing fixtures are operational. The ones that are left are in poor condition. As part of the water piping replacement, the following is recommended in both the Washeteria and WTP:

- Replace the shower assemblies completely as previously noted including shower valves.
- Replace all water closets including new angle stops and supply tubes.
- The existing drinking fountain can probably be reused, but would need to be disinfected. If replaced, a unit that has an integral bottle filler function may be desired.
- The existing lavatories can remain, but it is recommended to replace the faucets as well as providing new angle stops and water supply tubes. Install ASSE 1070 certified tempering valves at each lavatory. Provide new Americans with Disability Act (ADA) insulation kits for domestic water.

To reduce having sewer gases rising up through empty traps, it is recommended that water be poured down all fixtures on a regular basis. Pressure fluctuations in the waste system, such as that from the activation of the school lift station, may remove water from these traps faster than evaporation alone.

The following actions are recommended for the clothes washers:

- Provide at least two new clothes washers to replace the two non-functional units and add the missing sixth washer if desired by the village. Washers should be selected at 120-volt, single phase. An electrical upgrade associated with this voltage is described under Section 8.8.
- Add lint screen at the waste pipe entrance to the trough.
- Replace all of the supply water piping feeding the washers as part of the overall piping replacement. Provide new water hammer arrestors on the hot and cold water piping.

8.4.2. Heating System

The existing heating distribution system that is served from the WTP appeared to be appropriate and no immediate action items on that system are proposed.

The room thermostats should be installed tight to the wall surfaces to reduce future damage.

Washeteria boiler and heating system recommendations:

- Replace boiler pressure relief valve with a 30-pounds per square inch (psi) valve so that the existing expansion tank does not need to be ASME rated. This installation does not need the 45-psi rating that is currently installed.
- Renovate the boiler including having the flue and heat exchanger cleaned of excess soot. Complete combustion testing on the boiler to ensure it is burning cleanly.
- Troubleshoot if the reason why the Dryer 4 pump was field wired as an electrical circuit/relay issue or pump issue. Replace failed components as necessary.
- Verify relays activate the heating coil pumps when a dryer is activated.
- Install isolation ball valves on the return side of the heating coil pump loops so that the balance valves are not cycled to isolate a pump and therefore lose their balance.
- For the long term, consider removing the boiler in the Washeteria and connect the dryer heating coils to the WTP heating plant. This will allow the use of “waste” heat from the power plant during the summer and reduce the need for maintenance on an additional boiler. A complete heating capacity study should be completed prior to this action.

The pumping systems throughout the facility may benefit from the integration of variable speed technology, though the complexity needs to be considered for the application.

8.4.3. Ventilation System

Existing restroom fans should be cleaned immediately to extend their life and replaced as part of extending the facility usage an additional 10-20 years of service.

The following are recommended actions regarding the clothes dryers and their associated ventilation system:

- Replace the single non-functioning dryer and the original dryer that is in disrepair. It is recommended to continue using the hydronicly heated commercial units so that waste heat can be used to offset electricity costs.
- Clean and inspect each of the air-to-air heat exchangers. Inspect the heating coils and clean them while they are exposed. Insert access doors to facilitate future inspection and cleaning.
- Investigate converting make-up air unit and exhaust fan to variable speed per the intent of the original design documents.

8.4.4. Fuel System

The following actions are proposed for the fuel system:

- Add a Tiger Loop deaerator assembly to the single-pipe fuel oil system that serves the water heater.
- Replace the soft copper supply line with a stainless-steel braided assembly be used to protect against potential kinking of the soft copper.

8.5. Electrical Systems Recommendations

8.5.1. Existing System Improvements

The existing electrical distribution system for the washeteria building is in fair to good condition. Most immediate needs are in addressing the life safety and energy efficiency concerns. These include the following:

1. Provide dedicated branch circuits from Panel A at 120 volt, single-phase to supply existing or new washers for the facility. The existing washers are using extension cords from adjacent general-use duplex receptacles within the washeteria to supply power to this equipment. New, code compliant, wet location rated dedicated receptacles should be provided to replace this existing installation.
2. Provide new, hard wired circuit connection for one of the secondary heat circulation pump supplying the dryers, currently connected using an extension cord.

8.5.2 Longer Term Solutions/New Equipment

The longer term electrical improvements for the water treatment plant include the following:

1. Provide upgrade to a variable speed control scheme for the dryer ventilation system.

9. References

Alaska Division of Environmental Health, 2018. Drinking Water Program. "Drinking Water Watch" Website: http://dec.alaska.gov/DWW/

Department of Commerce, Community, and Economic Development (DCCED), 2018. "Community Database Online" Website: https://dcra-cdo-dcced.opendata.arcgis.com

Design Report, Water Supply and Storage Project, Kongiganak, VSW Facility, Kongiganak, Alaska, QUADRA Engineering, Inc., November, 1981.

Final Report, Sanitation Facilities Improvements, Village of Kongiganak, Alaska, Project no. AN 91-025, Office of Environmental Health and Engineering, Indian Health Service, Alaska Area Native Health Service, October 2002, June 2004.

Laundry Facility for the Village of Kongiganak, Kumin Associates, Inc, 2/25/2000.

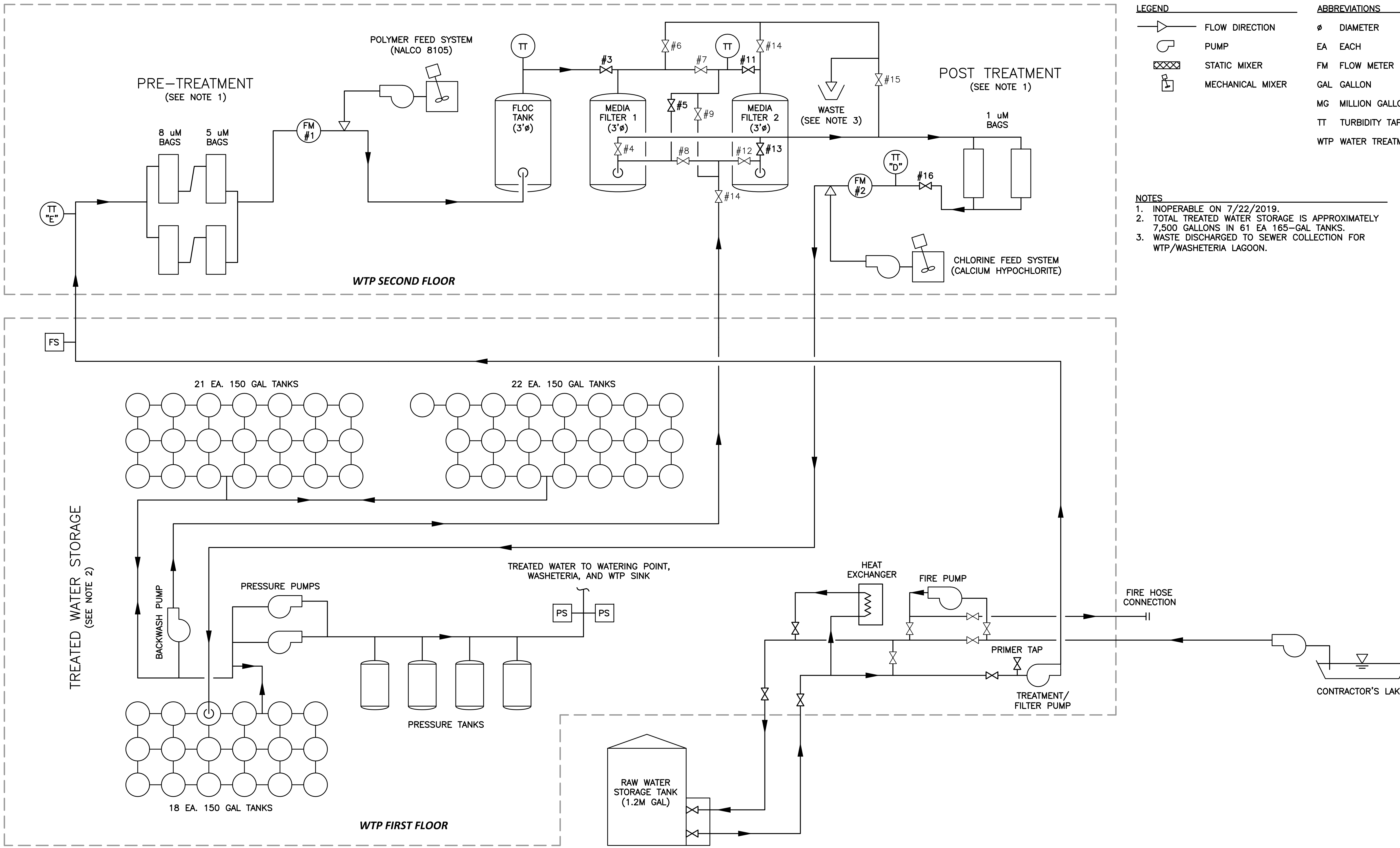
Native Village of Kongiganak, Sanitation Facilities Feasibility Study, Summit Consulting Services, Inc., August 2003.

Preliminary Engineering Report Final Draft, Kongiganak, Alaska, Summit Consulting Inc., June 12, 2018.

Village of Kongiganak, Alaska, Kongiganak Water and Sewer, 2000 Upgrades, Montgomery Watson, August 2000.

Village of Kongiganak, Sanitation Facilities Master Plan Update, Planning for Future Water and Sewer Infrastructure, Summit Consulting Inc., August 2003.

