Executive Summary

Introduction

CRW Engineering Group, LLC was hired to prepare assessments of communities throughout Alaska that do not have piped water and sewer systems. These communities are considered "unserved" as their current water and sewer service consists of small-haul, self-haul and/or honey buckets. Assessment work included drafting conceptual-level layouts of piped water and sewer systems, estimating the size of needed associated infrastructure and estimating both the O&M and capital costs of these systems.

Initially 36 village were identified as being "unserved." A few more were added for a total of 38 communities. This executive summary provides a brief overview of how the assessments were prepared and what conclusions could potentially be derived from the analysis. This was a desk-top level effort. Site visits were not included as part of the effort. The basis for the assessments was previous community information provided by VSW, available mapping from the DCCED and limited input from the communities and currently assigned engineers/project managers for those communities.

Sizing Model

The first step was to develop a system sizing model. Using industry-standard rules of thumb, we developed an excel-based spreadsheet that used the following:

- 20 year population growth of 1.5%
- Water demand of 50 gallons per person per day
- Max circulating water loop length 10,000 feet
- Water treatment facility-additions of 800 square feet for "good water" i.e. groundwater with minimal-required treatment and 1,200 for "poor water", i.e. surface water or groundwater high in iron and manganese
- Water storage tanks were sized based on daily demand, fire flows and 3 days of storage reserve. If the source is surface water, chlorine contact time was also factored into the sizing.
- Commercial, residential and school service numbers were obtained from the HITS database and a review of the DCCED Community Maps
- Upgraded two-cell sewage lagoons were sized to provide secondary treatment based on organic loading rates of 0.17 lbs of BOD5 per capita per day or hydraulic loading, whichever was greater

Soils & Foundation

We hired Golder Associates Inc. who provided us with a summary of soils information for each community. The recommendations for above grade vs below grade piping and the foundation type for buildings and water storage tanks, were based on the following:

- A review of the soils information from Golder. Generally speaking:
 - Soft, poorly drained soils or discontinuous permafrost = Pile foundations
 - o Firm soils or continuous permafrost = Thermosyphon stabilized gravel pads
 - Stiff soils and no permafrost = Gravel pads
- Photographic research of existing foundations within the community (i.e. the school)
- Unique circumstances i.e. some communities may have soils suitable for a buried system but have a significant amount of buried historical resources, posing problems for a below grade system.

Water Mains & Services

All the water mains were laid out to be circulating loops with a max length of 10,000 feet. Multiple loops were used in several communities. All water services were assumed to be an average length of 75 feet and all use circulating pumps.

Gravity vs. Pressure Sewer

Most of the unserved communities are in flatter areas with ice-rich silty soils that are not conducive to gravity sewer systems. Where topo showed suitable elevation gain and soils were better, we proposed buried gravity sewer mains and service lines in combination with community lift stations as needed to pump waste to the lagoon. Systems in flatter areas are shown with above grade, pressure systems that use individual sewage pump stations at each structure. The systems for some communities included a combination of gravity and pressure sewer systems.

Capital and O&M Costs

The system components were input in the state-provided capital cost model, last updated in 2010. Additional costs were added for items not included in the model including sewage grinder pump stations and electrical service upgrades. Each capital cost estimate includes inflation (3%), 15% construction contingency and 20% for design and construction administration.

The O&M costs are a function of the population, number of services and local energy costs. Administration costs are fixed at \$500 per month. Labor costs are a function of the size of the system (i.e. less than 50 services equates to 24 hours per week of operator time, etc.). Repair/replacement costs were calculated at 5% of the labor, fuel and electricity. Because of the desk-top nature of these assessments, it is not recommended that decision-making be solely based on the estimated O&M costs.

User Fees

Each assessment includes an estimate of the user fees that would be required to cover the costs of operating the piped water and sewer system. The user fee breakdown generally follows ARUC averages. As directed by the state, the following percentages were used:

Residential Rate
 Commercial Rate
 School Rate
 Sef total O&M cost
 26.5% of total O&M cost
 26.5% of total O&M cost

Since proposed user fees are based on the O&M estimates and the above directed percentages, it is not recommended that decision-making be solely based on these numbers. Those systems that show residential user fees within 10% to 20% of the estimated users' ability to pay, may benefit from future study.

Findings & Conclusions

The attached Chart 1 lists the communities in order by population, along with the estimated residential user fee and the Homeowners' ability to pay the fee. The ability to pay is based on 5% of the median household income for that community (obtained from US Census data). As can be seen on the chart, there is a clear and obvious relationship between the population and residential O&M costs. The smaller the community, the higher the user fee and vice versa. Based on the results of the assessment and with a few exceptions, Chart 1 generally shows that a piped system is unlikely to be affordable for a community with less than 100 residents.

Chart 2 lists the communities in order of population density, along with the overall population and estimated capital costs of the piped water and sewer system. Density was calculated as a function of population over the length of circulating water mains. The general trend of higher capital costs per person with lower community density can be seen. This shows the benefit to more dense community planning, in order to keep costs down for future projects. Additionally, some variation was found in the graph trend aside from density, which could usually be explained by the increased cost of transporting workers and materials to more remote communities.

Finally, there are a handful of other factors that can impact the costs of building and maintaining a piped water and sewer system:

- 1) Seasonal Water Source A piped water system requires year round flows. Many communities use a seasonal water source. In these cases, we assumed a large raw water reservoir (storage tank) would be needed to provide the flows for a piped system. Heat add and circulation of such a large tank increases O&M costs. If this community has poor soils, a large tank could require a pile supported foundation which drives the costs up even further.
- 2) Functioning School Because of the user fee breakdown, not having a school to cover almost 30% of the system O&M means residential and commercial customers carry a higher financial burden.
- 3) Community Population As noted above, the population base covers the cost of operating and maintaining the system. The smaller the population, the larger the user fee.
- 4) Community Layout/Density If the community is spread out, pipe runs are longer which translates to increased capital costs. Longer pipe runs also increase the costs of heating and circulating, which means higher O&M costs.

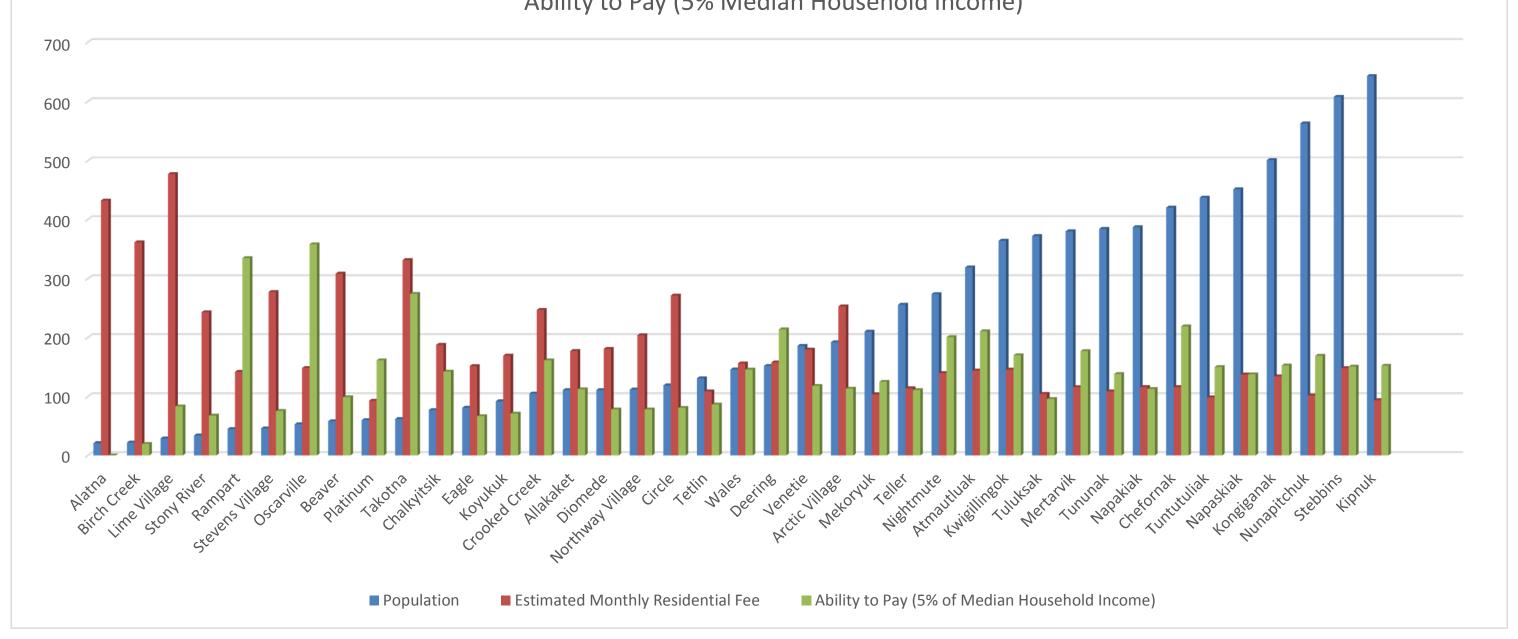
Generally speaking, those communities that have a year-round water source, a functioning school and are densely populated are good candidates for further study of a piped water and sewer system.

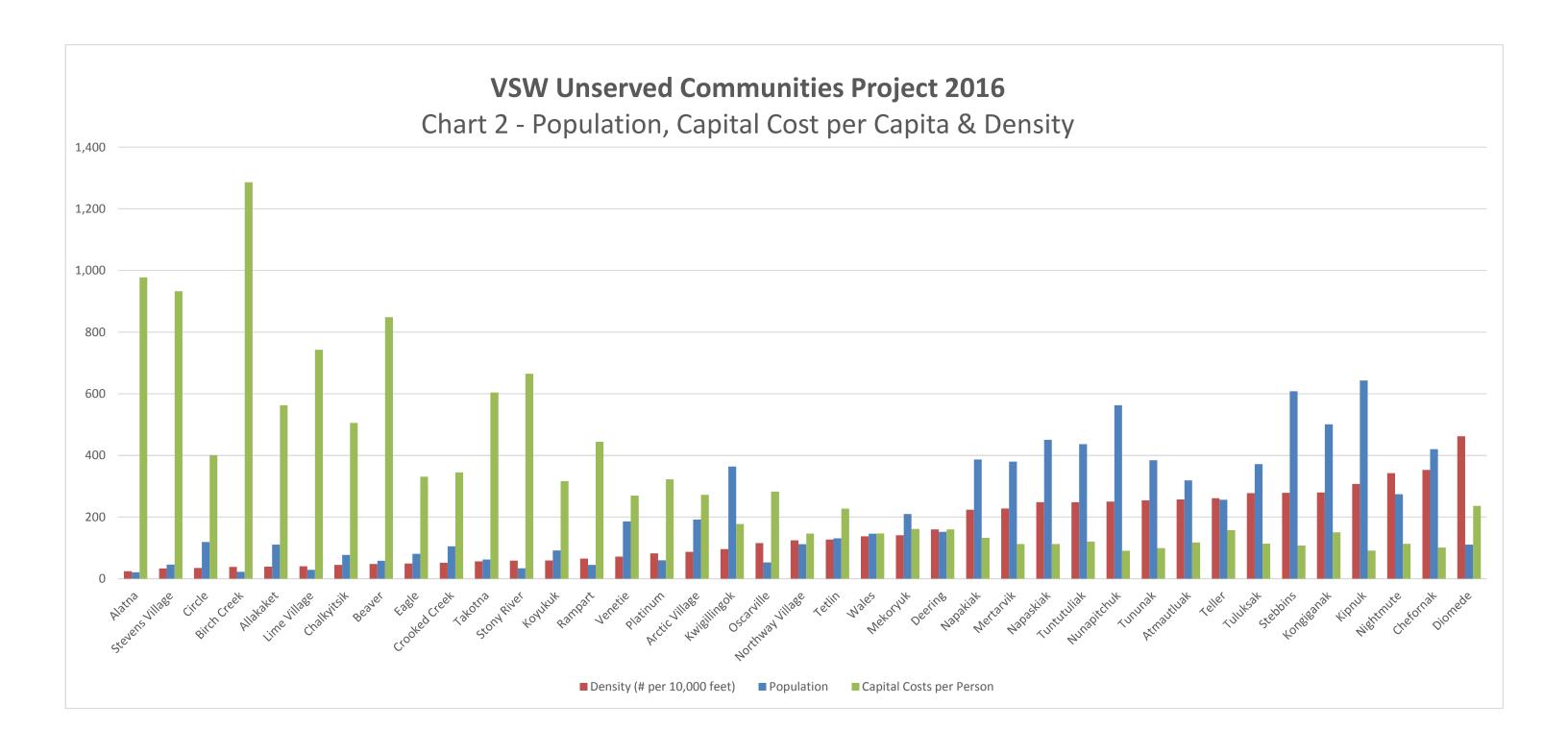
Attachments: Chart 1 – Population, Estimated Monthly Residential Fee & Ability to Pay

Chart 2 – Population, Capital Cost per Capita & Density



Chart 1 - Population, Estimated Monthly Residential Fee and Ability to Pay (5% Median Household Income)





Alatna, Alaska

Community Information & Existing Infrastructure

The Village of Alatna is an Inupiaq community of 21 people located on the north bank of Koyukuk River, southwest of its junction with the Alatna River. There are 17 residential units and 4 commercial/public facilities for a total of 21 services. The existing water and sewer services provided in Alatna consist of self-haul system from the central watering point attached to the water treatment plant and honey buckets. Only the washeteria/clinic discharge to the lagoon through a force main. The existing water and sewer infrastructure consists of the following:

- Well Water 10 gpm transfer pump
- Treated Water Storage 4,800 gallons
- Water Treatment Plant/Multi-Purpose Building – 2,312 SF, built in 2008
- Water Treatment Filtration, chlorination, and potassium permanganate
- Sewage Lagoon Two Cell, 1.2 acres

Soils around Alatna consist of non-plastic silt material with permafrost approximately 8-18 feet below surface.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 8,500 feet of pipe, and the pressure sewer system approximately 5,900 feet of pipe. The water system will consist of a single circulating loop. The pressure sewer system would require individual grinder pump stations at each house, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	2	10	-		
Water Storage (gallons)	40,200	4,800	35,400		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Sewage Lagoon Size (acre)	0.4	1.2	-		
Required Foundation System for WTP and/or WST					
Pile Foundation	1,840	-	1,840		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	8,500	-	8,500		
Wastewater Collection System	Wastewater Collection System				
Sewer Main with Glycol Heat Trace (If)	5,900	-	5,900		
Individual Grinder Pump Stations (GPS) (ea)	21	-	21		
Water & Sewer Service Lines					
Circulating Water Service Lines (If)	1,600	-	1,600		
Pressure Sewer Service Lines (If)	1,600	=	1,600		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Alatna. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

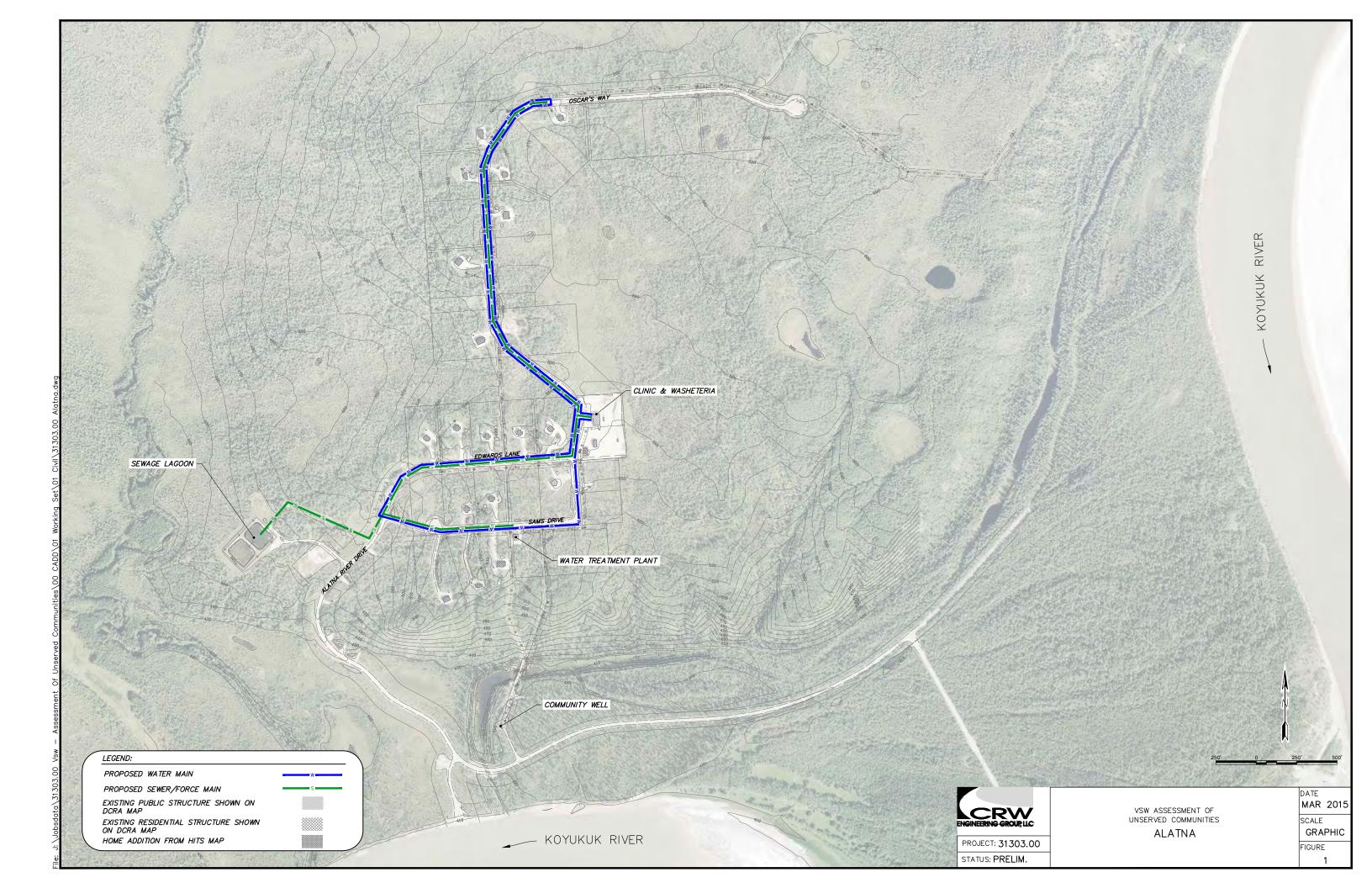
				Village	
	Estimated Capital Costs				
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	21	\$28,096.69	\$590,031
3	Sewage collection mains or services (gravity or force), above ground	LF	7,500	\$323.17	\$2,423,773
12	Water distribution, mains or services, above ground	LF	10,100	\$435.26	\$4,396,125
14	Water storage tank, no foundation	Gal	35,400	\$12.80	\$453,226
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
18	Foundation - freeze back piles	SF	1,840	\$692.10	\$1,273,464
	Total Estimated Cost in 2010 dollars (rounded): \$12,112,00				
	Total with Inflation (3% per year for 6 years) \$14,462,4				\$14,462,400
27	Individual Grinder Pump Stations	EA	21	\$30,000	\$630,000
28	Electrical Service Upgrades	EA	21	\$5,500	\$115,500
				Subtotal	\$15,207,900
29	Construction Contingency (15%)	LS	1	\$2,281,200	\$2,281,200
30	Design & Construction Administration Services (20%)	LS	1	\$3,041,600	\$3,041,600
		•		Total	\$20,530,700

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$25,000			
Fuel	\$40,500			
Electricity	\$21,900			
Other (R&R, Training, etc.)	\$13,000			
Total	\$106,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Alatna are listed below.

Estimated User Fees						
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate		evenues
Residential Service	\$	432	17	85%	\$	74,900
Public/Commercial Service	\$	648	4	100%	\$	31,100
School Service	\$	-	0	100%	\$	
Local Capital Contribution					\$	-
Total Revenue					\$ 1	106,000



VSW Unserved Communi	ties - Pined W	ater & Sewer System Type and Si	zing Model	
Date	-	2/26/2016	gouc.	
Community		Alatna		
Input				
Existing Community & System Data				
2015 Population		21		
2015 Number of Services HITS Database (E1 & H1-H7)		21 17		
DCED Mapping Commerical/Public Facilities/School		4		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		4800		
Water Treatment Capacity		10		
Existing Sewage Lagoon Size		1.2		
Soil Conditions (check only one)		112		
Soft poorly drained soils or discontinuous permafrost		x		
Firm soils, or continuous permafrost				
Stiff soils, no permafrost				
			Sewer Main Length	Water Main
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost				
Above ground system or buried with permafrost		х	5854	8464
Gravity Sewer Main			0	
Pressure Sewer Main		х	5854	75
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Alatna		
Output for Cost Model (calculated)				
			Foundatio	n Size
Water Treatment Capacity (gpm)		2		
Req Water Storage (gallons) (less existing)		35,400	640	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		-		
			Quantity	Notes
		Pile Foundation (sf)		
		. ,		
Required Foundation System for WTP and/or WST			1,840	
Water Distribution System				
		Circulating Water Main with	8,500	
		Pitorifices (If)		
		Sewer Main with Glycol Heat Trace		
Wastowater Collection System		(If)	5,900	
Wastewater Collection System				
		Individual Grinder Pump Stations	21	
		(GPS) (ea)		
		Circulating Water Service Lines (If)	1 600	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	1,600	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	1,600	
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Water & Sewer Service Lines		Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	1,600 1,600	
Water & Sewer Service Lines				
Water & Sewer Service Lines				
	Piped System	Pressure Sewer Service Lines (If)	1,600	
Water & Sewer Service Lines System Description	Piped System Need			
System Description	Need	Pressure Sewer Service Lines (If) Existing Facility	1,600	
System Description Water Treatment Capacity (gpm)	Need 2	Pressure Sewer Service Lines (If) Existing Facility	1,600 Net Need	
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System Description Water Treatment Capacity (gpm)	Need 2	Pressure Sewer Service Lines (If) Existing Facility 10 4,800	1,600 Net Need	
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System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	2 40,200 1,200	Pressure Sewer Service Lines (If) Existing Facility 10 4,800	1,600 Net Need - 35,400	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	2 40,200 1,200 0.4	Pressure Sewer Service Lines (If) Existing Facility 10 4,800 - 1.2	1,600 Net Need - 35,400 1,200	
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System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 2 40,200 1,200 0.4 1,840	Pressure Sewer Service Lines (If) Existing Facility 10 4,800 - 1.2	1,600 Net Need - 35,400 1,200 - 1,840 8,500	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If)	Need 2 40,200 1,200 0.4 1,840 8,500 5,900	Pressure Sewer Service Lines (If) Existing Facility 10 4,800 - 1.2	1,600 Net Need - 35,400 1,200 - 1,840 8,500 5,900	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) Was Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Need 2 40,200 1,200 0.4 1,840	Pressure Sewer Service Lines (If) Existing Facility 10 4,800 - 1.2	1,600 Net Need - 35,400 1,200 - 1,840 8,500	
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Date		served Communities - Piner	Water & Sewer	System Type and Sizing Model
System Parameters	Date	•	Water & Jewer	System Type and Sizing Model
Design Projection Design Projection Design Projection Place Design Projectio	Community	1		
20 years	System Parameters	Model Results		Criteria & Calculations
2015 Normalization (P)		20		20 years
2015 Number of Services 2015 15 15 15 15 15 15 15	* *			
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Susting Water Storage Tank A,800 gallons Surface Storage Tank A,800 gallons Surface Storage Tank A,800 gallons Subject Tank A,800 gallons A	Makey Skayaga Touk Siring			
Demand Based Volume (if source is GW)		4.800	gallons	Built in 2010
Daily Operation (DOI) (gallons) 1.582 gallons 3.0000 gallons 5.0000 gallons 5.000			1000.13	
Reserve Volume (KV) 1,687 gallons 40,230 gallons 4	Daily Operation (DO) (gallons)	2,562		
Water Statistics of Ministration (NC) Doing Eastwald Concentration (RC) Doing Eastwald			-	
Not Required O.A mg/L				
Disinfection/Log inactivation (LI) ### Care Imperature (T) ### Care Imperature (T) ### Care Imperature (T) ### Disinfection/Log inactivation (A c elsius/40 F ### Contact Time Required (CT) ### Baffing Coefficient (#P) ### Contact Time Required (CT) ### Baffing Coefficient (#P) ### District Coefficient (#P) ### Contact Time Required (CT) ### Baffing Coefficient (#P) ### Contact Time Required (CT) ### Baffing Coefficient (#P) ### Baffing Co			J .	
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Existing Sewage Lagoon Organic Loading Based Size Check 79.1 Hydraulic Loading Based Size 0.4 acres 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Capita day x	Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 0	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
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Two cell lagoon, combined acreage 0.4 acres Either organic loading based or hydraulic, whichever is greater	Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x 0 x 0 x 3 0.2 79.1	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)

Capital Cost Estimate Piped Water & Sewer System

Village	
Alatna	

Item	Line Item		Estimated	Adjusted	Total
No.	Description		Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	21	\$28,096.69	\$590,031
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	7,500	\$323.17	\$2,423,773
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0	#DIV/0!	\$0
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	10,100	\$435.26	\$4,396,125
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	35,400	\$12.80	\$453,226
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
	Washeteria, no foundation	SF	0	#DIV/0!	\$0
	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	1,840	\$692.10	\$1,273,464
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$12,112,277

Community:	Alatna	
General Community Dat	a	
Current population	on	21 persons
Average number Service Connect	of people per house	1.2
Number of he		17
Number of pu Number of so	ublic/commerical buildings	4 0
Number of Sc	Total number of service connecti	
Burdened labor r		\$20 hr
Electricity cost (F	Public facilty) Residential service)	\$0.66 kWh \$0.24 kWh
Cost per gallon for	,	\$6.00 gal
Water consumpt	·	50 gpd
Wastewater gene	eration per capita	50 gpd
Water & Sewer System (Water Source	Characteristics	
Type of syste	em (Surface(SW) or Groundwater(GW))	GW
Length of rav Water line he	v water line eated for freeze protection (Yes or No)	1280 ft No
	rater line (Above ground (AG) or Buried)	Buried
Water Treatment		0710
	treatment plant building uality (Good or Poor)	3512 sf Poor
Water Storage		
Size of tank(s		40,200 gallons
•	ter line to/ from tank eated for freeze protection (Yes or No)	75 ft Yes
Location of w	ater line (Above ground (AG) or Buried)	AG
Water Distributio	<u>n</u> em (Static or Circulating (Circ))	Circ
	rculating water loops	1
	of Water Main heated for freeze protection (Yes or No)	8500 ft Yes
	ne mains (Above ground (AG) or Buried)	AG
· ·	rice line length	75 ft
Wastewater Colle Type of syste	ection em (Gravity or Pressure)	Pressure
Number of in	dividual facility pump stations	1 1000010
	ommunity lift/pump stations of facilities served by lift/pump station #1	
Number	of facilities served by lift/pump station #2	
	of facilities served by lift/pump station #3 of facilities served by lift/pump station #4	
Number	of facilities served by lift/pump station #5	
	t stations of sewer mains	sf 4810 ft
Sewer mains	heated for freeze protection (Yes or No)	Yes
	rculating glycol loops ne mains (Above ground (AG) or Buried)	1 AG
	rice line length	75 ft
Wastewater Trea		222 %
Length of for Force main h	ce main leated for freeze protection (Yes or No)	990 ft Yes
Location of fo	orce main (Above ground (AG) or Buried)	AG
Lagoon disch	narged seasonally with pump (Yes or No)	Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator) Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		· ·
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	24	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$1,076	/month		\$8,609.51
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$77	/month		\$919.30
Water storage tank	\$37	/month		\$293.30
Water storage tank line	\$16	/month		\$131.33
Water mains	\$1,860	/month		\$14,884
Service lines	\$345	/month		\$2,758
Wastewater system				
Sewer mains		/month		\$8,423
Service lines	*	/month		\$2,758
Lift/pump station buildings	* -	/month		\$0.00
Force main to lagoon	\$217	/month		\$1,734
			Subtotal	\$40,500
Electricity				
Water system				
WTP building				
Lights and controls		/month		\$8,118
HVAC/hydronic system	*	/month		\$5,412
Water treatment	\$11	/month		\$126
Pumps				
Intake or well	· ·	/month		\$126.40
WST circulation	·	/month		\$713
Pressure/booster	· ·	/month		\$189.60
Main line circulation	\$709	/month		\$5,671
Wastewater system				
Lift /pump station buildings				
Lights and controls	* -	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps				
Individual facility pump stations		/month		\$0
Community lift/pump station(s)	·	/month		\$0.00
Sewer/force main glycol circulation		/month		\$1,415
Lagoon discharge pump	\$152	/year	Subtotal	\$152 \$21,900
Other Costs			Gubiolai	Ψ21,000
	¢4 260	lyear		¢4 260
Equipment R&R	\$4,368 \$2,621	/year		\$4,368 \$2,621
Miscellaneous materials & supplies	\$2,621	,		\$2,621
Water quality testing	\$2,000 \$2,500	•		\$2,000 \$2,500
Operator training		/year		\$2,500 \$1,500
Insurance	\$1,500	ryear	Subtotal	\$1,500
			Subloidi	\$13,000

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$40,500
Electricity	\$21,900
Other	\$13,000
Total	\$106,000

Revenue	Monthly	# of		,	early
Source	Rate	Customers	Collection Rate	Re	venues
Residential Serv	\$ 432	17	85%	\$	74,900
Public/Commerc	\$ 647.92	4	100%	\$	31,100
School Service (\$ -	0	100%	\$	-
Local Capital Cor	ntribution			\$	-
Total Revenue	-	-	_	\$	106,000

Allakaket, Alaska

Community Information & Existing Infrastructure

The City of Allakaket is a Koyukon community of 111 people located on the south bank of the Koyukuk River, southwest of the Alatna River junction. There are 68 residential units, 13 commercial/public facilities and one school for a total of 82 services. The existing water and sewer services provided in Allakaket consist of self-haul system from watering points and honey buckets. The water treatment plant and washeteria discharge to the lagoon through a force main. The existing water and sewer infrastructure consists of the following:

- Well Water 20 gpm transfer pump
- Treated Water Storage 100,000 gallons
- Water Treatment Plant/Washeteria –
 2,048 SF, built in 1996
- Water Treatment Addition of chlorine and fluoride
- Sewage Lagoon Two Cell, 0.8 acres

City of Allakaket is located within the continuous permafrost region of Alaska. Most areas are underlain by fine-grained frozen soils varying in depth.

Piped System Description

The piped water and sewer system will be a combination of above and below grade piping. The northern part of the community is flat terrain and would best be served by an above ground pressure sewer system (10,600 LF) and circulating water loop (16,300 LF). The southern area of the community is built on a hillside and can likely accommodate a buried gravity sewer system (7,600 linear feet) and circulating water main (11,600 LF). A total of 22 services will be connected to the buried gravity sewer will not require individual grinder pump stations (GPS). Approximately 55 homes and buildings on the north side would require GPS units. The pressure sewer system including the force main will require two sewer main lift stations, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 800 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	9	20	-	
Water Storage (gallons)	84,200	100,000	-	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	800	-	800	
Sewage Lagoon Size (acre)	2.4	0.8	1.6	
Required Foundation System for WTP and/or WST				
Thermosyphon stabilized gravel pad (sf)	800	-	800	
Water Distribution System				
Circulating Water Main with Pitorifices (If)	27,900	-	27,900	
Wastewater Collection System				
Sewer Main with Glycol Heat Trace (If)	20,200	-	20,200	
Individual Grinder Pump Stations (GPS) (ea)	55	-	55	
Water & Sewer Service Lines				
Circulating Water Service Lines (If)	6,200	-	6,200	
Pressure Sewer Service Lines (If)	4,200	-	4,200	
Gravity Sewer Service Lines (If)	2,000	-	2,000	

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Allakaket. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

				Village	
	Estimated Capital Costs			Allakaket	
			•		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	82	\$28,096.69	\$2,303,929
2	Sewage collection mains or services (gravity or force), buried	LF	9,600	\$585.53	\$5,621,061
3	Sewage collection mains or services (gravity or force), above ground	LF	16,800	\$308.62	\$5,184,824
4	Sewage lift station	EA	2	\$1,172,426.77	\$2,344,854
10	Sewage lagoon, barrow, local material	Acre	1.6	\$1,157,613.17	\$1,852,181
12	Water distribution, mains or services, above ground	LF	34,100	\$426.53	\$8,701,122
13	Water distribution, mains or services, buried	LF	13,700	\$594.07	\$8,138,772
15	Water treatment plant, no foundation	SF	800	\$2,542.06	\$2,033,649
19	Foundation - thermosyphen stabilized gravel pad	SF	800	\$1,049.95	\$839,957
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$37,020,000

Estimated Capital Costs (cont.)					
	Total v	with Inf	lation (3% pe	er year for 6 years)	\$44,203,800
27	Individual Grinder Pump Stations	EA	60	\$30,000	\$1,650,000
28	Electrical Service Upgrades	EA	82	\$5,500	\$451,000
				Subtotal	\$46,304,800
29	Construction Contingency (15%)	LS	1	\$6,945,700	\$6,945,700
30	Design & Construction Administration Services (20%)	LS	1	\$9,261,000	\$9,261,000
				Total	\$62,511,500

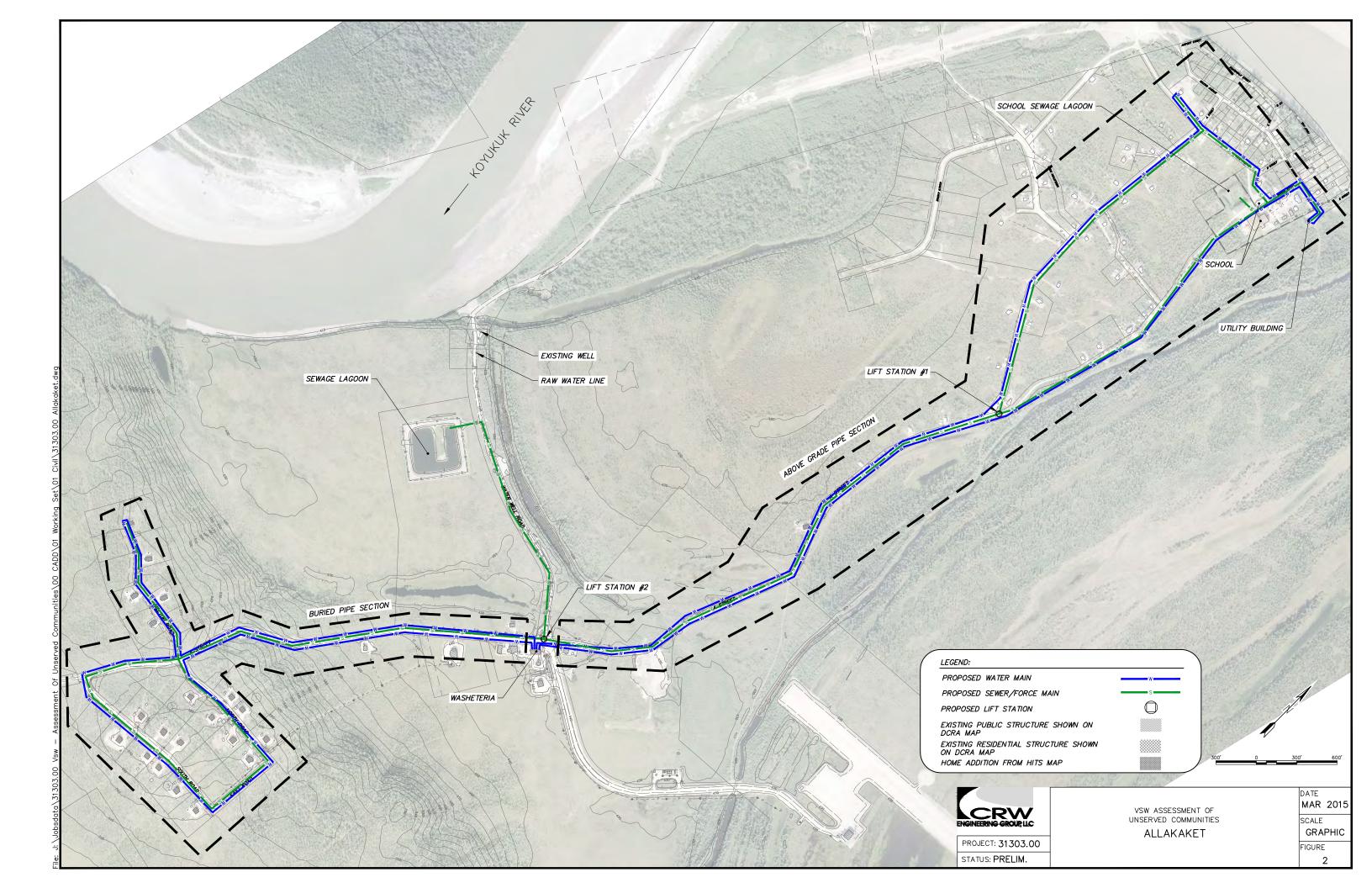
The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$26,600			
Fuel	\$116,700			
Electricity	\$38,100			
Other (R&R, Training, etc.)	\$20,500			
Total	\$207,900			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Allakaket are listed below:

Estimated User Fees						
Revenue Source	ſ	Monthly Rate	# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	177	68	85%	\$ 122,995	
Public/Commercial Service	\$	186	13	100%	\$ 29,046	
School Service	\$	6,206	1	100%	\$ 55,858	
Local Capital Contribution					\$ -	
Total Revenue					\$ 207,900	

Due to the layout of the community and the required water main length needed to serve the north and south sections of town, this project would be ideal for the incorporation of a heat recovery system.



VSW Unserved Communit	ties - Piped W	ater & Sewer System Type and Si	zing Model	
Date Community		3/4/2016 Allakaket		
Input		Allakaket		
Existing Community & System Data				
2015 Population		111		
2015 Number of Services		82		
HITS Database (E1 & H1-H7)		68		
DCED Mapping Commerical/Public Facilities/School		14		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Good		
Water Storage Tank		100000		
Water Treatment Capacity		20		
Existing Sewage Lagoon Size		0.8		
Soil Conditions (check only one)		r	Ī	
Soft poorly drained soils or discontinuous permafrost				
Firm soils, or continuous permafrost		х		
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length (ft)	Water Main Length (ft)
Buried system with no permafrost				- U- (-,
Above ground system or buried with permafrost		х	20200	27900
Gravity Sewer Main		х	7600	
Pressure Sewer Main		х	12600	
Typical Service Line Length (ea)			75	75
Pined System Poguiroments	Community	Allakaket		
Piped System Requirements Output for Cost Model (calculated)	community	Allakaket		
Output for cost Model (calculated)			Foundatio	n Sizo
Water Treatment Capacity (gpm)		9	roundatio	II Size
Req Water Storage (gallons) (less existing)	- (-f)		- 200	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (ST)	800	800	sf
Req Sewage Lagoon Size (acre) (less existing)		1.6	Quantitu	Notes
			Quantity	notes
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	800	
Required Foundation System for WTP and/or WST Water Distribution System			27,900	
		Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains		
Water Distribution System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations	27,900 20,200 2	
Water Distribution System		Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains	27,900	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations	27,900 20,200 2	
Water Distribution System Wastewater Collection System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations	27,900 20,200 2	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea)	27,900 20,200 2 55	
Water Distribution System Wastewater Collection System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (lf)	27,900 20,200 2 55 6,200 2,000	
Water Distribution System Wastewater Collection System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (lf)	27,900 20,200 2 55	
Water Distribution System Wastewater Collection System	Piped System Need	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If)	27,900 20,200 2 55 6,200 2,000	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines		(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If)	27,900 20,200 2 55 6,200 2,000 4,200	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If)	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm)	Need 9	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 9 84,200	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	9 84,200 800 2.4	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Wastewater Collection System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	9 84,200 800	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Wastewater Collection System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	9 84,200 800 2.4	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000 - 0.8	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	9 84,200 800 2.4	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000 - 0.8	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 9 84,200 800 2.4 800 27,900	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000 - 0.8	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf)	Need 9 84,200 800 2.4 800 27,900	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000 - 0.8	27,900 20,200 2,000 4,200 Net Need	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 9 84,200 800 2.4 800 27,900	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000 - 0.8	27,900 20,200 2 55 6,200 2,000 4,200 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 9 84,200 800 2.4 800 27,900 20,200 55	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000 - 0.8	27,900 20,200 2,000 2,000 4,200 Net Need 800 1.6 800 27,900 20,200 55	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines Circulating Water Service Lines Circulating Water Service Lines	Need 9 84,200 800 2.4 800 27,900 20,200 55 6,200 6,200	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000 - 0.8	27,900 20,200 2,000 4,200 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 9 84,200 800 2.4 800 27,900 20,200 55	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 20 100,000 0.8	27,900 20,200 2,000 2,000 4,200 Net Need 800 1.6 800 27,900 20,200 55	

Date	3/4/2016	Water & Sewer	System Type and Sizing Model
Community System Parameters	Allakaket Model Results		Criteria & Calculations
Design Population			
Duration (n) 2015 Population (P)		years people	20 years 2015 ADOL
2015 Population (P) 2015 Number of Services		services	Only 55 will require GPS units
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	135	people	Px(1+i)^n
Water Demand Estimates		1	
Existing Capacity Average Day (ADD)	6,772	gpm	50 gallons per Capita
Max Day (MDD)	13,544		2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	9	gpm	MDD
Water Source Assumptions		1	
Type (surface water or groundwater) Required Capacity	GW 9	gpm	MDD
		Ph	
Water Storage Tank Sizing Existing Water Storage Tank	100,000	gallons	Built in 2010
Demand Based Volume (if source is GW)	Applicable	Iganons	Built III 2010
Daily Operation (DO) (gallons)	13,544	•	Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)	30,000		500 gpm for 60 minutes
Reserve volume (RV) Water Storage Tank Volume	40,632 84,176		3 days x DO DO + FF + RV
CT Based Volume (min if source is SW)	Not Required		
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)		mg/L log inactivation	0.4 mg/L 1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT) Baffling Coefficient (BF)	49 0.1	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC) 0.1
Required Volume to meet CT*	47,980		CT/RCxPeak Hour/BF
Required Water Storage	84,200		
Required Additional Storage Estimate of Min Platform Size (3' clearance		gallons	0
around)	-	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
			0
Water Treatment Plant Requirements* Water Quality	Good		Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	800	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (MCT and MTD)			
Foundation (WST and WTP) Soft poorly drained soils or discontinuous			Bills Franchallan
permafrost	0		Pile Foundation
Firm soils, or continuous permafrost	x	Thermosyphon	Thermosyphon stabilized gravel pad
Timi sons, or continuous permanost	^	pad (sf)	Thermosyphon stabilized graver pad
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)			
Buried system with no permafrost	0		Static Water Mains
		Circulating Water Main	
Above ground system or buried with permafrost	х	with Pitorifices	Circulating Water Main with Pitorifices
		(If)	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0	Sewer Main	Bare sewer main, no heat trace
Above ground or buried with permafrost	x		Sewer main with glycol heat trace
		Trace (If)	.
		Lift Stations for	
Gravity Sewer Main	x	Gravity Sewer	Lift stations for gravity sewer mains, every 1,000 ft
		Mains, every 1,000 ft (ea)	
		Individual	
Pressure Sewer Main	x	Grinder Pump	Individual Grinder Pump Stations
Pressure Sewer Main		Stations (GPS)	mulvidual Grinder Pullip Stations
		(ea)	
Water & Sewer Services (Check all that apply)			Static Water Service Line
Water & Sewer Services (Check all that apply)	0		Static Water Service Line
Water & Sewer Services (Check all that apply) Static Water Main		(ea) Circulating Water Service	Static Water Service Line Circulating Water Service Lines
Water & Sewer Services (Check all that apply) Static Water Main	0	(ea) Circulating	
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0	(ea) Circulating Water Service Lines (If) Gravity Sewer	Circulating Water Service Lines
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x	(ea) Circulating Water Service Lines (If)	
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	Circulating Water Service Lines
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main	0 x	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main	0 x x x	(ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x x x	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x x x	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x x x x	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x x x x	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per

Capital Cost Estimate Piped Water & Sewer System

Village	
Allakaket	

Item	Line Item	T	Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	82	\$28,096.69	\$2,303,929
2	Sewage collection mains or services (gravity or force), buried	LF	9,600	\$585.53	\$5,621,061
3	Sewage collection mains or services (gravity or force), above ground	LF	16,800	\$308.62	\$5,184,824
4	Sewage lift station	EA	2	\$1,172,426.77	\$2,344,854
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	1.6	\$1,157,613.17	\$1,852,181
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	20,400	\$426.53	\$8,701,122
13	Water distribution, mains or services, buried	LF	13,700	\$594.07	\$8,138,772
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
15	Water treatment plant, no foundation	SF	800	\$2,542.06	\$2,033,649
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	800	\$1,049.95	\$839,957
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$37,020,349

Community: Allakaket (North Side Plus)

General Community Data

Current population		persons
Average number of people per house Service Connections (North Side)	2.4	
Number of houses	46	
Number of public/commerical buildings Number of schools	8	
Total number of service connections		
Burdened labor rate	\$16	hr
Electricity cost (Public facilty)	\$0.66	
Electricity cost (Residential service) Cost per gallon for heating oil	\$0.24 \$6.00	
Water consumption per capita		gpd
Wastewater generation per capita		gpd
Water & Sewer System Characteristics		
Water Source		
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line	GW 2532	#
Water line heated for freeze protection (Yes or No)	2532 Y	IL
Location of water line (Above ground (AG) or Buried)	Buried	
Water Treatment		
Size of water treatment plant building	2848	sf
Raw water quality (Good or Poor)	Good	
Water Storage	100 000	aallana
Size of tank(s) Length of water line to/ from tank	100,000	•
Water line heated for freeze protection (Yes or No)	Yes	
Location of water line (Above ground (AG) or Buried)	AG	
Water Distribution		
Type of system (Static or Circulating (Circ))	Circ	
Number of circulating water loops Total length of Water Main (North Side)	16300	ft
Water mains heated for freeze protection (Yes or No)	Yes	
Location of the mains (Above ground (AG) or Buried)	AG	
Average service line length	75	π
Wastewater Collection Turns of purchase (Crouthy or Procesure)	Dragging	
Type of system (Gravity or Pressure) Number of individual facility pump stations	Pressure	
Number of community lift/pump stations	2	
Number of facilities served by lift/pump station #1	51	
Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3	82	
Number of facilities served by lift/pump station #4		
Number of facilities served by lift/pump station #5		
Size of lift stations	500	
Total length of sewer mains (North Side)	10600	ft
Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops	Yes 1	
Location of the mains (Above ground (AG) or Buried)	AG	
Average service line length	75	ft
Wastewater Treatment / Disposal		ı
Length of force main	1970	ft
Force main heated for freeze protection (Yes or No) Location of force main (Above ground (AG) or Buried)	Yes AG	
Lagoon discharged seasonally with pump (Yes or No)	Yes	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week Less than 50 services	24	bro huo ale
Less than 50 services Between 50 and 100 services	24 32	hrs/week hrs/week
More than 100 services	32 40	hrs/week
More than 100 services	40	IIIS/WEEK
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
		• •

ted O& M Costs					Annual Cost
Administration (Utility management, billings, etc.)		\$500	/month		\$6,00
Labor (WTP Operator)		32	hrs/week		\$26,6
Fuel (Heating Demand)					
Water system					
WTP building		\$873	/month		\$6,981.7
Raw water line		\$0	/month		\$0.0
Raw water heat addition		\$405	/month		\$4,859.1
Water storage tank		\$91	/month		\$729.6
Water storage tank line		\$13	/month		\$105.0
Water mains		•	/month		\$28,54
Service lines			/month		\$7,22
Wastewater system					
Sewer mains		\$2,320	/month		\$18,56
Service lines		\$903	/month		\$7,22
Lift/pump station buildings		\$306	/month		\$2,451.4
Force main to lagoon		\$431	/month		\$3,45
		•		Subtotal	\$80,10
Electricity					
Water system					
WTP building					
Lights and controls		\$549	/month		\$6,58
HVAC/hydronic system		\$549	/month		\$4,38
Water treatment		\$11	/month		\$13
Pumps					
Intake or well		\$56	/month		\$668.1
WST circulation		\$89	/month		\$71
Pressure/booster		\$84	/month		\$1,002.2
Main line circulation		\$709	/month		\$5,67
Wastewater system					
Lift /pump station buildings					
Lights and controls		\$193	/month		\$2,31
HVAC/hydronic system		\$193	/month		\$1,54
Pumps					
Individual facility pump stations		\$0	/month		\$
Community lift/pump station(s)		\$193	/month		\$2,318.1
Sewer/force main glycol circulation		\$177	/month		\$1,41
Lagoon discharge pump		\$802	/year		\$80
				Subtotal	\$27,50
Other Costs					
Equipment R&R		\$6,711	/year		\$6,71
Miscellaneous materials & supplies		\$4,027	/year		\$4,02
Water quality testing		\$2,000	/year		\$2,00
Operator training		\$2,500	/year		\$2,50
Insurance		\$1,500	/year	—	\$1,50
				Subtotal	\$16,70
Summary (North Side Plus)	Summary	(North & South	1)		
Administration \$6,000	Administratio	n		\$6,000	
Labor \$26,600	Labor			\$26,600	
Fuel \$80,100	Fuel			\$116,700	

\$6,000
\$26,600
\$80,100
\$27,500
\$16,700
\$157,000

<u> </u>	
Administration	\$6,000
Labor	\$26,600
Fuel	\$116,700
Electricity	\$38,100
Other	\$20,500
Total	\$207,900

Revenue		# of		,	Yearly
Source	Monthly Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 177	68	85%	\$	122,995
Public/Commerc	\$ 186.19	13	100%	\$	29,046
School Service (\$ 6,206.50	1	100%	\$	55,858
Local Capital Co	ntribution			\$	-
Total Revenue				\$	207,900

Community: Allakaket (South Side)

General Community Data

Water

ral Community Data		
Current population Average number of people per house Service Connections (South Side) Number of houses	0.0	persons
Number of public/commerical buildings Number of schools Total number of service connections	5 0 27	
Total number of service confinections		
Burdened labor rate Electricity cost (Public facilty) Electricity cost (Residential service) Cost per gallon for heating oil	\$16 \$0.66 \$0.24 \$6.00	kWh kWh
Water consumption per capita Wastewater generation per capita		gpd gpd
& Sewer System Characteristics <u>Water Source</u>		
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)		ft
Water Treatment Size of water treatment plant building Raw water quality (Good or Poor)		sf
Water Storage Size of tank(s) Length of water line to/ from tank Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)		gallons ft
Water Distribution		
Type of system (Static or Circulating (Circ)) Number of circulating water loops Total length of Water Main	Circ 1 11600	ft
Water mains heated for freeze protection (Yes or No) Location of the mains (Above ground (AG) or Buried)	Yes Buried	ι
Average service line length	75	ft
Wastewater Collection Type of system (Gravity or Pressure) Number of individual facility pump stations Number of community lift/pump stations Number of facilities served by lift/pump station #1	Pressure	
Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5 Size of lift stations		sf
Total length of sewer mains Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops	7600 Yes 1	ft
Location of the mains (Above ground (AG) or Buried) Average service line length	Buried 75	ft
Wastewater Treatment / Disposal Length of force main Force main heated for freeze protection (Yes or No) Lecation of force main (Above ground (AG) or Buried)		ft

Location of force main (Above ground (AG) or Buried) Lagoon discharged seasonally with pump (Yes or No)

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management		/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		· ·
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$0	/month	_	\$0
Labor (WTP Operator)	24	hrs/week		\$0
Fuel (Heating Demand)				
Water system				
WTP building	\$0	/month		\$0.00
Raw water line	•	/month		\$0.00
Raw water heat addition	\$0	/month		\$0.00
Water storage tank	\$0	/month		\$0.00
Water storage tank line	\$0	/month		\$0.00
Water mains	\$1.523	/month		\$18,281
Service lines		/month		\$3,191
Wastewater system				
Sewer mains	\$998	/month		\$11,977
Service lines	\$266	/month		\$3,191
Lift/pump station buildings	\$0	/month		\$0.00
Force main to lagoon	\$0	/month		\$0
			Subtotal	\$36,600
Electricity				
Water system				
WTP building				
Lights and controls	* -	/month		\$0
HVAC/hydronic system	* -	/month		\$0
Water treatment	\$0	/month		\$0
Pumps				
Intake or well	·	/month		\$0.00
WST circulation	·	/month		\$0
Pressure/booster	·	/month		\$0.00
Main line circulation	\$709	/month		\$8,506
Wastewater system				
Lift /pump station buildings				
Lights and controls	•	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps				
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	* -	/month		\$0.00
Sewer/force main glycol circulation	\$177			\$2,123
Lagoon discharge pump	\$0	/year	Subtotal	\$0 \$10,600
Other Costs			Gubiolai	ψ 10,000
Equipment R&R	\$2,360	lyear		\$2,360
·	\$2,360 \$1,416	•		\$2,360 \$1,416
Miscellaneous materials & supplies Water quality testing		•		\$1,416 \$0
Water quality testing		/year		\$0 \$0
Operator training Insurance	\$0 \$0	/year		\$0 \$0
insulance	\$0	/year	Subtotal	\$3,800
			Subiolal	ψ5,000

Summary (South Side)

Administration Labor	· ·	Covered in North Plus Estimate Covered in North Plus Estimate
Fuel	\$36,600	Overed in North Flus Estimate
Electricity	\$10,600	
Other	\$3,800	
Total	\$51,000	

Arctic Village, Alaska

Community Information & Existing Infrastructure

Arctic Village is a Gwichin community of 192 people located on a terrace above the east fork of the Chandalar River, a tributary of the Yukon River. There are 59 residential units, 15 commercial/public facilities and one elementary/high school for a total of 75 services. The existing water and sewer services provided in Arctic Village consist of self-haul water system from the water treatment building and outhouses. The water treatment plant/washeteria and school are served with piped water and sewer. The existing water and sewer infrastructure consists of the following:

- Chandalar River 25 gpm portable transfer pump
- Treated Water Storage 100,000 gallons
- Water Treatment Plant/Washeteria –
 2,158 SF, built in 2015/2016
- Water Treatment Conventional filtration and chlorination
- Sewage Lagoon Single Cell, 0.8 acres

Arctic Village is situated on the northern edge of the Porcupine Plateau Physiographic Province just south of the eastern Brooks Range. The area is generally underlain by frozen sand and silt. The thickness of the permafrost ranges from 5 to 10 feet deep.

Piped System Description

The piped water and sewer system will be buried and consist of approximately 22,000 feet of circulating water mains, and 13,100 feet of pressure sewer mains. The water system will consist of three circulating loops. The pressure sewer system would require individual grinder pump stations at each building, glycol heat trace for freeze protection, and one lift station to transport wastewater to the lagoon. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 600 sf facility is included to house the equipment needed for water distribution equipment. The existing 100,000 gallon water storage tank is sufficient to meet the CT-required volume of 83,000 gallons and provide a small reserve for fire flows.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	16	25	-
Water Storage (gallons)	83,000	100,000	-
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	600	-	600
Sewage Lagoon Size (acre)	4.1	0.8	3.3
Required Foundation System for WTP and/or WST			
Thermosyphon stabilized gravel pad (sf)	600	-	600
Water Distribution System			
Circulating Water Main with Pitorifices (If)	22,000	-	22,000
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	13,100	-	13,100
Individual Grinder Pump Stations (GPS) (ea)	74	-	74
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	5,600	-	5,600
Pressure Sewer Service Lines (If)	5,600	-	5,600

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Arctic Village. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

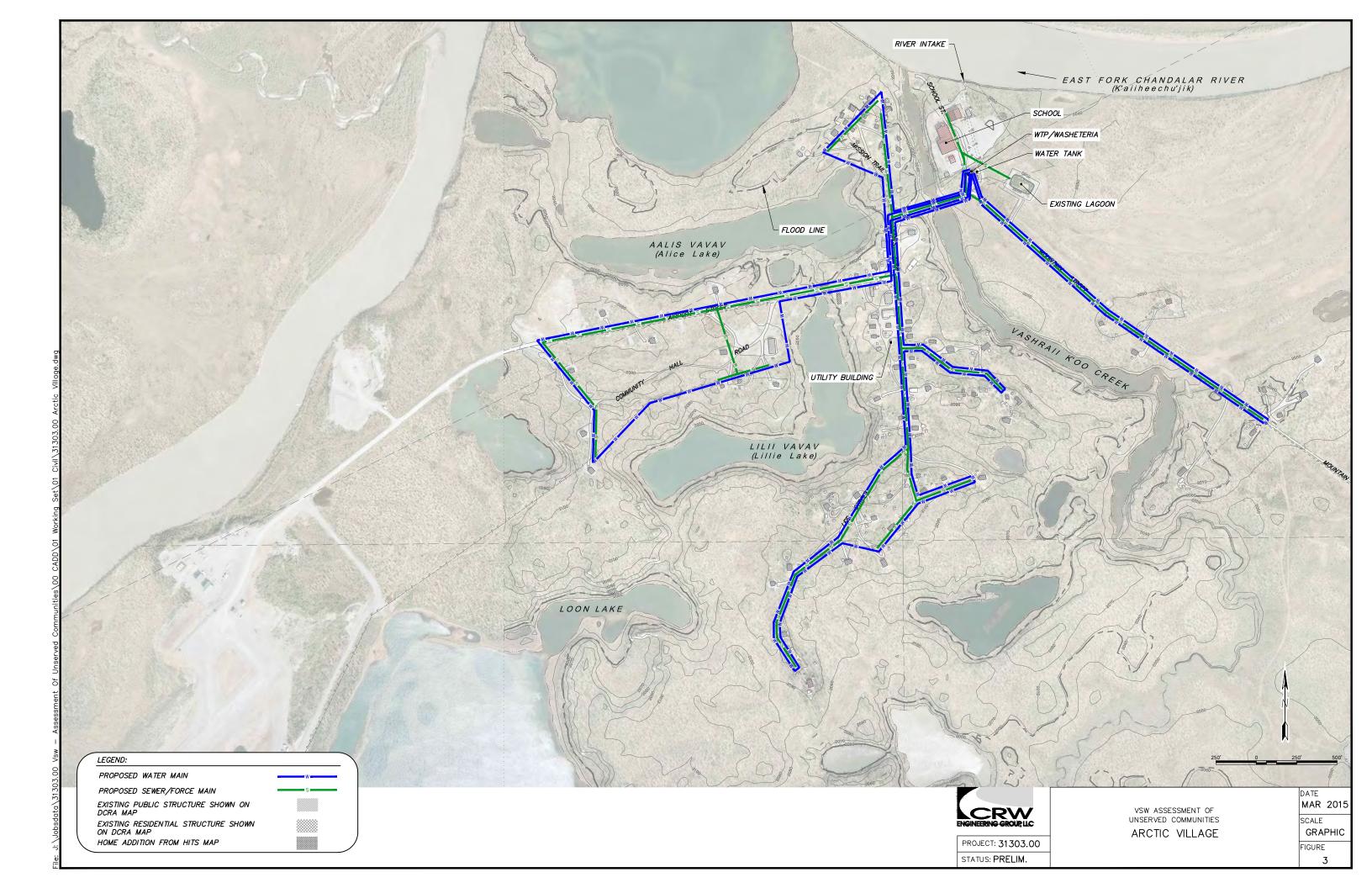
				Village	
	Estimated Capital Costs	Arctic Village			
Item	Item Line Item Estimated				Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	74	\$28,096.69	\$2,079,155
2	Sewage collection mains or services (gravity or force), buried	LF	12,750	\$566.33	\$7,220,716
3	Sewage collection mains or services (gravity or force), above ground	LF	350	\$860.09	\$301,030
4	Sewage lift station	EA	1	\$1,097,461.43	\$3,292,384
10	Sewage lagoon, barrow, local material	Acre	3.3	\$997,504.08	\$3,291,763
12	Water distribution, mains or services, above ground	LF	27,600	\$424.29	\$11,710,440
15	Water treatment plant, no foundation	SF	600	\$2,604.41	\$1,562,645
19	Foundation - thermosyphen stabilized gravel pad	SF	600	\$1,329.95	\$797,967
	Total Estim	ated Co	st in 2010 do	llars (rounded):	\$30,256,000
	Total wi	th Inflat	tion (3% per y	vear for 6 years)	\$36,127,200
27	Individual Grinder Pump Stations	EA	75	\$30,000	\$2,220,000
28	Electrical Service Upgrades	EA	75	\$5,500	\$407,000
				Subtotal	\$38,754,200
29	Construction Contingency (15%)	LS	1	\$5,813,100	\$5,813,100
30	Design & Construction Administration Services (20%)	LS	1	\$7,750,800	\$7,750,800
				Total	\$52,318,100

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$26,600			
Fuel	\$177,100			
Electricity	\$44,600			
Other (R&R, Training, etc.)	\$25,900			
Total	\$280,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Arctic Village are listed below:

Estimated User Fees					
Revenue Source	Мо	nthly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	253	59	85%	\$ 152,382
Public/Commercial Service	\$	266	15	100%	\$ 47,857
School Service	\$	8,862	1	100%	\$ 79,761
Local Capital Contribution					\$ -
Total Revenue					\$ 280,000



VSW Unserved Communities - Piped Water & Sewer System Type and Sizing Model					
Date		3/6/2016			
Community		Arctic Village			
Input	i .				
Existing Community & System Data					
2015 Population		192			
2015 Number of Services		75			
HITS Database (E1 & H1-H7)		59			
DCED Mapping Commerical/Public Facilities/School Type (surface water or groundwater)		16 SW			
Water quality (Poor or Good)		Poor			
Water Storage Tank		100000			
Water Treatment Capacity		25			
Existing Sewage Lagoon Size		0.8			
Soil Conditions (check only one)					
Soft poorly drained soils or discontinuous permafrost					
Firm soils, or continuous permafrost		х			
Stiff soils, no permafrost			Sewer Main Length	Water Main	
Piping Configurations (check all that apply)			(ft)	Length (ft)	
Buried system with no permafrost			(-9)		
Above ground system or buried with permafrost		х	13100	22000	
Gravity Sewer Main Pressure Sewer Main		X	0 13100		
Typical Service Line Length (ea)		^	75	75	
Piped System Requirements	Community	Arctic Village			
Output for Cost Model (calculated)					
			Foundatio	n Size	
Water Treatment Capacity (gpm)		16			
Req Water Storage (gallons) (less existing)	n (cf)	- 600	600	sf	
Req W&S Utility Bldg/Water Treatment Plant/Addition Req Sewage Lagoon Size (acre) (less existing)	11 (51)	3.3	600	31	
med semage rapoon size (acie) (less existing)		5.3	Quantity	Notes	
			Quartity		
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	600		
Water Distribution System		Circulating Water Main with Pitorifices (If)	22,000		
		Sewer Main with Glycol Heat Trace	13,100		
Wastewater Collection System		Sewer Main with Glycol Heat Trace (lf)	13,100	school already	
Wastewater Collection System		•	13,100 74	school already connected	
Wastewater Collection System		(lf) Individual Grinder Pump Stations			
Wastewater Collection System Water & Sewer Service Lines		(lf) Individual Grinder Pump Stations			
		(lf) Individual Grinder Pump Stations (GPS) (ea)	74		
		(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	5,600		
		(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	5,600		
Water & Sewer Service Lines System Description	Piped System Need	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	5,600 5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm)	Need 16	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	5,600 5,600		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 16 83,000	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	5,600 5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm)	Need 16	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	5,600 5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	16 83,000 600	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 100,000	5,600 5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	16 83,000 600	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 100,000	5,600 5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	Need 16 83,000 600 4.1	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 100,000 - 0.8	5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	16 83,000 600 4.1	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 100,000	5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	Need 16 83,000 600 4.1	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 100,000 - 0.8	5,600 Net Need		
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 16 83,000 600 4.1 600 22,000	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 100,000 0.8	74 5,600 5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 16 83,000 600 4.1 600 22,000 13,100 74	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 100,000 - 0.8	5,600 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 16 83,000 600 4.1 600 22,000	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 100,000 - 0.8	5,600 Net Need	school already connected	

VCW III	served Communities - Piner	Water & Sower	System Type and Sizing Model
Date	3/6/2016	i watei & sewei	System Type and Sizing Woder
Community	Arctic Village		
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P) 2015 Number of Services		people services	2015 ADOL Decrease to 74 because the school is already served
Growth Rate (i)	1%		1%
2035 Design Population (Capita)		people	Px(1+i)^n
Water Demand Estimates Existing Capacity	25	gpm	
Average Day (ADD)		gpd	50 gallons per Capita
Max Day (MDD)	23,428	gpd	2 x ADD
Peak Hour	49	gpm	3 x MDD MDD
Treatment Capacity	10	gpm	MIDD
Water Source Assumptions		_	
Type (surface water or groundwater)	SW	-	
Required Capacity	16	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW)	Check Min CT Requirements		Marcha (MDD 4 da)
Daily Operation (DO) (gallons) Fire Flow (FF)	23,428 30,000	•	Max Day (MDDx1 day) 500 gpm for 60 minutes
Reserve Volume (RV)	70,283		3 days x DO
Water Storage Tank Volume	123,711		DO + FF + RV
CT Based Volume (min if source is SW)	Required	mg/L	0.4 mg/L
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)		mg/L log inactivation	1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT) Baffling Coefficient (BF)	49 0.1	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Required Volume to meet CT*	82,992		CT/RCxPeak Hour/BF
Required Water Storage	83,000		Existing Tank is larger than CT-Required Tank
Required Additional Storage	-	gallons	0
Estimate of Min Platform Size (3' clearance around)	-	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			0
Water Treatment Plant Requirements*			
Water Quality Minimum WTP Size	Poor		Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	600	sf	Good Water Quality (no treatment other than CL) = 800 sf The WTP is brand new. Additional space of 600 sf is sufficient to
	<u> </u>		accommodate distribution system equipment.
Foundation (WST and WTP)		7	
Soft poorly drained soils or discontinuous permafrost	0		Pile Foundation
permanost		Thermosyphon	
Firm soils, or continuous permafrost	x		Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0	pad (sf)	Gravel pad
Still soils, no permanost			draver pau
Water Distribution (Check either or both)			
Buried system with no permafrost	0	Circulating	Static Water Mains
		Water Main	
Above ground system or buried with permafrost	х	with Pitorifices	Circulating Water Main with Pitorifices
		(If)	
	<u> </u>		
Wastewater Collection (Check all that apply)	<u> </u>		
Buried system with no permafrost	0		Bare sewer main, no heat trace
Above ground or buried with permafrost	x	Sewer Main	Sewer main with glycol heat trace
Above ground or buried with permanost	*	Trace (If)	Sewer main with gryton heat trace
Gravity Sewer Main	0	.,,	Lift stations for gravity sewer mains, every 1,000 ft
		Individual Grinder Pump	
Pressure Sewer Main	х	Stations (GPS)	Individual Grinder Pump Stations
		(ea)	
Water & Sewer Services (Check all that apply)			
Static Water Main	0		Static Water Service Line
		Circulating	
Circulating Water Main	х	Water Service	Circulating Water Service Lines
Gravity Sewer Main	0	Lines (If)	Gravity Service Line
		Pressure Sewer	·
Pressure Sewer Main	х	Service Lines (If)	Pressure Service Line with GPS
Sewage Lagoon Size			
Existing Sewage Lagoon		acres	
Organic Loading Based Size		acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	239.1		Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size	4.1	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
			of berms (area to be fenced)
Two cell lagoon, combined acreage	4.1	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village			
Arctic Village			

Item	Line Item	T	Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	74	\$28,096.69	\$2,079,155
	Sewage collection mains or services (gravity or force), buried	LF	12,750	\$566.33	\$7,220,716
	Sewage collection mains or services (gravity or force), above ground	LF	350	\$860.09	\$301,030
4	Sewage lift station	EA	3	\$1,097,461.43	\$3,292,384
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	3.3	\$997,504.08	\$3,291,763
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	27,600	\$424.29	\$11,710,440
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
15	Water treatment plant, no foundation	SF	600	\$2,604.41	\$1,562,645
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	600	\$1,329.95	\$797,967
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$30,256,100

Community:	Arctic Village			

General Community Data

General Community Data		
Current population		persons
Average number of people per house Service Connections	3.3	
Number of houses	59	
Number of public/commerical buildings Number of schools	15 1	
Total number of service connections	75	
Burdened labor rate	\$16	
Electricity cost (Public facilty) Electricity cost (Residential service)	\$0.54 \$0.36	
Cost per gallon for heating oil	\$12.00	
Water consumption per capita Wastewater generation per capita		gpd gpd
Water & Sewer System Characteristics		3 P -
Water Source	OW	
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line	SW 600	ft
Water line heated for freeze protection (Yes or No)	Yes	
Location of water line (Above ground (AG) or Buried)	AG	
Water Treatment Size of water treatment plant building	2758	sf
Raw water quality (Good or Poor)	Poor	
Water Storage		
Size of tank(s) Length of water line to/ from tank	100,000 50	
Water line heated for freeze protection (Yes or No)	Yes	
Location of water line (Above ground (AG) or Buried)	AG	
Water Distribution Type of system (Static or Circulating (Circ))	Circ	
Number of circulating water loops	3	
Total length of Water Main Water mains heated for freeze protection (Yes or No)	22000 Yes	ft
Location of the mains (Above ground (AG) or Buried)	Buried	
Average service line length	75	ft
Wastewater Collection	D	
Type of system (Gravity or Pressure) Number of individual facility pump stations	Pressure	
Number of community lift/pump stations	1	
Number of facilities served by lift/pump station #1 Number of facilities served by lift/pump station #2	75	
Number of facilities served by lift/pump station #3		
Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5		
Size of lift stations	500	sf
Total length of sewer mains Sewer mains heated for freeze protection (Yes or No)	12750 Yes	
Number of circulating glycol loops	3	
Location of the mains (Above ground (AG) or Buried)	Buried	
Average service line length	75	π
Wastewater Treatment / Disposal Length of force main	350	ft
Force main heated for freeze protection (Yes or No)	Yes	
Location of force main (Above ground (AG) or Buried) Lagoon discharged seasonally with pump (Yes or No)	AG Yes	
-g g,, panp (100 of 110)		

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		•
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500 \$1,500	per year
modrano	Ψ1,000	por your

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	32	hrs/week		\$26,624
Fuel (Heating Demand)				
Water system				
WTP building	\$1.690	/month		\$13,522.23
Raw water line		/month		\$2,101.25
Raw water heat addition	·	/month		\$11,206.66
Water storage tank		/month		\$1,459.20
Water storage tank line	·	/month		\$175.10
Water mains	·	/month		\$69,341
Service lines		/month		\$17,729
Wastewater system				
Sewer mains	\$3,349	/month		\$40,186
Service lines	\$1,477	/month		\$17,729
Lift/pump station buildings	\$306	/month		\$2,451.46
Force main to lagoon	\$153	/month		\$1,226
•			Subtotal	\$177,100
Electricity				
Water system				
WTP building				
Lights and controls	\$435	/month		\$5,216
HVAC/hydronic system	\$435	/month		\$5,216
Water treatment	\$79	/month		\$946
Pumps				
Intake or well	\$79	/month		\$945.56
WST circulation	\$73	/month		\$583
Pressure/booster	\$118	/month		\$1,418.34
Main line circulation	\$1,740	/month		\$20,879
Wastewater system				
Lift /pump station buildings				
Lights and controls	·	/month		\$946
HVAC/hydronic system	\$79	/month		\$630
Pumps				
Individual facility pump stations	\$0	/month		\$0
Community lift/pump station(s)	\$120	/month		\$1,442.38
Sewer/force main glycol circulation	\$434	/month		\$5,210
Lagoon discharge pump	\$1,135	/year		\$1,135
			Subtotal	\$44,600
Other Costs	.			
Equipment R&R	\$12,416	-		\$12,416
Miscellaneous materials & supplies	\$7,450	•		\$7,450
Water quality testing	\$2,000	/year		\$2,000
Operator training	\$2,500	/year		\$2,500
Insurance	\$1,500	/year	_	\$1,500
			Subtotal	\$25,900

Summary

Administration	\$6,000
Labor	\$26,600
Fuel	\$177,100
Electricity	\$44,600
Other	\$25,900
Total	\$280,000

Revenue M	onthly	# of		,	Yearly
Source R	ate	Customers	Collection Rate	Re	evenues
Residential Serv \$	253	59	85%	\$	152,382
Public/Commerc \$	266	15	100%	\$	47,857
School Service (\$	8,862	1	100%	\$	79,761
Local Capital Contr	ibution			\$	-
Total Revenue				\$	280.000

Atmautluak, Alaska

Community Information & Existing Infrastructure

Atmautluak is a Yup'ik community of 319 people located on the west bank of the Pikmiktalik River, 20 miles northwest of Bethel within the Yukon-Kuskokwim Delta. There are 63 residential units, 19 commercial/public facilities, one elementary school and one high school for a total of 84 services. The existing water and sewer services provided in Atmautluak consist of self-haul system from a watering point located at the water treatment plant, and sewage bunkers throughout the community. The existing water and sewer infrastructure consists of the following:

- Well Water 20 gpm transfer pump
- Treated Water Storage 10,000 gallons
- Water Treatment Plant/Washeteria –
 2,048 SF, built in 1980
- Water Treatment Greensand filter and potassium permanganate

The community currently utilizes a tundra honeybucket lagoon and pond, which equates to a little over 10 acres to dispose of the community's waste. While not uncommon in the region, tundra sewage lagoons can be extremely difficult to quantify, properly maintain, and permit. For the purposes of this assessment, the tundra lagoons are not included as an existing "usable" facility.