Appendix A – Figures



LEGEND

- FLOW DIRECTION
- PUMP
- STATIC MIXER
- MECHANICAL MIXER

ABBREVIATIONS

ø	DIAMETER
EA	EACH
FM	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.

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

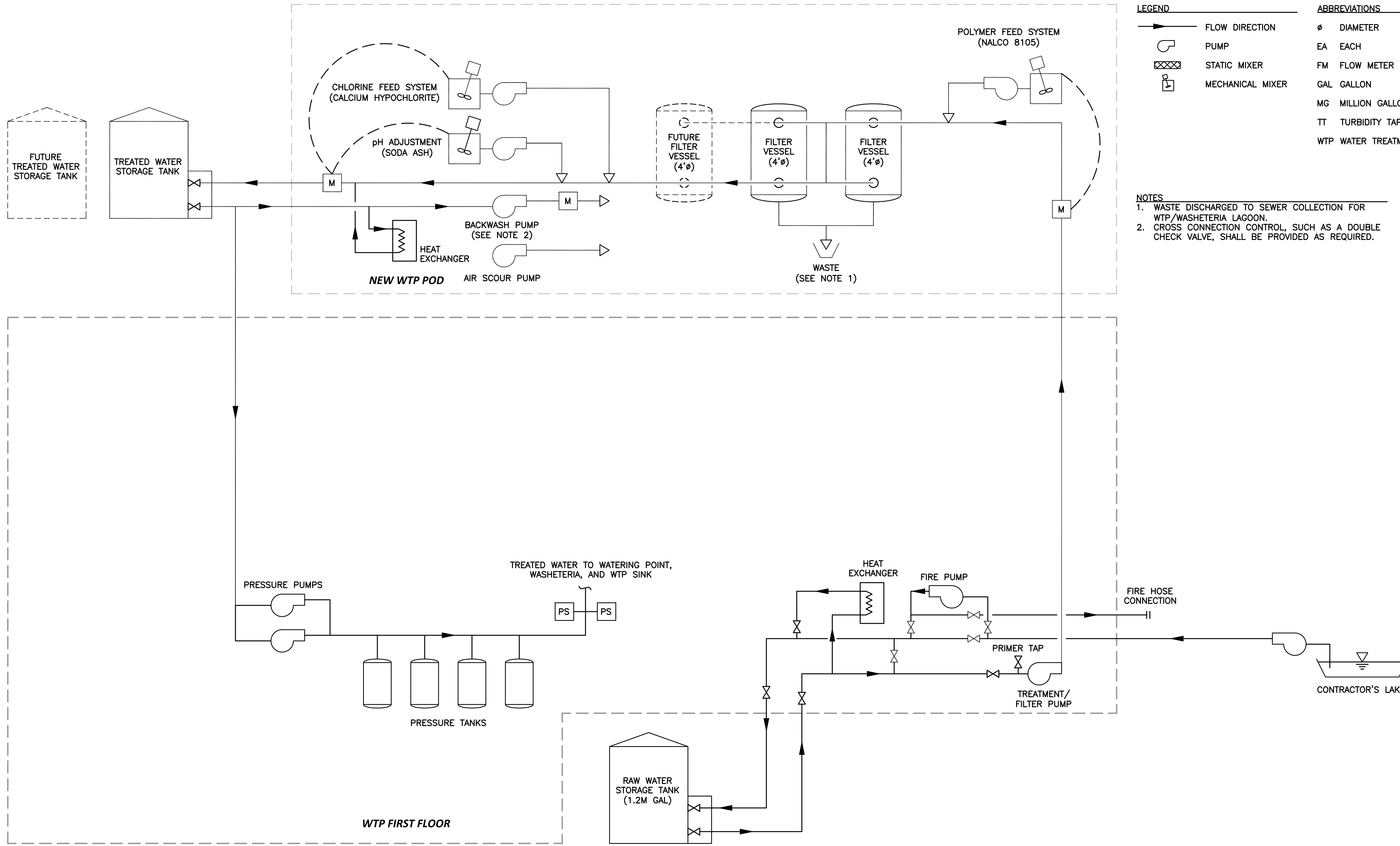
NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

EXISTING WATER TREATMENT PROCESS SCHEMATIC

SHEET NO. **FIG 1**

SCALE: NTS | DESIGNED: DWB | CHECKED: VBW | DRAWN: DWB | DATE: OCT 2019 | SHEET 1 OF 3



LEGEND

- FLOW DIRECTION
- PUMP
- STATIC MIXER
- MECHANICAL MIXER

ABBREVIATIONS

ø	DIAMETER
EA	EACH
FM	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.

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

PROPOSED WATER TREATMENT PROCESS SCHEMATIC

SCALE: NTS | DESIGNED: DWB | CHECKED: VBW | DRAWN: DWB | DATE: OCT 2019

SHEET NO.

FIG 2

SHEET 2 OF 3

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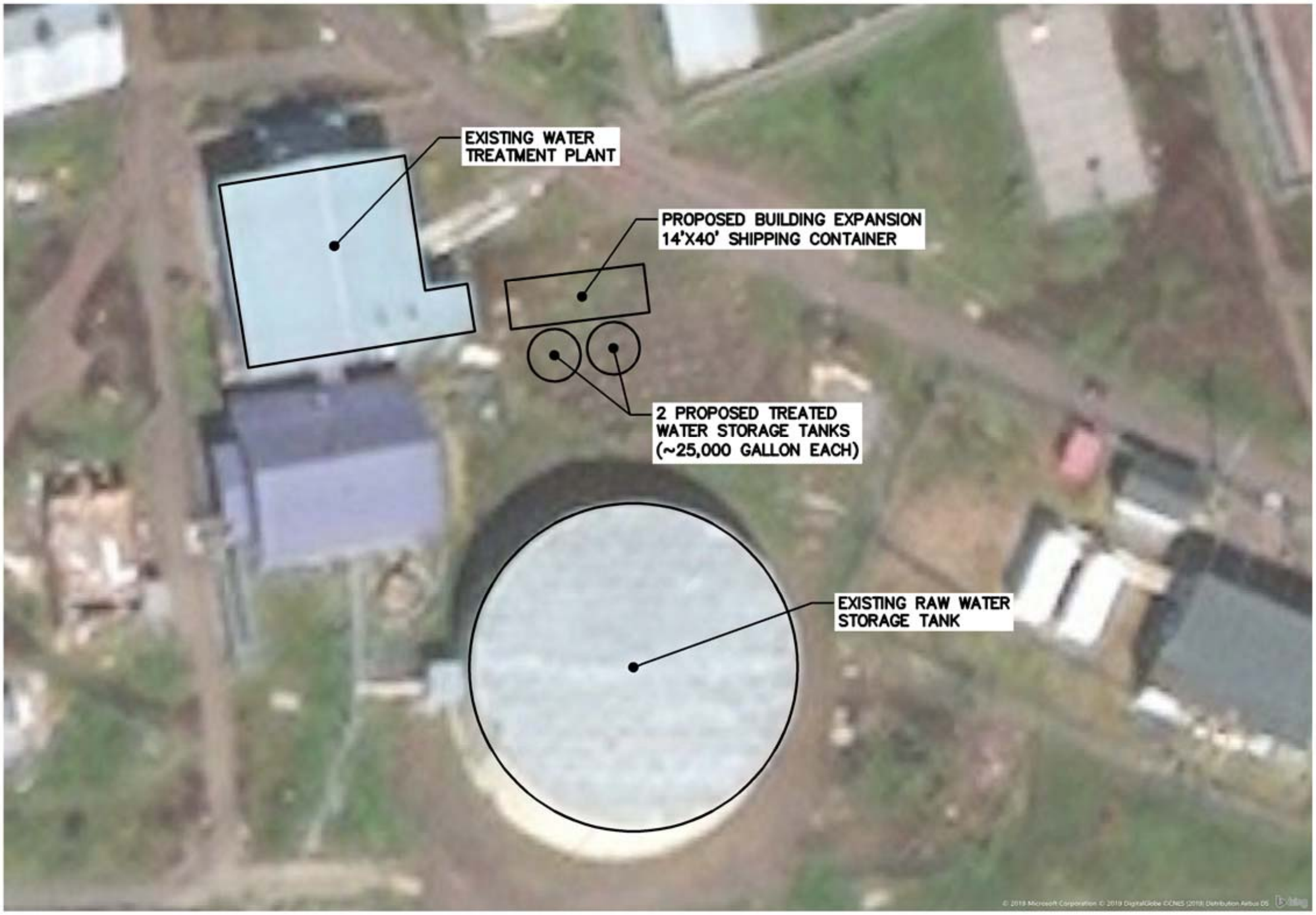
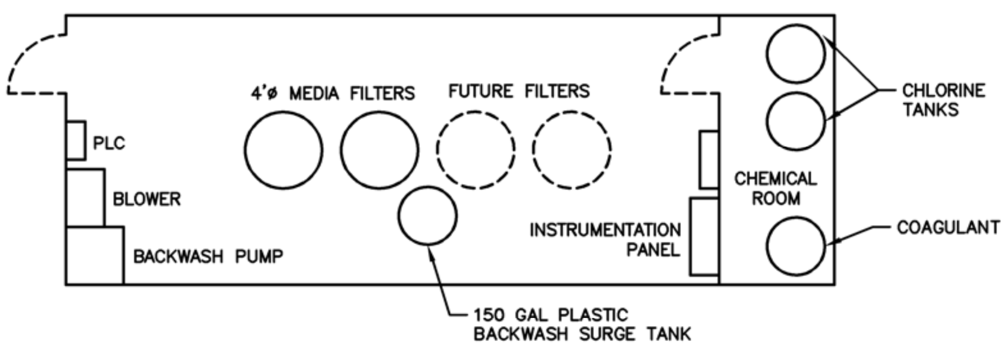