The area around Atmautluak is generally underlain by continuous permafrost with thawed areas adjoining large bodies of water. The soil is characterized as poorly drained, medium loam with a medium erosion potential. The surface layer consists of poorly drained, non-arable fibrous peat.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 14,900 feet of pipe, and the pressure sewer approximately 8,700 feet of pipe. The water system will consist of two circulating loops. The pressure sewer system would require individual grinder pump stations at each house, glycol heat treat for freeze protection, and a lift station to transport wastewater to the lagoon. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	27	20	7
Water Storage (gallons)	185,700	10,000	175,700
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	6.8	-	6.8
Required Foundation System for WTP and/or WST	•		
Pile Foundation (sf)	3,620	-	3,620
Water Distribution System	•		
Circulating Water Main with Pitorifices (If)	12,400	-	12,400
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	9,500	-	9,500
Individual Grinder Pump Stations (GPS) (ea)	84	-	84
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	6,300	-	6,300
Pressure Sewer Service Lines (If)	6,300	-	6,300

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Atmautlauk. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30):

		Village			
	Estimated Capital Costs	Atmautluak			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	84	\$26,403.25	\$2,217,873
3	Sewage collection mains or services (gravity or force), above ground	LF	15,800	\$200.95	\$3,174,979
4	Sewage lift station	EA	1	\$678,792.59	\$678,793
10	Sewage lagoon, barrow, local material	Acre	6.8	\$694,724.45	\$4,724,126
12	Water distribution, mains or services, above ground	LF	18,700	\$331.68	\$6,202,500
14	Water storage tank, no foundation	Gal	175,700	\$2.73	\$479,969
15	Water treatment plant, no foundation	SF	1,200	\$1,635.59	\$1,962,712
18	Foundation - freeze back piles	SF	3,620	\$326.71	\$1,182,688
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
Total Estimated Cost in 2010 dollars (rounded):					
	Total v	vith Infl	lation (3% pe	year for 6 years)	\$24,808,800
27	Individual Grinder Pump Stations	EA	84	\$30,000	\$2,520,000
28	Electrical Service Upgrades	EA	84	\$5,500	\$462,000
				Subtotal	\$27,790,800
29	Construction Contingency (15%)	LS	1	\$4,168,600	\$4,168,600
30	Design & Construction Administration Services (20%)	LS	1	\$5,558,200	\$5,558,200
				Total	\$37,517,600

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs					
Description	Cost				
Administration	\$6,000				
Labor	\$33,300				
Fuel	\$87,100				
Electricity	\$33,900				
Other (R&R, Training, etc.)	\$18,300				
Total	\$179,000				

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Atmautluak are listed below:

Estimated User Fees					
Revenue Source	Моі	nthly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	144	63	85%	\$ 92,613
Public/Commercial Service	\$	151	19	100%	\$ 34,503
School Service	\$	2,882	2	100%	\$ 51,884
Local Capital Contribution					\$ -
Total Revenue					\$ 179,000

Date Community Input		ater & Sewer System Type and Si	zing Model	
		2/29/2016 Atmautluak		
Existing Community & System Data				
2015 Population		319		
2015 Number of Services		84		
HITS Database (E1 & H1-H7)		63		
DCED Mapping Commerical/Public Facilities/School		21		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		10000		
Water Treatment Capacity		20		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)			•	
Soft poorly drained soils or discontinuous permafrost		x		
Firm soils, or continuous permafrost				
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length (ft)	Water Main Length (ft)
Buried system with no permafrost			V-9/	
Above ground system or buried with permafrost		х	9450	12400
Gravity Sewer Main			0	
Pressure Sewer Main		х	9450	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Atmautluak		
Output for Cost Model (calculated)				
, ,			Foundatio	n Size
Water Treatment Capacity (gpm)		27		
Req Water Storage (gallons) (less existing)		175,700	2,420	sf
Req W&S Utility Bldg/Water Treatment Plant/Addition	n (sf)	1,200	1,200	
Req Sewage Lagoon Size (acre) (less existing)	. 10.1	6.8	1,230	
2 Po - mpoon are facility (1022 evisinib)		0.0	Quantity	Notes
Required Foundation System for WTP and/or WST		Pile Foundation (sf)	3,620	
Water Distribution System		Circulating Water Main with Pitorifices (If)	12,400	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	9,500	
		(GPS) (ea)	84	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	6,300	
		Pressure Sewer Service Lines (If)	6,300	
		.,	, ,	
<u> </u>				
İ	Piped System Need	Existing Facility	Net Need	
System Description				
System Description Water Treatment Capacity (gpm)	27	20	7	
Water Treatment Capacity (gpm) Water Storage (gallons)		20 10,000	175,700	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	27 185,700 1,200	10,000	175,700 1,200	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	27 185,700	10,000	175,700	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	27 185,700 1,200 6.8	10,000	175,700 1,200 6.8	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf)	27 185,700 1,200	10,000	175,700 1,200	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System	27 185,700 1,200 6.8 3,620	10,000	175,700 1,200 6.8 3,620	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	27 185,700 1,200 6.8	10,000	175,700 1,200 6.8	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	27 185,700 1,200 6.8 3,620	10,000	175,700 1,200 6.8 3,620	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf)	27 185,700 1,200 6.8 3,620 12,400	10,000 - - -	175,700 1,200 6.8 3,620 12,400	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	27 185,700 1,200 6.8 3,620	10,000	175,700 1,200 6.8 3,620	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	27 185,700 1,200 6.8 3,620 12,400 9,500 84	10,000	175,700 1,200 6.8 3,620 12,400 9,500 84	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	27 185,700 1,200 6.8 3,620 12,400	10,000 - - -	175,700 1,200 6.8 3,620 12,400	

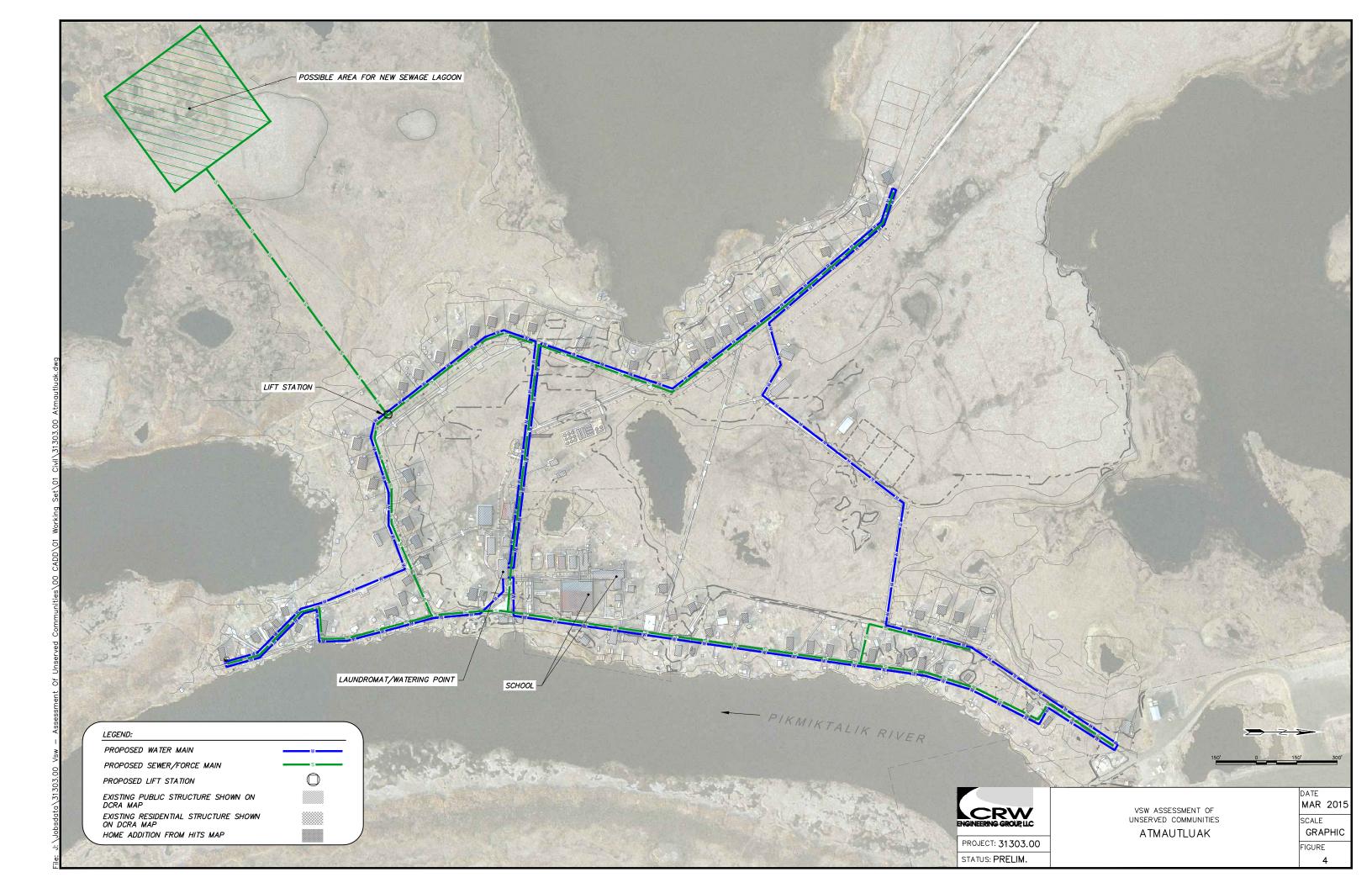
(/CM/11)	somed Communities Division	Motor C Carr	System Type and Sizing Model
Date		water & Sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services Growth Rate (i)	84 1%	services	1%
2035 Design Population (Capita)		people	Px(1+i)^n
Water Demand Estimates	20	1	
Existing Capacity Average Day (ADD)	19,462	gpm	50 gallons per Capita
Max Day (MDD)	38,924		2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	27	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW]	
Required Capacity	27	gpm	MDD
Motor Storage Toul Siring			
Water Storage Tank Sizing Existing Water Storage Tank	10,000	gallons	
Demand Based Volume (if source is GW)	Applicable	10	
Daily Operation (DO) (gallons)	38,924		Max Day (MDDx1 day)
Fire Flow (FF)	30,000		500 gpm for 60 minutes
Reserve Volume (RV) Water Storage Tank Volume	116,772 185,696	•	3 days x DO DO + FF + RV
CT Based Volume (min if source is SW)	Not Required	J .	
Chlorine Residual Concentration (RC)	0.4	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T) pH (PH)	4.4		4.4 celsius/40 F 7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*	137,888		CT/RCxPeak Hour/BF
Required Water Storage Required Additional Storage	185,700 175,700	-	
Estimate of Min Platform Size (3' clearance		-	
around)	2,420	sf	D = $0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
Water Treatment Plant Requirements* Water Quality	Poor	1	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		Pile Foundation	
Ipermafrost	x		Pile Foundation
permafrost Firm soils, or continuous permafrost	x 0	(sf)	Pile Foundation Thermosyphon stabilized gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost	0		Thermosyphon stabilized gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both)	0		Thermosyphon stabilized gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost	0 0	(sf) Circulating	Thermosyphon stabilized gravel pad Gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0 0	(sf) Circulating Water Main	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost	0 0	(sf) Circulating Water Main with Pitorifices	Thermosyphon stabilized gravel pad Gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0 0	(sf) Circulating Water Main	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0 0	(sf) Circulating Water Main with Pitorifices	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	0 0 0 x	(sf) Circulating Water Main with Pitorifices	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0 0	(sf) Circulating Water Main with Pitorifices	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace
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Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
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Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 0 x x 0 x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
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Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 0 x x 0 0 x x 0 0 3.3 308.2	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Lines
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Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 0 0 0 x 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Lines 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Atmautluak	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	84	\$26,403.25	\$2,217,873
	Sewage collection mains or services (gravity or force), buried	LF		#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	15,800	\$200.95	\$3,174,979
4	Sewage lift station	EA	1	\$678,792.59	\$678,793
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	5.2	\$704,910.88	\$3,665,537
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	18,700	\$331.68	\$6,202,500
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	175,700	\$2.73	\$479,969
15	Water treatment plant, no foundation	SF	1,200	\$1,635.59	\$1,962,712
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	3,620	\$326.71	\$1,182,688
19	Foundation - thermosyphen stabilized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$19,718,648



Community:	Atmautluak		
General Community Dat	ta		
Current population	on	319	persons
	of people per house	5.1	porcorio
Number of he		63	
· ·	ublic/commerical buildings	19	
Number of so	chools Total number of service connections	84	
		-	
Burdened labor r		\$20	
Electricity cost (F	Public facility) Residential service)	\$0.54 \$0.36	
Cost per gallon f	,	\$6.50	
	•		
Wastewater gen	ion per capita eration per capita		gpd gpd
wastewater geri	еганоп рег сарна	50	gpu
Water & Sewer System Water Source	Characteristics		
Type of syste	em (Surface(SW) or Groundwater(GW))	GW	
Length of rav		500	
	eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	No	
Location of w	vater line (Above ground (AG) or Burled)	AG	
Water Treatment			
	r treatment plant building uality (Good or Poor)	3248 Poor	
•	uality (Good of Pool)	FUUI	
Water Storage	-1	105 700	
Size of tank(s) iter line to/ from tank	185,700 100	•
•	eated for freeze protection (Yes or No)	Yes	IL
	vater line (Above ground (AG) or Buried)	AG	
Water Distributio	n , , , ,		
	n (Static or Circulating (Circ))	Circ	
	rculating water loops	2	
Total length	of Water Main	12400	ft
	heated for freeze protection (Yes or No)	Yes	
	ne mains (Above ground (AG) or Buried)	AG	a.
Average serv	vice line length	75	π
Wastewater Coll		_	
Type of syste	em (Gravity or Pressure) Idividual facility pump stations	Pressure	
	ommunity lift/pump stations	1	
	of facilities served by lift/pump station #1	84	
	of facilities served by lift/pump station #2		
	of facilities served by lift/pump station #3		
	of facilities served by lift/pump station #4		
	of facilities served by lift/pump station #5 ft stations	500	of
	of sewer mains	8360	
	s heated for freeze protection (Yes or No)	Yes	
Number of ci	rculating glycol loops	2	
	ne mains (Above ground (AG) or Buried)	AG	_
Average serv	vice line length	75	tt
	atment / Disposal		
Length of for		1140	ft
	neated for freeze protection (Yes or No)	Yes	
	orce main (Above ground (AG) or Buried) narged seasonally with pump (Yes or No)	AG Yes	
Lagoon disci	larged seasonally with pump (165 of 140)	168	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		•
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500 \$1,500	per year
modrano	Ψ1,000	por your

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	32	hrs/week		\$33,280
Fuel (Heating Demand)				
Water system				
WTP building	\$1,078	/month		\$8,625.86
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$1,261	/month		\$10,085.50
Water storage tank	\$183	/month		\$1,467.77
Water storage tank line	\$24	/month		\$189.70
Water mains	\$2,940	/month		\$23,522
Service lines	\$1,494	/month		\$11,951
Wastewater system				
Sewer mains	\$1,982	/month		\$15,859
Service lines	\$1,494	/month		\$11,951
Lift/pump station buildings	\$166	/month		\$1,327.87
Force main to lagoon	\$270	/month		\$2,163
			Subtotal	\$87,100
Electricity				
Water system				
WTP building				
Lights and controls	\$512	/month		\$6,142
HVAC/hydronic system	\$512	/month		\$4,095
Water treatment	\$131	/month		\$1,571
Pumps				
Intake or well	\$131	/month		\$1,571.01
WST circulation	\$73	/month		\$583
Pressure/booster	\$196	/month		\$2,356.52
Main line circulation	\$1,160	/month		\$9,279
Wastewater system				
Lift /pump station buildings				
Lights and controls	* -	/month		\$946
HVAC/hydronic system	\$79	/month		\$630
Pumps				
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	·	/month		\$2,513.62
Sewer/force main glycol circulation	·	/month		\$2,316
Lagoon discharge pump	\$1,886	/year	Subtotal	\$1,886 \$33,900
Other Costs			Gubiolai	ψ55,300
	Ф7 74 4	h.c		Ф 7 74 4
Equipment R&R	\$7,714	,		\$7,714
Miscellaneous materials & supplies	\$4,628	,		\$4,628
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	/year		\$2,500
Insurance	\$1,500	/year	0	\$1,500
			Subtotal	\$18,300

Summary

Administration	\$6,000
Labor	\$33,300
Fuel	\$87,100
Electricity	\$33,900
Other	\$18,300
Total	\$179,000

Revenue M	onthly	# of		,	Yearly
Source R	ate	Customers	Collection Rate	Re	venues
Residential Serv \$	144	63	85%	\$	92,613
Public/Commerc \$	151.33	19	100%	\$	34,503
School Service (; \$	2,882.45	2	100%	\$	51,884
Local Capital Contr	ibution			\$	-
Total Revenue				\$	179,000

Beaver, Alaska

Community Information & Existing Infrastructure

The village of Beaver is a predominately mixed Gwitchin/Koyukuk Athabascan and Inupiat community of 58 people located along the north bank of the Yukon River in north-central Alaska. There are 27 residential units (2 additional units are out of the service area range, and were not included in the model), 13 commercial/public facilities and one school for a total of 41 services. The existing water and sewer services provided in Beaver consist of large truck haul. The existing water and sewer infrastructure consists of the following:

- Well Water 6-10 gpm transfer pump
- Treated Water Storage 66,000 gallons
- Water Treatment Plant/Washeteria –
 1,708 SF, built in 1978 and refurbished in
 1990
- Water Treatment –Filtration, chlorine, and polymer
- Sewage Lagoon Two Cell, 0.74 acres (too close to the runway to be considered usable)

The area around Beaver consists of permafrost soil conditions. Layer of frozen silts sits between stable sand and gravel layer typically found 6 feet deep.

Piped System Description

The piped water and sewer system will be a below grade system. The water system will consist of approximately 12,200 feet of pipe, and the sewer system approximately 14,300 feet of pipe. The water system will consist of two circulating loops. The gravity sewer system would require glycol heat treat for freeze protection, and 5 lift stations to collect and transport wastewater to the lagoon. The limitations posed by the runway and the Joe Guay Slough, would likely require the new lagoon to be sited one mile north of the community off the existing road to the landfill. It is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	5	8	-
Water Storage (gallons)	58,300	66,000	-
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	1.2	-	1.2
Required Foundation System for WTP and/or WST			
Thermosyphon stabilized gravel pad (sf)	1,200	-	1,200
Water Distribution System			
Circulating Water Main with Pitorifices (If)	12,200	-	12,200
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	14,300	-	14,300
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	3,100	-	3,100
Gravity Sewer Service Lines (If)	3,100	-	3,100

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Beaver. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30):

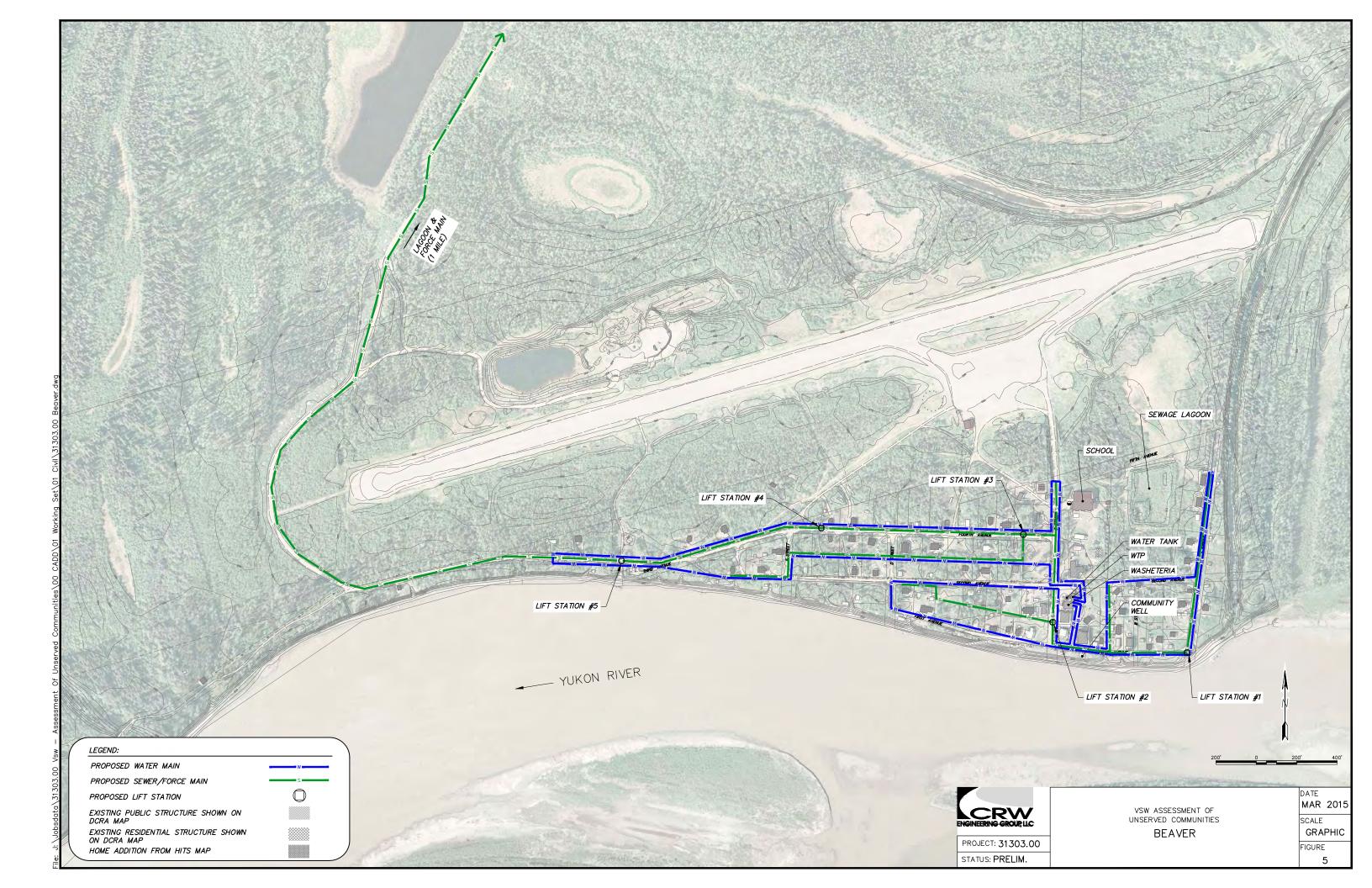
				Village	
	Estimated Capital Costs				
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	41	\$28,096.69	\$1,151,964
2	Sewage collection mains or services (gravity or force), buried	LF	17,400	\$550.70	\$9,582,112
4	Sewage lift station	EA	5	\$1,037,489.17	\$5,187,446
10	Sewage lagoon, barrow, local material	Acre	1.2	\$1,261,213.17	\$1,513,456
13	Water distribution, mains or services, buried	LF	15,300	\$588.38	\$9,002,171
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$769.95	\$923,935
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$30,337,000
	Total v	vith Infl	ation (3% pe	year for 6 years)	\$36,224,000
28	Electrical Service Upgrades	EA	41	\$5,500	\$225,500
Subtotal					\$36,449,500
29	Construction Contingency (15%)	LS	1	\$5,467,400	\$5,467,400
30	Design & Construction Administration Services (20%)	LS	1	\$7,289,900	\$7,289,900
				Total	\$49,206,800

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$22,500			
Fuel	\$101,600			
Electricity	\$41,600			
Other (R&R, Training, etc.)	\$19,300			
Total	\$191,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Beaver are listed below:

Estimated User Fees						
Revenue Source	Мо	nthly Rate	# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	308	27	85%	\$ 84,951	
Public/Commercial Service	\$	324	13	100%	\$ 50,526	
School Service	\$	6,169	1	100%	\$ 55,523	
Local Capital Contribution					\$ -	
Total Revenue					\$ 191,000	



VSW Unserved Communities - Piped Water & Sewer System Type and Sizing Model						
VSW Unserved Communi	-	3/4/2016	zing iviodei			
Community		3/4/2016 Beaver				
Inpu	t					
E into a community of Control Date						
Existing Community & System Data 2015 Population		58				
2015 Number of Services		41				
HITS Database (E1 & H1-H7)		27				
DCED Mapping Commerical/Public Facilities/School		14				
Type (surface water or groundwater) Water quality (Poor or Good)		GW Poor				
Water Storage Tank		66000				
Water Treatment Capacity		8				
Existing Sewage Lagoon Size		0				
Soil Conditions (check only one)						
Soft poorly drained soils or discontinuous permafrost						
Firm soils, or continuous permafrost		х				
Stiff soils, no permafrost			Sewer Main Length	Water Main		
Piping Configurations (check all that apply)			(ft)	Length (ft)		
Buried system with no permafrost			\ .,	U- \/		
Above ground system or buried with permafrost		х	14300	12200		
Gravity Sewer Main Pressure Sewer Main		Х	9000 5300			
Typical Service Line Length (ea)			75	75		
, /p. ea. ea ea. a ge. (ea./						
Piped System Requirements	Community	Beaver				
Output for Cost Model (calculated)						
			Foundatio	n Size		
Water Treatment Capacity (gpm)		5				
Req Water Storage (gallons) (less existing)		-	-	sf		
Req W&S Utility Bldg/Water Treatment Plant/Addition Req Sewage Lagoon Size (acre) (less existing)	on (st)	1,200	1,200	ST		
ned Sewage Lagoon Size (acre) (less existing)		1,2	Quantity	Notes		
			Quarterty			
		Th				
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	1,200			
		(3.1)				
				i		
L.,						
Water Distribution System		Circulating Water Main with	12,200			
		Pitorifices (If)	12,200	i		
		Sewer Main with Glycol Heat Trace	14,300			
Wastewater Collection System		(If)	14,500			
·		Lift Stations for Gravity Sewer Mains	5			
				i		
		Circulating Water Service Lines (If)	3,100			
Water & Sewer Service Lines			3,2.0			
		Gravity Sewer Service Lines (If)	3,100			
	Piped System			•		
System Description	Need	Existing Facility	Net Need			
Water Treatment Capacity (gpm)	5	8	-			
Water Storage (gallons)	58,300	66,000	-			
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200			
Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	1.2	-	1.2			
	1,200	-	1,200			
Thermosyphon stabilized gravel pad (sf)	-,-50		_,_50			
Water Distribution System						
Water Distribution System Circulating Water Main with Pitorifices (If)	12,200	-	12,200			
Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System						
Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If)	12,200	-	12,200 14,300			
Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System						
Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If) Water & Sewer Service Lines	14,300	-	14,300			

		ped Water	& Sewer	System Type and Sizing Model
Date Community	3/4/2016 Beaver			
System Parameters	Model Results			Criteria & Calculations
Design Population Duration (n)		20 years		20 years
2015 Population (P)		58 people		2015 ADOL
2015 Number of Services		41 service	S	
Growth Rate (i) 2035 Design Population (Capita)		1% 71 people		1% Px(1+i)^n
2033 Designi opulation (capita)		71 people		1 7(1-1)
Water Demand Estimates		8 gpm		
Existing Capacity Average Day (ADD)	3,5			50 gallons per Capita
Max Day (MDD)	7,0			2 x ADD
Peak Hour		15 gpm		3 x MDD
Treatment Capacity		5 gpm		MDD
Water Source Assumptions				
Type (surface water or groundwater)		GW 5 gpm		MDD
Required Capacity		5 gpm		WIDD
Water Storage Tank Sizing				
Existing Water Storage Tank		00 gallons		
Demand Based Volume (if source is GW) Daily Operation (DO) (gallons)	Applicable 7.0	77 gallons		Max Day (MDDx1 day)
Fire Flow (FF)		00 gallons		500 gpm for 60 minutes
Reserve Volume (RV)		31 gallons		3 days x DO
Water Storage Tank Volume CT Based Volume (min if source is SW)	Not Required	08 gallons		DO + FF + RV
Chlorine Residual Concentration (RC)		0.4 mg/L		0.4 mg/L
Disinfection/Log Inactivation (LI)		1.0 log inac	ctivation	1.0-log Inactivation
Temperature (T) pH (PH)		4.4 C 7		4.4 celsius/40 F 7
Contact Time Required (CT)		49 minute	s	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)		0.1		0.1
Required Volume to meet CT*		71 gallons		CT/RCxPeak Hour/BF
Required Water Storage Required Additional Storage		00 gallons 0) gallons		0
Estimate of Min Platform Size (3' clearance	(1)10			
around)	·	- sf		D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
Water Treatment Plant Requirements*				0
Water Quality	Poor			Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,20	10 sf		6
Foundation (WST and WTP)				
Soft poorly drained soils or discontinuous	0			Pile Foundation
permafrost		Thormo	osyphon	
Firm soils, or continuous permafrost	x			Thermosyphon stabilized gravel pad
	_	pad (sf)	
Stiff soils, no permafrost	0			Gravel pad
Water Distribution (Check either or both)				
Buried system with no permafrost	0	Circula	. :	Static Water Mains
		Circula: Water	-	
Above ground system or buried with permafrost	x		torifices	Circulating Water Main with Pitorifices
		(If)		
Wastewater Collection (Check all that apply)				
Buried system with no permafrost	0	Sewer	Main	Bare sewer main, no heat trace
Above ground or buried with permafrost	x			Sewer main with glycol heat trace
		Trace (lf)	
			tions for	
Gravity Sewer Main	х		Sewer	Lift stations for gravity sewer mains
		Mains(ea)	
Pressure Sewer Main	0			Individual Grinder Pump Stations
Water & Sower Services (Check-III that and 1				
Water & Sewer Services (Check all that apply)				la u u u a a a u
Static Water Main	0	Circula	tina	Static Water Service Line
Circulating Water Main	x	Water:		Circulating Water Service Lines
		Lines (I		
Gravity Sewer Main	x	-	Sewer	Gravity Service Line
Stately Sewer Hulli	^	Service	Lines (If)	States Service Line
Pressure Sewer Main	0			Pressure Service Line with GPS
Sewage Lagoon Size				
Existing Sewage Lagoon		0 acres		
Organic Loading Based Size		0.6 acres		0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	13	31.4		Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size		1.2 acres		Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
_				of berms (area to be fenced)
Two cell lagoon, combined acreage	1.	2 acres		Either organic loading based or hydraulic, whichever is greater
L				

Capital Cost Estimate Piped Water & Sewer System

Village	
Beaver	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	41	\$28,096.69	\$1,151,964
	Sewage collection mains or services (gravity or force), buried	LF	17,400	\$550.70	\$9,582,112
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	5	\$1,037,489.17	\$5,187,446
	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	1.2	\$1,261,213.17	\$1,513,456
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	15,300	\$588.38	\$9,002,171
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$769.95	\$923,935
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$30,336,742

Community:	Beaver	
General Community Dat	a	
Current population		58 persons
Average number Service Connect	of people per house ions	2.1
Number of ho	ouses ublic/commerical buildings	27 13
Number of so	chools	1
Burdened labor r	Total number of service	ce connections 41 \$18 hr
Electricity cost (F		\$0.54 kWh
Electricity cost (F Cost per gallon fo	Residential service) or heating oil	\$0.36 kWh \$9.00 gal
Water consumpt	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System		oo gpa
Water Source Type of syste	em (Surface(SW) or Groundwater(GW))	GW
Length of rav	v water line	335 ft
	eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	No Buried
Water Treatment		
	treatment plant building uality (Good or Poor)	2908 sf Poor
Water Storage		
Size of tank(s Length of wa	s) ter line to/ from tank	66,000 gallons 25 ft
Water line he	eated for freeze protection (Yes or No)	No
Water Distributio	rater line (Above ground (AG) or Buried)	AG
Type of syste	em (Static or Circulating (Circ))	Circ
	rculating water loops of Water Main	2 12200 ft
	heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried)	Yes Buried
	rice line length	75 ft
Wastewater Colle		Crowity
Number of in	em (Gravity or Pressure) dividual facility pump stations	Gravity
Number of co Number of	ommunity lift/pump stations of facilities served by lift/pump station #1	5 6
Number of	of facilities served by lift/pump station #2	19
	of facilities served by lift/pump station #3 of facilities served by lift/pump station #4	30 38
	of facilities served by lift/pump station #5 of facilities served by lift/pump station #6	41
Size of lif	t stations	500 sf
•	of sewer mains heated for freeze protection (Yes or No)	9000 ft Yes
Number of ci	rculating glycol loops	3 Puriod
	ne mains (Above ground (AG) or Buried) vice line length	Buried 75 ft
Wastewater Trea	-	5000 %
	eated for freeze protection (Yes or No)	5300 ft Yes
	orce main (Above ground (AG) or Buried) narged seasonally with pump (Yes or No)	Buried Yes
Lagoon disci	goa sousonan, mar pump (100 or 110)	100

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	24	hrs/week		\$22,464
Fuel (Heating Demand)				
Water system				
WTP building	\$1,337	/month		\$10,693.25
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$317	/month		\$3,808.51
Water storage tank	\$90	/month		\$722.30
Water storage tank line	\$0	/month		\$0.00
Water mains	\$2,403	/month		\$28,840
Service lines	\$606	/month		\$7,269
Wastewater system				
Sewer mains		/month		\$21,275
Service lines	*	/month		\$7,269
Lift/pump station buildings	, , -	/month		\$9,192.96
Force main to lagoon	\$1,044	/month		\$12,529
			Subtotal	\$101,600
Electricity				
Water system				
WTP building				
Lights and controls	\$458	/month		\$5,499
HVAC/hydronic system	\$458	/month		\$5,499
Water treatment	\$24	/month		\$286
Pumps				
Intake or well	\$24	/month		\$285.64
WST circulation	\$73	/month		\$583
Pressure/booster	\$36	/month		\$428.46
Main line circulation	\$1,160	/month		\$13,919
Wastewater system				
Lift /pump station buildings				
Lights and controls	\$394			\$4,728
HVAC/hydronic system	\$394	/month		\$3,152
Pumps				
Individual facility pump stations		/month		\$0
Community lift/pump station(s)	·	/month		\$1,701.14
Sewer/force main glycol circulation	·	/month		\$5,210
Lagoon discharge pump	\$343	/year	Subtotal	\$343 \$41,600
Other Costs			Jubiolai	Ψ+1,000
	¢0 202	lyoor		¢0 202
Equipment R&R	\$8,283	•		\$8,283 \$4,970
Miscellaneous materials & supplies	\$4,970 \$2,000	•		
Water quality testing	\$2,000 \$2,500	•		\$2,000 \$3,500
Operator training	\$2,500 \$1,500	•		\$2,500 \$1,500
Insurance	\$1,500	ryear	Subtotal	\$1,500 \$10,300
			Sublolai	\$19,300

Summary

Administration	\$6,000
Labor	\$22,500
Fuel	\$101,600
Electricity	\$41,600
Other	\$19,300
Total	\$191,000

Revenue M	lonthly	# of		,	Yearly
Source R	ate	Customers	Collection Rate	Re	venues
Residential Serv \$	308	27	85%	\$	84,951
Public/Commerc \$	323.89	13	100%	\$	50,526
School Service (; \$	6,169.25	1	100%	\$	55,523
Local Capital Contr	ribution			\$	-
Total Revenue				\$	191,000

Birch Creek, Alaska

Community Information & Existing Infrastructure

The village of Birch Creek is a Dendu Gwichin Athabascan community of 22 people located along the Birch Creek River. There are 18 residential units and 8 commercial/public facilities for a total of 26 services. The existing water and sewer services provided in Birch Creek consist of self-haul system and waste disposal at the sewage lagoon or backyard pit privies. The existing water and sewer infrastructure consists of the following:

- Underneath Birch Creek River 20 gpm transfer pump
- Water Treatment –Sand filters and chlorination
- Treated Water Storage 80,000 gallons
- Sewage Lagoon Single Cell, 0.3 acres
- Water Treatment Plant/Washeteria 640
 SF, built in 1988

Soil investigations in the Birch Creek area revealed a fairly consistent subsurface of frozen soils made up of sandy silt and silty sand with gravel with no groundwater to a depth of approx. 25 feet.

Piped System Description

The piped water and sewer system will be a below grade system. The water system will consist of approximately 5,700 feet of pipe, and the sewer system approximately 3,800 feet of pipe. The water system will consist of two circulating loops. The gravity sewer system would require glycol heat treat for freeze protection, and two lift stations to collect and transport wastewater to the lagoon. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	2	20	-		
Water Storage (gallons)	40,700	80,000	-		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Sewage Lagoon Size (acre)	0.5	-	0.5		
Required Foundation System for WTP and/or WST					
Thermosyphon stabilized gravel pad (sf)	1,200	-	1,200		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	5,700	-	5,700		
Wastewater Collection System					
Sewer Main with Glycol Heat Trace (If)	3,800	-	3,800		
Water & Sewer Service Lines					
Circulating Water Service Lines (If)	2,000	-	2,000		
Gravity Sewer Service Lines (If)	2,000	-	2,000		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Birch Creek. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30):

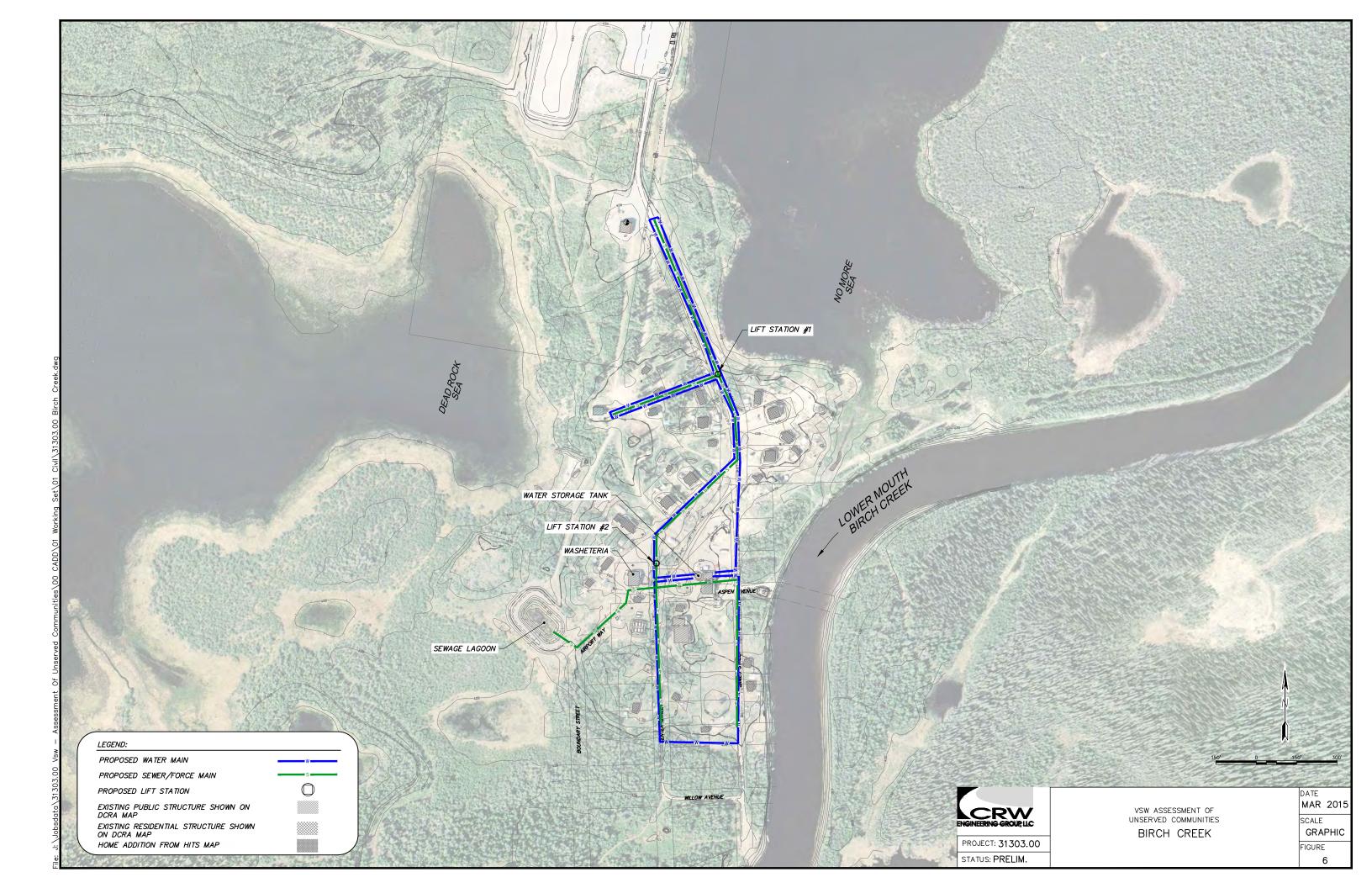
				Village	
	Estimated Capital Costs	Birch Creek			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	26	\$28,096.69	\$730,514
2	2 Sewage collection mains or services (gravity or force), buried		5,800	\$636.43	\$3,691,317
4	4 Sewage lift station EA 3			\$1,097,461.43	\$3,292,384
10	Sewage lagoon, barrow, local material	Acre	0.5	\$1,841,373.17	\$920,687
13	Water distribution, mains or services, buried	LF	7,700	\$636.50	\$4,901,027
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
19	19 Foundation - thermosyphen stabilized gravel pad SF 1,200		1,200	\$769.95	\$923,935
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$17,436,000
	Total v	vith Infl	ation (3% pe	year for 6 years)	\$20,819,500
28 Electrical Service Upgrades EA 26		26	\$5,500	\$143,000	
Subtotal					\$20,962,500
29	29 Construction Contingency (15%) LS		1	\$3,144,400	\$3,144,400
30	Design & Construction Administration Services (20%)	LS	1	\$4,192,500	\$4,192,500
				Total	\$28,299,400

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$25,000			
Fuel	\$30,900			
Electricity	\$33,100			
Other (R&R, Training, etc.)	\$13,100			
Total	\$108,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Birch Creek are listed below:

Estimated User Fees						
Revenue Source	Month	ly Rate	# of Customers	Collection Rate		arly enues
Residential Service	\$	361	18	85%	\$ 60	6,361
Public/Commercial Service	\$	434	8	100%	\$ 4:	1,639
School Service	\$	-	0	100%	\$	-
Local Capital Contribution					\$	-
Total Revenue					\$ 10	8,000



VSW Unserved Commun		ato. a conta opotem type and o	zing Model	
Dat	e	3/5/2016		
Communit		Birch Creek		
Inpu	ıt			
Existing Community & System Data			İ	
2015 Population		22 26		
2015 Number of Services HITS Database (E1 & H1-H7)		18		
DCED Mapping Commerical/Public Facilities/School		8		
Type (surface water or groundwater)		SW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		80000		
Water Treatment Capacity		20		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)				
Soft poorly drained soils or discontinuous permafrost	:			
Firm soils, or continuous permafrost		x		
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length	Water Mai
Buried system with no permafrost			(ft)	Length (ft)
Above ground system or buried with permafrost		x	3750	5700
Gravity Sewer Main		x	3300	2.00
Pressure Sewer Main			450	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Birch Creek		
Output for Cost Model (calculated)			Foundatio	n Size
Water Treatment Capacity (gpm)		2		
Req Water Storage (gallons) (less existing)		-	-	sf
Req W&S Utility Bldg/Water Treatment Plant/Additi	on (sf)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		0.5		
			Quantity	Notes
IKEQUITED FOUNDATION SYSTEM for WIP and/or WSI		Thermosyphon stabilized gravel pad (sf)	1,200	
Water Distribution System		Circulating Water Main with Pitorifices (If)	5,700	
		Sewer Main with Glycol Heat Trace (If)	3,800	
Wastewater Collection System	Wastewater Collection System			
		Lift Stations for Gravity Sewer Mains	2	
		Lift Stations for Gravity Sewer Mains	2	
		Lift Stations for Gravity Sewer Mains	2	
		Lift Stations for Gravity Sewer Mains Circulating Water Service Lines (If)	2,000	
Water & Sewer Service Lines				
Water & Sewer Service Lines		Circulating Water Service Lines (If)	2,000	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	2,000	
Water & Sewer Service Lines System Description	Piped System	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	2,000	
System Description	Need	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility	2,000 2,000 Net Need	
System Description Water Treatment Capacity (gpm)	Need 2	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility	2,000 2,000 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 2 40,700	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility	2,000 2,000 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 2	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 20 80,000	2,000 2,000 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 2 40,700 1,200	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 20 80,000	2,000 2,000 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 2 40,700 1,200	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 20 80,000	2,000 2,000 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	Need 2 40,700 1,200 0.5	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 20 80,000	2,000 2,000 Net Need - - 1,200 0.5	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	Need 2 40,700 1,200 0.5	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 20 80,000	2,000 2,000 Net Need - - 1,200 0.5	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System	Need 2 40,700 1,200 0.5 1,200 5,700	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 20 80,000 -	2,000 2,000 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf)	Need 2 40,700 1,200 0.5	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 20 80,000 -	2,000 2,000 Net Need 1,200 0.5	1
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System	Need 2 40,700 1,200 0.5 1,200 5,700	Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 20 80,000 -	2,000 2,000 Net Need	

System Parameters Design Pepulation Design Pepula		-	Water & Sewer	System Type and Sizing Model
Design Population Distriction (i) 20) expendence 2015 Foundation (ii) 20) expendence 2015 Foundation (iii) 20) expendence 2015 Foundation (iii) 20) expendence 2015 Foundation 215 Sough Population (Capital) 225 people 2015 ADDL 215 Sough Population (Capital) 225 people 2015 ADDL 2016 Foundation (iii) 215 germ 215 Sough Population (Capital) 226 people 2015 ADDL 2016 Foundation (iii) 216 germ 217 Sough Population (Capital) 227 people 2016 Foundation (iii) 228 germ 229 ACRES Sough Population (Capital) 238 germ 239 ACRES Sough Population (Capital) 24 germ 25 germ 25 Sough Population (iii) 26 germ 25 germ 25 germ 25 germ 25 germ 25 germ 25 germ 25 germ 25 germ 26 germ 26 germ 27 germ 28 germ 28 germ 28 germ 28 germ 28 germ 28 germ 28 germ 28 germ 29 germ 29 germ 29 germ 29 germ 2015 ADDL 20 germ 29 germ 2015 ADDL 20 germ 29 germ 2015 ADDL 20 germ 2016				
Duration (s) 220 years 220	System Parameters	Model Results		Criteria & Calculations
2015 Frout-intention Properties 2015 ADCL		20	vears	20 years
Growth Relate () 27 people polithron (Capital) 28 people polithron (Capital) 28 people polithron (Capital) 28 people polithron (Capital) 29 people polithron (Capital) 20 people pol		22	people	
### Part Design Peoplation Capitals Water Damand Estimates 30				1%
Easing Capacity Max Day (MDO) 1,342 gpd 2,2 ADD 1,342 gpd 3,3 MDO 2,644 gpd 2,2 ADD 4,400 1,342 gpd 3,3 MDO 3,4 MDO 4,4 Seguent Capacity Treatment	* *			
Average Day (ADD) 1,342 gpd 2 x ADD 2,664 gpd 2 x ADD 4 x MDD 5 x MDD 7 x MDD 8 x MDD 9 x MDD 9 x MDD 1 x MDD 1 x MDD 1 x MDD 2 x MDD 2 x MDD 3 x MDD 4 x MDD 5 x MDD 5 x MDD 6 x pm 3 x MDD 7 x MDD 8 x MDD 9	Water Demand Estimates			
Max Day (MIDD) 2,881 gpd 2 x ADD 1				50 gallons per Capita
Treatment Capacity Water Source Assumptions Proper Eurofice water or groundwater) Required Capacity Water Storage Tank String Easting water Storage Tank String Easting water Storage Tank String Easting water Storage Tank String Easting water Storage Tank String Easting water Storage Tank String Easting water Storage Tank String Water Storage Tank Volume 40,738 gallons Check Min CT Requirements* 40,738 gallons C				
Water Source Assumptions Type Gurdace water or groundwater) Required Capacity Water Storage Tank Sizing Sessing Water Storage Tank Demand Based Wolume (If gource is GW) Day Operation (10) (glallors) Five Flow (F) Receive Volume (N) Water Source (R) Water (R) Water Source (R) Water (R)				
Type Gurdace water or groundwater) Required Capacity Water Storage Tank Stding Existing Water Storage Tank Stding Existing Water Storage Tank Stding Existing Water Storage Tank Stding Existing Water Storage Tank Stding Existing Water Storage Tank Stding Existing Water Storage Tank Stding Existing Water Storage Tank Volume The Flow (File Manager Std) Water Storage Tank Volume Check Min CT Requirements 30,000 gallons Stdorage Tank Volume Check Min CT Requirements 30,000 gallons Stdorage Tank Volume Check Min CT Requirements 30,000 gallons Stdorage Tank Volume Check Min CT Requirements 30,000 gallons Stdorage Tank Volume Check Min CT Requirements 30,000 gallons Stdorage Tank Volume Check Min CT Requirements 30,000 gallons Stdorage Tank Volume Check Min CT Requirements 30,000 gallons Stdorage Tank Volume Check Min CT Requirements 30,000 gallons Stdorage Tank Volume Check Min CT Requirements 4,4 C d. A. a. d. d. d. d. d. d. d. d. m. d. A. d. existing 40 d. a. m. d. A. d. existing 40 d. a. d. existing 40 d. a. m. d. A. d. existing 40 d. a. d. existing 40 d. existin		2	урт	WIDD
Required Vater Storage Tank Sizing S0,000 Solitons Common Storage Tank Sizing S0,000 Solitons Common Storage Tank Solitons Common State Common St	· ·	SW	1	
Easting water Storage Tank Daily Operation (DO) (gallons) Pier Flow (FP) Reserve Volume (RV) Required Volume to meet reserve (RV) Required Volume to meet (RV) R				MDD
Demand Based Volume (if source is GWI)				
Daily Operation (DO) (gallons) Reserve Volume (RV) Required Volume for Contentration (RC) Disinfection/tog inactivation (LV) Required Volume to meet CT* Required Volume to meet CT* Required Volume to meet CT* Required Volume Storage Required Additional Storage Required			gallons	
Reserve Volume (RV) Water Storage Fair Volume CT Based Volume (Imit if source is SM) CT Based Volume (Imit if source is SM) CT Based Volume (Imit if source is SM) CT Based Volume (Imit if source is SM) Continct Recided Concentration (RC) Distriction/Log Inactivation (LI) Temperature (T) pit (PH) 7		· ·	gallons	Max Day (MDDx1 day)
April Apri				6.
Clorione Residual Concentration (RC) Disinfection/(pg) analtaviation (L) Temperature (T) Pin (PH) Contact Time Required (CT) Sequired Value to meet CT* Required Value to storage Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Marks Storage Required Additional Storage Required Marks Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Marks Storage Required Additional Storage Required Marks Marks Storage Required Marks Marks Storage Required Marks Marks Storage Required Marks Marks Storage Required Marks Marks Storage Required Marks Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Storage Required Marks Marks Storage Required Marks Storage Required Marks Storage Required Marks Marks Storage Required Marks Marks Storage Required Ma		· ·	•	
Disinfection/Log mactivation (LI) Temperature (T) pH (PH) 7 7 7 Required (CT) Baffling Coefficient (BF) Required Water to meet CT* Required Water Storage Required Water Storage Required Water Storage Required Water Storage Required Main to meet CT* Required Water Storage Required Main to meet CT* Required Water Storage Required Additional Storage Latimate of Min Platform Size (3' clearance around) Water Treatment Plant Requirements* Water Quality Water Assembly Stem or buried with permafrost Water Distribution (Check all that apply) Buried system with no permafrost Water Objects my with no permafrost Above ground or buried with permafrost Water W		•	ma/l	0.4 mg/l
Contact Time Required (CT) Baffling Coefficient (BF) Baffling Coeffici				1.0-log Inactivation
Contact Time Required (CT) Seguired Volume to meet CT* Required Matrix Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Additional Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Matrix Storage Required Additional Storage Required Matrix Storage Required Additional Storage Required Matrix Storage Required Matrix Storage Required Additional Storage Required Additional Storage Required Matrix Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Matrix Storage Required Additional Storage Requir				· · · · · · · · · · · · · · · · · · ·
Required Volume to meet CT* Required Volume to meet CT* Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Required Additional Storage Statinate of Min Platform Size (3' clearance around) Water Treatment Plant Requirements* Water Cuality Minimum WTP Size Poor Poor Water Quality (For DF) = 1200 sf Good Water Quality (For DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf	Contact Time Required (CT)	49	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Required Matchinal Storage Required Additional Storage Estimate of Min Platform Size (3' clearance around) Water Treatment Plant Requirements* Water Quality March Totality Minimum WTP Size Foundation (WST and WTP) Soft poorly drained soils or discontinuous permafrost Wiff soils, or continuous permafrost Water Distribution (Check either or both) Buried system with no permafrost Water Stribution (Check either or both) Buried system or buried with permafrost Water Stribution (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Above ground or buried with permafrost Water Stribution (Check either or both) Buried system with no permafrost Water Main with Pitorifices Circulating Water Main Water Trace (if) Lift Stations for Gravity Sewer Main Pressure Sewer Main Water Sewer Services (Check all that apply) Static Water Main Water Sewer Services (Check all that apply) Static Water Main Water Sewer Service Lines Circulating Water Service Lines Circulatin				
Estimate of Min Platform Size (3' clearance around) Water Treatment Plant Requirements* Water Quality Minimum WTP Size Foundation (WST and WTP) Soft poorly drained soils or discontinuous permafrost Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system or buried with permafrost Above ground system or buried with permafrost Water Sewer Main Gravity Sewer Main Water Sewer Main Water Sewer Main Water Sewer Main Water Main Water Mains, severy 1,000 ft (ea) Pressure Sewer Main Water Main Water Sewer Main Circulating Water Main Water Sewer				CITICAL CURTICULAR
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Name Name	Water Treatment Plant Requirements*			0
Foundation (WST and WTP) Soft poorly drained soils or discontinuous permafrost If mr soils, or continuous permafrost X]	
Soft poorly drained soils or discontinuous permafrost Ithermosyphon stabilized gravel pad gravel p	IVIIIIIIUM WTP Size	1,200	sj	Good Water Quality (no treatment other than CL) = 800 Si
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Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with Pitorifices Circulating Water Service Line Circulating Wat	Firm soils or continuous permafrost	¥		Thermosyphon stabilized gravel pad
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with permafrost Above ground or buried with apply) Bare sewer main, no heat trace Sewer main with glycol heat trace Water Trace (If) Lift Stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Service Line Circulating Water Service Line Circulating Water Service Lines Circulating Water Service				
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Gravity Sewer Main x Gravity Sewer Service Line Pressure Sewer Main 0 Gravity Service Line Pressure Service Line with GPS Sewage Lagoon Size	Circulating Water Main	x		Circulating Water Service Lines
Gravity Sewer Main Pressure Sewer Main O Service Lines (If) Pressure Service Line with GPS Sewage Lagoon Size	Canada Couran Marin			Carrier Consider Line
Sewage Lagoon Size			Service Lines (If)	
	Pressure Sewer Main	0		Pressure Service Line with GPS
EXISTING DEWAGE LAGOON UTACLES			1	
	Existing Sewage Lagoon Organic Loading Based Size			0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check 80.9				
	Hydraulic Loading Based Size	0.5	acres	Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
of berms (area to be fenced)				
Two cell lagoon, combined acreage 0.5 acres Either organic loading based or hydraulic, whichever is greater	Two cell lagoon, combined acreage	0.5	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Birch Creek	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	26	\$28,096.69	\$730,514
	Sewage collection mains or services (gravity or force), buried	LF	5,800	\$636.43	\$3,691,317
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	3	\$1,097,461.43	\$3,292,384
	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
	Sewage lagoon, barrow, local material	Acre	0.5	\$1,841,373.17	\$920,687
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	7,700	\$636.50	\$4,901,027
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
	Washeteria, no foundation	SF	0	#DIV/0!	\$0
	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$769.95	\$923,935
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$17,435,522

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General Community Data	
Current population	
Average number of people per house	
Service Connections	
Number of houses	
Number of public/commerical building	s
Number of schools	
-	Total number of service connections

Birch Creek

Burdened labor rate	\$20	hr
Electricity cost (Public facilty)	\$0.55	kWh
Electricity cost (Residential service)	\$0.40	kWh
Cost per gallon for heating oil	\$6.00	gal

Water consumption per capita 50 gpd Wastewater generation per capita 50 gpd

Water & Sewer System Characteristics

Water Source

Community:

Type of system (Surface(SW) or Groundwater(GW))	SW	
Length of raw water line	290	ft
Water line heated for freeze protection (Yes or No)	No	
Location of water line (Above ground (AG) or Buried)	Buried	

Water Treatment

Size of water treatment plant building	2340 sf
Raw water quality (Good or Poor)	Poor

Water Storage

Size of tank(s)	80,000	gallons
Length of water line to/ from tank	50	ft
Water line heated for freeze protection (Yes or No)	Yes	
Location of water line (Above ground (AG) or Buried)	AG	

Water Distribution

Type of system (Static or Circulating (Circ))	Circ	
Number of circulating water loops	2	
Total length of Water Main	5700	ft
Water mains heated for freeze protection (Yes or No)	Yes	
Location of the mains (Above ground (AG) or Buried)	Buried	
Average service line length	75	ft

Wastewater Collection

Type of system (Gravity or Pressure) Gravit	V
Number of individual facility pump stations	
71 1	2
Number of facilities served by lift/pump station #1	5
Number of facilities served by lift/pump station #2	7
Number of facilities served by lift/pump station #3	
Number of facilities served by lift/pump station #4	
Number of facilities served by lift/pump station #5	
Size of lift stations 50) sf
Total length of sewer mains 330) ft
Sewer mains heated for freeze protection (Yes or No)	S
Number of circulating glycol loops	3
Location of the mains (Above ground (AG) or Buried) Burie	t
Average service line length 7	5 ft

Wastewater Treatment / Disposal

Length of force main	450 ft
Force main heated for freeze protection (Yes or No)	Yes
Location of force main (Above ground (AG) or Buried)	Buried
Lagoon discharged seasonally with pump (Yes or No)	Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u>		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	24	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$717	/month		\$5,736.41
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$80	/month		\$963.07
Water storage tank	\$73	/month		\$583.68
Water storage tank line	\$11	/month		\$87.55
Water mains	\$749	/month		\$8,983
Service lines	\$256	/month		\$3,073
Wastewater system				
Sewer mains	·	/month		\$5,201
Service lines	,	/month		\$3,073
Lift/pump station buildings	,	/month		\$2,451.46
Force main to lagoon	\$59	/month		\$709
			Subtotal	\$30,900
Electricity				
Water system				
WTP building				
Lights and controls	\$376	/month		\$4,507
HVAC/hydronic system	\$376	/month		\$4,507
Water treatment	\$9	/month		\$110
Pumps				
Intake or well	\$9	/month		\$110.35
WST circulation	\$74	/month		\$594
Pressure/booster	\$14	/month		\$165.53
Main line circulation	\$1,181	/month		\$14,177
Wastewater system				
Lift /pump station buildings				
Lights and controls	\$161	/month		\$1,926
HVAC/hydronic system	\$161	/month		\$1,284
Pumps				
Individual facility pump stations	\$0	/month		\$0
Community lift/pump station(s)	\$26	/month		\$308.99
Sewer/force main glycol circulation	\$442	/month		\$5,306
Lagoon discharge pump	\$132	/year	0	\$132
			Subtotal	\$33,100
Other Costs		h		04.440
Equipment R&R	\$4,448	/year		\$4,448
Miscellaneous materials & supplies	\$2,669	•		\$2,669
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	/year	0	\$1,500
			Subtotal	\$13,100

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$30,900
Electricity	\$33,100
Other	\$13,100
Total	\$108,000

Revenue M	/lonthly	# of		,	Yearly
Source F	Rate	Customers	Collection Rate	Re	evenues
Residential Serv S	\$ 361	18	85%	\$	66,361
Public/Commerc §	433.73	8	100%	\$	41,639
School Service (5	5 -	0	100%	\$	-
Local Capital Cont	tribution			\$	-
Total Revenue				s	108,000

Chalkyitsik, Alaska

Community Information & Existing Infrastructure

The village of Chalkyitsik is a Gwichin Athabascan community of 77 people located along the Black River. There are 51 residential units, 16 commercial/public facilities and one school for a total of 68 services. The existing water and sewer services provided in Chalkyitsik consist of self-haul water system and honey buckets/outhouses for waste disposal. The water treatment plant (WTP) distributes water from the water storage tank (WST) to the washeteria, community water point, village council building, clinic, and the school's wood-stave WST. The washeteria, WTP, council building, and the clinic discharge wastewater to a lift station under the WTP that is piped to the sewage lagoon. The existing water and sewer infrastructure consists of the following:

- Black River 15 gpm transfer pump
- Treated Water Storage 95,000 gallons
- Water Treatment Plant/Washeteria –
 2,314 SF, upgraded in 2008
- Water Treatment Treated with coagulant, filtered, passed through a granulated carbon filter, and chlorinated
- Sewage Lagoon Two Cell, 1.0 acres

Subsurface conditions in Chalkyitsik typically consist of several feet of organic soils overlying ice-rich silts to depths of 16.5 to 27.5 feet.

Piped System Description

The piped water and pressure sewer system will be a buried system. The system will consist of approximately 17,100 feet of circulating water mains, and 9,300 feet of pressure sewer mains. The water system will consist of two circulating loops. The pressure sewer system would require individual grinder pump stations at each house, glycol heat trace for freeze protection, and one lift station. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment. The existing 95,000 gallon water storage tank is sufficient to meet the CT-required volume and provide a reserve for fire flows and/or emergencies.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need			
Water Treatment Capacity (gpm)	7	15	-			
Water Storage (gallons)	67,600	95,000	-			
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200			
Sewage Lagoon Size (acre)	1.6	1.0	0.6			
Required Foundation System for WTP and/or WST						
Thermosyphon Stabilized Gravel Pad (sf)	1,200	-	1,200			
Water Distribution System						
Circulating Water Main with Pitorifices (If)	17,100	-	17,100			
Wastewater Collection System						
Sewer Main with Glycol Heat Trace (lf)	9,300	-	9,300			
Individual Grinder Pump Stations (GPS) (ea)	68	-	68			
Water & Sewer Service Lines						
Circulating Water Service Lines (If)	5,100	-	5,100			
Pressure Sewer Service Lines (If)	5,100	-	5,100			

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Chalkyitsik. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30):

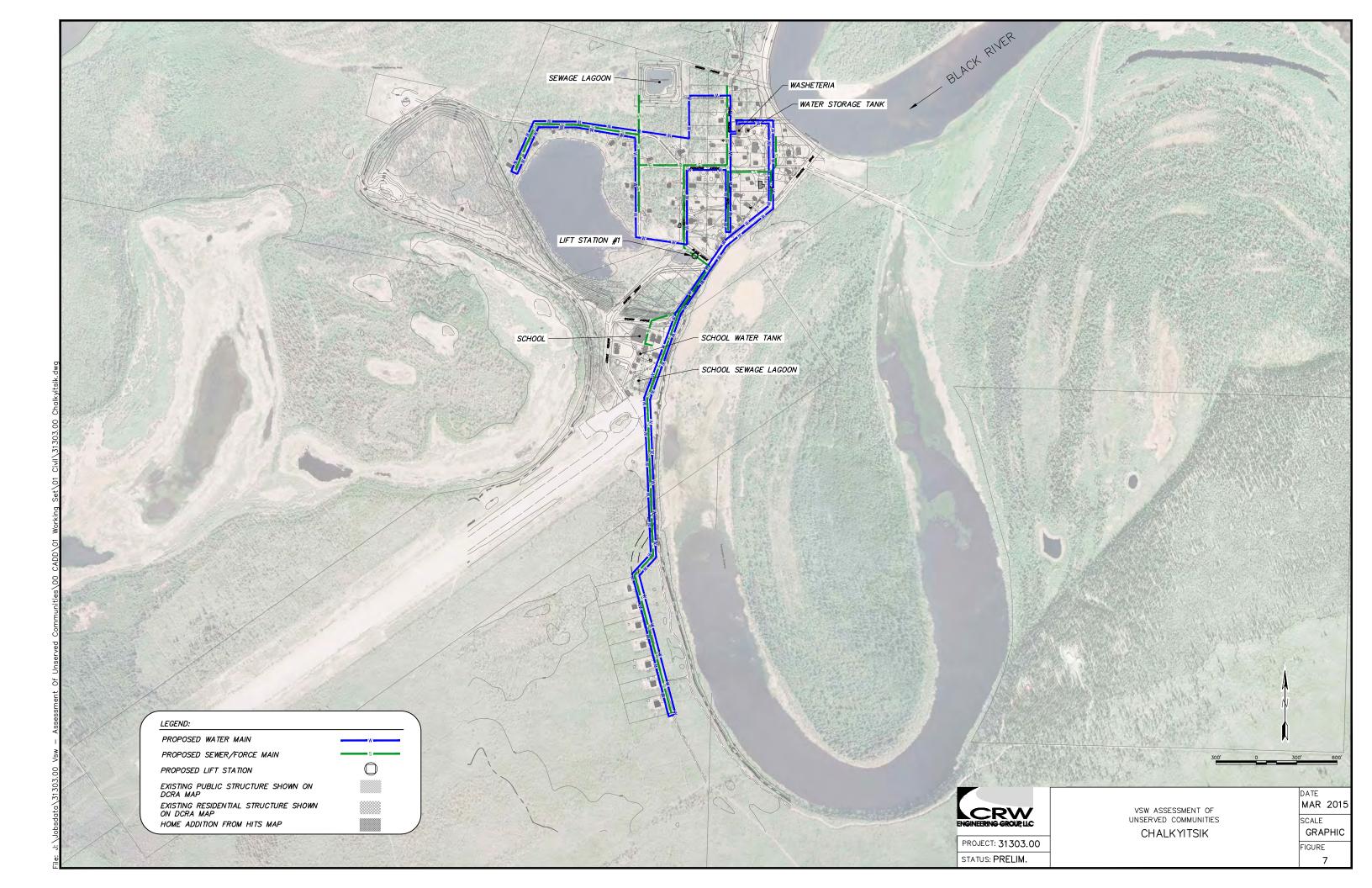
			Village		
Estimated Capital Costs			Chalkyitsik		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	68	\$28,096.69	\$1,910,575
3	Sewage collection mains or services (gravity or force), above ground	LF	14,400	\$310.58	\$4,472,295
4	Sewage lift station	EA	1	\$1,397,322.77	\$1,397,323
10	Sewage lagoon, barrow, local material	Acre	0.6	\$1,675,613.17	\$1,005,368
12	Water distribution, mains or services, above ground	LF	22,200	\$425.83	\$9,453,451
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$769.95	\$923,935
Total Estimated Cost in 2010 dollars (rounded):					\$22,139,000
Total with Inflation (3% per year for 6 years)					\$26,435,100
27	Individual Grinder Pump Stations	EA	68	\$30,000	\$2,040,000
28	Electrical Service Upgrades	EA	68	\$5,500	\$374,000
Subtotal					\$28,849,100
29	Construction Contingency (15%)	LS	1	\$4,327,400	\$4,327,400
30	Design & Construction Administration Services (20%)	LS	1	\$5,769,800	\$5,769,800
				Total	\$38,946,300

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$30,000			
Fuel	\$95,500			
Electricity	\$37,100			
Other (R&R, Training, etc.)	\$19,000			
Total	\$188,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Chalkyitsik are listed below:

Estimated User Fees					
Revenue Source	Мо	nthly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	188	51	85%	\$ 97,661
Public/Commercial Service	\$	207	16	100%	\$ 39,650
School Service	\$	5,632	1	100%	\$ 50,689
Local Capital Contribution					\$ -
Total Revenue					\$ 188,000



MOM II I O				
	-	ater & Sewer System Type and Siz	zing iviodei	
Date Community		2/29/2016 Chalkyitsik		
Input		,		
Existing Community & System Data 2015 Population		77		
2015 Population 2015 Number of Services		68		
HITS Database (E1 & H1-H7)		51		
CED Mapping Commerical/Public Facilities/School		17		
ype (surface water or groundwater)		SW		
Water quality (Poor or Good)		Poor		
Water Storage Tank Water Treatment Capacity		95000 15		
Existing Sewage Lagoon Size		1		
Soil Conditions (check only one)		-		
Soft poorly drained soils or discontinuous permafrost				
Firm soils, or continuous permafrost		х		
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length	Water Main
Buried system with no permafrost			(ft)	Length (ft)
Above ground system or buried with permafrost		Х	9300	17100
Gravity Sewer Main				
Pressure Sewer Main		X	9300	75
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Chalkyitsik		
Output for Cost Model (calculated)	Community	Charryttsik		
(Foundatio	n Size
Water Treatment Capacity (gpm)		7		
Req Water Storage (gallons) (less existing)		-	-	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	1,200	1,200 sf	
Req Sewage Lagoon Size (acre) (less existing)		0.6		
			Quantity	Notes
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	1,200	
Water Distribution System		Circulating Water Main with	17,100	
		Pitorifices (If)	·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	9,300	
		Individual Grinder Pump Stations (GPS) (ea)	68	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	5,100	
		Pressure Sewer Service Lines (If)	5,100	
			3,100	
System Description	Piped System	Existing Facility	Net Need	
System Description	Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	Need 7	Existing Facility 15	Net Need -	
·	Need	Existing Facility		
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 7 67,600	15 95,000	-	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	7 67,600 1,200 1.6	15 95,000 - 1.0	- - 1,200 0.6	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	Need 7 67,600 1,200	15 95,000 -	- - 1,200	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	7 67,600 1,200 1.6	15 95,000 - 1.0	- - 1,200 0.6	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	Need 7 67,600 1,200 1.6	Existing Facility 15 95,000 - 1.0	- - 1,200 0.6	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf)	Need 7 67,600 1,200 1.6	Existing Facility 15 95,000 - 1.0	- - 1,200 0.6	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Residential Grinder Pump Stations (GPS) (ea)	Need 7 67,600 1,200 1.6 1,200	Existing Facility 15 95,000 -	1,200 0.6 1,200	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Residential Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 7 67,600 1,200 17,100 9,300 68	Existing Facility 15 95,000 -	1,200 0.6 1,200 17,100 9,300 68	
Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Residential Grinder Pump Stations (GPS) (ea)	Need 7 67,600 1,200 1.6 1,200 17,100 9,300	Existing Facility	1,200 0.6 1,200 17,100	

	nonwood Communication C'	Matau C C	Custom Time and Cining Madel
VSW U	•	ı water & Sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years people	20 years
2015 Population (P) 2015 Number of Services		services	2015 ADOL
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	94	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		gpm	
Average Day (ADD) Max Day (MDD)	4,698 9,395	gpd gpd	50 gallons per Capita 2 x ADD
Peak Hour	20	gpm	3 x MDD
Treatment Capacity	7	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	SW	1	
Required Capacity	7	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank	95,000	gallons	
Demand Based Volume (if source is GW)	Check Min CT Requirements		M. D. (MDD 4 II.)
Daily Operation (DO) (gallons) Fire Flow (FF)	9,395 30,000		Max Day (MDDx1 day) 500 gpm for 60 minutes
Reserve Volume (RV)	28,186	gallons	3 days x DO
Water Storage Tank Volume	67,582	gallons	DO + FF + RV
CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC)	Required 0.4	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)	1.0	log inactivation	1.0-log Inactivation
Temperature (T) pH (PH)	4.4		4.4 celsius/40 F 7
Contact Time Required (CT)		minutes	/ LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT* Required Water Storage	33,283 67,600		CT/RCxPeak Hour/BF
Required Additional Storage	-	gallons	0
Estimate of Min Platform Size (3' clearance		sf	$D = 0.103 \times Vg^{(1/2)}$ H=16 assumed (H is height of tank)
around)		-,	0
Water Treatment Plant Requirements*		_	<u> </u>
Water Quality	Poor]	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)		1	
Soft poorly drained soils or discontinuous permafrost	0		Pile Foundation
permanost		Thermosyphon	
Firm soils, or continuous permafrost	x	_	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0	pad (sf)	Gravel pad
Water Distribution (Check either or both)	•		Static Water Mains
Buried system with no permafrost	0	Circulating	Static water Mains
Above ground system or buried with permafrost	x	Water Main	Circulating Water Main with Pitorifices
Theore ground system of buried with permanest	•	with Pitorifices	chediating vacci main with restricts
		(lf)	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0	1	Bare sewer main, no heat trace
system with no permanost	·	Sewer Main	
Above ground or buried with permafrost	x	-	Insulated sewer main with glycol heat trace
Gravity Sewer Main	0	Trace (If)	Lift stations for gravity sewer mains, every 1,000 ft
,		Individual	
Pressure Sewer Main	x	Grinder Pump	Individual Grinder Pump Stations
		Stations (GPS) (ea)	
		J ,	
Water & Sewer Services (Check all that apply)			
Static Water Main	0		Static Water Service Line
Static Water Main		Circulating	
	0 x	Water Service	Static Water Service Line Circulating Water Service Lines
Static Water Main			
Static Water Main Circulating Water Main Gravity Sewer Main	x 0	Water Service	Circulating Water Service Lines Gravity Service Line
Static Water Main Circulating Water Main	х	Water Service Lines (If)	Circulating Water Service Lines
Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main	x 0	Water Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size	x 0 x	Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Service Lines Gravity Service Line
Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	x 0 x	Water Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size	x 0 x	Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 1 0.8 151.4	Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	x 0 x 1 0.8 151.4	Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 1 0.8 151.4	Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Chalkyitsik	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	68	\$28,096.69	\$1,910,575
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	14,400	\$310.58	\$4,472,295
4	Sewage lift station	EA	1	\$1,397,322.77	\$1,397,323
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0.6	\$1,675,613.17	\$1,005,368
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	22,200	\$425.83	\$9,453,451
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$769.95	\$923,935
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$22,138,605

Community:	Chalkyitsik		
General Community Date	a		
Current population	on	77 per	rsons
Service Connect		1.5	
•	ublic/commerical buildings	51 16	
Number of se	cnools Total number of servi	ce connections 68	
Burdened labor i	rate	\$18 hr	
Electricity cost (F	• •	\$0.55 kW	
Cost per gallon f	Residential service) or heating oil	\$0.40 kW \$8.00 gal	
Water consumpt		50 gpc	
wastewater gen	eration per capita	50 gpc	a
Water & Sewer System Water Source	Characteristics		
Type of syste Length of ray	em (Surface(SW) or Groundwater(GW))	SW 460 ft	
•	eated for freeze protection (Yes or No)	No	
Location of v	vater line (Above ground (AG) or Buried)	Buried	
Water Treatmen	=	2711	
	treatment plant building uality (Good or Poor)	3514 sf Poor	
Water Storage			
Size of tank(•	95,000 gal	lons
· ·	ter line to/ from tank eated for freeze protection (Yes or No)	40 ft Yes	
	water line (Above ground (AG) or Buried)	AG	
Water Distribution	<u>ın</u>		
	em (Static or Circulating (Circ))	Circ	
	rculating water loops of Water Main	2 17100 ft	
Water mains	heated for freeze protection (Yes or No)	Yes	
	ne mains (Above ground (AG) or Buried) vice line length	Buried 75 ft	
Wastewater Coll	· ·	70 10	
	em (Gravity or Pressure)	Pressure	
	dividual facility pump stations	4	
	ommunity lift/pump stations of facilities served by lift/pump station #1	1 10	
Number	of facilities served by lift/pump station #2		
	of facilities served by lift/pump station #3 of facilities served by lift/pump station #4		
	of facilities served by lift/pump station #5		
	ft stations	500 sf	
	of sewer mains heated for freeze protection (Yes or No)	8700 ft Yes	
Number of ci	rculating glycol loops	3	
	ne mains (Above ground (AG) or Buried) vice line length	Buried 75 ft	
	atment / Disposal		
Length of for	ce main neated for freeze protection (Yes or No)	600 ft Yes	
	orce main (Above ground (AG) or Buried)	Buried	
Lagoon discl	narged seasonally with pump (Yes or No)	Yes	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	32	hrs/week		\$29,952
Fuel (Heating Demand)				
Water system				
WTP building	\$1,436	/month		\$11,485.89
Raw water line		/month		\$0.00
Raw water heat addition	·	/month		\$4,494.34
Water storage tank	\$116	/month		\$924.16
Water storage tank line	\$12	/month		\$93.39
Water mains	•	/month		\$35,931
Service lines	\$893	/month		\$10,716
Wastewater system				
Sewer mains	\$1,523	/month		\$18,281
Service lines	\$893	/month		\$10,716
Lift/pump station buildings	\$204	/month		\$1,634.30
Force main to lagoon	\$105	/month		\$1,261
			Subtotal	\$95,500
Electricity				
Water system				
WTP building				
Lights and controls	· ·	/month		\$6,768
HVAC/hydronic system	\$564			\$6,768
Water treatment	\$32	/month		\$386
Pumps				
Intake or well	•	/month		\$386.23
WST circulation	•	/month		\$594
Pressure/booster	, -	/month		\$579.35
Main line circulation	\$1,181	/month		\$14,177
Wastewater system				
Lift /pump station buildings	***	, ,,		***
Lights and controls	•	/month		\$963
HVAC/hydronic system	\$80	/month		\$642
Pumps	40	, ,,		
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	* -	/month		\$90.88
Sewer/force main glycol circulation	*	/month		\$5,306
Lagoon discharge pump	\$464	/year	Subtotal	\$464 \$37,100
Other Costs				Ţ-·,·••
Equipment R&R	\$8,128	/year		\$8,128
Miscellaneous materials & supplies	\$4,877	•		\$4,877
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	-		\$2,500
Insurance	\$1,500	•		\$2,500 \$1,500
modianoc	ψ1,300	, y cui	Subtotal	\$19,000
			อนมเบเลเ	φ 19,000

Summary

Administration	\$6,000
Labor	\$30,000
Fuel	\$95,500
Electricity	\$37,100
Other	\$19,000
Total	\$188,000

Revenue Mo	onthly	# of		,	Yearly
Source Ra	ite	Customers	Collection Rate	Re	evenues
Residential Serv \$	188	51	85%	\$	97,661
Public/Commerc \$	207	16	100%	\$	39,650
School Service (\$	5,632	1	100%	\$	50,689
Local Capital Contri	bution			\$	-
Total Revenue				\$	188.000

Chefornak, Alaska

Community Information & Existing Infrastructure

Chefornak is a Yup'ik Eskimo community of 420 people located on the south bank of the Kinia River, at its junction with the Keguk River, in the Yukon Kuskokwim Delta. There are 83 residential units, 24 commercial/public facilities, and one K-12 school for a total of 108 services. The existing water and sewer services provided in Chefornak consist of a self-haul system from watering points for water and honey buckets for waste disposal. The school has a treatment system, but purchases raw water from the City. There is a piped distribution loop with about 10 watering points throughout the community that provide service to the washeteria, clinic, and school. The existing water and sewer infrastructure consists of the following:

- Well Water 6 gpm transfer pump
- Treated Water Storage 4,000 gallons (very poor condition)
- Water Treatment Plant 768 SF, built in 1984 (very poor condition)
- Water Treatment Chlorination (water quality is very poor, high in salinity and not consumed by the community, only used for washing/bathing)
- Sewage Lagoon Two cell, 4.2 acres

The soil section underlying the community generally consists of a matrix of large pumice boulders with organics and/or silt. There is peat 1-2 feet below ground surface, and organic silt up to 3-5 feet below ground surface; typically frozen. Groundwater encountered around 10 feet at one test pit.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 11,900 feet of pipe, and the pressure sewer approximately 8,500 feet of pipe. The water system will consist of two circulating loops. The pressure sewer system would require individual grinder pump stations at each house in addition to one sewer main lift station, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 2,500 sf facility is included to house the equipment needed for water treatment and distribution equipment. A new well is also proposed.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	36	6	30
Water Storage (gallons)	235,000	-	235,000
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	2,500	-	2,500
Sewage Lagoon Size (acre)	8.9	4.2	4.7
Required Foundation System for WTP and/or WST			
Pile Foundation (sf)	5,630	-	5,630
Water Distribution System			
Circulating Water Main with Pitorifices (If)	11,900	-	11,900
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	9,000	-	9,000
Individual Grinder Pump Stations (GPS) (ea)	108	-	108
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	8,100	-	8,100
Pressure Sewer Service Lines (If)	8,100	-	8,100

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Chefornak. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

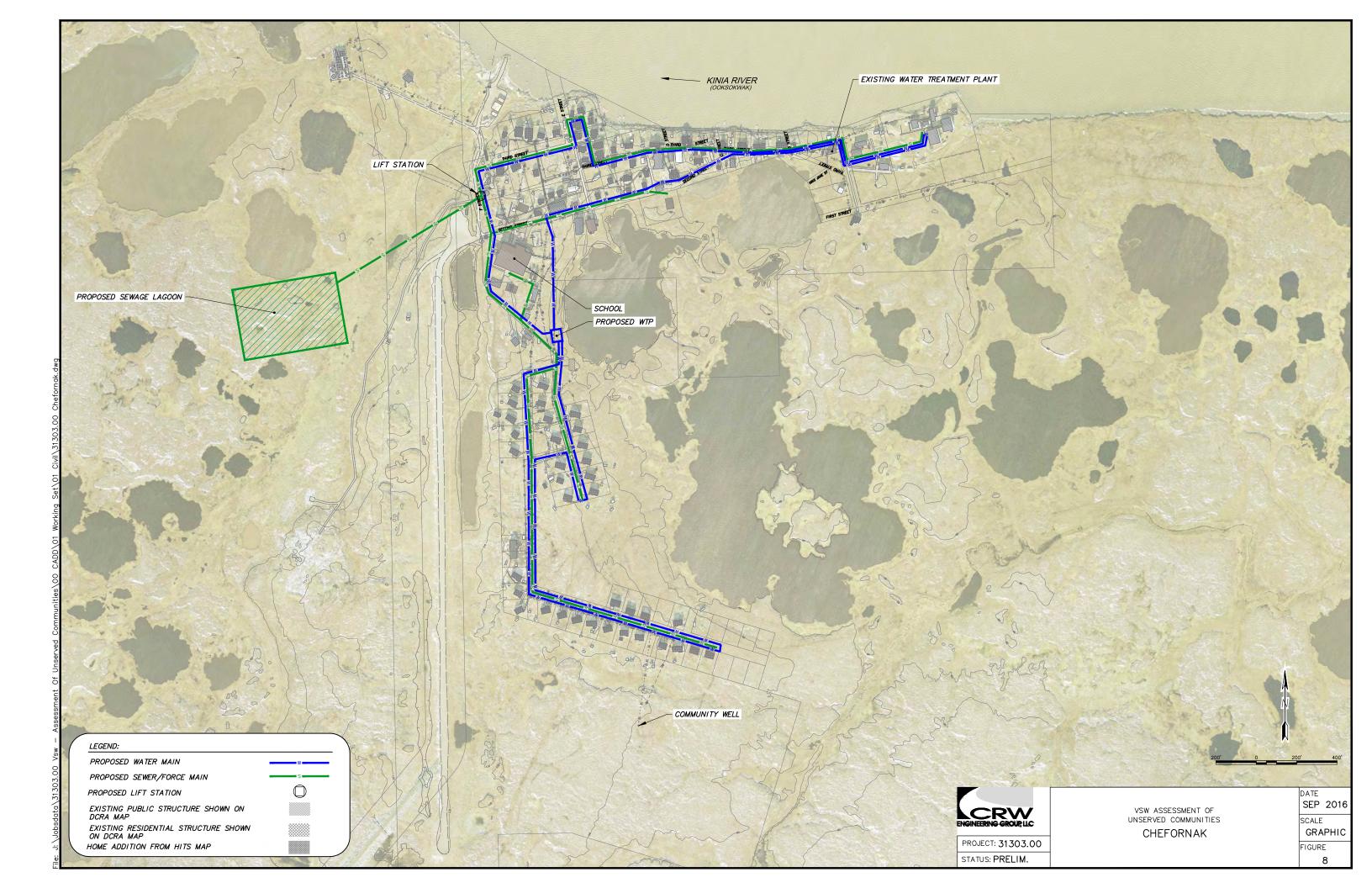
		Village			
	Estimated Capital Costs	Chefornak			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	108	\$26,342.77	\$2,845,020
3	Sewage collection mains or services (gravity or force), above ground	LF	17,100	\$196.77	\$3,364,753
4	Sewage lift station	EA	1	\$662,130.80	\$662,131
10	Sewage lagoon, barrow, local material	Acre	4.7	\$702,902.35	\$3,303,641
12	Water distribution, mains or services, above ground	LF	20,000	\$328.15	\$6,563,015
14	Water storage tank, no foundation	Gal	235,000	\$2.45	\$576,884
15	Water treatment plant, no foundation	SF	2,500	\$1,582.62	\$3,956,543
18	Foundation - freeze back piles	SF	5,360	\$299.71	\$1,606,470
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$23,032,000
	Total v	vith Infl	ation (3% pe	year for 6 years)	\$27,501,400
27	Individual Grinder Pump Stations	EA	108	\$30,000	\$3,240,000
28	Electrical Service Upgrades	EA	108	\$5,500	\$594,000
				Subtotal	\$31,335,400
29	Construction Contingency (15%)	LS	1	\$4,700,300	\$4,700,300
30	Design & Construction Administration Services (20%)	LS	1	\$6,267,100	\$6,267,100
				Total	\$42,302,800