1 – **EXTERIOR SITE LAYOUT**
SCALE: NTS



2 – **BUILDING EXPANSION INTERIOR LAYOUT**
SCALE: NTS

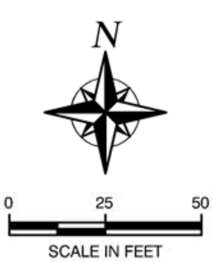


FIGURE 3
KONGIGANAK, AK
KONGIGANAK WATER TREATMENT PLANT UPGRADES
PROPOSED SITE LAYOUT

Bristol
ENGINEERING SERVICES COMPANY, LLC

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PROJECT No.	APPRVD. VBW	3

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Appendix B – Regulatory Compliance

ADEC Public Water System Compliance Monitoring Summary

ADEC Operator Certification Estimates

ADNR Water Rights

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 C – Water Quality Information

Lab Test Results – July 2019

Jar Testing Treatability Study – June 2019

Disinfection By-Product Assessment

Corrosion Control Assessment

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

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.

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t 907.562.2343 f 907.561.5301 www.us.sgs.com
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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

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

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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**

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

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(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.

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

Kongiganak Jar Test Results

Samples taken July 23, 2019 (4 7.5-gallon jugs)

A coagulation study was conducted on July 25-26, 2019, on water samples collected on July 23, 2019, in Kongiganak, Alaska. Four 7-gallon jugs of raw water were obtained from a spigot at the entry to the WTP. The raw WST had been filled from Contractor's Lake the prior week.

Three coagulants were tested: Nalco 8105 (the coagulant the system currently uses), Nalco 8185, and Nalco 8186. These were chosen because of their use and ready availability in rural Alaskan communities.

The results were evaluated based on particulate removal and on organic reduction. Organic reduction was estimated based on UVA reduction.

A table of test results, a graph showing particulate and UVA reduction with each coagulant tested, and a summary of test proccedures is included.

Kongiganak Jar Test Results

Samples taken July 23, 2019 (4 7.5-gallon jugs)

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	
Raw Water Quality					**Average**
Conductivity (µS/m)	20.4	19.8	17.5	15.6	19.23
Salinity (%)	0	0	0	0	0.00
TDS (mg/L)	17.1	16.5	14.5	13.6	16.03
Temperature (°F)	63.9	67.8	67.8	68.5	66.50
pH (mg/L)	6.2	6.2	6.6	6.6	6.33
Iron (mg/L)	0.8	0.6	0.6	0.6	0.67
Hardness (mg/L)	50	50	50	35	50.00
Alkalinity (mg/L)	0	0	0	0	0.00
Turbidity (NTU)	1.3	1.09	1.14	1.05	1.18
UVA (cm-1)	0.375	0.388	0.382	0.386	0.382
Settled Water Turbidity (NTU)					
0 mg/L Dose	1.19	1.14	1.08		
1 mg/L Dose	1.28	1.14	1.40		
3 mg/L Dose	1.91	1.29	1.86		
4 mg/L Dose	1.68	1.62	1.66		
6 mg/L Dose	1.88	1.60	0.80		
8 mg/L Dose	1.19	1.86	0.63	0.58	
10 mg/L Dose				1.95	
12 mg/L Dose				0.70	
14 mg/L Dose				0.90	
Settled Water UVA					
0 mg/L Dose	0.381	0.387	0.386		
1 mg/L Dose	0.383	0.310	0.387		
3 mg/L Dose	0.382	0.259	0.387		
4 mg/L Dose	0.384	0.240	0.323		
6 mg/L Dose	0.382	0.187	0.160		
8 mg/L Dose	0.230	0.226	0.125	0.123	
10 mg/L Dose				0.318	
12 mg/L Dose				0.176	

Test No.	1	2	3	4	1	2	3	4				
Dosage	**Settled Water Turbidity**				**Filtered Water Turbidity (NTU)**				**% Reduction IFE = [1-(Filt/Raw)]*100**			
0 mg/L	1.19	1.14	1.08	0.00	0.43	0.12	0.11	0.00	63.46	89.80	90.65	
1 mg/L	1.28	1.14	1.40	0.00	0.40	0.12	0.13	0.00	66.01	89.80	88.95	
3 mg/L	1.91	1.29	1.86	0.00	0.14	0.17	0.10	0.00	88.10	85.55	91.50	
4 mg/L	1.68	1.62	1.66	0.00	0.14	0.13	0.15	0.00	88.10	88.95	87.25	
6 mg/L	1.88	1.60	0.80	0.00	0.17	0.13	0.10	0.00	85.55	88.95	91.50	
8 mg/L	1.19	1.86	0.63	0.58	0.13	0.65	0.15	0.10	88.95	44.76	87.25	91.50
10 mg/L	0.00	0.00	0.00	1.95	0.00	0.00	0.00	0.09				92.35
12 mg/L	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.10				91.50
14 mg/L	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.01				99.15
Dosage	**Settled Water UVA**				**Filtered Water UVA**				**% Reduction UVA = [1-(Filt/Raw)]*100**			
0 mg/L	0.381	0.387	0.386	0.000	0.325	0.337	0.325	0.000	14.85	11.70	14.85	
1 mg/L	0.383	0.310	0.387	0.000	0.242	0.310	0.228	0.000	36.59	18.78	40.26	
3 mg/L	0.382	0.259	0.387	0.000	0.156	0.259	0.159	0.000	59.13	32.14	58.34	
4 mg/L	0.384	0.240	0.323	0.000	0.179	0.240	0.145	0.000	53.10	37.12	62.01	
6 mg/L	0.382	0.187	0.160	0.000	0.159	0.187	0.104	0.000	58.34	51.00	72.75	
8 mg/L	0.230	0.226	0.125	0.123	0.123	0.226	0.091	0.090	67.77	40.79	76.16	76.42
10 mg/L	0.000	0.000	0.000	0.318	0.000	0.000	0.000	0.080				79.04
12 mg/L	0.000	0.000	0.000	0.176	0.000	0.000	0.000	0.116				69.61
14 mg/L	0.000	0.000	0.000	0.190	0.000	0.000	0.000	0.088				76.94

Lab Results (Sampled 7/23/2019, SGS Report Aug 9, 2019)

Calcium	282	ug/L
Iron	750	ug/L
Mn	9.96	ug/L
Color	70	PCU
pH	5.8	

If UVA relationship with DOC is linear:

Start DOC 5.96

Reduce by	Final DOC
60%	2.384
65%	2.086 <-----
70%	1.788
75%	1.49

14 mg/L Dose				0.190
Filtered Water Turbidity (NTU)				
0 mg/L Dose	0.43	0.12	0.11	
1 mg/L Dose	0.40	0.12	0.13	
3 mg/L Dose	0.14	0.17	0.10	
4 mg/L Dose	0.14	0.13	0.15	
6 mg/L Dose	0.17	0.13	0.10	
8 mg/L Dose	0.13	0.65	0.15	0.10
10 mg/L Dose				0.09
12 mg/L Dose				0.10
14 mg/L Dose				0.01
Filtered Water UVA				
0 mg/L Dose	0.325	0.337	0.325	
1 mg/L Dose	0.242	0.310	0.228	
3 mg/L Dose	0.156	0.259	0.159	
4 mg/L Dose	0.179	0.240	0.145	
6 mg/L Dose	0.159	0.187	0.104	
8 mg/L Dose	0.123	0.226	0.091	0.090
10 mg/L Dose				0.080
12 mg/L Dose				0.116
14 mg/L Dose				0.088

TDS	27	mg/L
Nitrate	0.185	mg/L
TOC	7.22	mg/L
DOC	5.96	mg/L
UVA	0.35	cm-1

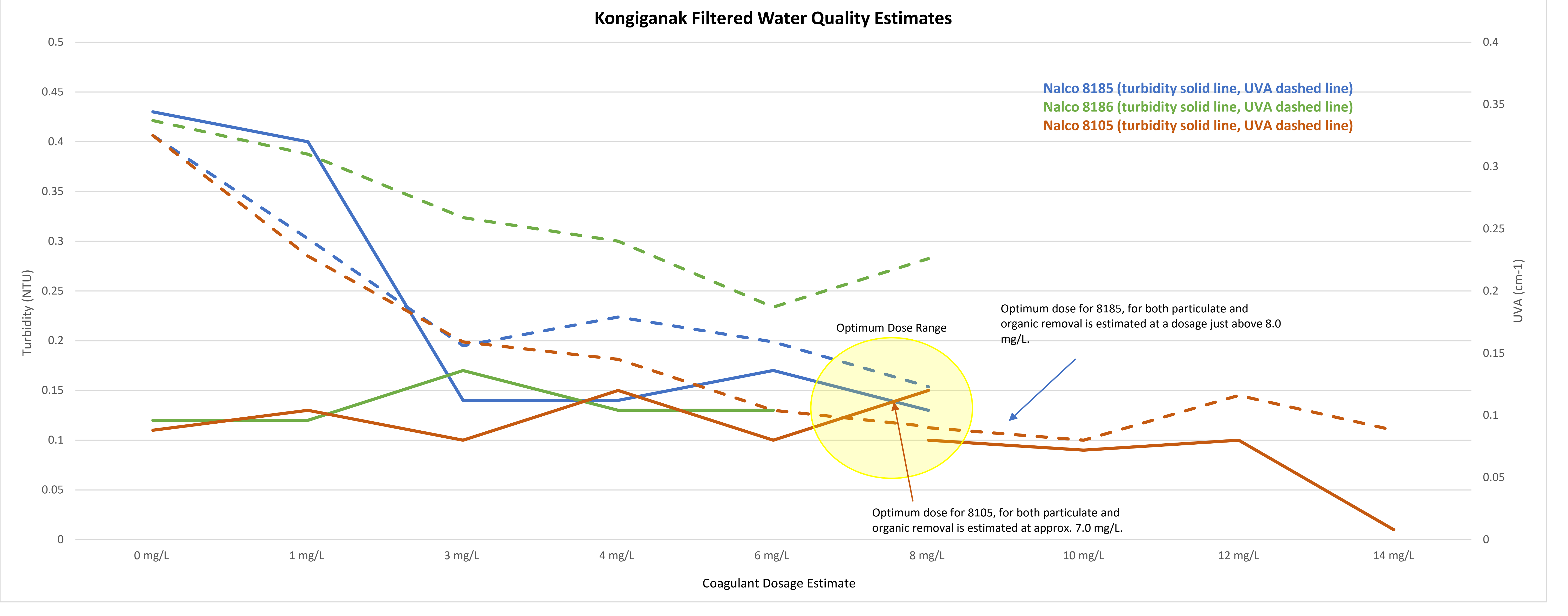
Field Tests (Field Kit, Sampled 7/23/2019)

Temp	67.5	F
Hardness	40	mg/L
Alkalinity	0	mg/L
pH	6.2	
Iron	0.9	mg/L
Turbidity	1.07	NTU
UVA	0.389	cm-1
Conduct	21.7	µS/m
TDS	16.3	mg/L
Salinity	0	

Kongiganak Jar Test Results

Samples taken July 23, 2019 (4 7.5-gallon jugs)

	Filtered Water Turbidity				Filtered Water UVA			
	Test T1	Test T2	Test T3	Test T4	Test UVA1	Test UVA2	Test UVA3	Test UVA4
0 mg/L	0.43	0.12	0.11		0.325	0.337	0.325	
1 mg/L	0.4	0.12	0.13		0.242	0.31	0.228	
3 mg/L	0.14	0.17	0.1		0.156	0.259	0.159	
4 mg/L	0.14	0.13	0.15		0.179	0.24	0.145	
6 mg/L	0.17	0.13	0.1		0.159	0.187	0.104	
8 mg/L	0.13		0.15	0.1	0.123	0.226	0.091	0.09
10 mg/L				0.09				0.08
12 mg/L				0.1				0.116
14 mg/L				0.01				0.088



Jar Testing

General

* Please try to follow these procedures and note on lab sheet where changes were made (so we can compare results).
* Rinse the tensett with DI **immediately** after use with a coagulant/stock solution to avoid fouling and cross contamination.
* Rinse glassware with tap water and invert to drain (and to verify that they have been rinsed).
* End of Jar Test: Organize and pick up lab and trash (dumpster out back); and
* Please update sheets/procedures and order more supplies (standards, reagents, coagulants...) before you forget.

Collection / Prep

Collect field samples in water jugs. Rinse with source water before filling. Measure raw water quality in field. Ship "cool" if possible.
Store in dark, cool (preferably 42 deg F) area. Typically test within 48-72 hours (unless modeling long term raw water storage).
Label the jugs (location/date collected). Preferably use the same jug for a single run of 6 jars.
When beginning jar test, swirl the jug being used for about 5-10 secs before pulling water for jar test.

Step 1 Measure Raw Water Quality (before each round of jar tests)

These tests can also be done while you are waiting 30 min for settling.

Conductivity Salinity TDS Temp	*Multi-meter (soak for at least 1 min before taking readings).* *Lab thermometer can also be used to verify temps.*
pH Hardness Alkalinity Fe	*Test strips*

Step 2 Mix Stock Solution (1%)

Mix stock solution using raw water collected.
In practice, operators are trained to mix stock solution based on volume (1% = 1 in 100).

To calculate stock solutions based on specific gravity and strength use Water Pro:

For Nalco coagulants:			Dose for 1% stock solution
sp.gr. 8105 =	1.16 g/ml	(1.14-1.18)	1.08 ml in 98.92 ml
sp.gr. 8185 =	1.24 g/ml	(1.22-1.26)	1.01 ml in 98.99 ml
sp.gr. 8186 =	1.19 g/ml	(1.14-1.23)	1.05 ml in 98.95 ml

All assumed with 80% strength (10%-30% inactive), documentation of this only provided on 8185.

If using all Nalco coagulants, the differences in specific gravity and resulting dosages are not within the reasonably measurable range of the jar test. Just use operator/volumetric method (1 in 100).

Step 3 Prepare 2L test jars

	C2 Desired Dose (mg/L)	V1 Amount 1% Solution (ml)
Dose 0	0	0
Dose 1	0.5	0.1
Dose 2	1	0.2
Dose 3	2	0.4
Dose 4	3	0.6
Dose 5	4	0.8
Dose 6	5	1
Dose 7	6	1.2
Dose 8	7	1.4
Dose 9	8	1.6
Dose 10	9	1.8
Dose 11	10	2
Dose 12	11	2.2
Dose 13	12	2.4
Dose 14	13	2.6
Dose 15	14	2.8

Include a jar with no coagulant in study

Most common dosages highlighted. One jar should be reserved for raw water (so choose 5 dilutions).

Dosages based on:

C1V1=C2V2
V1=(C2*V2)/C1

C1= 10,000 mg/L for 1% solution
V1= volume of 1% solution needed
C2= desired dose
V2= 2,000 ml (volume of Jar)

Step 4 Simulate Rapid Mixing and In-line Flocculation

300 rpm	1 min	to simulate static mixing
20 rpm	10min	to simulate floc for direct filtration*

* *If modeling conventional filtration, increase floc time to about 30 min.*

Step 5 Simulate Settled Water Quality

Wait 30 min then:
Flush 200 ml from each jar.
Decant 250 ml for filter /lab tests from each jar. *This is an attempt to test water that is the same age.*
Measure Settled Water Quality for each jar (two measurements, same exact sample):
Turbidity
UVA
(don't overfill cuvettets, stay just below "dot" / "line")

Step 6 Simulate Media Filtration (filter with .45 micron filter)

Filter 100 ml from decant (optimally, if filtration is very slow, need at least 60 ml).
Using either vacuum filter flask (preferred) or filter syringe (backup if needed).
Press stopper firmly into vacuum flask (will filter slow if not tight).
Vacuum filter discs should be installed with rough side up.
Measure Filtered Water Quality for each jar (two measurements, same exact sample):
Turbidity
UVA
(don't overfill cuvettet, stay just below "dot" / "line")

Water!Pro TM

Corrosion Control Modeling Program

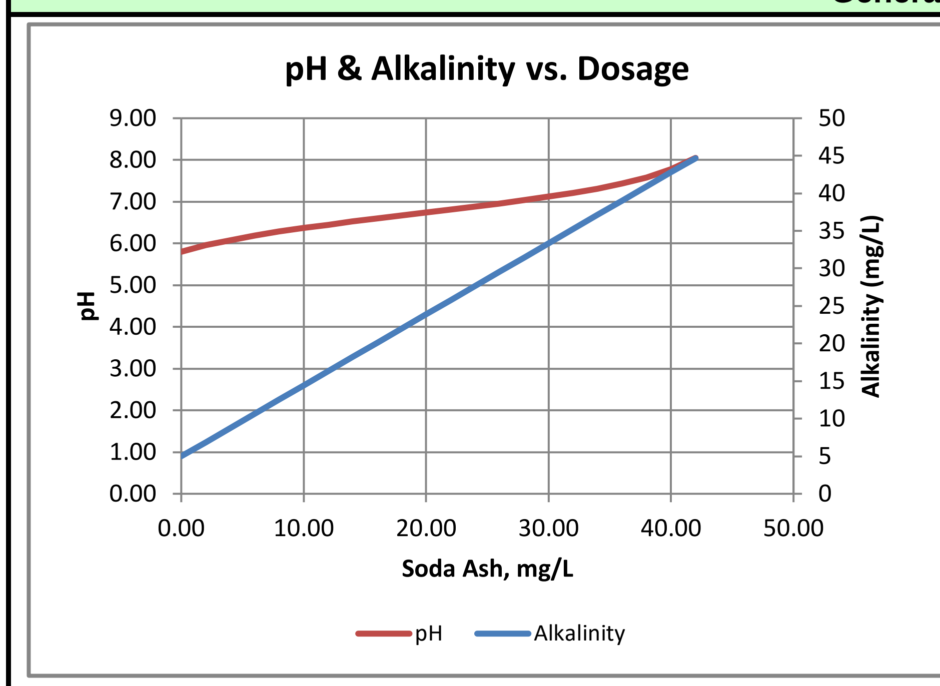
Step 1	**Enter Characteristics of Water to be Treated**			
System Name:	Example 5	Copy WaterPro		
Source Point:				
Date of Sample:				
TDS =	27	mg/L		
pH =	5.80	field pH is recommended		
Total Alkalinity =	5.0	mg/L as $CaCO_3$		
Calcium (total) =	0.3	mg/L Ca^{2+}	0.70	mg/L as $CaCO_3$
Water Temperature =	15.0	°C (temp. at which pH was analyzed)		
Field Water Temperature =	15.0	°C (operating temperature at facility)		
Cl^- =	4.2	mg/L	39.5	mg/L as $CaCO_3$
SO_4^{2-} =	0.6	mg/L	49.0	mg/L as $CaCO_3$
Mg^{2+} =	0	mg/L	0.0	mg/L as $CaCO_3$