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$25,000			
Fuel	\$90,900			
Electricity	\$30,100			
Other (R&R, Training, etc.)	\$17,700			
Total	\$170,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Chefornak are listed below:

Estimated User Fees								
Revenue Source	Mor	nthly Rate	# of Customers	Collection Rate	Yearly Revenues			
Residential Service	\$	116	83	85%	\$ 98,307			
Public/Commercial Service	\$	122	24	100%	\$ 35,115			
School Service	\$	4,064	1	100%	\$ 36,578			
Local Capital Contribution					\$ -			
Total Revenue					\$ 170,000			



VSW Unserved Commun	ities - Piped W	ater & Sewer System Type and Si	zing Model	
Dat	-	9/7/2016	8	
Communit		Chefornak		
Inpu	ıt			
Evicting Community & System Deta				
Existing Community & System Data 2015 Population		420	1	
2015 Number of Services		108		
HITS Database (E1 & H1-H7)		83		
DCED Mapping Commerical/Public Facilities/School		25		
Type (surface water or groundwater)	GW			
Water quality (Poor or Good)		Poor	High in salinity	
Water Storage Tank		0	Existing tank in poo	r condition
Water Treatment Capacity		6 4.2		
Existing Sewage Lagoon Size Soil Conditions (check only one)		4.2		
Soft poorly drained soils or discontinuous permafrost		x		
Firm soils, or continuous permafrost				
Stiff soils, no permafrost				
Pining Configurations (check all that annly)			Sewer Main Length	Water Main
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost			0000	11000
Above ground system or buried with permafrost Gravity Sewer Main		X	9000	11900
Pressure Sewer Main		x	9000	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Chefornak		
Output for Cost Model (calculated)				
			Foundatio	n Size
Water Treatment Capacity (gpm)		36		_
Req Water Storage (gallons) (less existing)	(-0)	235,000	3,130	
Req W&S Utility Bldg/Water Treatment Plant/Addition Req Sewage Lagoon Size (acre) (less existing)	on (st)	2,500	2,500	sf
Red Sewage Lagoon Size (acre) (less existing)		4.7	Quantity	Notes
			Quantity	· · · · · · · · · · · · · · · · · · ·
		Pile Foundation (sf)		
Required Foundation System for WTP and/or WST			5,630	
.,			5,555	
Water Distribution System		Circulating Water Main with		
		Pitorifices (If)	11,900	
		Pitorifices (If)	11,900	
			11,500	
		Sewer Main with Glycol Heat Trace	9,000	
Wastewater Collection System			·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (lf)	·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations	·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (lf)	9,000	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations	9,000	
		Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations	9,000	
Wastewater Collection System Water & Sewer Service Lines		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	9,000	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	9,000	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	9,000	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	9,000	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	9,000	
·	Piped System Need	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	9,000	
Water & Sewer Service Lines	Piped System Need 36	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	9,000 108 8,100	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	9,000 108 8,100 8,100	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 36 235,000 2,500	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 Net Need 30 235,000 2,500	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 36 235,000	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	9,000 108 8,100 Net Need 30 235,000	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	Need 36 235,000 2,500 8.9	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 Net Need 30 235,000 2,500 4,7	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) Was Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf)	Need 36 235,000 2,500	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 Net Need 30 235,000 2,500	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	Need 36 235,000 2,500 8.9	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 Net Need 30 235,000 2,500 4,7	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System	Need 36 235,000 2,500 8.9 5,630	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 Net Need 30 235,000 2,500 4.7 5,630	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf)	Need 36 235,000 2,500 8.9 5,630 11,900	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 Net Need 30 235,000 2,500 4.7 5,630 11,900	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if) Individual Grinder Pump Stations (GPS) (ea)	Need 36 235,000 2,500 8.9 5,630	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 8,100 Net Need 235,000 2,500 4,7 5,630 11,900	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 36 235,000 2,500 8.9 5,630 11,900 9,000 108	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 Net Need 30 235,000 2,500 4.7 5,630 11,900 9,000 108	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 36 235,000 2,500 8.9 5,630 11,900	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 6	9,000 108 8,100 Net Need 30 235,000 2,500 4.7 5,630 11,900	

	10 00 00		6
VSW Un Date	served Communities - Piped 9/7/2016	Water & Sewer	System Type and Sizing Model
Community	Chefornak		
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P) 2015 Number of Services		people services	2015 ADOL
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	512	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		gpm	
Average Day (ADD) Max Day (MDD)	25,624 51,248		50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	36	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW		
Required Capacity	36	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW) Daily Operation (DO) (gallons)	Applicable 51,248	gallons	Max Day (MDDx1 day)
Fire Flow (FF)	30,000	•	500 gpm for 60 minutes
Reserve Volume (RV)	153,744	-	3 days x DO
Water Storage Tank Volume CT Based Volume (min if source is SW)	234,992 Not Required	gailons	DO + FF + RV
Chlorine Residual Concentration (RC)	0.4	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI) Temperature (T)	1.0 4.4	log inactivation	1.0-log Inactivation 4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*	0.1 181,545		0.1 CT/RCxPeak Hour/BF
Required Water Storage	235,000		CI/NCXFEdk Houl/Br
Required Additional Storage	235,000	gallons	
Estimate of Min Platform Size (3' clearance around)	3,130	sf	$D = 0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
ar ound)			
Water Treatment Plant Requirements*		1	D 111 (07 DF) 1000 (
Water Quality Minimum WTP Size	Poor 2,500	sf .	Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf
	3,000		Existing WTP<800 sf and in poor condition
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		Pile Foundation	
permafrost	х	(sf)	Pile Foundation
Firm soils, or continuous permafrost	0		Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
West Bistillaries (Charlesisters a bash)		-	
Water Distribution (Check either or both) Buried system with no permafrost	0		Static Water Mains
		Circulating	
Above ground system or buried with permafrost	х	Water Main with Pitorifices	Circulating Water Main with Pitorifices
permanost		(If)	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0		Bare sewer main, no heat trace
Above ground or buried with permafrost	x	Sewer Main with Glycol	Insulated sewer main with glycol heat trace
Above ground of buried with permanost	*	Heat Trace (If)	insulated sewer main with grycorneat trace
Gravity Sewer Main	0		Lift stations for gravity sewer mains, every 1,000 ft
		Individual Grinder Pump	
1		oac ap	
Pressure Sewer Main	x	Stations (GPS)	Individual Grinder Pump Stations
Pressure Sewer Main	x	Stations (GPS) (ea)	individual Grinder Pump Stations
	x		individual Grinder Pump Stations
Water & Sewer Services (Check all that apply)			
	x 0	(ea)	Static Water Service Line
Water & Sewer Services (Check all that apply)			
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x	(ea) Circulating	Static Water Service Line Circulating Water Service Lines
Water & Sewer Services (Check all that apply) Static Water Main	0	(ea) Circulating Water Service Lines (If)	Static Water Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x	Circulating Water Service Lines (If) Pressure Sewer	Static Water Service Line Circulating Water Service Lines
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x	(ea) Circulating Water Service Lines (If)	Static Water Service Line Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size	0 x	Circulating Water Service Lines (If) Pressure Sewer	Static Water Service Line Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 x	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Lines
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size	0 x 0 x	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Static Water Service Line Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x 0 x 4.2 4.4 353.6	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Lines 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 x 4.2 4.4 353.6	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Lines 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x 0 x 4.2 4.4 353.6 8.9	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Lines 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,

Capital Cost Estimate Piped Water & Sewer System

Village	
Chefornak	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	108	\$26,342.77	\$2,845,020
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	17,100	\$196.77	\$3,364,753
4	Sewage lift station	EA	1	\$662,130.80	\$662,131
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	4.7	\$702,902.35	\$3,303,641
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	20,000	\$328.15	\$6,563,015
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	235,000	\$2.45	\$576,884
	Water treatment plant, no foundation	SF	2,500	\$1,582.62	\$3,956,543
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	5,360	\$299.71	\$1,606,470
19	Foundation - thermosyphen stabilized gravel pad	SF	0	#DIV/0!	\$0
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$23,032,054

Community:	Chefornak	
General Community Dat	a	
Current population Average number Service Connecti	of people per house	420 persons 5.1
Number of ho Number of pu Number of so	ıblic/commerical buildings rhools	83 24 1
5	Total number of servic	
Burdened labor ra Electricity cost (P Electricity cost (R Cost per gallon fo	rublic facilty) desidential service)	\$12 hr \$0.47 kWh \$0.19 kWh \$6.00 gal
Water consumpti Wastewater gene		50 gpd 50 gpd
Water & Sewer System (Characteristics	
Type of syste Length of raw Water line he	ated for freeze protection (Yes or No)	GW 2560 ft Yes
Location of w Water Treatment	ater line (Above ground (AG) or Buried)	AG
Size of water	treatment plant building uality (Good or Poor)	2500 sf Poor
Water line he	ter line to/ from tank ated for freeze protection (Yes or No) ater line (Above ground (AG) or Buried)	235,000 gallons 50 ft Yes AG
Water Distribution Type of syste Number of cit Total length of Water mains Location of the	<u>1</u> m (Static or Circulating (Circ)) culating water loops	Circ 2 11900 ft Yes AG 75 ft
Wastewater Colle Type of syste Number of ice Number of collect Number of collect Number of collect Number of collect Number of	ection wm (Gravity or Pressure) dividual facility pump stations mmunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4	Pressure 1 108
Size of lif Total length o Sewer mains Number of ci Location of th	of facilities served by lift/pump station #5 t stations of sewer mains heated for freeze protection (Yes or No) roulating glycol loops he mains (Above ground (AG) or Buried) ice line length	500 sf 8000 ft Yes 2 AG 75 ft
Wastewater Trea	tment / Disposal	
Location of fo	ce main eated for freeze protection (Yes or No) orce main (Above ground (AG) or Buried) larged seasonally with pump (Yes or No)	1000 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		•
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500 \$1,500	per year
modrano	Ψ1,000	por your

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	40	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$766	/month		\$6,128.64
Raw water line	\$560	/month		\$4,482.66
Raw water heat addition	\$1,532	/month		\$12,257.28
Water storage tank	\$214	/month		\$1,714.56
Water storage tank line	\$11	/month		\$87.55
Water mains	\$2,605	/month		\$20,837
Service lines	\$1,773	/month		\$14,183
Wastewater system				
Sewer mains		/month		\$14,008
Service lines		/month		\$14,183
Lift/pump station buildings	*	/month		\$1,225.73
Force main to lagoon	\$219	/month	_	\$1,751
			Subtotal	\$90,900
Electricity				
Water system				
WTP building				
Lights and controls	\$343	/month		\$4,115
HVAC/hydronic system	\$343	/month		\$2,743
Water treatment	\$150	/month		\$1,800
Pumps				
Intake or well	\$150	/month		\$1,800.29
WST circulation	\$63	/month		\$508
Pressure/booster	\$225	/month		\$2,700.43
Main line circulation	\$1,010	/month		\$8,076
Wastewater system				
Lift /pump station buildings				
Lights and controls	\$69	/month		\$823
HVAC/hydronic system	\$69	/month		\$549
Pumps				
Individual facility pump stations	\$0	/month		\$0
Community lift/pump station(s)	\$234	/month		\$2,811.05
Sewer/force main glycol circulation	\$252	/month		\$2,015
Lagoon discharge pump	\$2,162	/year	0	\$2,162
011 0 1			Subtotal	\$30,100
Other Costs	0= 000	,		47.000
Equipment R&R	\$7,298	•		\$7,298
Miscellaneous materials & supplies	\$4,379	•		\$4,379
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	/year	0	\$1,500
			Subtotal	\$17,700

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$90,900
Electricity	\$30,100
Other	\$17,700
Total	\$170,000

Revenue I	Monthly	# of		,	early
Source I	Rate	Customers	Collection Rate	Re	venues
Residential Serv	\$ 116	83	85%	\$	98,307
Public/Commerc	\$ 122	24	100%	\$	35,115
School Service (\$ 4,064	1	100%	\$	36,578
Local Capital Con	tribution			\$	-
Total Revenue	-	-	_	\$	170,000

Circle, Alaska

Community Information & Existing Infrastructure

The village of Circle is an Athabascan community of 119 people located at the terminus of the Steese Highway on the west bank of the Yukon River. There are 38 residential units, 14 commercial/public facilities and one school for a total of 53 services. The existing water services provided in Circle consist of self-haul water system from the washeteria building watering point. The existing sewer service consists of individual septic and leach fields for a few commercial facilities such as the the post office, and clinic. The school and the washeteria discharge into the lagoon through a piped sewer line. Residents without wastewater facilities use outhouses/honey buckets. The existing water and sewer infrastructure consists of the following:

- Well Water 10 gpm transfer pump
- Treated Water Storage 3,500 gallons
- Water Treatment Plant/Washeteria –
 1,400 SF, built in 1994
- Water Treatment Addition of chlorine
- School Sewage Lagoon Single Cell, 0.5 acres

The general soil profile in the area consists of 1-4 feet of organic layer overlaying 6-7 feet of silts and clay, which is underlain by gravel beds. There is discontinuous permafrost in the area.

Piped System Description

The piped water and sewer system will be a buried system consisting of approximately 34,200 feet of circulating water mains and approximately 18,800 feet of gravity sewer mains. The water system will consist of two circulating loops. The sewer system will require glycol heat trace for freeze protection, and 10 lift stations throughout the system. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 800 sf facility is included to house the equipment needed for additional treatment and water distribution.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need			
Water Treatment Capacity (gpm)	10	10	-			
Water Storage (gallons)	88,100	3,500	84,600			
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	800	-	800			
Sewage Lagoon Size (acre)	2.5	-	2.5			
Required Foundation System for WTP and/or WST	Required Foundation System for WTP and/or WST					
Thermosyphon Stabilized Gravel Pad (sf)	2,090	-	2,090			
Water Distribution System						
Circulating Water Main with Pitorifices (If)	34,200	-	34,200			
Wastewater Collection System						
Sewer Main with Glycol Heat Trace (If)	18,800	-	18,800			
Lift Stations for Gravity Sewer Mains (ea)	10	-	10			
Water & Sewer Service Lines						
Circulating Water Service Lines (If)	4,000	-	4,000			
Gravity Sewer Service Lines (If)	4,000	-	4,000			

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Circle. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30):

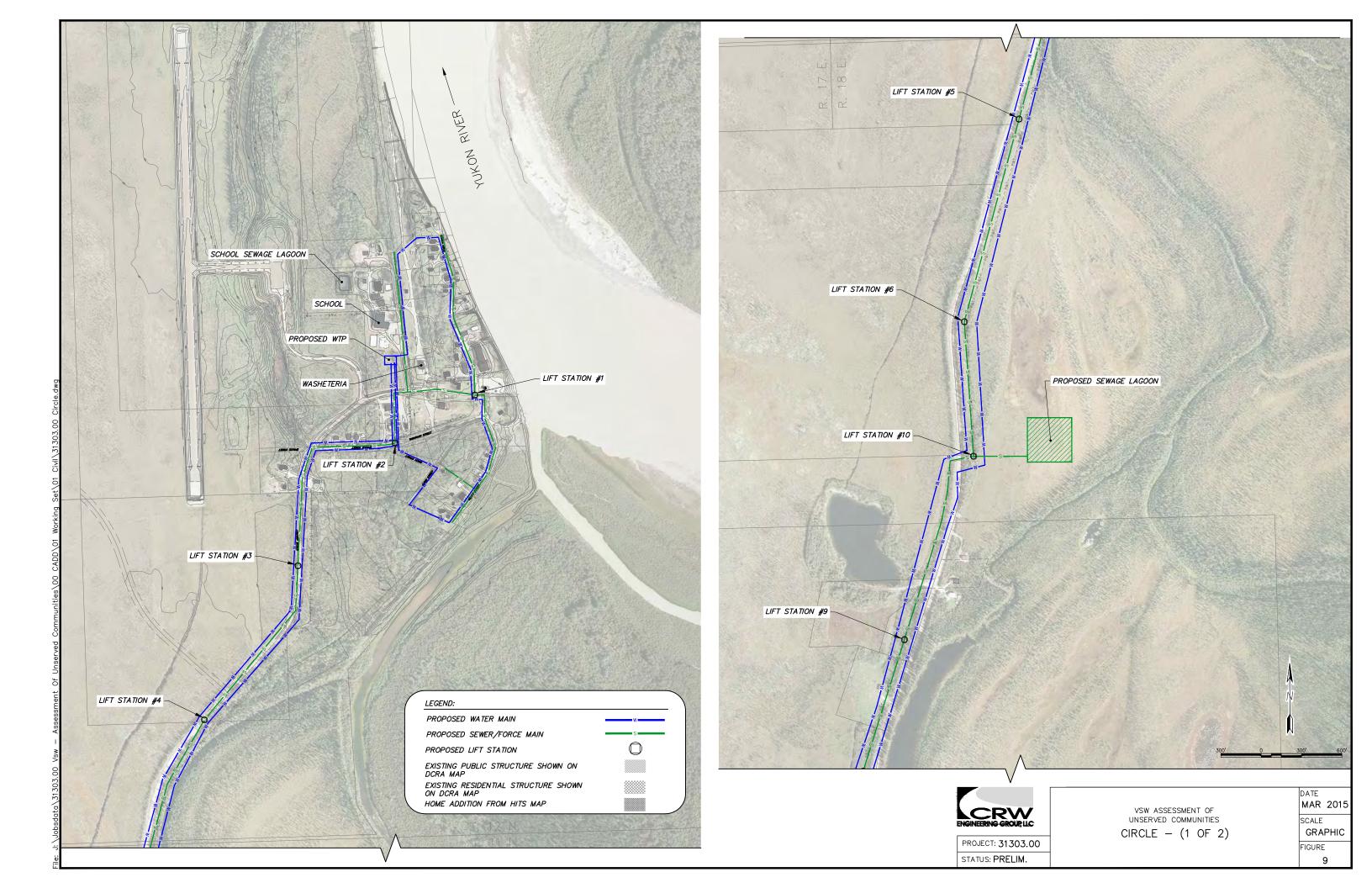
				Village	
	Estimated Capital Costs			Circle	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	53	\$26,191.57	\$1,388,153
2	Sewage collection mains or services (gravity or force), buried	LF	22,800	\$352.90	\$8,046,061
4	Sewage lift station	EA	10	\$430,053.92	\$4,300,539
10	Sewage lagoon, barrow, local material	Acre	2.5	\$672,606.85	\$1,681,517
12	Water distribution, mains or services, above ground	LF	38,200	\$316.71	\$12,098,262
14	Water storage tank, no foundation	Gal	84,600	\$2.38	\$201,540
15	Water treatment plant, no foundation	SF	800	\$1,515.91	\$1,212,732
19	Foundation - thermosyphen stabilized gravel pad	SF	2,090	\$207.24	\$433,136
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$29,362,000
	Total v	vith Infl	ation (3% per	year for 6 years)	\$35,059,800
28	Electrical Service Upgrades	EA	53	\$5,500	\$291,500
				Subtotal	\$35,351,300
29	Construction Contingency (15%)	LS	1	\$5,302,700	\$5,302,700
30	Design & Construction Administration Services (20%)	LS	1	\$7,070,300	\$7,070,300
				Total	\$47,724,300

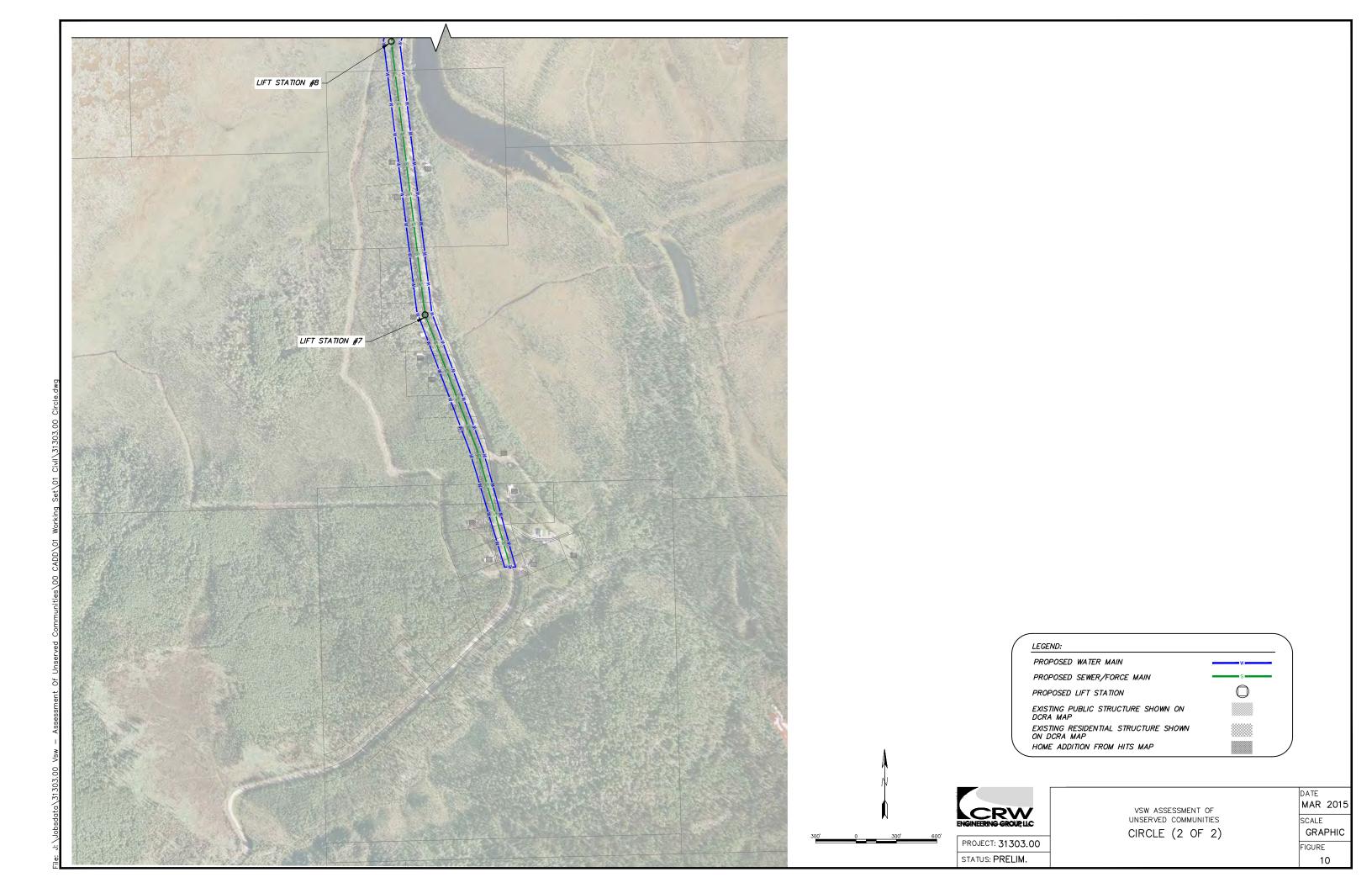
The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs					
Description	Cost				
Administration	\$6,000				
Labor	\$25,000				
Fuel	\$99,700				
Electricity	\$50,800				
Other (R&R, Training, etc.)	\$20,000				
Total	\$202,000				

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Circle are listed below:

Estimated User Fees							
Revenue Source	Мо	nthly Rate	# of Customers	Collection Rate	Yearly Revenues		
Residential Service	\$	272	38	85%	\$ 105,235		
Public/Commercial Service	\$	285	14	100%	\$ 47,894		
School Service	\$	5,430	1	100%	\$ 48,871		
Local Capital Contribution					\$ -		
Total Revenue					\$ 202,000		





VSW Haranied Communi	tios Dinod M	lator & Cower System Type and Si	zing Model	
VSW Unserved Communi	-	ater & Sewer System Type and Si 3/4/2016	zing ividaei	
Community		Circle		
Inpu	t			
E into a constant of control put				
Existing Community & System Data 2015 Population		119	Í	
2015 Number of Services		53		
HITS Database (E1 & H1-H7)		38		
DCED Mapping Commerical/Public Facilities/School		15		
Type (surface water or groundwater) Water quality (Poor or Good)		GW		
Water Storage Tank		Good 3500		
Water Treatment Capacity		10		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)				
Soft poorly drained soils or discontinuous permafrost				
Firm soils, or continuous permafrost		х		
Stiff soils, no permafrost			Sewer Main Length	Water Main
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost			\ .7	J- 1:-7
Above ground system or buried with permafrost		х	18800	34200
Gravity Sewer Main Pressure Sewer Main		X	18400 400	
Typical Service Line Length (ea)			75	75
, Abreat ear tree and acregin (ear)				
Piped System Requirements	Community	Circle		
Output for Cost Model (calculated)	·			
·			Foundatio	n Size
Water Treatment Capacity (gpm)		10		
Req Water Storage (gallons) (less existing)		84,600	1,290	
Req W&S Utility Bldg/Water Treatment Plant/Addition	n (sf)	800	800	sf
Req Sewage Lagoon Size (acre) (less existing)		2.5	Quantitu	Notes
			Quantity	ivotes
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	2,090	
Water Distribution System		Circulating Water Main with Pitorifices (If)	34,200	
		,		
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	18,800	
		Lift Stations for Gravity Sewer Mains (ea)	10	
		(ca)		
Water & Sewer Service Lines		Circulating Water Service Lines (If)	4,000	
WALLE OF DEMANDE THIES		Gravity Sewer Service Lines (If)	4,000	
System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	10	10	0	
Water Storage (gallons)	88,100	3,500	84,600	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	88,100 800		84,600 800	
Water Storage (gallons)	88,100	3,500	84,600	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	88,100 800	3,500	84,600 800	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	88,100 800 2.5 2,090	3,500	84,600 800 2.5 2,090	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	88,100 800 2.5	3,500	84,600 800 2.5	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	88,100 800 2.5 2,090	3,500	84,600 800 2.5 2,090	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	88,100 800 2.5 2,090	3,500	84,600 800 2.5 2,090	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Lift Stations for Gravity Sewer Mains (ea) Water & Sewer Service Lines	88,100 800 2.5 2,090 34,200 18,800 10	3,500 - - - -	84,600 800 2.5 2,090 34,200 18,800	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Lift Stations for Gravity Sewer Mains (ea)	88,100 800 2.5 2,090 34,200	3,500	84,600 800 2.5 2,090 34,200	

VSW Un Date Community	3/4/2016	- Piped	Water & Sewer	System Type and Sizing Model
System Parameters	Model Results	5		Criteria & Calculations
Design Population Duration (n)		20	years	20 years
2015 Population (P)			people	2015 ADOL
2015 Number of Services			services	
Growth Rate (i) 2035 Design Population (Capita)		1% 145	people	1% Px(1+i)^n
Water Demand Estimates				_
Existing Capacity		10	gpm	
Average Day (ADD)		7,260		50 gallons per Capita 2 x ADD
Max Day (MDD) Peak Hour		14,520 30	gpm	3 x MDD
Treatment Capacity		10	gpm	MDD
Water Source Assumptions			1	
Type (surface water or groundwater) Required Capacity		10	gpm	MDD
Water Storage Tank Sizing Existing Water Storage Tank		2 500	gallons	Built in 2010
Demand Based Volume (if source is GW)	Applicable	3,300	galions	Built III 2010
Daily Operation (DO) (gallons)		14,520	-	Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)		30,000 43,561		500 gpm for 60 minutes 3 days x DO
Water Storage Tank Volume		88,081		DO + FF + RV
CT Based Volume (min if source is SW)	Not Required			0.4 mg/l
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	1		mg/L log inactivation	0.4 mg/L 1.0-log Inactivation
Temperature (T)		4.4	c	4.4 celsius/40 F
pH (PH) Contact Time Required (CT)		7	minutes	7 LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)		0.1		0.1
Required Volume to meet CT* Required Water Storage		51,438 88,100		CT/RCxPeak Hour/BF
Required Additional Storage		84,600		0
Estimate of Min Platform Size (3' clearance		1,290	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)				0
Water Treatment Plant Requirements*			Ī	
Water Quality Minimum WTP Size	Good	800	sf	Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP) Soft poorly drained soils or discontinuous				
permafrost	0			Pile Foundation
Firm soils, or continuous permafrost	x		Thermosyphon stabilized	Thermosyphon stabilized gravel pad
·			gravel pad (sf)	
Stiff soils, no permafrost	0			Gravel pad
Water Distribution (Check either or both)				In
Buried system with no permafrost	0		Circulating	Static Water Mains
Above ground system or buried with	x		Water Main	Circulating Water Main with Pitorifices
permafrost			with Pitorifices (If)	
Wastewater Collection (Check all that apply)				
Buried system with no permafrost	0		Sewer Main	Bare sewer main, no heat trace
Above ground or buried with permafrost	x		with Glycol	Insulated sewer main with glycol heat trace
			Heat Trace (If)	
Gravity Sewer Main	x		Lift Stations for Gravity Sewer	Lift stations for gravity sewer mains, every 1,000 ft +/-
7			Mains (ea)	, , , , , , , , , , , , , , , , , , , ,
Pressure Sewer Main	0			Individual Grinder Pump Stations
Water & Sewer Services (Check all that apply)	†			
Static Water Main	0			Static Water Service Line
	· ·		Circulating	
Circulating Water Main	х		Water Service Lines (If)	Circulating Water Service Lines
	х		Gravity Sewer Service Lines (If)	Gravity Service Line
Gravity Sewer Main			octation rules (IJ)	Pressure Service Line with GPS
	n			
Pressure Sewer Main	0			
Pressure Sewer Main Sewage Lagoon Size	0	0	acres	
Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0	1.2	acres acres	0.17 lbs of BODS per capita day x Design Population / 20 lbs BOD5 per
Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0		acres	
Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0	1.2 188.2	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0	1.2 188.2	acres	Volume is based on ADDx365x20% factor to account for precipitation,

Capital Cost Estimate Piped Water & Sewer System

Village	
Circle	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	53	\$26,191.57	\$1,388,153
2	Sewage collection mains or services (gravity or force), buried	LF	22,800	\$352.90	\$8,046,061
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	10	\$430,053.92	\$4,300,539
	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
	Sewage lagoon, barrow, local material	Acre	2.5	\$672,606.85	\$1,681,517
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	38,200	\$316.71	\$12,098,262
	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
	Water storage tank, no foundation	Gal	84,600	\$2.38	\$201,540
	Water treatment plant, no foundation	SF	800	\$1,515.91	\$1,212,732
	Washeteria, no foundation	SF	0	#DIV/0!	\$0
	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	2,090	\$207.24	\$433,136
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$29,361,940

Community:	Circle	
General Community Dat	a	
Current population Average number Service Connecti	of people per house	119 persons 3.1
Number of ho Number of po Number of so	ublic/commerical buildings chools	38 14 1
	Total number of service	ce connections 53
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon fo	Public facilty) Residential service)	\$15 hr \$0.55 kWh \$0.26 kWh \$5.00 gal
Water consumpti Wastewater gene	•	50 gpd 50 gpd
Water & Sewer System (Water Source	Characteristics	
Type of syste Length of rav		GW 870 ft
	eated for freeze protection (Yes or No) rater line (Above ground (AG) or Buried)	No Buried
Water Treatment Size of water	treatment plant building	2200 sf
	uality (Good or Poor)	Good
Water Storage Size of tank(s		88,100 gallons
Length of wa	ter line to/ from tank	50 ft
	rated for freeze protection (Yes or No) rater line (Above ground (AG) or Buried)	Yes AG
Water Distributio		Circ
Number of ci	em (Static or Circulating (Circ)) rculating water loops	Circ 2
	of Water Main	34200 ft
	heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried)	Yes Buried
-	ice line length	75 ft
Wastewater Colle Type of syste	ection em (Gravity or Pressure)	Pressure
Number of in	dividual facility pump stations	
	ommunity lift/pump stations of facilities served by lift/pump station #1	10 21
	of facilities served by lift/pump station #2	32
Number	of facilities served by lift/pump station #3	38
	of facilities served by lift/pump station #4	38
	of facilities served by lift/pump station #5 of facilities served by lift/pump station #6	38 38
	of facilities served by introducing station #7	11
	of facilities served by lift/pump station #8	14
	of facilities served by lift/pump station #9	14
Number of Size of life	of facilities served by lift/pump station #10	53 500 sf
	of sewer mains	18400 ft
Sewer mains	heated for freeze protection (Yes or No)	Yes
	rculating glycol loops	2 Durin d
	ne mains (Above ground (AG) or Buried) rice line length	Buried 75 ft
Wastewater Trea		
Length of for		400 ft
	eated for freeze protection (Yes or No) orce main (Above ground (AG) or Buried)	Yes Buried
	parged seasonally with pump (Yes or No)	Yes