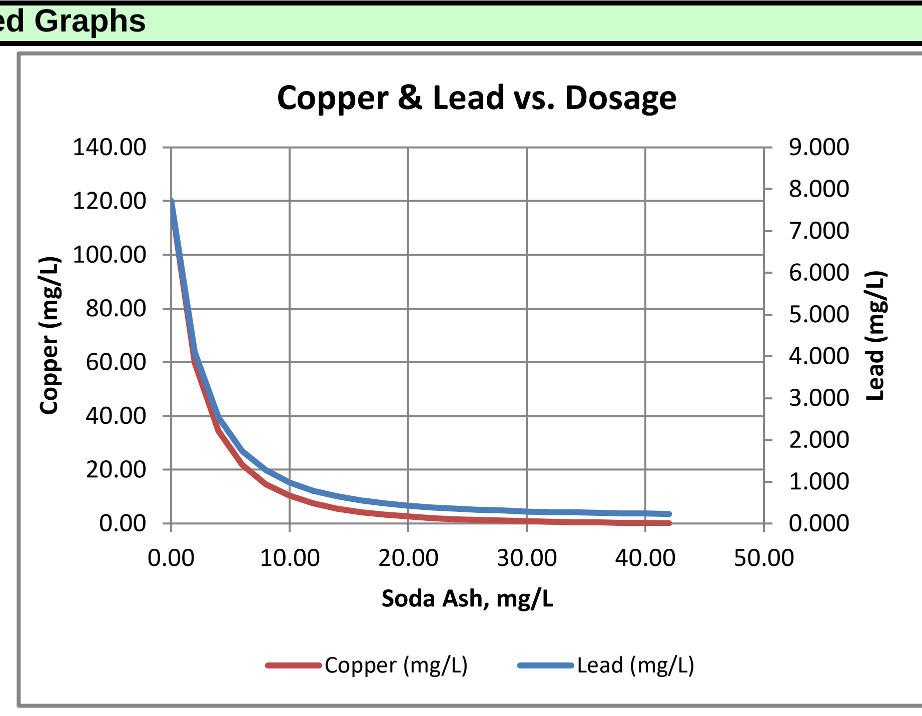
Step 2	**Chemical Selection & Constraints**	
Select Corrosion Control Chemical	Soda Ash (Na2CO3)	
Enter Constraints:		
Upper limit dose to plot:	80.0	mg/L
Upper Bound pH:	8.0	
Step 3	**Enter Desired Dose if Added**	
Orthophosphate as PO_4^{3-}	0.0	mg/L
Step 4	**Plot Data**	Activate button "***Plot Data***" to plot any new data entered in Steps 1 to 3.

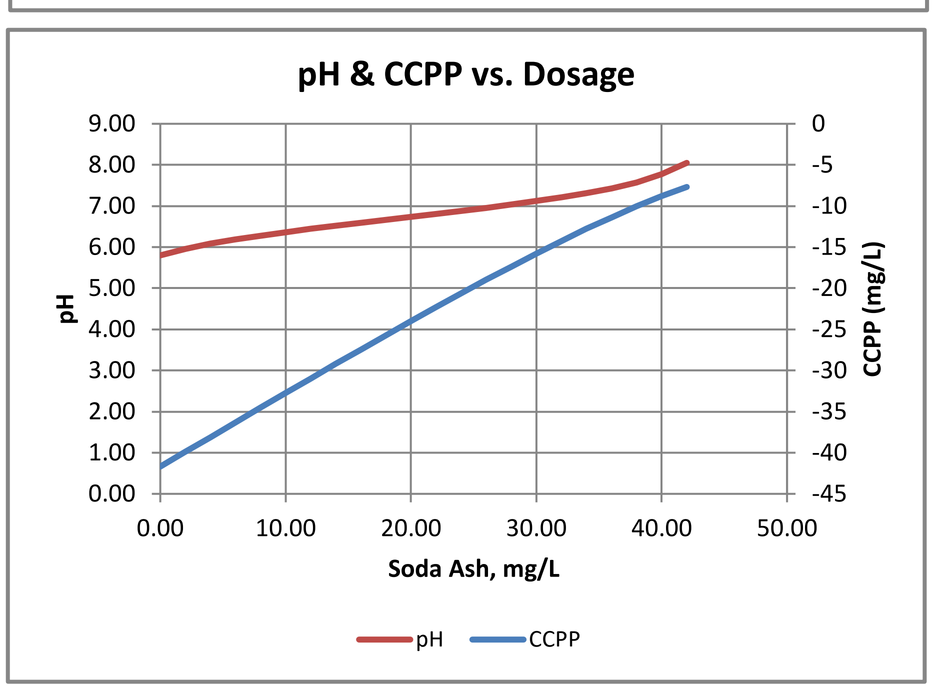
Plotting Points for Graphs

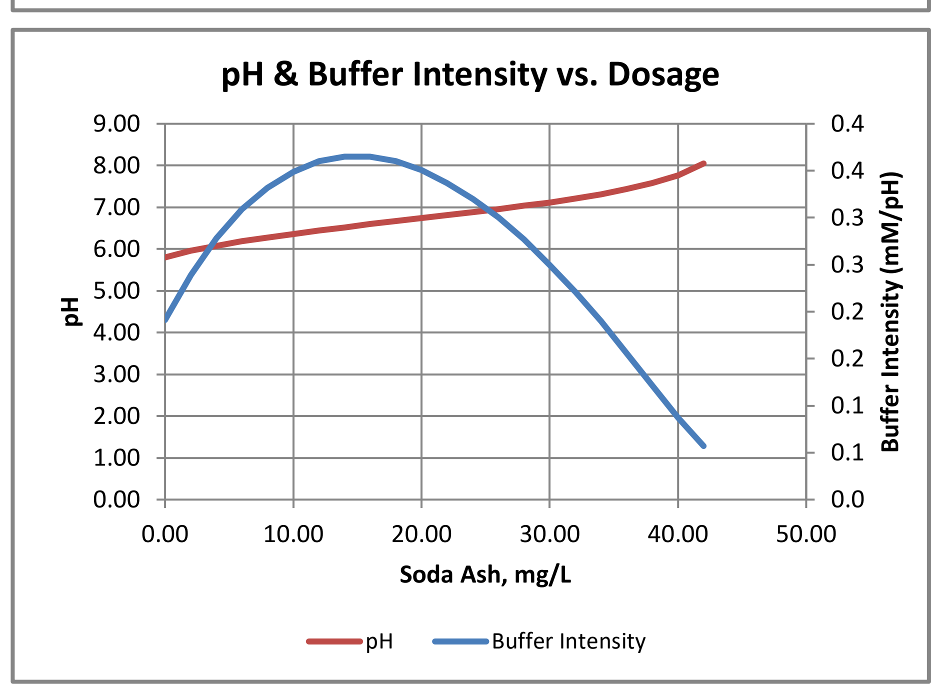
Dosage mg/L	with Ortho mg/L	pH	Alkalinity mg/L	DIC mg/L C	LI	CCPP mg/L	Copper mg/L	Lead mg/L	Buffer Intensity mM/pH	CO_2 mg/L	AI	RI
0.00	0	5.80	5.00	6.15	-5.41	-41.69	120.000	7.726	0.191	18.10	6.35	16.62
2.00	0	5.96	6.89	6.37	-5.12	-39.89	59.800	4.106	0.239	17.20	6.64	16.19
4.00	0	6.08	8.78	6.60	-4.89	-38.09	34.500	2.542	0.278	16.40	6.87	15.86
6.00	0	6.19	10.67	6.83	-4.70	-36.30	21.800	1.736	0.309	15.60	7.06	15.58
8.00	0	6.28	12.55	7.05	-4.53	-34.52	14.600	1.270	0.332	14.80	7.23	15.35
10.00	0	6.37	14.44	7.28	-4.39	-32.74	10.300	0.978	0.349	14.00	7.37	15.14
12.00	0	6.45	16.33	7.51	-4.26	-30.97	7.480	0.785	0.360	13.10	7.50	14.96
14.00	0	6.52	18.22	7.73	-4.13	-29.21	5.590	0.651	0.365	12.30	7.63	14.79
16.00	0	6.59	20.11	7.96	-4.02	-27.46	4.260	0.554	0.365	11.50	7.74	14.63
18.00	0	6.67	22.00	8.19	-3.91	-25.73	3.310	0.483	0.360	10.60	7.85	14.48
20.00	0	6.74	23.89	8.41	-3.80	-24.01	2.600	0.429	0.351	9.82	7.96	14.34
22.00	0	6.81	25.78	8.64	-3.70	-22.31	2.060	0.387	0.337	8.99	8.06	14.20
24.00	0	6.88	27.66	8.87	-3.59	-20.63	1.650	0.354	0.320	8.16	8.17	14.07
26.00	0	6.96	29.55	9.09	-3.49	-18.98	1.320	0.327	0.300	7.34	8.27	13.94
28.00	0	7.03	31.44	9.32	-3.38	-17.36	1.060	0.306	0.277	6.51	8.38	13.80
30.00	0	7.12	33.33	9.55	-3.28	-15.78	0.842	0.289	0.250	5.68	8.49	13.67
32.00	0	7.21	35.22	9.77	-3.16	-14.24	0.663	0.275	0.221	4.86	8.60	13.53
34.00	0	7.31	37.11	10.00	-3.03	-12.77	0.512	0.263	0.190	4.04	8.73	13.38
36.00	0	7.43	39.00	10.23	-2.89	-11.36	0.384	0.253	0.156	3.22	8.87	13.22
38.00	0	7.58	40.88	10.45	-2.73	-10.04	0.272	0.245	0.122	2.41	9.03	13.04
40.00	0	7.77	42.77	10.68	-2.52	-8.81	0.176	0.238	0.087	1.62	9.24	12.81
42.00	0	8.05	44.66	10.91	-2.22	-7.68	0.096	0.226	0.057	0.88	9.54	12.50

Generated Graphs









(707)322-2001;p/n11068; April 17, 2019

TTHMs/HAA6/CH Modeling Program

Predictive Raw-Water Models for TTHM, THAA, CH and Respective Species

Step 1: Enter Information for Predicted THMs, HAA6, CH formations

Sample Point	Raw Water	
Raw Water DOC =	5.96	mg/L as C
Applied Chlorine dose (Cl_2) =	2.2	mg/L
Contact time (t) =	8.0	hour
Bromide ion concentration (Br) =	0.10	mg/L
pH =	5.80	
Water Temperature =	10.0	°C

Step 2: Results - Predicted THMs, HAA6 & CH

Trihalomethanes (THMs)				
$CHCl_3$ (chloroform); R^2 = 0.87	41.8	ug/L	0.350	umol/L
$CHCl_2Br$ (bromodichloromethane); R^2 = 0.90	13.4	ug/L	0.082	umol/L
$CHClBr_2$ (dibromochloromethane); R^2 = 0.89	1.5	ug/L	0.007	umol/L
$CHBr_3$ (bromoform); R^2 = 0.61	0.0	ug/L	0.000	umol/L
TTHM (total trihalomethane); R^2 = 0.90	52.8	ug/L	0.439	umol/L
Haloacetic Acids (HAAs)				
$CHCl_2$-CO_2H (dichloroacetic acid); R^2 = 0.83	16.1	ug/L	0.125	umol/L
CCl_3-CO_2H (trichloroacetic acid); R^2 = 0.87	54.3	ug/L	0.332	umol/L
CH_2Cl -CO_2H (monochloroacetic acid); R^2 = 0.14	2.2	ug/L	0.023	umol/L
CH_2Br-CO_2H (monobromoacetic acid); R^2 = 0.43	0.1	ug/L	0.001	umol/L
$CHBr_2$-CO_2H (dibromoacetic acid); R^2 = 0.77	0.3	ug/L	0.001	umol/L
BrCl-CO_2H (Bromochloroacetic Acid); R^2 = 0.76	4.3	ug/L	0.027	umol/L
Total HAAs; R^2 = 0.87	72.7	ug/L	0.509	umol/L
Chloral Hydrate (CH)				
$C_2HCl_3(OH)_2$ (chloral hydrate); R^2 = 0.81	4.2	ug/L	0.026	umol/L

Models were developed based on the following parameters:

Reaction Time; 2 to 168 hours
DOC; 1.2 to 10.7 mg/L for HAA model and 1.2 to 10.6 mg/L for THM model
DOC; 2.78 to 10.6 mg/L for CH model
Applied Chlorine Dose; 2.11 to 26.4 mg/L for HAA model
Applied Chlorine Dose; 1.51 to 33.55 mg/L for THM model
Applied Chlorine Dose; 1.89 to 33.55 mg/L for CH model
Bromide; 0.007 to 0.560 mg/L
Temp, °C; 15 <= Temp <= 25
pH; 6.5 <= pH <= 8.5
EPA 815-R-98-005, August 1998

 (707)322-2001;p/n11068; April 17, 2019

TTHMs/HAA6/CH Modeling Program

Predictive Coagulated-Water Models for TTHM, THAA, CH and Respective Species

Step 1: Enter Information for Predicted THMs,HAA6, and CH formations

Sample Point	Filtered Water		
DOC =	0.89	mg/L as C	
Applied Chlorine dose (Cl_2) =	2.2	mg/L	
Contact time (t) =	8.0	hour	
Bromide ion concentration (Br) =	0.10	mg/L	
pH =	7.50		Models were based on the adjacent parameters
Water Temperature =	20.0	°C	

Step 2: Results - Predicted THMs, HAA6 & CH

Trihalomethanes (THMs)				
$CHCl_3$ (chloroform); R^2 = 0.91	3.9	ug/L	0.032	umol/L
$CHCl_2Br$ (bromodichloromethane); R^2 = 0.83	7.7	ug/L	0.047	umol/L
$CHClBr_2$ (dibromochloromethane); R^2 = 0.32	1.2	ug/L	0.006	umol/L
$CHBr_3$ (bromoform); R^2 = 0.72	0.3	ug/L	0.001	umol/L
TTHM (total trihalomethane); R^2 = 0.89	17.8	ug/L	0.087	umol/L
Haloacetic Acids (HAAs)				
$CHCl_2$-CO_2H (dichloroacetic acid); R^2 = 0.88	2.6	ug/L	0.020	umol/L
CCl_3-CO_2H (trichloroacetic acid); R^2 = 0.93	3.5	ug/L	0.022	umol/L
CH_2Cl -CO_2H (monochloroacetic acid); R^2 = 0.36	4.6	ug/L	0.028	umol/L
CH_2Br-CO_2H (monobromoacetic acid); R^2 = 0.35	0.3	ug/L	0.002	umol/L
$CHBr_2$-CO_2H (dibromoacetic acid); R^2 = 0.84	2.2	ug/L	0.010	umol/L
BrCl-CO_2H (Bromochloroacetic Acid); R^2 = 0.87	4.5	ug/L	0.028	umol/L
Total HAAs; R^2 = 0.92	12.1	ug/L	0.109	umol/L
Chloral Hydrate (CH)				
$C_2HCl_3(OH)_2$ (chloral hydrate); R^2 = 0.87	1.1	ug/L	0.007	umol/L

Models were developed based on the following parameters:

Reaction Time; 2 to 168 hours
DOC; 1 to 4.6 mg/L for HAA model
DOC; 1 to 7.77 mg/L for THM & CH models
Applied Chlorine Dose; 1.11 to 24 mg/L
Bromide; 0.036 to 0.306 mg/L as Br
Temp, °C = 25
pH = 7.5 for THM model, HAA model not dependent on pH

Models were developed for Alum and Iron coagulants.
EPA 815-R-98-005, August 1998

 (707)322-2001;p/n11068; April 17, 2019

Appendix D – Supplemental Information

Water Treatment Plant Equipment Inventory

Assumptions and Design Calculations

Standard System Operating Procedures

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.

KONGIGANAK - General Assumptions

Kong has no individual plumbed services. The community relies on the Washeteria, which is overused and in poor repair. The operator reports using 1,000 -3,000 gpd with current system. System flow rates will depend heavily on how many operable washers are available for use. Washeteria is currently open about 12 hours per day. The current hours of operation are not capable of meeting demand. This is managed by managing a wait list for washers, and limiting the amount of laundry per person. Water use is expected to increase with repaired / operable facilities and improved water quality.

Water use was estimated based on current operator records, population estimates, and typical water use (Reported Use Est tab). These were compared against Washeteria / Haul estimates (Washeteria Est tab), which were based on available fixtures.

Expanded washeteria services would be needed to reasonably meet the demand of the future, estimated population. Expanded washeteria hours will not fully address a growing population.

WTP / Washeteria Constructed	1978 -1999	
Washeteria Addition Constructed	2002	
Source Water	Contractor's Lake	
Available Source Water Volume	4-5 MG	
Water Rights (2002, LAS 23946)	3,600 gpd	
1990 Population	294	people
2000 WTP Design Population (Montgomery Watson)	360	people
Current Population (2018 DCCED Certified)	539	people
2010 Service Connections (2010 Census)	90	
2038 Design Pop (0.9% growth)	644	people
2000 Design Treated Water Storage Volume Specified (Montgomery Watson, 2000)	20,000	gallons
2002 Treated Water Storage Volume Installed	9,150	gallons
2019 Water Use Estimate		
2019 Wash/WTP/Home Haul, all fixtures operational	3,800	gpd
Per Cap Rate	7	gpd/cap
Washeteria Access	12	hours / day
Avg Use Rate	5	gpm
Peak Hourly Flow	20	gpm
2038 Water Use Estimate - limited Washeteria hours		
2038 Wash/WTP/Home Haul, all fixtures operational	4,500	gpd
Per Cap Rate	7	gpd/cap
Washeteria Access	12	hours / day
Avg Use Rate	6	gpm
Peak Hourly Flow	20	gpm
2038 Water Use Estimate - extended Washeteria hours		
2038 Wash/WTP/Home Haul, all fixtures operational	6,300	gpd
Per Cap Rate	10	gpd/cap
Washeteria Access	20	hours / day
Avg Use Rate	5	gpm
Peak Hourly Flow	20	gpm

2038 Expanded WTP Production

2038 Wash/WTP providing increased capacity	30,000 gpd
Per Cap Rate (40 gpd/cap plus washeteria use)	47 gpd/cap
Hours per Day of Primary Use	24 hours / day
Avg Use Rate	21 gpm
Peak Hourly Flow	100 gpm

Kongiganak WTP - Current Treatment

The existing system, as it currently operates, includes raw water storage (1.2MG), coagualtion, a floc tank, (2) 36-inch diameter media filters (run in series at 7 gpm), chlorination, and treated water storage in (61) 150-gallon plastic tanks (all tanks full equals about 8,000 gallons, typical max storage 7,000 gallons). Backwash is run for approx 5-7 minutes, using approx. 1,000 gallons (based on operator estimates, about 170 gpm, no air scour, no backwash flow meter). The water is distributed to the washeteria and a community watering point. Raw water is provided to the school (they own/operate their own treatment system). The system demand, with current washeteria fixtures, is 1,000 - 2,000 gpd.