Operation & Maintenance Cost Assumptions

Labor (Operator) Hours per week Less than 50 services 24 hrs/week Between 50 and 100 services 32 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 8 months Heating season (above ground components) 8 months Heating season (buried components) 8 months Heating season (buried components) 12 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/galday Mater storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building	Administration Billing, CCR and management	\$500	/month
Less than 50 services 24 hrs/week Between 50 and 100 services 32 hrs/week More than 100 services 40 hrs/week Fuel (Heating) This/week Available energy per gallon of heating fuel 100,000 BTUs/gallon Heating season (buried components) 8 months Buildings 7 BTU/hr/sf BTU/hr/sf Raw water heat addition (5F) 40 BTU/gal-day Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/yallon Water treatment 0.5 watts/gallon Water system pumps watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kV/h/month/loop Sewer system pumps 107 watts/gallon Individual facility pump stations 0.7 watts/gallon/service Community lift stations 8 kV/h/month/loop Sewer main glycol circulation 268 kV/h/month/loop	Labor (Operator)		
Between 50 and 100 services 32 hrs/week More than 100 services 40 hrs/week Fuel (Heating) Fuel (Heating) Navailable energy per gallon of heating fuel 100,000 BTUs/gallon Heating season (above ground components) 8 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Buried mains (permafrost conditions) 4 watts/hr/sf WTP building V Watts/hr/sf Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/pallon Water treatment 0.5 watts/gallon Good quality water 0.5 watts/gall	Hours per week		
More than 100 services	Less than 50 services	24	hrs/week
Available energy per gallon of heating fuel	Between 50 and 100 services	32	hrs/week
Available energy per gallon of heating fuel Heating season (above ground components) 8 months	More than 100 services	40	hrs/week
Heating season (above ground components)	Fuel (Heating)		
Heating season (above ground components)	Available energy per gallon of heating fuel	100,000	BTUs/gallon
Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building WTP building Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month/loop Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps 0.6 watts/gallon Individual facility pump stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop		8	months
Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Use the stand controls 0.4 watts/hr/sf Lights and controls 0.4 watts/hr/sf watts/pr/sf HVAC/hydronic system 0.4 watts/gallon Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month/loop Sewer system pumps 0.7 watts/gallon Individual facility pump stations 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon	Heating season (buried components)	12	months
Water storage tank0.5BTU/gal-dayAbove ground mains5BTU/hr/ftBuried mains (permafrost conditions)3BTU/hr/ftElectricityWTP buildingLights and controls0.4watts/hr/sfHVAC/hydronic system0.4watts/hr/sfWater treatment0.1watts/gallonGood quality water0.5watts/gallonPoor quality water0.5watts/gallonWater system pumps0.5watts/gallonIntake or well0.5watts/gallonWST circulation135kWh/monthPressure/booster0.75watts/gallonMain line circulation1074kWh/month/loopSewer system pumps0.6watts/gallon/serviceIndividual facility pump stations0.7watts/gallon/serviceCommunity lift stations0.6watts/gallonSewer main glycol circulation268kWh/month/loopForce main0.6watts/gallonLagoon discharge0.6watts/gallonOther Costs5% of labor, fuel and electricityWater quality testing3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,000per year	Buildings	7	BTU/hr/sf
Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Poor quality water Poor quality water Poor quality water System pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training \$2,000 Per year	Raw water heat addition (5F)	40	BTU/gallon
Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Poor quality water Poor quality water Poor quality water System pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training \$2,000 Per year	Water storage tank	0.5	BTU/gal-day
Electricity WTP building 0.4 watts/hr/sf Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Lagoon discharge 0.6 watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Water quality testing 3 % of labor, fuel and electricity		5	BTU/hr/ft
WTP building Lights and controls Lights and controls HVAC/hydronic system Water treatment Good quality water Poor quality water Poor quality water Poor quality water Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Usatts/qallon Watts/gallon Watt	Buried mains (permafrost conditions)	3	BTU/hr/ft
Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps 0.7 watts/gallon/service Individual facility pump stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Lagoon discharge 0.6 watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Water quality testing \$2,000 per year Operator training \$2,500 per year	Electricity		
HVAC/hydronic system Water treatment Good quality water Poor quality water O.5 watts/gallon Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O.1 watts/hr/sf Watts/gallon Watts/gallon Watts/gallon No.6 watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Sewer main glycol circulation O.6 watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Sewer main glycol circulation Sewer main glycol circulation Sewer main glycol circulation Sewer wain Watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Sewer wain Watts/gallon Watts/g	WTP building		
Water treatment Good quality water Poor quality water Poor quality water User system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Ose watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon/service Watts/gallon Watts/gall	G	0.4	watts/hr/sf
Good quality water Poor quality water O.5 watts/gallon Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O.5 watts/gallon Watts/gallon Matts/gallon/service Watts/gallon/service Watts/gallon Watts/gallon Watts/gallon Autts/gallon Watts/gallon	HVAC/hydronic system	0.4	watts/hr/sf
Poor quality water Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Natts/gallon Natts/gallon Natts/gallon/service Watts/gallon Natts/gallon	Water treatment		
Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Eagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water system pumps Individual facility pump stations O.7 watts/gallon/service watts/gallon Watts/gallon Sewer main glycol circulation Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R S % of labor, fuel and electricity Water quality testing Operator training \$2,000 per year Poperator training	Good quality water	0.1	watts/gallon
Intake or well WST circulation Heressure/booster Main line circulation Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Other Costs Sever well AWh/month/loop Watts/gallon Watts/ga	Poor quality water	0.5	watts/gallon
WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps Individual facility pump stations 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Lagoon discharge 0.6 watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Miscellaneous materials & supplies 3 % of labor, fuel and electricity Water quality testing \$2,000 per year Operator training \$2,500 per year	Water system pumps		•
Pressure/booster Main line circulation 1074 kWh/month/loop Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Force main Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training New matts/gallon Watts/gallon Pother Costs Equipment R&R S W of labor, fuel and electricity Water quality testing S2,000 Per year Per year	Intake or well	0.5	watts/gallon
Main line circulation1074kWh/month/loopSewer system pumps0.7watts/gallon/serviceIndividual facility pump stations0.6watts/gallonCommunity lift stations0.6watts/gallonSewer main glycol circulation268kWh/month/loopForce main0.6watts/gallonLagoon discharge0.6watts/gallonOther CostsEquipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year	WST circulation	135	kWh/month
Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Force main Lagoon discharge Other Costs Equipment R&R Figuipment R&R Miscellaneous materials & supplies Water quality testing Operator training On the Sewer main glycol circulation Sewer main glycol circulation 268 kWh/month/loop watts/gallon watts/gallon watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon watts/gallon	Pressure/booster	0.75	watts/gallon
Individual facility pump stations Community lift stations Sewer main glycol circulation Force main Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	Main line circulation	1074	kWh/month/loop
Community lift stations Sewer main glycol circulation Force main Lagoon discharge Other Costs Equipment R&R Biguipment R&R Miscellaneous materials & supplies Water quality testing Operator training Oe watts/gallon watts/gallon watts/gallon watts/gallon Watts/gallon of labor, fuel and electricity \$2,000 per year per year per year	Sewer system pumps		
Sewer main glycol circulation268kWh/month/loopForce main0.6watts/gallonLagoon discharge0.6watts/gallonOther CostsEquipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year	Individual facility pump stations	0.7	watts/gallon/service
Force main Lagoon discharge Other Costs Equipment R&R Biguite Miscellaneous materials & supplies Water quality testing Operator training One watts/gallon Watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon watts/gallon one watts/gallon one watts/gallon one watts/gallon watts/gallon one watts/gallon watts/gallon one watts/gallon watts/gallon watts/gallon	Community lift stations	0.6	watts/gallon
Force main Lagoon discharge Other Costs Equipment R&R Biguite Miscellaneous materials & supplies Water quality testing Operator training One watts/gallon Watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon one watts/gallon watts/gallon one watts/gallon one watts/gallon one watts/gallon watts/gallon one watts/gallon watts/gallon one watts/gallon watts/gallon watts/gallon	Sewer main glycol circulation	268	kWh/month/loop
Other Costs5% of labor, fuel and electricityEquipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year		0.6	watts/gallon
Equipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year	Lagoon discharge	0.6	watts/gallon
Miscellaneous materials & supplies Water quality testing Operator training 3 % of labor, fuel and electricity per year \$2,000 per year per year	Other Costs		
Water quality testing \$2,000 per year Operator training \$2,500 per year	Equipment R&R	5	% of labor, fuel and electricity
Operator training \$2,500 per year	Miscellaneous materials & supplies	3	% of labor, fuel and electricity
	Water quality testing	\$2,000	per year
Insurance \$1,500 per year	Operator training	\$2,500	per year
	Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	32	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$562	/month		\$4,494.34
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$362	/month		\$4,341.12
Water storage tank	\$67	/month		\$535.65
Water storage tank line	\$9	/month		\$72.96
Water mains	\$3,743	/month		\$44,914
Service lines		/month		\$5,220
Wastewater system				
Sewer mains	\$2,014	/month		\$24,164
Service lines	\$435	/month		\$5,220
Lift/pump station buildings	\$1,277	/month		\$10,214.40
Force main to lagoon	\$44	/month	_	\$525
			Subtotal	\$99,700
Electricity				
Water system				
WTP building				
Lights and controls	\$353	/month		\$4,238
HVAC/hydronic system	\$353	/month		\$4,238
Water treatment	\$10	/month		\$119
Pumps				
Intake or well	\$50	/month		\$596.90
WST circulation	\$74	/month		\$594
Pressure/booster	\$75	/month		\$895.36
Main line circulation	\$1,181	/month		\$14,177
Wastewater system				
Lift /pump station buildings				
Lights and controls	\$803	/month		\$9,631
HVAC/hydronic system	\$803	/month		\$6,420
Pumps				
Individual facility pump stations	\$0	/month		\$0
Community lift/pump station(s)	\$467	/month		\$5,598.33
Sewer/force main glycol circulation	\$295	/month		\$3,538
Lagoon discharge pump	\$717	/year	0	\$717
			Subtotal	\$50,800
Other Costs	40	,		40.77
Equipment R&R	\$8,773	,		\$8,773
Miscellaneous materials & supplies	\$5,264	,		\$5,264
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	/year		\$2,500
Insurance	\$1,500	/year	0	\$1,500
			Subtotal	\$20,000

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$99,700
Electricity	\$50,800
Other	\$20,000
Total	\$202,000

Revenue M	onthly	# of		,	Yearly
Source Ra	ate	Customers	Collection Rate	Re	evenues
Residential Serv \$	272	38	85%	\$	105,235
Public/Commerc \$	285	14	100%	\$	47,894
School Service (\$	5,430	1	100%	\$	48,871
Local Capital Contr	ibution			\$	-
Total Revenue				\$	202.000

Crooked Creek, Alaska

Community Information & Existing Infrastructure

The village of Crooked Creek is a mixed Yup'ik Eskimo and Athabascan community of 105 people located on the Kuskokwim River at its junction with Crooked Creek in the Kilbuk-Kuskokwim Mountains. The community is spread out over a distance of approximately 2 miles. There are 43 residential units, 10 commercial/public facilities and one school for a total of 54 services. The existing water and sewer service consists primarily of a haul system from the river, and honeybuckets. There is piped water and sewer to the washeteria, school, and clinic. The existing water and sewer infrastructure consists of the following:

- Well Water 10 gpm transfer pump
- Treated Water Storage 3,800 gallons
- Water Treatment Plant/Washeteria –
 1,200 SF, built in 1998
- Water Treatment Potassium permanganate, polymer, greensand filter, chlorine, and fluoride
- Sewage Lagoon Two Cell, 0.5 acres

The general subsurface condition in the area consists of discontinuous permafrost and wetlands.

Piped System Description

The piped water and pressure sewer system will be a buried system. The water system will consist of approximately 20,200 feet of pipe, and the pressure sewer approximately 14,800 feet of pipe. The water system will consist of two circulating loops. The pressure sewer system would require individual grinder pump stations at each house, glycol heat trace for freeze protection, and 1 lift station throughout the system. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new well and two new 1,200 sf facilities are included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	9	10	-		
Water Storage (gallons)	81,200	3,800	77,400		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	2,400	-	2,400		
Sewage Lagoon Size (acre)	2.2	0.5	1.7		
Required Foundation System for WTP and/or WST					
Thermosyphon stabilized gravel pad (sf)	3,600	-	3,600		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	20,200	-	20,200		
Wastewater Collection System					
Sewer Main with Glycol Heat Trace (lf)	14,800	-	14,800		
Individual Grinder Pump Stations (GPS) (ea)	54	-	54		
Water & Sewer Service Lines					
Circulating Water Service Lines (If)	4,100		4,100		
Pressure Sewer Service Lines (If)	4,100	-	4,100		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Crooked Creek. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30):

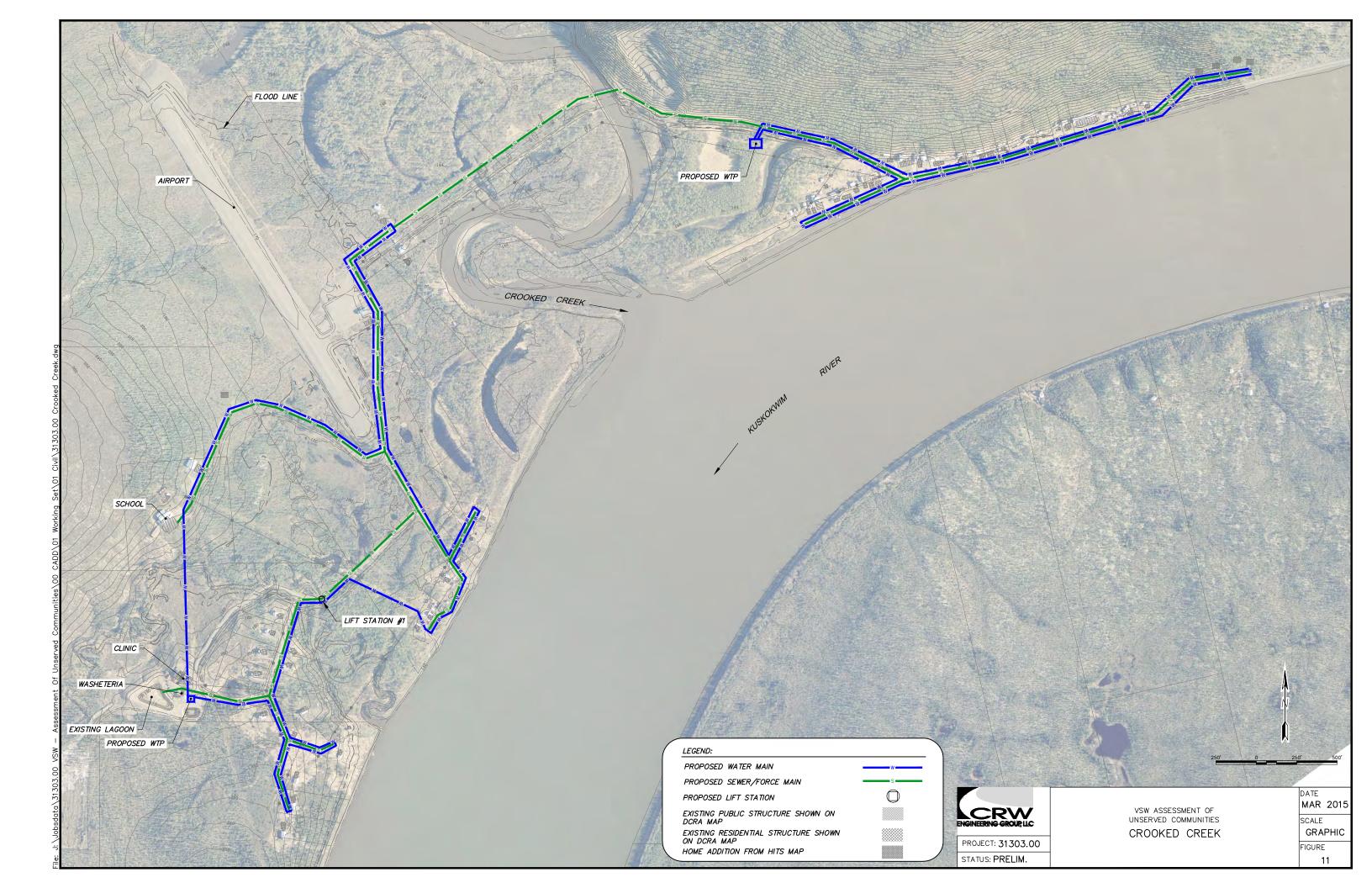
				Village	
	Estimated Capital Costs			Crooked Creek	
	1		T		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	54	\$26,403.25	\$1,425,776
2	Sewage collection mains or services (gravity or force), buried	LF	18,900	\$260.13	\$4,916,364
4	Sewage lift station	EA	1	\$762,792.59	\$762,793
10	Sewage lagoon, barrow, local material	Acre	1.7	\$847,406.81	\$1,440,592
13	Water distribution, mains or services, buried	LF	24,300	\$283.67	\$6,893,232
14	Water storage tank, no foundation	Gal	77,400	\$4.66	\$360,897
15	Water treatment plant, no foundation	SF	2,400	\$1,623.65	\$3,896,751
19	Foundation - thermosyphen stabilized gravel pad	SF	3,600	\$276.71	\$996,146
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Esti	mated (Cost in 2010	dollars (rounded):	\$20,846,000
	Total v	vith Infl	ation (3% pe	r year for 6 years)	\$24,891,200
27	Individual Grinder Pump Stations	EA	54	\$30,000	\$1,620,000
28	Electrical Service Upgrades	EA	54	\$5,500	\$297,000
				Subtotal	\$26,808,200
29	Construction Contingency (15%)	LS	1	\$4,021,200	\$4,021,200
30	Design & Construction Administration Services (20%)	LS	1	\$5,361,600	\$5,361,600
			•	Total	\$36,191,000

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$20,000			
Fuel	\$81,800			
Electricity	\$57,300			
Other (R&R, Training, etc.)	\$18,700			
Total	\$184,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Crooked Creek are listed below:

Estimated User Fees					
Revenue Source	Мо	nthly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	247	43	85%	\$ 108,384
Public/Commercial Service	\$	259	10	100%	\$ 31,136
School Service	\$	4,942	1	100%	\$ 44,480
Local Capital Contribution					\$ -
Total Revenue					\$ 184,000



VSW Unserved Communit	ties - Piped W	ater & Sewer System Type and Si	zing Model	
Date		3/4/2016	-	
Community		Crooked Creek	-	
Input				
5 inti- Committee Control Date				
Existing Community & System Data 2015 Population		105	1	
2015 Population 2015 Number of Services		54		
HITS Database (E1 & H1-H7)		43		
DCED Mapping Commerical/Public Facilities/School		11		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		3800		
Water Treatment Capacity		10		
Existing Sewage Lagoon Size		0.5		
Soil Conditions (check only one) Soft poorly drained soils or discontinuous permafrost			1	
Firm soils, or continuous permafrost		X		
Stiff soils, no permafrost		^		
			Sewer Main Length	Water Main
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost				
Above ground system or buried with permafrost		х	14800	20200
Gravity Sewer Main		,,	0	
Pressure Sewer Main Typical Service Line Length (ea)		X	14800 75	75
Typical Service Line Length (ea)			73	,3
Piped System Requirements	Community	Crooked Creek		
Output for Cost Model (calculated)	Community	Crooked Creek		
Output for cost Model (calculated)			Foundatio	ın Siza
Water Treatment Capacity (gpm)		9	roundatio	iii Size
Req Water Storage (gallons) (less existing)		77,400	1,200	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	2,400	2,400	
Req Sewage Lagoon Size (acre) (less existing)		1.7		
			Quantity	Notes
			,	
1				
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad	3,600	
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	3,600	
Required Foundation System for WTP and/or WST			3,600	
Required Foundation System for WTP and/or WST			3,600	
Required Foundation System for WTP and/or WST Water Distribution System		(sf)	,	
			3,600	
		(sf) Circulating Water Main with	,	
		(sf) Circulating Water Main with Pitorifices (If)	,	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace	,	
		(sf) Circulating Water Main with Pitorifices (If)	20,200	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace	20,200	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations	20,200	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	20,200	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations	20,200	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations	20,200	
Water Distribution System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	20,200 14,800 54	
Water Distribution System Wastewater Collection System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	20,200 14,800 54	
Water Distribution System Wastewater Collection System		(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	20,200 14,800 54	
Water Distribution System Wastewater Collection System		(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	20,200 14,800 54 4,100	
Water Distribution System Wastewater Collection System		(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	20,200 14,800 54 4,100	
Water Distribution System Wastewater Collection System		(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	20,200 14,800 54 4,100	
Water Distribution System Wastewater Collection System	Piped System	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	20,200 14,800 54 4,100	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description	Piped System Need	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (lf) Pressure Sewer Service Lines (lf)	20,200 14,800 54 4,100	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm)	Need 9	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	20,200 14,800 54 4,100 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 9 81,200	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800	20,200 14,800 54 4,100 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	9 81,200 2,400	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800	20,200 14,800 54 4,100 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 9 81,200	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800	20,200 14,800 54 4,100 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	9 81,200 2,400	(sf) Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800	20,200 14,800 54 4,100 Net Need	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	9 81,200 2,400 2.2	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800 - 0.5	20,200 14,800 54 4,100 A,100 Net Need 77,400 2,400 1.7	
Wastewater Collection System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	9 81,200 2,400 2.2	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800 - 0.5	20,200 14,800 54 4,100 A,100 Net Need 77,400 2,400 1.7	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 9 81,200 2,400 2.2 3,600	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800 - 0.5	20,200 14,800 54 4,100 Net Need 77,400 2,400 1.7 3,600 20,200	
Wastewater Collection System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf)	Need 9 81,200 2,400 2.2 3,600 20,200 14,800	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800 - 0.5	20,200 14,800 4,100 Net Need 77,400 2,400 1.7 3,600 20,200	
Wastewater Collection System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 9 81,200 2,400 2.2 3,600	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800 - 0.5	20,200 14,800 54 4,100 Net Need 77,400 2,400 1.7 3,600 20,200	
Water Distribution System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Circulating Water Main with Pitorifices (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 9 81,200 2,400 2.2 3,600 20,200 14,800 54	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800 - 0.5	20,200 14,800 4,100 Net Need 77,400 2,400 1.7 3,600 20,200 14,800 54	
Wastewater Collection System Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 9 81,200 2,400 2.2 3,600 20,200 14,800	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 10 3,800 - 0.5	20,200 14,800 4,100 Net Need 77,400 2,400 1.7 3,600 20,200	

	served Communities	- Piped	Water & Sewer	System Type and Sizing Model
Date	3/4/2016	•	water a sewer	System Type and Sizing Model
Community	1			
System Parameters	Model Results	;		Criteria & Calculations
Design Population Duration (n)		20	years	20 years
2015 Population (P)			people	2015 ADOL
2015 Number of Services			services	
Growth Rate (i) 2035 Design Population (Capita)		1% 128	people	1% Px(1+i)^n
2033 Design Copulation (capita)		120	рсоріс	17(11)
Water Demand Estimates		10	1	
Existing Capacity Average Day (ADD)		6,406	gpm gnd	50 gallons per Capita
Max Day (MDD)		12,812		2 x ADD
Peak Hour			gpm	3 x MDD
Treatment Capacity		9	gpm	MDD
Water Source Assumptions			1	
Type (surface water or groundwater) Required Capacity		GW	gpm	MDD
nequired Capacity		9	gpiii	NUD
Water Storage Tank Sizing			1	
Existing Water Storage Tank Demand Based Volume (if source is GW)	Applicable	3,800	gallons	Built in 2010
Daily Operation (DO) (gallons)	Аррисавіс	12,812	gallons	Max Day (MDDx1 day)
Fire Flow (FF)			gallons	500 gpm for 60 minutes
Reserve Volume (RV) Water Storage Tank Volume		38,436 81,248		3 days x DO DO + FF + RV
CT Based Volume (min if source is SW)	Not Required		5-110113	
Chlorine Residual Concentration (RC)			mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI) Temperature (T)		1.0 4.4	-	1.0-log Inactivation 4.4 celsius/40 F
pH (PH)		7		7
Contact Time Required (CT)			minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*		0.1 45,386		0.1 CT/RCxPeak Hour/BF
Required Water Storage			gallons	
Required Additional Storage		77,400	gallons	0
Estimate of Min Platform Size (3' clearance around)		1,200	sf	$D = 0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
·				0
Water Treatment Plant Requirements* Water Quality	Poor		1	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	POOI	2,400	sf	Good Water Quality (no treatment other than CL) = 800 sf
			-	Need two facilities to accommodate both sides of community
Foundation (WST and WTP) Soft poorly drained soils or discontinuous				
permafrost	0			Pile Foundation
			Thermosyphon	
Firm soils, or continuous permafrost	x		stabilized gravel pad (sf)	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		9	Gravel pad
Water Distribution (Check either or both)				
Buried system with no permafrost	0			Static Water Mains
			Circulating	
Above ground system or buried with permafrost	х		Water Main with Pitorifices	Circulating Water Main with Pitorifices
permanosc			(If)	
Wastewater Collection (Check all that apply)				
Buried system with no permafrost	0			Bare sewer main, no heat trace
L			Sewer Main	
Above ground or buried with permafrost	x		with Glycol Heat Trace (If)	Insulated sewer main with glycol heat trace
Gravity Sewer Main	0		neut mate (ij)	Lift stations for gravity sewer mains, every 1,000 ft
			Individual	
Pressure Sewer Main	x		Grinder Pump Stations (GPS)	Individual Grinder Pump Stations
			(ea)	
Water & Sewer Services (Check all that apply)				
Static Water Main	0			Static Water Service Line
			Circulating	Circulating Water Carries Lines
Circulating Water Main	x		Water Service Lines (If)	Circulating Water Service Lines
Circulating Water Main			.,,	Gravity Service Line
Circulating Water Main Gravity Sewer Main	0			
Gravity Sewer Main			Pressure Sewer	Proceure Service Lines
_	0 x		Pressure Sewer Service Lines (If)	Pressure Service Lines
Gravity Sewer Main Pressure Sewer Main				Pressure Service Lines
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size		0.5	Service Lines (If)	Pressure Service Lines
Gravity Sewer Main Pressure Sewer Main				Pressure Service Lines 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon			Service Lines (If) acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check		1.1 176.8	Service Lines (If) acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size		1.1 176.8	Service Lines (If) acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check		1.1 176.8 2.2	Service Lines (If) acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village Crooked Creek

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	54	\$26,403.25	\$1,425,776
	Sewage collection mains or services (gravity or force), buried	LF	18,900	\$260.13	\$4,916,364
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	1	\$762,792.59	\$762,793
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
	Sewage lagoon, barrow, local material	Acre	1.7	\$847,406.81	\$1,440,592
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	24,300	\$283.67	\$6,893,232
14	Water storage tank, no foundation	Gal	77,400	\$4.66	\$360,897
	Water treatment plant, no foundation	SF	2,400	\$1,623.65	\$3,896,751
	Washeteria, no foundation	SF	0	#DIV/0!	\$0
	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	3,600	\$276.71	\$996,146
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$20,846,148

Community: Cro	oked Creek
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General Cor	mmunity Data	
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General Community Bata		
Current population Average number of people per house Service Connections	105 person 2.4	ıS
Number of houses Number of public/commerical buildings Number of schools Total number of service connections	43 10 1 54	
Burdened labor rate Electricity cost (Public facilty) Electricity cost (Residential service) Cost per gallon for heating oil	\$12 hr \$0.85 kWh \$0.35 kWh \$6.00 gal	
Water consumption per capita Wastewater generation per capita	50 gpd 50 gpd	
Water & Sewer System Characteristics Water Source		
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	GW 200 ft No AG	
Water Treatment Size of water treatment plant building Raw water quality (Good or Poor)	3600 sf Poor	
Water Storage Size of tank(s) Length of water line to/ from tank Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	81,200 gallons 100 ft Yes Buried	}
Water Distribution Type of system (Static or Circulating (Circ)) Number of circulating water loops Total length of Water Main Water mains heated for freeze protection (Yes or No) Location of the mains (Above ground (AG) or Buried) Average service line length	Circ 2 20200 ft Yes Buried 75 ft	
Wastewater Collection Type of system (Gravity or Pressure) Number of individual facility pump stations Number of community lift/pump stations Number of facilities served by lift/pump station #1 Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4 Size of lift stations	Pressure 1 54	
Total length of sewer mains Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried) Average service line length	14600 ft Yes 2 Buried 75 ft	
Wastewater Treatment / Disposal Length of force main Force main heated for freeze protection (Yes or No) Location of force main (Above ground (AG) or Buried) Lagoon discharged seasonally with pump (Yes or No)	200 ft Yes Buried Yes	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		9
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
	. ,	• •

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	32	hrs/week		\$19,968
Fuel (Heating Demand)				
Water system				
WTP building	\$1.103	/month		\$8,825.24
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$383	/month		\$3,064.32
Water storage tank	\$74	/month		\$592.44
Water storage tank line	\$13	/month		\$157.59
Water mains	\$2,653	/month		\$31,834
Service lines	\$532	/month		\$6,383
Wastewater system				
Sewer mains	\$1,917	/month		\$23,009
Service lines	\$532	/month		\$6,383
Lift/pump station buildings		/month		\$1,225.73
Force main to lagoon	\$26	/month		\$315
			Subtotal	\$81,800
Electricity				
Water system				
WTP building				
Lights and controls	*	/month		\$10,716
HVAC/hydronic system	*	/month		\$10,716
Water treatment	\$68	/month		\$814
Pumps				
Intake or well	·	/month		\$813.96
WST circulation	•	/month		\$918
Pressure/booster	* -	/month		\$1,220.94
Main line circulation	\$1,826	/month		\$21,910
Wastewater system				
Lift /pump station buildings	£404	/ma a math		£4.400
Lights and controls		/month /month		\$1,488 \$992
HVAC/hydronic system	\$124	/month		\$992
Pumps	¢Λ	/month		\$0
Individual facility pump stations Community lift/pump station(s)	* -	/month		\$1,226.62
Sewer/force main glycol circulation	•	/month		\$1,220.02
Lagoon discharge pump	•	/month /year		\$5,467 \$977
Lagoon discharge pump	φ977	/усаі	Subtotal	\$57,300
Other Costs				
Equipment R&R	\$7,953	/year		\$7,953
Miscellaneous materials & supplies	\$4,772	•		\$4,772
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	-		\$2,500
Insurance	\$1,500	-		\$1,500
	. ,	•	Subtotal	\$18,700

Summary

Administration	\$6,000
Labor	\$20,000
Fuel	\$81,800
Electricity	\$57,300
Other	\$18,700
Total	\$184,000

Revenue I	Monthly	# of		,	Yearly
Source F	Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 247	43	85%	\$	108,384
Public/Commerc	\$ 259	10	100%	\$	31,136
School Service (\$ 4,942	1	100%	\$	44,480
Local Capital Con	tribution			\$	-
Total Revenue	-	-	_	\$	184,000

Deering, Alaska

Community Information & Existing Infrastructure

The City of Deering is an Inupiaq community of 152 people located on Kotzebue Sound at the mouth of the Inmachuk River. There are 68 residential units and 9 commercial/public facilities and one K-12 school for a total of 78 services. The existing water service provided in Deering consists of self-haul system from the central watering point located at the washeteria. The community operates a vacuum sewer collection system hooked up to the existing homes. Only the washeteria, health clinic, and school are served with piped water service. The existing water and sewer infrastructure consists of the following:

- Inmachuk River 30 gpm (Seasonal)
- Treated Water Storage 21,000 gallons
- Raw Water Storage 425,000 & 440,000 gallons
- Community-wide buried vacuum sewer collection system
- Water Treatment Plant 1,500 SF, built in 1993, Renovated between 1993-2002
- Water Treatment Pressure sand filtration & chlorination
- Sewage Lagoon Single Cell, 1.7 acres

Deering is built on a flat sand and gravel spit approximately 300 feet wide and a half-mile long. The terrain upstream of the community consists of treeless tundra.

Piped System Description

The piped water system will consist of approximately 9,500 feet of buried pipe in two circulating loops. The existing vacuum sewer system is old but reportedly in good condition. Service lines have had minimal issues with failed heat tapes and will not be replaced. As the mains are glycol traced, it is recommended that new vacuum sewer system service lines with glycol heat trace lines are installed. Based on average per capita water consumption of 50 gallons per person per day, the existing water storage capacity would need to be increased to provide sufficient water year round. Approximately 2.8 million gallons of raw water in addition to the treated water would need to be stored during the operation of the seasonal water source to provide water for the piped system when the source is non-producing. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	13	30	-		
Raw Water Storage (gallons)	2,800,000	865,000	1,935,000		
Treated Water Storage (gallons)	104,200	21,000	83,200		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Sewage Lagoon Size (acre)	3.2	1.7	1.5		
Required Foundation System for WTP and/or WST					
Thermosyphon Stabilized Gravel Pad	24,400	-	24,400		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	9,500	=	9,500		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Deering. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30).

				Village	
	Estimated Capital Costs			Deering	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	78	\$22,235.73	\$1,734,387
10	Sewage lagoon, barrow, local material	Acre	1.5	\$787,792.89	\$1,181,689
13	Water distribution, mains or services, buried	LF	9,500	\$269.86	\$2,563,693
14	Water storage tank, no foundation	Gal	2,018,200	\$1.80	\$3,625,138
15	Water treatment plant, no foundation	SF	1,200	\$1,465.72	\$1,758,867
19	Foundation - thermosyphen stabilized gravel pad	SF	24,400	\$159.13	\$3,882,806
	Total Estir	mated (Cost in 2010 o	dollars (rounded):	\$14,747,000
	Total v	vith Infl	ation (3% per	r year for 6 years)	\$17,608,700
28	Electrical Service Upgrades	EA	78	\$5,500	\$429,000
				Subtotal	\$18,037,700
29	Construction Contingency (15%)	LS	1	\$2,705,700	\$2,705,700
30	Design & Construction Administration Services (20%)	LS	1	\$3,607,500	\$3,607,500
				Total	\$24,350,900

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment. The O&M cost for the existing vacuum sewer system was provided by the City of Deering.

Estimated O&M Costs						
Description	Cost	Existing Vacuum Sewer O&M	Water + Vaccum Sewer O&M			
Administration	\$6,000	\$10,000	\$16,000			
Labor	\$33,300	\$0	\$33,300			
Fuel	\$57,800	\$10,000	\$67,800			
Electricity	\$36,600	\$12,000	\$48,600			
Other (R&R, Training, etc.)	\$16,200	\$3,200	\$19,400			
		Total	\$185,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Deering are listed below.

Estimated User Fees						
Revenue Source	Monthly Rate	# of Customers	Collection Rate		Yearly evenues	
Residential Service	\$ 158	68	85%	\$	109,616	
Public/Commercial Service	\$ 237	9	100%	\$	25,602	
School Service	\$ 5,531	1	100%	\$	49,782	
Local Capital Contribution				\$	-	
Total Revenue				\$	185,000	

VSW Unserved Communities - Piped Water & Sewer System Type and Sizing Model					
Date Community Input	·	9/6/2016 Deering	ı		
input					
Existing Community & System Data			-		
2015 Population		152			
2015 Number of Services		78			
HITS Database (E1 & H1-H7) DCED Mapping Commerical/Public Facilities/School		68			
Type (surface water or groundwater)		SW			
Water quality (Poor or Good)		Poor			
Water Storage Tank		886000			
Water Treatment Capacity		30			
Existing Sewage Lagoon Size		1.7			
Soil Conditions (check only one)					
Soft poorly drained soils or discontinuous permafrost					
Firm soils, or continuous permafrost		х			
Stiff soils, no permafrost					
Piping Configurations (check all that apply)			Sewer Main Length (ft)	Water Main Length (ft)	
Buried system with no permafrost				0457	
Above ground system or buried with permafrost Gravity Sewer Main		X		9467	
Pressure Sewer Main					
Typical Service Line Length (ea)			0	0	
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Piped System Requirements	Community	Deering			
Output for Cost Model (calculated)					
			Foundatio	n Size	
Water Treatment Capacity (gpm)		13			
Req Water Storage (gallons) (less existing)		2,018,200	23,200		
Req W&S Utility Bldg/Water Treatment Plant/Addition	(st)	1,200	1,200	st	
Req Sewage Lagoon Size (acre) (less existing)		1.5	Quantity	Notes	
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad	1,200		
		(sf)			
Water Distribution System		Circulating Water Main with Pitorifices (If)	9,500		
Wastewater Collection System					
wastewater conection system					
Water & Sewer Service Lines		Circulating Water Service Lines (If)			
		Vaccum Sewer Service Lines (If)	-		
System Description	Piped System Need	Existing Facility	Net Need	,	
Water Treatment Capacity (gpm)	13	30			
Raw Water Storage (gallons)	2,800,000	865,000	1,935,000		
Treated Water Storage (gallons)	104,200	21,000	83,200		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Source Lagon Size (acre)					
Sewage Lagoon Size (acre)	3.2	1.7	1.5		
Required Foundation System for WTP and/or WST	3.2	1.7			
Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)		1.7	24,400		
Required Foundation System for WTP and/or WST	3.2	-			

VSW Ur	scarued Communities Pinnel	Mater 9 Course	Sustam Tuno and Sizing Model
Date		water & Sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services Growth Rate (i)	78 1%	services	1%
2035 Design Population (Capita)		people	Px(1+i)^n
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Water Demand Estimates	20	1	
Existing Capacity Average Day (ADD)	9,273	gpm	50 gallons per Capita
Max Day (MDD)	18,547		2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	13	gpm	MDD
Water Course Assumentions			
Water Source Assumptions Type (surface water or groundwater)	SW	7	
Required Capacity		gpm	MDD
Water Storage Tank Sizing		1	
Existing Water Storage Tank	Chack Min CT Paguiroments	gallons	
Demand Based Volume (if source is GW) Daily Operation (DO) (gallons)	Check Min CT Requirements 18,547	gallons	Max Day (MDDx1 day)
Fire Flow (FF)	30,000		500 gpm for 60 minutes
Reserve Volume (RV)	55,641	gallons	3 days x DO
Water Storage Tank Volume	104,188	gallons	DO + FF + RV
CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC)	Required	mg/L	0.4 mg/L
Disinfection/Log Inactivation (II)		log inactivation	1.0-log Inactivation
Temperature (T)	4.4	•	4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*	0.1 65.702	gallons	0.1 CT/RCxPeak Hour/BF
Required Water Storage	104,200		CI/NCAF Edit Houl/Bi
Required Additional Storage	2,018,200		0
Estimate of Min Platform Size (3' clearance	23,200	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)		-,	
Water Treatment Plant Requirements*			0
Water Quality	Poor	Ì	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Form debies (MCT and MCTD)			
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		1	
permafrost	0		Pile Foundation
Firm soils, or continuous permafrost	x	Thermosyphon	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
Motor Distribution (Charlestal 1913			
	 		
Water Distribution (Check either or both) Buried system with no permafrost	0		Static Water Mains
Buried system with no permafrost	0	Circulating	Static Water Mains
		Circulating Water Main	
Buried system with no permafrost	0 x	Water Main with Pitorifices	Static Water Mains Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with		Water Main	
Buried system with no permafrost Above ground system or buried with permafrost		Water Main with Pitorifices	
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with permafrost		Water Main with Pitorifices (If)	
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	x 0	Water Main with Pitorifices (lf) Sewer Main	Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	x	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	x 0	Water Main with Pitorifices (lf) Sewer Main	Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 x 0 0 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 0 x 0 0 x 0 0 x 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x 0 0 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 0 x 0 0 x 0 0 x 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Vacuum Sewer Main Sewage Lagoon Size	0 x 0 0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Vacuum Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 0 x 0 x 0 x 1.7	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Vacuum Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Vacuum Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 0 x 0 x 0 x 1.7 1.6	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Vacuum Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 0 x 0 x 0 x 1.7	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Vacuum Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Vacuum Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 0 x 0 x 1.7 1.6 212.7	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Vacuum Service Line 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Vacuum Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x 0 0 x 0 x 1.7 1.6 212.7	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Vacuum Service Line 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Vacuum Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 0 x 0 x 1.7 1.6 212.7	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Vacuum Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Vacuum Service Line 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Deering	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	78	\$22,235.73	\$1,734,387
	Sewage collection mains or services (gravity or vacuum), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	0	#DIV/0!	\$0
	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	1.5	\$787,792.89	\$1,181,689
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	9,500	\$269.86	\$2,563,693
14	Water storage tank, no foundation	Gal	2,018,200	\$1.80	\$3,625,138
15	Water treatment plant, no foundation	SF	1,200	\$1,465.72	\$1,758,867
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	24,400	\$159.13	\$3,882,806
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$14,746,580

Community:	Deering		
General Community Dat	a		
Current population Average number Service Connect	of people per house	152 2.2	persons
Number of ho Number of po Number of so	ublic/commerical buildings chools	68 9 1	
	Total number of servi	ce connections 78	
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon fo	Public facilty) Residential service)	\$20 \$0.70 \$0.45 \$6.00	kWh kWh
Water consumpti Wastewater gene			gpd gpd
Water & Sewer System (Water Source	Characteristics		
Type of syste Length of rav Water line he	em (Surface(SW) or Groundwater(GW)) v water line eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	SW 11275 No AG	ft
	treatment plant building uality (Good or Poor)	2700 Poor	
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) /ater line (Above ground (AG) or Buried)	2,904,200 100 Yes Buried	ft
Water Distributio			
Type of syste Number of ci Total length o Water mains Location of th	em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) rice line length	Circ 2 9500 Yes Buried 75	ft
Wastewater Colle	<u>ection</u>		
Number of in Number of co Number of Number of Number of Number of Size of lif Total length of Sewer mains Number of ci Location of th	em (Gravity or Pressure) dividual facility pump stations ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #4 of facilities served by lift/pump station #5 of stations of sewer mains heated for freeze protection (Yes or No) rculating glycol loops ne mains (Above ground (AG) or Buried) rice line length		Used O&M cos existing vacuur sewer.
Location of fo		750 Yes Buried Yes	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

ed O& M Costs		4- \		4=00	, ,,	_	Annual Cost
Administration (Utility management, bi	ilings, e	tc.)		\$500	/month		\$6,00
Labor (WTP Operator)				32	hrs/week		\$33,2
Fuel (Heating Demand)							
Water system							
WTP building				\$827	/month		\$6,618.9
Raw water line					/month		\$0.0
Raw water heat addition					/month		\$4,435.9
Water storage tank				. ,	/month		\$21,189.0
Water storage tank line				•	/month		\$157.
Water mains					/month		\$14,97
Service lines				\$768	/month		\$9,2
Wastewater system							
Sewer mains				\$0	/month		;
Service lines				\$0	/month		5
Lift/pump station buildings				\$0	/month		\$0.0
Force main to lagoon				\$98	/month	_	\$1,18
						Subtotal	\$57,80
Electricity							
Water system							
WTP building							
Lights and controls				\$552	/month		\$6,6
HVAC/hydronic system				\$552	/month		\$6,6
Water treatment				\$81	/month		\$97
Pumps							
Intake or well				* -	/month		\$970.3
WST circulation				•	/month		\$75
Pressure/booster					/month		\$1,455.5
Main line circulation				\$1,504	/month		\$18,04
Wastewater system							
Lift /pump station buildings							
Lights and controls					/month		(
HVAC/hydronic system				\$0	/month		Ç
Pumps							
Individual facility pump station					/month		
Community lift/pump station				\$0	/month		\$0.0
Sewer/force main glycol circ	ulation			\$0	/month		9
Lagoon discharge pump				\$1,165	/year	_	\$1,16
						Subtotal	\$36,60
Other Costs							
Equipment R&R				\$6,384			\$6,38
Miscellaneous materials & supplies				\$3,830			\$3,83
Water quality testing				\$2,000	•		\$2,00
Operator training				\$2,500			\$2,50
Insurance				\$1,500	/year	<u> </u>	\$1,50
Summon.		Existing				Subtotal	\$16,20
Summary		Vacuum Sewer	Total W+S	7			
	\$6,000	\$10,000	\$16,000				
	33,300	\$0	\$33,300				
	57,800	\$10,000	\$67,800				
	36,600	\$12,000	\$48,600				
·	16,200	\$3,200	\$19,400	I			
Other \$	10,200	ψ5,200	φ19, 4 00				

Revenue	Mor	nthly	# of		,	Yearly
Source	Rate	е	Customers	Collection Rate	Re	evenues
Residential Service	\$	158	68	85%	\$	109,616
Public/Commercial	\$	237.06	9	100%	\$	25,602
School Service (3)	\$	5,531.35	1	100%	\$	49,782
Local Capital Contr	ibutio	n			\$	-
Total Revenue					\$	185,000



Diomede, Alaska

Community Information & Existing Infrastructure

The community of Diomede is an Ingalikmiut Eskimo community of 111 people located on the west coast of Little Diomede Island in the Bering Straits, 135 miles northwest of Nome. There are 41 residential units, 9 commercial/public facilities, one elementary school, and one high school for a total of 52 services. The existing water service provided in Diomede consists of a self-haul system from the water storage tank. Gray water is disposed of onto the ground, and black water is disposed of onto the sea ice or thrown into the ocean. There is a piped utilidor system that provides water services to the washteria/clinic and the school. The existing water and sewer infrastructure consists of the following:

- Seasonal Runoff Stream 5 gpm
- Treated Water Storage 424,000 gallons
- Water Treatment Plant Building –600 SF, built in 1992
- Water Treatment Carbon filter, pH neutralization filter, bag filters, and chlorine (Not potable)
- Sewage Lagoon None

Little Diomede Island is a mass of boulders, covered in light gray granite. There is black, sandy gravel with coarser gravel above bedrock near the shore up to 13-feet thick.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 2,400 feet of pipe, and the sewer system approximately 1,000 feet of gravity and pressure pipe. The water system will consist of a single circulating loop. The sewer system including the force main will require one sewer main lift station and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet water pipe and 100 feet of gravity sewer pipe would be required for each service. Upgrades to the existing seasonal water source will be needed to provide adequate flow for a piped system. A 2012 study indicated that improvements could be made to achieve 50 gpm on a seasonal basis (~60 days per year). Approximately 2 million gallons of raw water would need to be stored during the operation of the seasonal water source to provide water for the piped system when the source is non-producing. The existing 424,000 gallon water storage tank is sufficient for storing treated water and meeting the systems CT requirements. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The sewage treatment system would consist of construction of septic tanks, and a primary outfall. As evaluated in a 2012 Master Plan by CRW Engineering Group, the system would be installed in place of the existing septic tanks that serve the washeteria and clinic. The 2012 study assumed a community water demand of 18 gpcd and sized the facility accordingly. For this assessment, the system has been increased to accommodate a community water use of 50 gpcd.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	9	5	4
New Water Source (gpm)	50	-	50
Raw Water Storage (gallons)	2,000,000	-	2,000,000
Treated Water Storage (gallons)	84,200	424,000	-
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Septic Tank System (gallons)	30,000	-	30,000
Required Foundation System for WTP and/or WST			
Pile Foundation	1,200	-	1,200
Conventional, Local Gravel Material	23,000	-	23,000
Water Distribution System			
Circulating Water Main with Pitorifices (If)	2,400	-	2,400
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	1,000	-	1,000
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	3,900	-	3,900
Gravity Sewer Service Lines (If)	5,200	-	5,200

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Diomede. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 23.1 & 28-30).