2019 Avg Daily Demand - Limited Washeteria Hours, limited operable fixtures	2,000	gpd	Operator reports 1,000 - 3,000 gpd.
Max Daily Demand	3,000	gpd	
Typical Filtration Rate			
Filtration Rate	7	gpm	Operator reports
# Filters	1		2 filters, but run in series, loading rate calculated bsed on first filter
Filter Diameter	36	inches	
Filter Area	7.07	sq ft	
Filter Loading Rate	0.99	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 # Backwashes per Filter Per Day	1		Operator says runs backwash as needed, takes about 5-7 minutes, and takes about 1,000 gallons. Each filter is backwashed in series.
Backwash Rate	85	gpm	Calculated from reported backwash operations, no backwash flow meter. Backwash pump is a 3 hp pump, located on same floor as storage tanks, one floor below filters),
	12	gpm/sqft	This is low (typically 16 gpm/sq ft), particularly with no air scour
Backwash Interval	6	min	Operator says about 5-7 minutes, or until runs "clear". May not be sufficient time.
Backwash Volume (all filters)	1,000	gpd	Reportedly about 1,000 gal is reserved to backwash both filters.
Total Max Treated Water Storage	8,000	gallons	Based on tank marking. Typical operating levels are less, about 7,000 gpd
Time to treat max daily demand (3,000 gallons at 7 gpm)	429	minutes	
	7	hours	Would need to do this at night, after the Wash is closed, so no demand.
Time to fill all tanks (8,000 gallons at 7 gpm)	1,143	minutes	
	19	hours	Would need to do this at night, after the Wash is closed, so no demand.
Peak Hour Flow	15	gpm	Chlorine is added immediately prior to distribution.
Storage Tank (assume 2 150 gal tanks, 75% full)	225	gal	
Chlorine Contact Time	15	minutes	might be enough to inactivate bacteria, at beginning of day when tanks are mostly full (at least 75% full)

KONGIGANAK - Water Use Estimates Based on Operator Records, Population, and Typical Use Rates
(Variables shaded green)

1. 2019 Washeteria / Home Haul Water Use Estimates, based on current population and operator records

Current Population (2018 DCCED Certified)	539	people	from Assumptions tab
Current Service Connections	90		from Assumptions tab
Average Daily Demand	2,000	gpd	Based on operator info.
Calculated Average Demand Per person	4	gal/cap/day	Calculated use, based on use records and population (washeteria + home haul)
Max Daily Demand	3,000	gpd	Based on operator info.
Calculated Max Demand Per person	6	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 currentsystem opertions)
Peaking Factor	4		
Peak Hourly Flow	16.67	gpm	

2. 2038 Washeteria/Home Haul Water Use Estimates, with modest increases in daily water use (gpd), based on improved wq and repaired fixtures.

2038 Design Pop	644	people	from Assumptions tab
Estimated Avg Demand Per person	5	gal/cap/day	assume avg water use increases with improved access to washeteria and improved water quality.
Estimated Average Daily Demand	3,220	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	7	gal/cap/day	assume avg water use increases with improved access to washeteria and improved water quality.
Estimated Maximum Daily Demand	4,508	gpd	Rough estimate based on population and modest increases in water use (gpd).
Hours per Day of Water Use / Availability	12	hours	Washeteria hours (based on current system opertions)
Peaking Factor	4		
Peak Hourly Flow	25.04	gpm	

3. 2038 Expanded production, providing approximately 40 gpd/capita, in addition to washeteria use.

2038 Design Pop	644	people	from Assumptions tab
Expanded Water Consumption	40	gpd/person	
Total Estimated Per Cap Demand	25,760	gpd	based on 2038 population
Washeteria (washing machines access)	5	gpd/person	assume each person requires 1 load (35 gal) of laundry per week, approx 5 gpd
Total Washeteria	3,220	gpd	
Total Future Piped Demand Estimate	28,980	gpd	This matches well with original design estimate (28,800 gpd)
Hours per Day of Water Use / Availability	20	hours	
Total Avg Flow	24	gpm	
Peaking Factor	4		
Peak Hourly Flow	97	gpm	

Kongiganak WTP - Washeteria Appliance Flow Rate Estimates

Use estimates were considered for three different operational scenarios for existing washeteria. No change in numbers of appliances. Current system (and associated flow rates) are impacted by unmet demand and limited access to limited appliances. Currently over 500 people depend on 6 washing machines and 4 showers. Increasing access to the facilities would increase daily demand.

1. Year 2019 - With limited water use, partially operating fixtures, water haul is based on current population and typical dail haul use.

APPLIANCE	TOTAL #	OPERATIONAL #	FLOW RATE (gpm)	FLOW TOTAL (gallons/use)	DAILY USES* (each)	ESTIMATED TOTAL FLOW (gpd)	ESTIMATED NON POTABLE (gpd)	ESTIMATED POTABLE (gpd)	NOTES
Washing Machine	6	4	2.5	35	10	1,400	1,400	NA	about 1 hr per cycle, with some time between uses
Showers	4	2	2.5	15	8	240	NA	240	less than 1 shower/hour (current showers are in rough shape)
Toilets	4	2	2.5	1.5	20	60	60	NA	
Lavatories	4	4	0.5	1	20	80	NA	80	
Community Watering Point	1	1	2.5	7	108	755	NA	755	Daily uses is number of 7-gallon jugs filled per day.
					TOTAL (gpd)	**2,535**	**1,460**	**1,075**	This roughly matches operator reports.
					Average (gpd)	3.52	2.03	1.49	
					Peak Hourly (gpm)	14.08	8.11	5.97	

Hours of Water Use / day	12		
Peaking Factor	4		
Hauled Water Use per day per person	1.5	gpd	
Total use	809	gpd	Assumes current population.
Total 7.5 gallon jugs	108	jugs per day	

2. Year 2019 - With limited Washeteria hours, all fixtures repaired, water haul is based on current population and typically daily haul use.

APPLIANCE	TOTAL #	OPERATIONAL #	FLOW RATE (gpm)	FLOW TOTAL (gallons/use)	DAILY USES* (each)	ESTIMATED TOTAL FLOW (gpd)	ESTIMATED NON POTABLE (gpd)	ESTIMATED POTABLE (gpd)	NOTES
Washing Machine	6	6	2.5	35	10	2,100	2,100	NA	About 1 hr per cycle, with some time between uses.
Showers	4	4	2.5	15	12	720	NA	720	About 1 shower/hour with improved facilities.
Toilets	4	4	2.5	1.5	20	120	120	NA	
Lavatories	4	4	0.5	1	20	80	NA	80	
Community Watering Point	1	1	2.5	7	108	755	NA	755	Daily uses is number of 7-gallon jugs filled per day.
					TOTAL (gpd)	**3,775**	**2,220**	**1,555**	
					Average (gpd)	5.24	3.08	2.16	
					Peak Hourly (gpm)	20.97	12.33	8.64	

Hours of Water Use / day	12		
Peaking Factor	4		
Hauled Water Use per day per person	2.5	gpd	Assumed water use increases with improved quality.
Total use	809	gpd	Assumes 2019 population.
Total 7.5 gallon jugs	108	jugs per day	

Kongiganak WTP - Washeteria Appliance Flow Rate Estimates (continued)

3. Year 2038 - With Extended Washeteria Use (to better meet demand), all fixtures repaired, water haul is based on 2038 population, and typical daily haul use.

APPLIANCE	TOTAL #	OPERATIONAL #	FLOW RATE (gpm)	FLOW TOTAL (gallons/use)	DAILY USES* (each)	ESTIMATED TOTAL FLOW (gpd)	ESTIMATED NON POTABLE (gpd)	ESTIMATED POTABLE (gpd)	
Washing Machine	6	6	2.5	35	16	3,360	134,400	15,805,440,000	about 1 hr per cycle, with some time between uses
Showers	4	4	2.5	15	18	1,080	48,600	787,320,000	1 shower/hour
Toilets	4	4	2.5	1.5	40	240	24,000	8,640,000	
Lavatories	4	4	0.5	1	40	160	3,200	512,000	
Community Watering Point	1	1	2.5	7	215	1,503	806,431	8,482,580,047	Daily uses is number of 7-gallon jugs filled per day

TOTAL (gpd)	**6,343**	This roughly matches operator reports on current water use.
Average (gpd)	5.29	
Peak Hourly (gpm)	21.14	

Hours of Water Use / day	20		
Peaking Factor	4		
Hauled Water Use per day per person	2.5	gpd	Assumed water use increases with improved quality.
Total use	1,610	gpd	Assumes 2038 population.
Total 7.5 gallon jugs	215	jugs per day	

Kongiganak WTP - Treatment / Operation Options

I. Treatment/Operations Option 1 - Repaired Washeteria facilities, no expansion in services, batch treat for CT

In this option the filtered water storage tank treatment would happen during the night, with no nightly water use (washeteria is closed, watering point closed). As soon as the washeteria closes, filters would backwash (if needed). Water would be filtered into the tank, chlorinated to meet CT (based on residual at tank outlet), then held for the minimum CT time needed. Washeteria and watering point would operate off stored/treated water during the day.

2038 Daily Demand - Limited Washeteria Hours	4,500	gpd	Batch treat so no extended hours (washeteria is closed at night for batch treat).
Max Hours to produce daily water	3	hours	Production hours needed to fill tank to daily demand volume, for overnight batch chlorination treatment.
Caculated Min Filtration Rate	25	gpm	Would have to filter water at least at this minimum rate to fill up the storage tank for batch treatment (this assumes completely filling tank - so is conservative).
Minimum required contact time for CT	154	min	From CT Calc tab (0.3 mg/L chlorine dosage, 7 pH, 5C, 1 log inactivation), could reduce time if increased chlorine.
	3	hours	
Total time needed for full treatment	6	hours	Time for full filtration + chlorination contact time before water could be used. Washeteria/Watering point would be closed for this amount of time each day.

Filtration

Filtration Rate	25	gpm	
# Filters	2		
Filter Diameter	48	inches	
Filter Area	12.57	sq ft	
Filter Loading Rate	0.99	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 # Backwashes per Filter Per Day	1		
Backwash Rate	16	gpm/sqft	
	201	gpm	
Backwash Interval	20	min	Could reduce this duration using optimized backwash technique.
Backwash Volume (all filters)	8,042	gpd	
Air Scour	4	cfm/sqft	

Days of finished water storage	3		
Min Treated water tank volume	21,542	gallons	Approx 22,000 gallons would allow 3 days demand storage and backwash for both filters.
Tank Sizing			
Total Tank Volume	22,000	gallons	
	2,941	cuft	
Tank Diameter	18	feet	This is about the max diameter that will fit on the existing pilings, and leave room for new WTP and filters.
Area per foot of height	254	sqft	
Min height to achieve volume	12	feet	

In this option chlorination would be achieved through batch treatment with no flow through tank. So BF and peak hourly flow aren't factors. But, minimal steps would be taken to provide a 0.1 BF to more easily accommodate changes in future operations (in case they wanted to go to continuous operation).

II. Treatment/Operations Option 2 - Repaired Washeteria facilities with extended hours, no expansion in plumbed services, continuously treat for CT

This option would continuously treat water, but would provide no added fixtures/appliances. This would provide an option for extended hours of washeteria operation, which would provide needed improved washeteria access to the community. For the purposes of this estimate it is assumed the Washeteria would be open 20 hours per day.

The water storage tank(s) would act as reservoir tanks as well as provide contact time for giardia and bacterial disinfection. Therefore, BF and peak hourly flow are critical, resulting in a relatively large, required storage volume.

2038 Daily Demand - extended Washeteria access	6,300	gpd	From assumptions tab
Avg estimated demand	5	gpm	From assumptions tab
Peak hourly demand	20	gpm	From assumptions tab
Minimum Volume for CT	25,000	gallons	From CT Calc Hauled tab (assumes 0.4 mg/L chlorine residual).
Minimum Daily Volume for Backwash	8,042	gallons	Assume same filtration sizing and backwash as in Option 1.
Minimum Operating Tank Volume	33,042	gallons	
Days of Finished Water Storage	3	days	
Estimated Total Tank Volume	51,942	gallons	= (days of storage * daily use) + min operating level for CT/backwash
	6,944	cuft	
Tank Diameter	18	feet	
Area per foot of height	254	sqft	
Min height to achieve volume	27	feet	Use two tanks, so each tank would be about 13' tall.
Treatment rate based on filtration rate	25	gpm	Matches filtration rate used above.
Time to fill tank (typical daily)	9.56	hours	Time to replace daily demand + daily backwash, operating hours per day.
Time to fill tank (from empty)	25.07	hours	Time to fill a completely empty tank (assumes typical water use and one backwash while filling).

III. Treatment/Operations Option 3 - expanded production, continuously treat for CT

This option would expand production to provide approximately 40 gpd/person, in addition to treated water for the washeteria. The WTP would continuously treat water.

2038 Daily Demand (expanded production)	30,000	gpd	From assumptions tab
Avg estimated demand	21	gpm	From assumptions tab
Peak hourly demand	100	gpm	From assumptions tab
Minimum Volume for CT	150,000	gallons	From CT tab - assume use 2 tanks in series (50,000 gal total) to meet CT.
Minimum Daily Volume for Backwash	16,085	gallons	Assume same filtration sizing and backwash as in option 1, but allow for 2 backwashes per day (24 hours) per filter.
Days of finished water storage	5		Tank would just be used for backwash water and finished water storage. CT would be met in the 50,000 CT tanks.
Estimated Min Tank Volume	230,425	gallons	
	30,805	cuft	
Tank Diameter	40	feet	
Area per foot of height	1,257	sqft	
Min height to achieve volume	25	feet	Would have to build a new finished water storage tank system.
Increase max filter production rate*	50	gpm	Increase water production rate, increase backwash rate to compensate for added loading.
# Filters	2		
Filter Diameter	48	inches	Keep same filter size as above.
Filter Area	12.57	sq ft	
Filter Loading Rate	1.99	gpm/sqft	ANTHC recommends 1 gpm/sqft, engineering standards say 1-4 gpm/sqft. Increase backwash rate to compensate for increased loading. Still within acceptable loading rates. This assumes filters operated in parallel. May need to add a thrid, 48 inch, polishing meda filter.
Time to fill tank (typical daily)	15	hours	Operating hours per day to replace daily demand + daily backwash (each filter twice a day), would need 2 operators.
Max fill rate	25,915	gallons	Max fill rate = production hours available (after meeting daily fill demand) * daily water production rate.
Days to fill completely empty tank	9	days	

Option 3 would provide an increased community demand. But would require mulitple operators, unexpected events would be harder to recover from. Operations (coagulation and backwash processes), would be more critical, to meet regulatory turbidity limits.

Would also need to increased raw water supply, preferably continuous. Would need to verify water availability in Contractor's Lake, improve Contractor's Lake (for increased storage), or develop additional source(s).

Kongiganak WTP -CT Estimates - Hauled Water

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**	**7.0**	**7.0**	**7.0**
(NLT .2)	**Free Chlorine Residual** (mg/l)	**0.50**	**0.40**	**0.30**
(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	2.53	2.53	2.53
	c = 0.113 * Free Cl Residual	0.06	0.05	0.03
	REQUIRED CT (min*(mg /liter))=	**47**	**47**	**46**
	Required Contact Time (min) = CT / (Free Cl Residual) =	**95**	**117**	**154**
	Achieved CT	50	50	45
	Design Flow Rate (gpm)	**20**	**20**	**20**
	CT Storage Volume (gal)	**20,000**	**25,000**	**30,000**
	Baffle Factor (0.1 to 1.0)	**0.1**	**0.1**	**0.1**
Effective Storage (gal) = (Storage * Baffle Factor)		2,000	2,500	3,000
Storage Time (min) @ Flow Rate = Eff. Storage / Des Flow Rate		100	125	150
Excess contact time (mins) = (Storage Time - Contact Time)		5	8	(4)
Achieved Inactivation		1.06	1.07	0.97

Note: Excess Contact Time must be positive under all operating conditions!

Kongiganak WTP -CT Estimates - Expanded Production

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**	**7.0**	**7.0**	**7.0**
(NLT .2)	**Free Chlorine Residual** (mg/l)	**0.60**	**0.50**	**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	2.53	2.53	2.53
	c = 0.113 * Free Cl Residual	0.07	0.06	0.05
	REQUIRED CT (min*(mg /liter))=	**48**	**47**	**47**
	Required Contact Time (min) = CT / (Free Cl Residual) =	**80**	**95**	**117**
	Achieved CT	60	50	40
	Design Flow Rate (gpm)	**100**	**100**	**100**
	CT Storage Volume (gal)	**50,000**	**50,000**	**50,000**
	Baffle Factor (0.1 to 1.0)	**0.2**	**0.2**	**0.2**
Effective Storage (gal) = (Storage * Baffle Factor)		10,000	10,000	10,000
Storage Time (min) @ Flow Rate = Eff. Storage / Des Flow Rate		100	100	100
Excess contact time (mins) = (Storage Time - Contact Time)		20	5	(17)
Achieved Inactivation		1.25	1.06	0.85

Note: Excess Contact Time must be positive under all operating conditions!

Kongiganak WTP - Virus Inactivation Estimates

Case 1	Case 2	Case 3		
2,000	2,500	3,000	effective volume (gal)	Uses tank info from CT Calc tab
100.0	125.0	150.0	Contact Time (min)	
50.0	50.0	45.0	CT achieved (mg/L-min)	
10.0	10.0	10.0	CT required (mg/L-min)	From EPA SWTR Guidance Table below
5.0	5.0	4.5	Inactivation ratio at 4-log	
20.0	20.0	18.0	Log Achieved virus inactivation (extrapolated)	Plenty of lach 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

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