				Village	
	Estimated Capital Costs			Little Diomede	
			•		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	52	\$22,235.73	\$1,156,258
3	Sewage collection mains or services (gravity or force), above ground	LF	6,200	\$202.72	\$1,256,855
4	Sewage lift station	EA	1	\$ 722,316.38	\$ 722,316
7	Septic tank, community	EA	2	\$311,494.26	\$622,989
12	Water distribution, mains or services, above ground	LF	6,300	\$302.61	\$1,906,414
14	Water storage tank, no foundation	Gal	2,000,000	\$1.80	\$3,594,426
15	Water treatment plant, no foundation	SF	1,200	\$1,465.72	\$1,758,867
17	Foundation - conventional, local gravel material	SF	23,000	\$183.21	\$4,213,790
18	Foundation - freeze back piles	SF	1,200	\$442.34	\$530,809
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$15,763,000
	Total v	vith Inf	lation (3% pe	r year for 6 years)	\$18,821,800
23.1	Upgrade Seasonal Stream Intake*	EA	1	\$336,000	\$336,000
28	Electrical Service Upgrades	EA	52	\$5,500	\$286,000
				Subtotal	\$19,443,800
29	Construction Contingency (15%)	LS	1	\$2,916,600	\$2,916,600
30	Design & Construction Administration Services (20%)	LS	1	\$3,888,800	\$3,888,800
				Total	\$26,249,200

^{*} From 2012 water and sewer master plan by CRW. Adjusted for inflation.

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs	
Description	Cost
Administration	\$6,000
Labor	\$33,300
Fuel	\$59,300
Electricity	\$18,400
Other (R&R, Training, etc.)	\$14,900
Total	\$132,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Diomede are listed below.

Estimated User Fees					
Revenue Source	M	onthly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	181	41	85%	\$ 75,661
Public/Commercial Service	\$	190	9	100%	\$ 20,516
School Service	\$	1,990	2	100%	\$ 35,822
Local Capital Contribution					\$ -
Total Revenue					\$ 132,000



111				*	
Community Comm		-		zing Model	
Imput					
2015 Number of Services	-		Diomede		
2015 Number of Services					
2015 Number of Services	Existing Community & System Data		444	1	
His Database (E1 & H1-H7)					
DED Mapping Commercial Public Facilities/School 3					
Mater containing	DCED Mapping Commerical/Public Facilities/School				
Water Storage Tank	Type (surface water or groundwater)		SW		
Water Treatment Capacity Sample S	Water quality (Poor or Good)		Poor		
Existing Sewage Lagoon Size Solf poorly drained soils or discontinuous permafrost Firm soils, or continuous permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Fresure Sewer Main Pressure Sewer Main with Provided Carbolistics Pressure Sewer Main with Provided Foundation System for WTP and/or WST Pressure Sewer Main with Glycol Heat Trace United Sewer Main with Glycol Heat Trace United Sewer Main with Glycol Heat Trace United Sewer Main with Glycol Heat Trace United Sewer Main with Glycol Heat Trace United Sewer Main with Glycol Heat Trace United Sewer Main with Glycol Heat Trace United Sewer Main with Glycol Heat Trace United Main Sewer Main with Glycol Heat Trace United Main Sewer Main with Glycol Heat Trace United Main Sewer Main with Glycol Heat Trace United Main Sewer Main with Glycol Heat Trace United Main Sewer Main with Glycol Heat Trace United Main Sewer Main with Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main With Glycol Heat Trace United Main Sewer Main Wi	Water Storage Tank				
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Above ground system or bursed with permafrost x 1000 2374	Piping Configurations (check all that apply)			-	
Piped System Requirements	Buried system with no permafrost				
Pressure Sewer Main	Above ground system or buried with permafrost		х	1000	2374
Typical Service Line Length (ea) Typica	,		v	1000	
Piped System Requirements Output for Cost Model (calculated) Water Teatment Capacity (gpm) Req Water Storage (gallons) (less existing) Req Submits (less existing) Req Submits (less existing) Req Sewage Lagoon Size (acre) (less existing) Water Distribution System for WTP and/or WST Pile Foundation (sf) Water Distribution System Groulating Water Main with Pitorifices (ff) Sewer Main with Glycol Heat Trace (If) Gravity Sewer Service Lines (if) System Description Water & Sewer Service Lines (if) System Description Piped System Circulating Water Service Lines (if) System Description Piped System Existing Facility Net Need Water Treatment Capacity (gpm) 9 5 1 100 Formation System System (gallons) System Description Piped System System Description Piped System Existing Facility Net Need Water Treatment Capacity (gpm) 9 5 1 100 100 100 100 100 100 100			X		75
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Req Sewage Lagoon Size (acre) (less existing) SEPTIC TANKS					
Pile Foundation (sf)		n (st)	,	1,200	st
Pile Foundation (sf)	Req Sewage Lagoon Size (acre) (less existing)		SEPTIC TANKS	Overstitu	Natas
A				Quantity	Notes
Water Distribution System Circulating Water Main with 2,400			Pile Foundation (sf)		
Water Distribution System Circulating Water Main with 2,400	Poquired Foundation System for WTP and for WST			1 200	
Sewer Main with Glycol Heat Trace 1,000	Required Foundation System for WTF and/or WST			1,200	
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Water Distribution System 2,400 - 2,400 Girculating Water Main with Pitorifices (If) 2,400 - 2,400 Wastewater Collection System - 1,000 - 1,000 Sewer Main with Glycol Heat Trace (If) 1,000 - 1,000 Water & Sewer Service Lines - 3,900 - 3,900	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) New Water Source (gpm) Raw Water Storage (gallons) Treated Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	9 50 2,000,000 84,200 1,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 5	1,000 3,900 5,200 Net Need 4 50 2,000,000 1,200	
Circulating Water Main with Pitorifices (If) 2,400 - 2,400 Wastewater Collection System - 1,000 - 1,000 Sewer Main with Glycol Heat Trace (If) 1,000 - 1,000 Water & Sewer Service Lines - 3,900 - 3,900	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) New Water Source (gpm) Raw Water Storage (gallons) Treated Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Septic Tank System (gallons) Required Foundation System for WTP and/or WST Pile Foundation	Need 9 50 2,000,000 84,200 1,200 30,000 1,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 5	1,000 3,900 5,200 Net Need 4 50 2,000,000 - 1,200 30,000 1,200	
Wastewater Collection System 1,000 - 1,000 Sewer Main with Glycol Heat Trace (If) 1,000 - 1,000 Water & Sewer Service Lines - 3,900 - 3,900	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) New Water Source (gpm) Raw Water Storage (gallons) Treated Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Septic Tank System (gallons) Required Foundation System for WTP and/or WST Pile Foundation Conventional, Local Gravel Material	Need 9 50 2,000,000 84,200 1,200 30,000 1,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 5	1,000 3,900 5,200 Net Need 4 50 2,000,000 - 1,200 30,000 1,200	
Sewer Main with Glycol Heat Trace (If) 1,000 - 1,000 Water & Sewer Service Lines - 3,900 - 3,900	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) New Water Source (gpm) Raw Water Storage (gallons) Treated Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Septic Tank System (gallons) Required Foundation Conventional, Local Gravel Material Water Distribution System	9 50 2,000,000 84,200 1,200 30,000 1,200 23,000	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 5	1,000 3,900 5,200 Net Need 4 50 2,000,000 1,200 30,000 1,200 23,000	
Water & Sewer Service Lines Circulating Water Service Lines (If) 3,900 - 3,900	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) New Water Source (gpm) Raw Water Storage (gallons) Treated Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Septic Tank System (gallons) Required Foundation System for WTP and/or WST Pile Foundation Conventional, Local Gravel Material Water Distribution System Circulating Water Main with Pitorifices (lf)	9 50 2,000,000 84,200 1,200 30,000 1,200 23,000	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 5	1,000 3,900 5,200 Net Need 4 50 2,000,000 1,200 30,000 1,200 23,000	
	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) New Water Source (gpm) Raw Water Storage (gallons) Treated Water Storage (gallons) W&S Utility Bildg/Water Treatment Plant/Addition (sf) Septic Tank System (gallons) Required Foundation System for WTP and/or WST Pile Foundation Conventional, Local Gravel Material Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 9 50 2,000,000 1,200 30,000 1,200 23,000 2,400	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 5	1,000 3,900 5,200 Net Need 4 50 2,000,000 1,200 30,000 1,200 23,000 2,400	
Gravity Sewer Service Lines (If) 5,200 - 5,200	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) New Water Source (gpm) Raw Water Storage (gallons) Treated Water Storage (gallons) W&S Utility Bildg/Water Treatment Plant/Addition (sf) Septic Tank System (gallons) Required Foundation System for WTP and/or WST Pile Foundation Conventional, Local Gravel Material Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 9 50 2,000,000 1,200 30,000 1,200 23,000 2,400	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 5	1,000 3,900 5,200 Net Need 4 50 2,000,000 1,200 30,000 1,200 23,000 2,400	
	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) New Water Source (gpm) Raw Water Storage (gallons) Treated Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Septic Tank System (gallons) Required Foundation System for WTP and/or WST Pile Foundation Conventional, Local Gravel Material Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Water & Sewer Service Lines Circulating Water Service Lines (lf)	Need 9 50 2,000,000 84,200 1,200 23,000 23,000 2,400 1,000 3,900	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 5	1,000 3,900 5,200 Net Need 4 50 2,000,000 1,200 30,000 1,200 23,000 2,400 1,000 3,900	

Date			System Type and Sizing Model
	•	water & sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P) 2015 Number of Services		people services	2015 ADOL
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	135	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity	5	gpm	
Average Day (ADD)	6,772		50 gallons per Capita
Max Day (MDD) Peak Hour	13,544	gpa gpm	2 x ADD 3 x MDD
Treatment Capacity		gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	SW	1	
Required Capacity	9	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank	424,000	gallons	
Demand Based Volume (if source is GW)	Check Min CT Requirements		
Daily Operation (DO) (gallons)		gallons	Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)	30,000 40,632		500 gpm for 60 minutes 3 days x DO
Water Storage Tank Volume	84,176		DO + FF + RV
CT Based Volume (min if source is SW)	Required 0.4	ma/l	0.4 mg/l
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)		mg/L log inactivation	0.4 mg/L 1.0-log Inactivation
Temperature (T)	4.4	С	4.4 celsius/40 F
pH (PH) Contact Time Required (CT)	7	minutes	7 LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*		gallons	CT/RCxPeak Hour/BF
Required Water Storage Required Additional Storage	84,200 2,000,000	-	0
Estimate of Min Platform Size (3' clearance		-	
around)	23,000	sf	D = $0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
Water Treatment Plant Requirements*			0
Water Quality	Poor	1	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	x	Pile Foundation	Pile Foundation
permafrost		(sf)	
Firm soils, or continuous permafrost Stiff soils, no permafrost	0		Thermosyphon stabilized gravel pad Gravel pad
	·		
Water Distribution (Check either or both) Buried system with no permafrost			
	0		Static Water Mains
	0	Circulating	Static Water Mains
Above ground system or buried with		Water Main	
	0 x	Water Main with Pitorifices	Static Water Mains Circulating Water Main with Pitorifices
Above ground system or buried with		Water Main	
Above ground system or buried with permafrost		Water Main with Pitorifices	
Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
Above ground system or buried with permafrost		Water Main with Pitorifices	
Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	x	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 v	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line with GPS
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size	O X O X O X O X NOT SUITABLE FOR DIOMEDE.	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line with GPS
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	O X O X O X O X O X O X NOT SUITABLE FOR DIOMEDE.	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) SEPTIC TANKS Afacres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size	O X O X O X O X O X O X NOT SUITABLE FOR DIOMEDE.	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) SEPTIC TANKS AF acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS RE PROPOSED. 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	O X O X O X O X O X O X O O O O O O	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) SEPTIC TANKS AF acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS RE PROPOSED. 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	O X O X O X O X O X O X O O O O O O	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) SEPTIC TANKS AF acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS RE PROPOSED. 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	O X O X O X O X O X O X O O O O O O	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) SEPTIC TANKS AF acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS RE PROPOSED. 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,

Capital Cost Estimate Piped Water & Sewer System

Village
Little Diomede

Item	Line Item	T	Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	52	\$22,235.73	\$1,156,258
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	6,200	\$202.72	\$1,256,855
4	Sewage lift station	EA	1	\$722,316.38	\$722,316
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	2	\$311,494.26	\$622,989
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0	#DIV/0!	\$0
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	6,300	\$302.61	\$1,906,414
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	2,000,000	\$1.80	\$3,594,426
15	Water treatment plant, no foundation	SF	1,200	\$1,465.72	\$1,758,867
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	23,000	\$183.21	\$4,213,790
	Foundation - freeze back piles	SF	1,200	\$442.34	\$530,809
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$15,762,724

Community:	Diomede		
General Community Dat	a		
Service Connecti	of people per house ons	2.7	ersons
Number of ho Number of pu Number of so	iblic/commerical buildings	41 9 2 ce connections 52	
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon fo	Public facilty) Residential service)	\$20 hr \$0.46 k\ \$0.14 k\ \$7.32 ga	Wh Wh
Water consumpti Wastewater gene	•	50 g _j 50 g _j	-
Water & Sewer System (Water Source	Characteristics		
Length of raw Water line he	m (Surface(SW) or Groundwater(GW)) water line ated for freeze protection (Yes or No) ater line (Above ground (AG) or Buried)	SW 1237 ft No AG	
	treatment plant building lality (Good or Poor)	1800 sf Poor	f
Water line he	s) ter line to/ from tank ated for freeze protection (Yes or No) ater line (Above ground (AG) or Buried)	2,424,000 ga 800 ft Yes AG	
Number of cir Total length o Water mains Location of th	n (Static or Circulating (Circ)) roulating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) ice line length	Circ 2 1600 ft Yes AG 75 ft	
Number of in Number of co Number o Number o Number o Number o	ection Im (Gravity or Pressure) dividual facility pump stations mmunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #4 of facilities served by lift/pump station #5	Pressure 1 47	
Sewer mains Number of cir Location of th	t stations of sewer mains heated for freeze protection (Yes or No) culating glycol loops he mains (Above ground (AG) or Buried) ice line length	500 sf 1000 ft Yes 1 AG 100 ft	
Location of fo	·	100 ft Yes AG Yes	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	32	hrs/week		\$33,280
Fuel (Heating Demand)				
Water system				
WTP building	\$673	/month		\$5,383.40
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$494	/month		\$3,952.10
Water storage tank	\$2,697	/month		\$21,576.31
Water storage tank line	\$214	/month		\$1,709.02
Water mains	\$427	/month		\$3,418
Service lines	\$1,041	/month		\$8,331
Wastewater system				
Sewer mains	* -	/month		\$2,136
Service lines		/month		\$11,109
Lift/pump station buildings	·	/month		\$1,495.39
Force main to lagoon	\$27	/month		\$214
			Subtotal	\$59,300
Electricity				
Water system				
WTP building				
Lights and controls	*	/month		\$2,900
HVAC/hydronic system	•	/month		\$1,933
Water treatment	\$39	/month		\$466
Pumps				
Intake or well	·	/month		\$465.67
WST circulation	* -	/month		\$497
Pressure/booster	*	/month		\$698.50
Main line circulation	\$988	/month		\$7,905
Wastewater system				
Lift /pump station buildings	007	, ,		****
Lights and controls	·	/month		\$805
HVAC/hydronic system	\$67	/month		\$537
Pumps	C O	/ 4 l-		00
Individual facility pump stations	* -	/month		\$0 \$640.50
Community lift/pump station(s)	*	/month		\$640.58
Sewer/force main glycol circulation	\$123	/month		\$986
Lagoon discharge pump	\$559	/year	Subtotal	\$559 \$18,400
Other Costs				, -,
Equipment R&R	\$5,549	/year		\$5,549
Miscellaneous materials & supplies	\$3,329	•		\$3,329
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	-		\$2,500
Insurance	\$1,500	•		\$1,500
	Ţ·,200	<i>y</i>	Subtotal	\$14,900

Summary

Administration	\$6,000
Labor	\$33,300
Fuel	\$59,300
Electricity	\$18,400
Other	\$14,900
Total	\$132,000

Revenue I	Monthly	# of		,	early
Source F	Source Rate		Collection Rate	Re	venues
Residential Serv	\$ 181	41	85%	\$	75,661
Public/Commerc	\$ 189.97	9	100%	\$	20,516
School Service (\$ 1,990.13	2	100%	\$	35,822
Local Capital Con	tribution			\$	-
Total Revenue				\$	132,000

Eagle City, Alaska

Community Information & Existing Infrastructure

Eagle City is a traditional Han Kutchin Indian community of 81 people located on the left bank of the Yukon River at the mouth of Mission Creek, on the Taylor Highway. There are 41 residential units, 12 commercial/public facilities, and one school for a total of 54 services. The existing water service provided in Eagle City consists of a self-haul system and septic systems/outhouses for wastewater disposal. The existing water and sewer infrastructure consists of the following:

• Well – 12 gpm

- Water Treatment –Filters, UV disinfection
- Treated Water Storage 87 gallons
- Sewage Lagoon None
- Well house 196 SF, built in 1905

Soil in the area consists of 1-3 inches of organic mat with 2-3 feet of a silt layer underneath. No permafrost encountered but lenses are known to exist in the area.

Piped System Description

The piped water and pressure sewer system will be a buried system. The water system will consist of approximately 16,400 feet of pipe, and the pressure sewer system approximately 14,900 feet of pipe. The water system will consist of two circulating loops. The pressure sewer system will require individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	6	12	-		
Water Storage (gallons)	69,500	87	69,413		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Sewage Lagoon Size (acre)	1.7	-	1.7		
Required Foundation System for WTP and/or WST	Required Foundation System for WTP and/or WST				
Thermosyphon stabilized gravel pad (sf)	2,300	-	2,300		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	16,400	-	16,400		
Wastewater Collection System					
Sewer Main with Glycol Heat Trace (If)	14,900	-	14,900		
Individual Grinder Pump Stations (GPS) (ea)	54	-	54		
Water & Sewer Service Lines					
Circulating Water Service Lines (If)	4,100	-	4,100		
Pressure Sewer Service Lines (If)	4,100	-	4,100		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Eagle City. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

				Village	
	Estimated Capital Costs	Eagle			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	54	\$26,191.57	\$1,414,345
3	Sewage collection mains or services (gravity or force), above ground	LF	19,000	\$183.70	\$3,490,342
10	Sewage lagoon, barrow, local material	Acre	1.7	\$688,671.60	\$1,170,742
12	Water distribution, mains or services, above ground	LF	20,500	\$317.45	\$6,507,780
14	Water storage tank, no foundation	Gal	69,413	\$2.54	\$176,378
15	Water treatment plant, no foundation	SF	1,200	\$1,507.42	\$1,808,905
19	19 Foundation - thermosyphen stablized gravel pad		2,300	\$202.08	\$464,773
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$15,033,000
	Total v	vith Infl	ation (3% pei	year for 6 years)	\$17,950,200
27	Individual Grinder Pump Stations	EA	54	\$30,000	\$1,620,000
28	Electrical Service Upgrades	EA	54	\$5,500	\$297,000
				Subtotal	\$19,867,200
29	Construction Contingency (15%)	LS	1	\$2,980,100	\$2,980,100
30	Design & Construction Administration Services (20%)	LS	1	\$3,973,400	\$3,973,400
				Total	\$26,820,700

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs					
Description	Cost				
Administration	\$6,000				
Labor	\$25,000				
Fuel	\$63,400				
Electricity	\$16,100				
Other (R&R, Training, etc.)	\$14,400				
Total	\$125,000				

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Eagle City are listed below.

Estimated User Fees						
Revenue Source	Moi	nthly Rate	# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	152	41	85%	\$ 63,502	
Public/Commercial Service	\$	190	12	100%	\$ 27,332	
School Service	\$	3,796	1	100%	\$ 34,165	
Local Capital Contribution					\$ -	
Total Revenue					\$ 125,000	



VSW Unserved Communit	ties - Piped W	ater & Sewer System Type and Si	zing Model	
Date		3/21/2016		
Community Input		Eagle City		
input				
Existing Community & System Data				
2015 Population		81		
2015 Number of Services		54		
DCCED Community Housing Info		41		
DCED Mapping Commerical/Public Facilities/School Type (surface water or groundwater)		13 GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		87		
Water Treatment Capacity		12		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)				
Soft poorly drained soils or discontinuous permafrost				
Firm soils, or continuous permafrost		х		
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length	Water Main
Buried system with no permafrost			(ft)	Length (ft)
Above ground system or buried with permafrost		X	14900	16400
Gravity Sewer Main		^	14300	20400
Pressure Sewer Main		х	14900	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Eagle City		
Output for Cost Model (calculated)				
		_	Foundatio	n Size
Water Treatment Capacity (gpm)		7	1.100	-6
Req Water Storage (gallons) (less existing) Req W&S Utility Bldg/Water Treatment Plant/Additio	n (cf)	69,413 1,200	1,100 1,200	
Req Sewage Lagoon Size (acre) (less existing)	11 (51)	1,200	1,200	31
ned sewage tagoon size (acre) (less existing)		1.7	Quantity	Notes
			Quantity	110105
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	1,200	
Water Distribution System		Circulating Water Main with Pitorifices (If)	16,400	,
		Pitornices (II)		•
Wastewater Collection System		Sewer Main with Glycol Heat Trace (lf)	14,900	
		Individual Grinder Dump Stations		
		Individual Grinder Pump Stations (GPS) (ea)	54	
		(5. 5) (50)		
Water & Sewer Service Lines		Circulating Water Service Lines (If)	4,100	
		Pressure Sewer Service Lines (If)	4,100	
				1
	1			
System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	7	12	-	
Water Storage (gallons)	69,500	87	69,413	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200	
Sewage Lagoon Size (acre)	1.7	-	1.7	
Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	2,300	_	2,300	
Water Distribution System	2,300	<u> </u>	2,300	
Circulating Water Main with Pitorifices (If)	16,400	-	16,400	
Wastewater Collection System		-		
Sewer Main with Glycol Heat Trace (If)	14,900	-	14,900	
Individual Grinder Pump Stations (GPS) (ea)	54	-	54	
Water & Sewer Service Lines Circulating Water Service Lines (If)	4 100		4.400	
Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	4,100 4,100	-	4,100 4,100	
	7,100	<u> </u>	4,100	

Messa III.	scorred Communities Disease	Mater O Camer	Sustam Tune and Sizing Madel
VSW Un Date		a water & Sewer	r System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services Growth Rate (i)	1%	services	1%
2035 Design Population (Capita)		people	Px(1+i)^n
,			
Water Demand Estimates	4.5	ā	
Existing Capacity Average Day (ADD)	4,942	gpm	50 gallons per Capita
Max Day (MDD)	9,884		2 x ADD
Peak Hour	21	gpm	3 x MDD
Treatment Capacity	7	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW	1	
Required Capacity	7	gpm	MDD
Water Storage Tank Sizing			
Water Storage Tank Sizing Existing Water Storage Tank	87	gallons	
Demand Based Volume (if source is GW)	Applicable		
Daily Operation (DO) (gallons)		gallons	Max Day (MDDx1 day)
Fire Flow (FF)		gallons	500 gpm for 60 minutes
Reserve Volume (RV) Water Storage Tank Volume		gallons gallons	3 days x DO DO + FF + RV
CT Based Volume (min if source is SW)	Not Required	00.10113	
Chlorine Residual Concentration (RC)	0.4	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T) pH (PH)	4.4		4.4 celsius/40 F 7
Contact Time Required (CT)		minutes	, LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*		gallons	CT/RCxPeak Hour/BF
Required Water Storage		gallons	
Required Additional Storage Estimate of Min Platform Size (3' clearance		gallons	0
around)	1,100	sf	D = $0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
,			0
Water Treatment Plant Requirements*		٦	D W + O I'' (OF DE) 4000 (
Water Quality Minimum WTP Size	Poor 1,200	ef	Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf
17411111111111111111111111111111111111	1,200	<i>.</i> ,	dood water quality (no treatment other than e2) = 000 si
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	0		Pile Foundation
permafrost Firm soils, or continuous permafrost	x	Thermosyphon	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0	c.mosypo	Gravel pad
Water Distribution (Check either or both)	0	1	Static Water Mains
Buried system with no permafrost	U	Circulating	Static Water Mains
Above ground system or buried with		Water Main	Circulating Mater Main with Ditarificas
permafrost	x	with Pitorifices	Circulating Water Main with Pitorifices
		(lf)	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0		Bare sewer main, no heat trace
Above ground or buried with permafrost	x	Sewer Main with Glycol	Sewer main with glycol heat trace
prove ground or buried with permanost	^	With Glycol Heat Trace (If)	Sewer main with grycorneat trace
Gravity Sewer Main	0		Lift stations for gravity sewer mains, every 1,000 ft
		Individual	
Pressure Sewer Main	x	Grinder Pump	Individual Grinder Pump Stations
		Stations (GPS) (ea)	
		_,,,	<u> </u>
Water & Sewer Services (Check all that apply)			
Static Water Main	0		Static Water Service Line
Static Water Ividili	U	Circulating	Static Water Service Line
Circulating Water Main	x	Water Service	Circulating Water Service Lines
		Lines (If)	
Gravity Sewer Main	0		Gravity Service Line
Pressure Sewer Main	x	Pressure Sewer	Pressure Service Line with GPS
		Service Lines (If)	
Samuel and Si			
Sewage Lagoon Size Existing Sewage Lagoon		acres	
Organic Loading Based Size		acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	155.3		
Hudroulis Loading Second Sing			Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size	1.7	' acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)
Ture cell legger granting description			
Two cell lagoon, combined acreage	1.7	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village					
Eagle Village					

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	54	\$26,191.57	\$1,414,345
	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	19,000	\$183.70	\$3,490,342
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	1.7	\$688,671.60	\$1,170,742
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	20,500	\$317.45	\$6,507,780
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	69,413	\$2.54	\$176,378
15	Water treatment plant, no foundation	SF	1,200	\$1,507.42	\$1,808,905
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	2,300	\$202.08	\$464,773
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$15,033,265

Community:	Eagle City	
General Community Dat	a	
Current population	on	81 persons
Service Connect		2.0
Number of he Number of pe Number of se	ublic/commerical buildings	41 12 1
	Total number of service	
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon f	Public facilty) Residential service)	\$15 hr \$0.48 kWh \$0.24 kWh \$5.00 gal
Water consumpt Wastewater gen	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source		9
Type of syste	em (Surface(SW) or Groundwater(GW))	GW
Length of rav Water line he	w water line eated for freeze protection (Yes or No)	100 ft No
	water line (Above ground (AG) or Buried)	AG
	<u>t</u> treatment plant building uality (Good or Poor)	1396 sf Good
Water Storage		
Size of tank(s) ter line to/ from tank	69,500 gallons 100 ft
•	eated for freeze protection (Yes or No)	No
Location of v	vater line (Above ground (AG) or Buried)	AG
Water Distribution		Circ
• • • • •	em (Static or Circulating (Circ)) rculating water loops	Circ 2
Total length	of Water Main	16400 ft
	heated for freeze protection (Yes or No) he mains (Above ground (AG) or Buried)	Yes AG
	vice line length	75 ft
Wastewater Coll	<u>ection</u>	
Type of syste	em (Gravity or Pressure)	Pressure
	dividual facility pump stations ommunity lift/pump stations	
	of facilities served by lift/pump station #1	
	of facilities served by lift/pump station #2 of facilities served by lift/pump station #3	
	of facilities served by lift/pump station #4	
	of facilities served by lift/pump station #5	
	ft stations of sewer mains	500 sf 14900 ft
	s heated for freeze protection (Yes or No)	Yes
	rculating glycol loops ne mains (Above ground (AG) or Buried)	2
	rice line length	AG 75 ft
	atment / Disposal	
Length of for Force main h	ce main neated for freeze protection (Yes or No)	444 ft Yes
Location of fo	orce main (Above ground (AG) or Buried)	AG
Lagoon disch	narged seasonally with pump (Yes or No)	Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		9
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
	. ,	• •

Administration (Utility management, billings, etc.) Labor (WTP Operator) Suer system Water system WTP building Raw water line Raw water heat addition Water storage tank Water storage tank line Water mains Service lines Sewer mains Sevice lines Lift/pump station buildings \$500 /month \$32 hrs/week \$32 hrs/week ### Month ### Aux water ### Aux water ### Aux	Annual Cost
Fuel (Heating Demand) Water system \$356 /month WTP building \$356 /month Raw water line \$0 /month Raw water heat addition \$246 /month Water storage tank \$53 /month Water storage tank line \$0 /month Water mains \$2,991 /month Service lines \$739 /month Wastewater system \$2,718 /month Service lines \$739 /month	\$6,000
Water system \$356 /month WTP building \$356 /month Raw water line \$0 /month Raw water heat addition \$246 /month Water storage tank \$53 /month Water storage tank line \$0 /month Water mains \$2,991 /month Service lines \$739 /month Wastewater system \$2,718 /month Sevice lines \$739 /month	\$24,960
WTP building \$356 /month Raw water line \$0 /month Raw water heat addition \$246 /month Water storage tank \$53 /month Water storage tank line \$0 /month Water mains \$2,991 /month Service lines \$739 /month Wastewater system Sewer mains \$2,718 /month Service lines \$739 /month	
WTP building \$356 /month Raw water line \$0 /month Raw water heat addition \$246 /month Water storage tank \$53 /month Water storage tank line \$0 /month Water mains \$2,991 /month Service lines \$739 /month Wastewater system Sewer mains \$2,718 /month Service lines \$739 /month	
Raw water heat addition \$246 /month Water storage tank \$53 /month Water storage tank line \$0 /month Water mains \$2,991 /month Service lines \$739 /month Wastewater system \$2,718 /month Sewer mains \$2,718 /month Service lines \$739 /month	\$2,851.86
Water storage tank \$53 /month Water storage tank line \$0 /month Water mains \$2,991 /month Service lines \$739 /month Wastewater system \$2,718 /month Sewer mains \$2,718 /month Service lines \$739 /month	\$0.00
Water storage tank line \$0 /month Water mains \$2,991 /month Service lines \$739 /month Wastewater system \$2,718 /month Sewer mains \$2,718 /month Service lines \$739 /month	\$1,969.92
Water mains \$2,991 /month Service lines \$739 /month Wastewater system \$2,718 /month Sewer mains \$2,718 /month Service lines \$739 /month	\$422.56
Service lines \$739 /month Wastewater system Sewer mains \$2,718 /month Service lines \$739 /month	\$0.00
Wastewater system Sewer mains \$2,718 /month Service lines \$739 /month	\$23,931
Sewer mains \$2,718 /month Service lines \$739 /month	\$5,910
Service lines \$739 /month	
·	\$21,742
Lift/pump station buildings \$0 /month	\$5,910
	\$0.00
Force main to lagoon \$81 /month	\$648
Subtotal	\$63,400
Electricity	
Water system	
WTP building	
Lights and controls \$196 /month	\$2,347
HVAC/hydronic system \$196 /month	\$1,564
Water treatment \$6 /month	\$71
Pumps	
Intake or well \$30 /month	\$354.59
WST circulation \$65 /month	\$518
Pressure/booster \$44 /month	\$531.88
Main line circulation \$1,031 /month	\$8,248
Wastewater system	
Lift /pump station buildings	•
Lights and controls \$0 /month	\$0
HVAC/hydronic system \$0 /month	\$0
Pumps	•
Individual facility pump stations \$0 /month	\$0
Community lift/pump station(s) \$0 /month	\$0.00
Sewer/force main glycol circulation \$257 /month	\$2,058
Lagoon discharge pump \$426 /year Subtotal	\$426 \$16,100
Other Costs	Ţ · -, · • •
Equipment R&R \$5,223 /year	\$5,223
Miscellaneous materials & supplies \$3,134 /year	\$3,134
Water quality testing \$2,000 /year	\$2,000
Operator training \$2,500 /year	\$2,500
Insurance \$1,500 /year	\$1,500
Subtotal	\$14,400

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$63,400
Electricity	\$16,100
Other	\$14,400
Total	\$125,000

Revenue M	onthly	# of		,	Yearly
Source R	ate	Customers	Collection Rate	Re	venues
Residential Serv \$	152	41	85%	\$	63,502
Public/Commerc \$	189.81	12	100%	\$	27,332
School Service (\$	3,796.16	1	100%	\$	34,165
Local Capital Contr	ibution			\$	-
Total Revenue				\$	125,000

Kipnuk, Alaska

Community Information & Existing Infrastructure

The Community of Kipnuk is a Yupik community of 643 people located on the west bank of Kugkaklik River in the Yukon-Kuskokwim Delta. There are 157 residential units, 31 commercial/public facilities and one school for a total of 189 services. The existing water and sewer services provided in Kipnuk consist of self-haul from the central watering point attached to the water treatment plant and honey buckets. Raw water is pumped from the reservoir to the WTP through a 4-inch arctic pipe. The raw water reservoir is replenished by a combination of surface water runoff, rain, and snow. The fish plant, clinic, and triplex housing have cowater haul systems installed. The school and the water treatment plant have piped water and sewer. The existing water and sewer infrastructure consists of the following:

- Raw Water Reservoir 17.5 million gallons
- WTP Treatment Capacity 40 gpm
- Two Water Storage Tanks 212,000 gallons & 100,000 gallons
- Water Treatment Plant/Washeteria 8,000 SF, built in 2012
- Water Treatment Calcium chlorite, potassium permanganate, soda ash
- Sewage Lagoon Four Cell, 7.14 acres

Soils around Kipnuk were observed to be marginally frozen soil and unfrozen soil; inorganic silt observed to be medium stiff and silty fine sand/fine sand observed to be medium dense.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 20,900 feet of pipe, and the pressure sewer system approximately 16,300 feet of pipe. The water system will consist of two circulating loops. The pressure sewer system would require one sewer main lift station, individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment. The existing water storage tank is sufficient to meet CT requirements (278,000 gallons) and provide a small reserve for fire flows.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	54	40	14
Water Storage (gallons)	343,800	312,000	31,800
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	13.7	7.1	6.6
Required Foundation System for WTP and/or WST			
Pile Foundation	1,760	-	1,760
Water Distribution System			
Circulating Water Main with Pitorifices (If)	20,900	-	20,900
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	16,300	-	16,300
Individual Grinder Pump Stations (GPS) (ea)	189	-	189
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	14,200	-	14,200
Pressure Sewer Service Lines (If)	14,200	-	14,200

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Kipnuk. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

				Village	
	Estimated Capital Costs			Kipnuk	
		•			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	189	\$26,342.77	\$4,978,784
3	Sewage collection mains or services (gravity or force), above ground	LF	30,500	\$194.04	\$5,918,082
4	Sewage lift station	EA	1	\$ 662,130.80	\$ 662,131
10	Sewage lagoon, barrow, local material	Acre	7	\$689,113.57	\$4,548,150
12	Water distribution, mains or services, above ground	LF	35,100	\$326.34	\$11,454,672
14	Water storage tank, no foundation	Gal	43,800	\$5.41	\$236,919
15	Water treatment plant, no foundation	SF	1,200	\$1,608.15	\$1,929,775
18	Foundation - freeze back piles	SF	1,760	\$374.51	\$659,140
22	Water source - surface water intake	EA	1	\$444,987.75	\$444,988
Total Estimated Cost in 2010 dollars (rounded): \$30,833,					\$30,833,000
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$36,816,200
27	Individual Grinder Pump Stations	EA	189	\$30,000	\$5,670,000
28	Electrical Service Upgrades	EA	189	\$5,500	\$1,039,500
				Subtotal	\$43,525,700
29	Construction Contingency (15%)	LS	1	\$6,528,900	\$6,528,900
30	Design & Construction Administration Services (20%)	LS	1	\$8,705,100	\$8,705,100
				Total	\$58,759,700

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs						
Description	Cost					
Administration	\$6,000					
Labor	\$27,000					
Fuel	\$143,900					
Electricity	\$45,000					
Other (R&R, Training, etc.)	\$23,300					
Total	\$245,000					

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Kipnuk are listed below.

Estimated User Fees					
Revenue Source	Monthly Rate		# of Custom ers	Collection Rate	Yearly Revenues
Residential Service	\$	94	157	85%	\$ 150,358
Public/Commercial Service	\$	141	31	100%	\$ 52,391
School Service	\$	4,695	1	100%	\$ 42,251
Local Capital Contribution					\$ -
Total Revenue					\$ 245,000

VSW Uncorred Communic	tion Dipod W	ater & Sewer System Type and Si	ring Model	
VSW Unserved Communi	-		zing wiodei	
Community		3/21/2016 Kipnuk		
Input		Пртик		
Existing Community & System Data		642		
2015 Population 2015 Number of Services		643 189		
HITS Database (E1 & H1-H7)		157		
DCED Mapping Commerical/Public Facilities/School		32		
Type (surface water or groundwater)		SW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		312000		
Water Treatment Capacity		40		
Existing Sewage Lagoon Size		7.14		
Soil Conditions (check only one) Soft poorly drained soils or discontinuous permafrost		Х		
Firm soils, or continuous permafrost		^		
Stiff soils, no permafrost				
			Sewer Main Length	Water Main
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost				
Above ground system or buried with permafrost		Х	16300	20900
Gravity Sewer Main Pressure Sewer Main		X	16300	
Typical Service Line Length (ea)		^	75	75
,,				
Piped System Requirements	Community	Kipnuk		
Output for Cost Model (calculated)		·		
			Foundatio	n Size
Water Treatment Capacity (gpm)		54		
Req Water Storage (gallons) (less existing)		31,800	590	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		6.6		
			Quantity	Notes
		Pile Foundation (sf)		
Required Foundation System for WTP and/or WST			1,200	
Water Distribution System				
water distribution system		Circulating Water Main with		
			20,900	
		Pitorifices (If)	20,900	
		Pitorifices (If)	20,900	
		Pitorifices (If) Sewer Main with Glycol Heat Trace	· ·	
Wastewater Collection System			16,300	
Wastewater Collection System		Sewer Main with Glycol Heat Trace	· ·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	16,300	
Wastewater Collection System		Sewer Main with Glycol Heat Trace	· ·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	16,300	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	16,300 189	
· 		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	16,300	
· 		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	16,300 189	
· 		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	16,300 189 14,200	
· 		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	16,300 189	
· 		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	16,300 189 14,200	
Wastewater Collection System Water & Sewer Service Lines	Dinad Custom	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	16,300 189 14,200	
	Piped System Need	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	16,300 189 14,200	
Water & Sewer Service Lines		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	16,300 189 14,200	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 54 343,800	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	16,300 189 14,200 14,200 Net Need	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 54 343,800 1,200	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000	16,300 189 14,200 Net Need 14 31,800 1,200	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 54 343,800	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	16,300 189 14,200 14,200 Net Need	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 54 343,800 1,200	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000	16,300 189 14,200 Net Need 14 31,800 1,200	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	Need 54 343,800 1,200 13.7	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000	16,300 189 14,200 Net Need 14 31,800 1,200 6.6	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf)	Need 54 343,800 1,200 13.7	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000	16,300 189 14,200 Net Need 14 31,800 1,200 6.6	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 54 343,800 1,200 13.7 1,790 20,900	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000 - 7.1	16,300 189 14,200 Net Need 14 31,800 1,200 6.6 1,790 20,900	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if)	Need 54 343,800 1,200 13.7 1,790 20,900 16,300	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000 - 7.1	16,300 189 14,200 14,200 Net Need 14 31,800 1,200 6.6 1,790 20,900 16,300	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 54 343,800 1,200 13.7 1,790 20,900	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000 - 7.1	16,300 189 14,200 Net Need 14 31,800 1,200 6.6 1,790 20,900	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if)	Need 54 343,800 1,200 13.7 1,790 20,900 16,300	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000 - 7.1	16,300 189 14,200 14,200 Net Need 14 31,800 1,200 6.6 1,790 20,900 16,300	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 54 343,800 1,200 13.7 1,790 20,900 16,300 189	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 312,000 - 7.1	16,300 189 14,200 Net Need 14 31,800 1,200 6.6 1,790 20,900 16,300 189	

	served Communities - Piner	Water & Sewer	System Type and Sizing Model
Date	•	Water & Jewer	System Type and Sizing Model
Community	1		
System Parameters	Model Results		Criteria & Calculations
Design Population Duration (n)	20		20 years
2015 Population (P)		years people	20 years 2015 ADOL
2015 Number of Services		services	
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	785	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		gpm	"
Average Day (ADD) Max Day (MDD)	39,229 78,458		50 gallons per Capita 2 x ADD
Peak Hour	·	gpm	3 x MDD
Treatment Capacity		gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	SW	1	
Required Capacity		gpm	MDD
Water Starger Took Siring			
Water Storage Tank Sizing Existing Water Storage Tank	312,000	gallons	
Demand Based Volume (if source is GW)	Check Min CT Requirements	10	
Daily Operation (DO) (gallons)		gallons	Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)	30,000 235,375	gallons	500 gpm for 60 minutes 3 days x DO
Water Storage Tank Volume	343,833	-	DO + FF + RV
CT Based Volume (min if source is SW)	Required		
Chlorine Residual Concentration (RC)		mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI) Temperature (T)	1.0	log inactivation C	1.0-log Inactivation 4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*	0.1 277,937		0.1 CT/RCxPeak Hour/BF
Required Water Storage	343,800		CI/NCAPEAN HOUI/DF
Required Additional Storage		gallons	0
Estimate of Min Platform Size (3' clearance	590	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			0
Water Treatment Plant Requirements*		_	
Water Quality	Poor	1	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)		_	
Soft poorly drained soils or discontinuous	x	Pile Foundation	Pile Foundation
permafrost Firm soils, or continuous permafrost		(sf)	= 1 112 1 1
	0		I nermosynnon stanilized gravel nad
Stiff soils, no permafrost	0		Thermosyphon stabilized gravel pad Gravel pad
Stiff soils, no permafrost		-	- · · · · · · · · · · · · · · · · · · ·
Stiff soils, no permafrost Water Distribution (Check either or both)	0	1	Gravel pad
Stiff soils, no permafrost		Circulating	- · · · · · · · · · · · · · · · · · · ·
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0	Water Main	Gravel pad Static Water Mains
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost	0	Water Main with Pitorifices	Gravel pad
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0	Water Main	Gravel pad Static Water Mains
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0	Water Main with Pitorifices	Gravel pad Static Water Mains
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	0 0 x	Water Main with Pitorifices	Gravel pad Static Water Mains Circulating Water Main with Pitorifices
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0	Water Main with Pitorifices	Gravel pad Static Water Mains
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	0 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Gravel pad Static Water Mains Circulating Water Main with Pitorifices
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x x 0 x	Water Main with Pitorifices (lf) Sewer Main	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x x 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x x 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x x 0 x x 0 x x 0 x x 0 x x x 0 x x x 0 x x x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 x x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x x 0 x x 0 x x 0 x x 0 x x x 0 x x x 0 x x x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x x 0 x x 0 x x 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 0 x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main	0 x x 0 x x 0 x x 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 0 x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x x 0 x x 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
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Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x x 0 x x 0 x x 0 x x 0 x x 0 0 x x 0 0 x x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x x 0 x x 0 x x 0 x x 0 x x 0 0 x x 0 0 x x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x x 0 x x 0 x x 0 x x 13.7	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Kipnuk	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	189	\$26,342.77	\$4,978,784
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	30,500	\$194.04	\$5,918,082
4	Sewage lift station	EA	1	\$662,130.80	\$662,131
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	6.6	\$689,113.57	\$4,548,150
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	35,100	\$326.34	\$11,454,672
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	43,800	\$5.41	\$236,919
15	Water treatment plant, no foundation	SF	1,200	\$1,608.15	\$1,929,775
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	1,760	\$374.51	\$659,140
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	1	\$444,987.75	\$444,988
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$30,832,641

Community:	Kipnuk	
General Community Dat	a	
Current population Average number Service Connect	of people per house	643 persons 4.1
Number of he Number of po Number of so	ublic/commerical buildings chools	157 31 1
B	Total number of servi	
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon f	Public facilty) Residential service)	\$13 hr \$0.40 kWh \$0.20 kWh \$5.40 gal
Water consumpt Wastewater gen	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source	Characteristics	
Length of ray Water line he	em (Surface(SW) or Groundwater(GW)) v water line eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	SW 2400 ft No AG
	t treatment plant building uality (Good or Poor)	9200 sf Poor
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	344,000 gallons 50 ft No AG
Water Distribution		
Number of ci Total length Water mains Location of tl	em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No) he mains (Above ground (AG) or Buried) vice line length	Circ 2 20900 ft Yes AG 75 ft
Wastewater Coll		
Number of in Number of co Number Number	em (Gravity or Pressure) Idividual facility pump stations Dommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3	Pressure 1 130
Number Number Size of lit	of facilities served by lift/pump station #4 of facilities served by lift/pump station #5 it stations of sewer mains	500 sf 13100 ft
Sewer mains Number of ci Location of ti	heated for freeze protection (Yes or No) rculating glycol loops ne mains (Above ground (AG) or Buried) vice line length	Yes 2 AG 75 ft
	atment / Disposal	3200 ft
Location of fo	neated for freeze protection (Yes or No) broce main (Above ground (AG) or Buried) brarged seasonally with pump (Yes or No)	Yes AG Yes

Operation & Maintenance Cost Assumptions

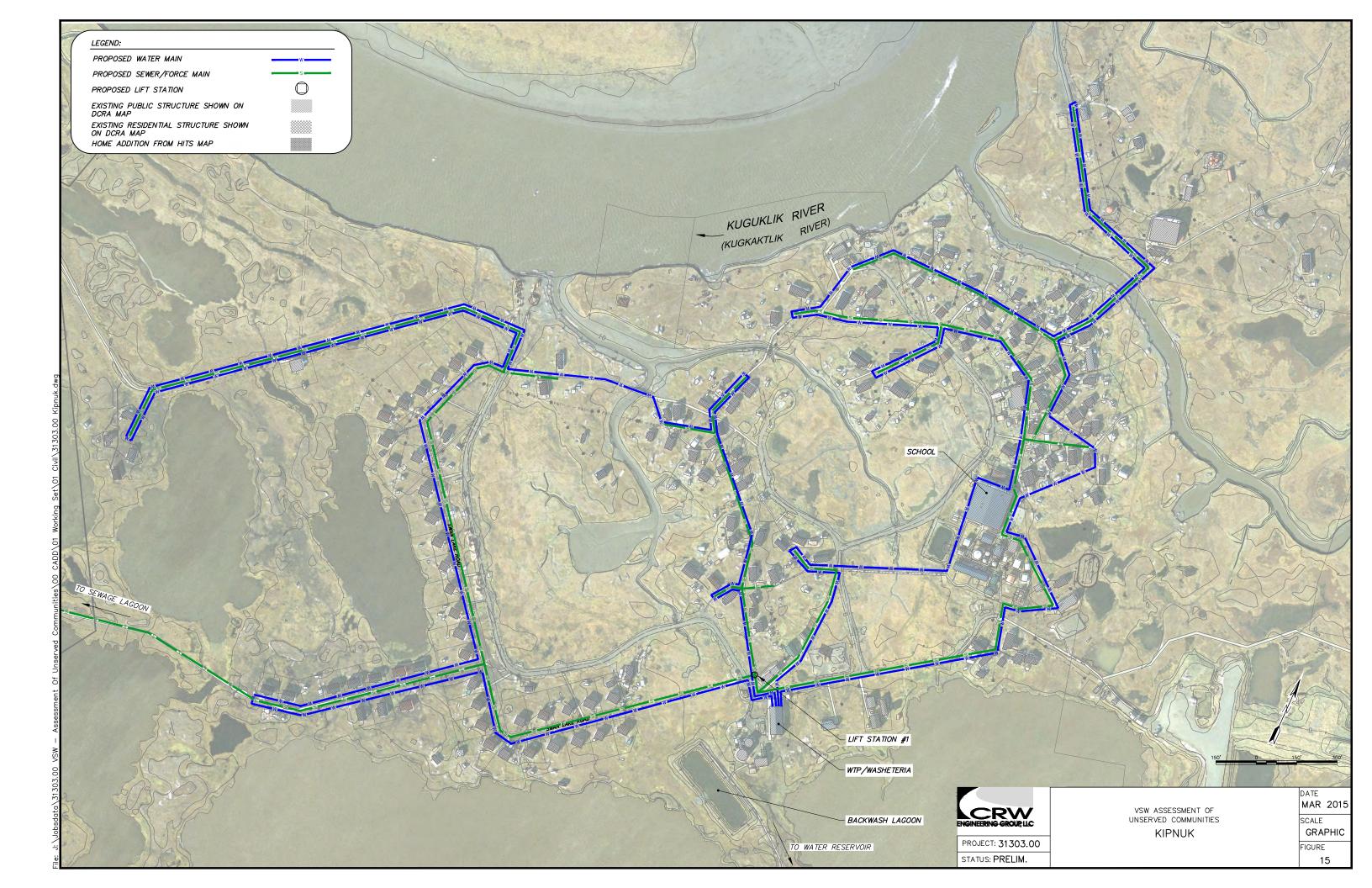
Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment	• • • • • • • • • • • • • • • • • • • •	nation in or
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500 \$2.500	per year
Insurance	\$1,500	per year
modiano	Ψ1,000	po. 30th

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	40	hrs/week		\$27,040
Fuel (Heating Demand)				
Water system				
WTP building	\$2,537	/month		\$20,298.06
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$2,111	/month		\$16,888.78
Water storage tank	\$282	/month		\$2,258.84
Water storage tank line	* -	/month		\$0.00
Water mains		/month		\$32,937
Service lines	\$2,792	/month		\$22,339
Wastewater system				
Sewer mains		/month		\$20,645
Service lines		/month		\$22,339
Lift/pump station buildings	*	/month		\$1,103.16
Force main to lagoon	\$630	/month	<u> </u>	\$5,043
			Subtotal	\$143,900
Electricity				
Water system				
WTP building				
Lights and controls	\$1,074	/month		\$12,888
HVAC/hydronic system	\$1,074	/month		\$8,592
Water treatment	\$195	/month		\$2,346
Pumps				
Intake or well	\$195	/month		\$2,345.66
WST circulation	\$54	/month		\$432
Pressure/booster	\$293	/month		\$3,518.50
Main line circulation	\$859	/month		\$6,874
Wastewater system				
Lift /pump station buildings				
Lights and controls	*	/month		\$700
HVAC/hydronic system	\$58	/month		\$467
Pumps	••	,		•
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	·	/month		\$2,330.72
Sewer/force main glycol circulation	·	/month		\$1,715
Lagoon discharge pump	\$2,816	/year	Subtotal	\$2,816 \$45,000
Other Costs				ψ.0,000
Equipment R&R	\$10,797	Mear		\$10,797
Equipment R&R Miscellaneous materials & supplies	\$6,478	,		\$10,797 \$6,478
Water quality testing	\$2,000	-		\$0,476 \$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$2,500 \$1,500	•		\$2,500 \$1,500
modiano	ψ1,300	, your	Subtotal	\$23,300
			Subtotal	Ψ20,000

Summary

Administration	\$6,000
Labor	\$27,000
Fuel	\$143,900
Electricity	\$45,000
Other	\$23,300
Total	\$245,000

Revenue M	Monthly	# of		,	Yearly
Source F	Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 94	157	85%	\$	150,358
Public/Commerc :	\$ 140.84	31	100%	\$	52,391
School Service (\$ 4,694.57	1	100%	\$	42,251
Local Capital Con	tribution			\$	-
Total Revenue	-	-	_	\$	245,000



Kongiganak, Alaska

Community Information & Existing Infrastructure

The Community of Kongiganak is a Yupik community of 501 people located on the west shore of Kuskokwim Bay, west of the mouth of the Kuskokwim River. There are 89 residential units, 31 commercial/public facilities and one school for a total of 121 services. The existing water and sewer services provided in Kongiganak consist of self-haul system from the central watering point attached to the water treatment plant and honey buckets. The washeteria and water treatment plant have piped water and sewer services, but the school only has a piped sewer service. The existing water and sewer infrastructure consists of the following:

- Contractor's Lake 50 gpm transfer pump (Seasonal)
- Treated Water Storage 10,000 gallons
- Raw Water Storage 1.2 MG & 500,000 gallons
- Water Treatment Plant/Multi-Purpose Building – 2,400 SF, built in 2002 (20 gpm)
- Water Treatment Bag filters, flocculation tanks, chlorine, and soda ash
- Sewage Lagoon Single Cell, 5.3 acres

The community is underlain by deep permafrost that has started to degrade at the surface.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 17,900 feet of pipe, and the pressure sewer system approximately 11,000 feet of pipe. The water system will consist of four circulating loops. The pressure sewer system would require one sewer main lift station, individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. Upgrades to the existing seasonal water source will be needed to provide adequate flow for a piped system. Approximately 7 million gallons of raw water would need to be stored during the operation of the seasonal water source to provide water for the piped system when the source is non-producing. In order to fill and store 7 million gallons of raw water, the existing transfer pump would need to be increased to transfer a minimum of 60 gpm. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	42	20	22
Raw Water Storage (gallons)	7,000,000	1,700,000	5,300,000
Water Storage (gallons)	274,500	10,000	264,500
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	10.7	5.3	5.4
Required Foundation System for WTP and/or WST			
Pile Foundation (sf)	1,200	-	1,200
Thermosyphon stabilized gravel pad (sf)	61,990	-	61,990
Water Distribution System			
Circulating Water Main with Pitorifices (If)	17,900	-	17,900
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	11,000	-	11,000
Individual Grinder Pump Stations (GPS) (ea)	121	-	121
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	9,100	-	9,100
Pressure Sewer Service Lines (If)	9,100	-	9,100

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Kongiganak. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

		Village			
	Estimated Capital Costs	Kongiganak			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	121	\$26,342.77	\$3,187,476
3	Sewage collection mains or services (gravity or force), above ground	LF	20,100	\$195.84	\$3,936,394
4	Sewage lift station	EA	1	\$ 662,130.80	\$ 662,131
10	Sewage lagoon, barrow, local material	Acre	5	\$696,693.37	\$3,762,144
12	Water distribution, mains or services, above ground	LF	27,000	\$327.06	\$8,830,671
14	Water storage tank, no foundation	Gal	5,565,000	\$1.81	\$10,053,951
15	Water treatment plant, no foundation	SF	1,200	\$1,608.15	\$1,929,775
18	Foundation - freeze back piles	SF	1,200	\$426.48	\$511,777
19	Foundation - thermosyphen stablized gravel pad	SF	61,990	\$160.34	\$9,939,782
22	Water source - surface water intake	EA	1	\$444,987.75	\$444,988
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$43,259,000
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$51,653,500
27	Individual Grinder Pump Stations	EA	121	\$30,000	\$3,630,000
28	Electrical Service Upgrades	EA	121	\$5,500	\$665,500
				Subtotal	\$55,949,000
29	Construction Contingency (15%)	LS	1	\$8,392,400	\$8,392,400
30	Design & Construction Administration Services (20%)	LS	1	\$11,189,800	\$11,189,800
				Total	\$75,531,200

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$22,900			
Fuel	\$145,600			
Electricity	\$28,800			
Other (R&R, Training, etc.)	\$21,800			
Total	\$225,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Kongiganak are listed below.

Estimated User Fees					
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	134	89	85%	\$ 121,798
Public/Commercial Service	\$	148	31	100%	\$ 54,902
School Service	\$	5,367	1	100%	\$ 48,301
Local Capital Contribution					\$ -
Total Revenue					\$ 225,000

2015 Supulation 2015 Number of Services 1212	VSW Unserved Communit	ties - Piped W	ater & Sewer System Type and Si	zing Model	
Input			3/21/2016		
Sisting Community & System Data 2015 Population 2015 Populat			Kongiganak	İ	
2015 Sumber of Services				ı	
131	Existing Community & System Data		F24	i	
Note Processing Processin	·				
Type Courties water or groundwater) SW	HITS Database (E1 & H1-H7)				
Note Poor	DCED Mapping Commerical/Public Facilities/School				
Mater Treatment Capacity 20	Type (surface water or groundwater)				
Water Treatment Capacity 20					
Sever Main Length	5				
Soli Conditions (check only one) Solif Conditions (price to any on					
Soft poorly drained soils or discontinuous permafrost			5.5		
Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main	Soft poorly drained soils or discontinuous permafrost		х		
Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Suried system with no permafrost	Firm soils, or continuous permafrost		x		
Circulating Water Main with Glycol Heat Trace Circulating Water Main with Glycol Heat Trace Circulating Water Main with Glycol Heat Trace Circulating Water Service Lines (If) 9,100 Water & Sewer Service Lines Water & Sewer Service Lines 11,000 Water Treatment Capacity (germ) 42 12,000 Required Foundation System Circulating Water Main with Glycol Heat Trace Circulating Water Service Lines (If) 9,100 Water Feature Capacity (germ) 1,000 Water Distribution System for WTP and/or WST 1,000 Water Sewer Service Lines (If) 9,100 Water Sewer Service Lines (If) 9,100 Water Sewer Service Lines (If) 1,200 Tressure Sewer Service Lines (If) 9,100 Water Treatment Capacity (germ) 1,000 Water Sewer Service Lines (If) 9,100 Water Sewer Service Lines (If) 9,100 Water Sewer Service Lines (If) 1,200 Tressure Sewer Service Lines (If) 9,100 Water Service Lines (If) 1,200 Tressure Sewer Service Lines (If) 9,100 Water Groundation System (Pripad System Need Circulating Water Service Lines (If) 9,100 Water Sewer Service Lines (If) 9,100 Water Groundation System (Pripad System Need Circulating Water Service Lines (If) 9,100 Water Sewer Service Lines (If) 9,100 Water Groundation System (Pripad System Need Circulating Water Service Lines (If) 9,100 Water Groundation System (Pripad System Need Circulating Water Service Lines (If) 9,100 Water Groundation System (Pripad System Need Circulating Water Service Lines (If) 9,100 Water Groundation System (Pripad System Need Circulating Water Freatment Pant/Addition (If) 1,200 Water Groundation System (Pripad Circulating Water Water Main with Pripad Water (If) 1,200 Water Water Main with Pripadrice (If) 1,200 Thermospyphon stabilized gravel pad (If) 1,200 Thermospyphon stabilized gravel pad (If) 1,200 Thermospyphon stabilized gravel pad (If) 1,200 Thermospyphon stabilized gravel pad (If) 1,200 Thermospyphon stabilized gravel pad (If) 1,200 Thermospyphon stabil	Stiff soils, no permafrost				
Above ground system or buried with permafrost x	Piping Configurations (check all that apply)				
Piped System Requirements	Buried system with no permafrost			11000	17000
Pressure Sewer Main	· .		X	11000	17900
Piped System Requirements Output for Cost Model (calculated) Water Treatment Capacity (gpm) Req Water Storage (gallons) (less existing) Req Water Storage (gallons) (less existing) Req Water Storage (gallons) (less existing) Req Water Storage (gallons) (less existing) Req Water Storage (gallons) (less existing) Req Submits (less existing) Req Submits (less existing) Req Sewage Lagoon Size (acre) (less existing) Required Foundation System for WTP and/or WST Pile Foundation (sf) Thermosyphon stabilized gravel pad (sf) Required Foundation System Groulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines Groulating Water Service Lines (lf) Pressure Sewer Service Lines (lf) 9,100 Water Treatment Capacity (gpm) Req System Req System Description Piped System Red System Pescription Piped System Red System Facility Ret Red System (line) System Description Piped System Red System Facility Ret Red System Facility Ret Red Red System (line) Net Red Red Red Red Red Red Red Red Red Red	Pressure Sewer Main		Х	11000	
Section Size	Typical Service Line Length (ea)	-		75	75
Section Size					
Section Size	Piped System Requirements	Community	Kongiganak		
Water Treatment Capacity (gpm) 42 5,65,000 61,990 sf	Output for Cost Model (calculated)				
Req Water Storage (gallons) (less existing)				Foundatio	n Size
Req W&S Utility Bldg/Water Treatment Plant/Addition (sf) 1,200 5.4					_
Req Sewage Lagoon Size (acre) (less existing) S.A		n (cf)			
Pile Foundation (sf) 1,200		11 (51)	·	1,200	31
Pile Foundation (sf) 1,200	ned acting a size (nere) (ress existing)		5.4	Quantity	Notes
Thermosyphon stabilized gravel pad (sf) Sewer Main with 17,900			Bile Foundation (cf)	·	
Sewer Main with Glycol Heat Trace (If) 17,900				1,200	
Circulating Water Main with 17,900	Required Foundation System for WTP and/or WST			61,990	
Sewer Main with Glycol Heat Trace 11,000			(3.7)		
Sewer Main with Glycol Heat Trace 11,000					
Sewer Main with Glycol Heat Trace 11,000					
Prioritices (if)	Water Distribution System			17.900	
(if)			Pitorifices (If)	17,500	
(if)					
Individual Grinder Pump Stations GPS) (ea) 121			-	11.000	
Circulating Water Service Lines (Iff) 9,100	Wastewater Collection System		(If)		
Circulating Water Service Lines (Iff) 9,100					
Circulating Water Service Lines (If) 9,100				121	
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Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Service Lines (If) Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size Check Hydraulic Loading Based Size 10.7 acres Static Water Service Line Circulating Water Service Line Circulating Water Service Line Circulating Water Service Line Circulating Water Service Lines Circulating Water Service Lines Circulating Water Service Lines Circulating Water Service Lines Circulating Water Service Line Circulating Water Service Line Circulating Water Service Line Circulating Water Service Lines Circulating Circulating Water Service Circulating Water Service Circulating Circulating Circulating Water Service Circulating Circulating Circulating Circulating Circulating Water Service Circulating Circula	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		Individual	, , , , , , , , , , , , , , , , , , , ,
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Circulating Water Main The sure Sewer Main The sure Service Line The sure Service Line with GPS The sure Service Line with	Pressure Sewer Main	x	-	Individual Grinder Pump Stations
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Service Lines (If) Gravity Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Sewer Main The sure Service Line With GPS The sure Service Line with G				
Static Water Main Circulating Water Main X Water Service Lines (If) Gravity Sewer Main X Pressure Sewer Main X Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check Hydraulic Loading Based Size 10.7 acres Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Sewer Pressure Service Line with GPS Sewage Lagoon 5.2 acres 38.2 Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)			11.50)	
Static Water Main Circulating Water Main X Water Service Lines (If) Gravity Sewer Main X Pressure Sewer Main X Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check Hydraulic Loading Based Size 10.7 acres Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Sewer Pressure Service Line with GPS Sewage Lagoon 5.2 acres 38.2 Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)	Water & Sewer Services (Check all that apply)			
Circulating Water Main x Water Service Lines (If) Gravity Sewer Main D Pressure Sewer Main X Pressure Sewer Main X Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check Hydraulic Loading Based Size 10.7 acres Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS Pressure Service Line with GPS O.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per check Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)		0		Static Water Service Line
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Service Lines (If) Service Lines (If) Service Lines (If) Service Lines (If) Service Lines (If) Service Lines (If) Service Line with GPS Sevage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size 5.3 acres 5.2 acres 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per check Volume is based on ADDx365x20% factor to account for precipitation, Hydraulic Loading Based Size 10.7 acres Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)	Gravity Sewer Main		Bressing Course	
Sewage Lagoon Size Existing Sewage Lagoon	Gravity Sewer Main			n
Existing Sewage Lagoon Organic Loading Based Size check 386.2 Volume is based on ADDx365x20% factor to account for precipitation, Hydraulic Loading Based Size 10.7 acres Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)				Pressure Service Line with GPS
Existing Sewage Lagoon Organic Loading Based Size check 386.2 Volume is based on ADDx365x20% factor to account for precipitation, Hydraulic Loading Based Size 10.7 acres Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)				Pressure Service Line with GPS
check 386.2 Hydraulic Loading Based Size 10.7 acres Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)	Pressure Sewer Main			Pressure Service Line with GPS
Hydraulic Loading Based Size Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)	Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	x 5.3	Service Lines (If)	
Hydraulic Loading Based Size 10.7 acres Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)	Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	5.3 5.2	Service Lines (If) acres acres	
	Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	5.3 5.2	Service Lines (If) acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Two cell lagoon, combined acreage 10.7 acres Either organic loading based or hydraulic, whichever is greater	Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	5.3 5.2 386.2	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
	Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check Hydraulic Loading Based Size	5.3 5.2 386.2 10.7	acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)

Capital Cost Estimate Piped Water & Sewer System

Village	
Kongiganak	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	121	\$26,342.77	\$3,187,476
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	20,100	\$195.84	\$3,936,394
4	Sewage lift station	EA	1	\$662,130.80	\$662,131
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	5.4	\$696,693.37	\$3,762,144
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	27,000	\$327.06	\$8,830,671
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	5,565,000	\$1.81	\$10,053,951
15	Water treatment plant, no foundation	SF	1,200	\$1,608.15	\$1,929,775
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	1,200	\$426.48	\$511,777
19	Foundation - thermosyphen stablized gravel pad	SF	61,990	\$160.34	\$9,939,782
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	1	\$444,987.75	\$444,988
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$43,259,089

Current population Average number of people per house Service Connections Number of houses Number of public/commerical buildings Number of schools Total number of service connections 121	Current population Average number	3		
Average number of people per house 5.6 Service Connections Number of houses 89 Number of public/commerical buildings 31 Number of schools 1	Average number			
Service Connections Number of houses Number of public/commerical buildings Number of schools 89 Number of public/commercial buildings 1	· ·		•	S
Number of public/commerical buildings Number of schools 31	Service Connect	• • •	5.6	
Number of schools 1				
Total number of service connections 121	•	hools	1	
D	D 1 111			
Burdened labor rate \$11 hr Electricity cost (Public facility) \$0.30 kWh			•	
Electricity cost (Residential service) \$0.35 kWh Cost per gallon for heating oil \$5.43 gal	, ,	,		
Water consumption per capita 50 gpd	. •	·	•	
Wastewater generation per capita 50 gpd			<u> </u>	
Water & Sewer System Characteristics	-	Characteristics		
Water Source Type of system (Surface(SW) or Groundwater(GW)) SW		m (Surface(SW) or Groundwater(GW))	SW	
Length of raw water line 9800 ft Water line heated for freeze protection (Yes or No) No	Length of rav	water line		
Location of water line (Above ground (AG) or Buried)				
Water Treatment			2000	
Size of water treatment plant building Raw water quality (Good or Poor) 3600 sf Poor				
Water Storage				
Size of tank(s) 7,275,000 gallons Length of water line to/ from tank 50 ft	,	· ·	_	j
Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried) No AG		• • • • • • • • • • • • • • • • • • • •		
Location of water line (Above ground (AG) or Buried) Water Distribution AG			AG	
Type of system (Static or Circulating (Circ))	Type of syste	m (Static or Circulating (Circ))		
Number of circulating water loops 4 Total length of Water Main 17900 ft		•		
Water mains heated for freeze protection (Yes or No) Yes Leasting of the project (Above ground (AC) or Buried)		. , ,		
Location of the mains (Above ground (AG) or Buried) Average service line length AG 75 ft		· • • • • • • • • • • • • • • • • • • •		
Wastewater Collection				
Type of system (Gravity or Pressure) Number of individual facility pump stations			Pressure	
Number of community lift/pump stations 1 Number of facilities served by lift/pump station #1 104	Number of co	mmunity lift/pump stations		
Number of facilities served by lift/pump station #2	Number	f facilities served by lift/pump station #2	104	
Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4				
Number of facilities served by lift/pump station #5	Number	f facilities served by lift/pump station #5		
Size of lift stations 500 sf Total length of sewer mains 11000 ft				
Sewer mains heated for freeze protection (Yes or No) Yes	Sewer mains	heated for freeze protection (Yes or No)	Yes	
Number of circulating glycol loops 4 Location of the mains (Above ground (AG) or Buried) AG				
Average service line length 75 ft			75 ft	
Wastewater Treatment / Disposal Length of force main 435 ft			435 ft	
Force main heated for freeze protection (Yes or No) Yes	Force main h	eated for freeze protection (Yes or No)	Yes	
Location of force main (Above ground (AG) or Buried) AG Lagoon discharged seasonally with pump (Yes or No) Yes				

Operation & Maintenance Cost Assumptions

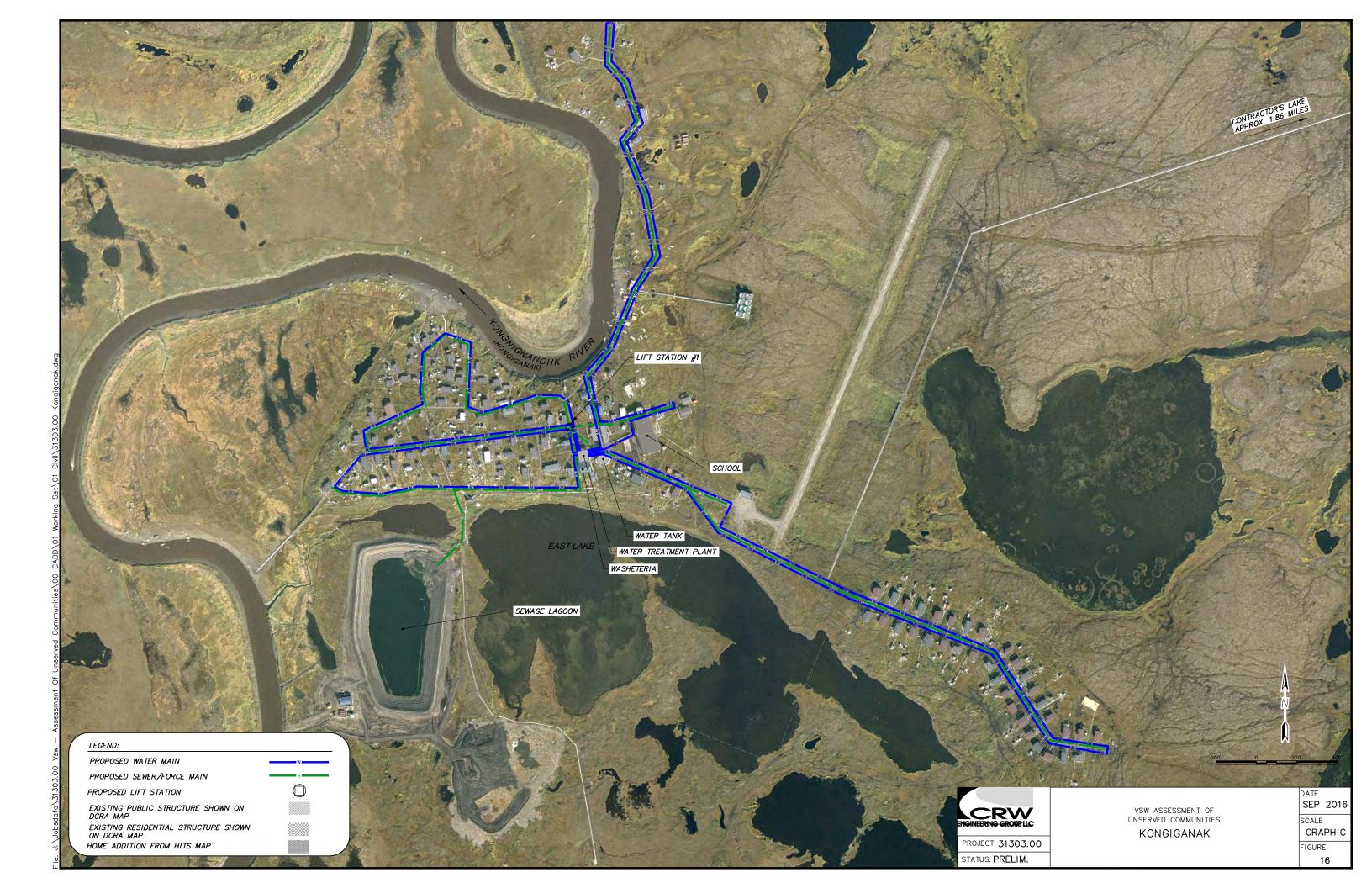
Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
	40	1113/WCCK
Fuel (Heating)	100,000	PTI la/gallen
Available energy per gallon of heating fuel	100,000	BTUs/gallon months
Heating season (above ground components)	-	
Heating season (buried components)	12 7	months
Buildings	40	BTU/hr/sf
Raw water heat addition (5F)	• •	BTU/gallon
Water storage tank	0.5	BTU/gal-day BTU/hr/ft
Above ground mains	5 3	BTU/nr/ft
Buried mains (permafrost conditions)	3	BTO/III/II
<u>Electricity</u>		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
	φ.,σσσ	F)-w

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	40	hrs/week		\$22,880
Fuel (Heating Demand)				
Water system				
WTP building	\$998	/month		\$7,986.84
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$1,654	/month		\$13,232.17
Water storage tank	\$6,004	/month		\$48,035.95
Water storage tank line	\$0	/month		\$0.00
Water mains	\$3,546	/month		\$28,366
Service lines	\$1,798	/month		\$14,381
Wastewater system				
Sewer mains		/month		\$17,432
Service lines		/month		\$14,381
Lift/pump station buildings	\$139			\$1,109.28
Force main to lagoon	\$86	/month		\$689
			Subtotal	\$145,600
Electricity				
Water system				
WTP building				
Lights and controls	\$315	/month		\$3,782
HVAC/hydronic system	\$315	/month		\$2,521
Water treatment	\$114	/month		\$1,371
Pumps				
Intake or well	\$114	/month		\$1,370.74
WST circulation	\$41	/month		\$324
Pressure/booster	\$171	/month		\$2,056.10
Main line circulation	\$1,289	/month		\$10,310
Wastewater system				
Lift /pump station buildings				
Lights and controls	· ·	/month		\$525
HVAC/hydronic system	\$44	/month		\$350
Pumps				
Individual facility pump stations		/month		\$0
Community lift/pump station(s)	*	/month		\$1,922.11
Sewer/force main glycol circulation	* -	/month		\$2,573
Lagoon discharge pump	\$1,646	/year	Subtotal	\$1,646 \$28,800
Other Costs			Capititul	Ψ20,000
Equipment R&R	\$9,864	/year		\$9,864
Miscellaneous materials & supplies	\$5,918	•		\$5,918
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	•		\$1,500
modiano	ψ1,300	. ,	Subtotal	\$21,800
			Castotal	Ψ= 1,000

Summary

Administration	\$6,000
Labor	\$22,900
Fuel	\$145,600
Electricity	\$28,800
Other	\$21,800
Total	\$225,000

Revenue I	Monthly	# of		,	Yearly
Source F	Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 134	89	85%	\$	121,798
Public/Commerc	\$ 147.58	31	100%	\$	54,902
School Service (\$ 5,366.73	1	100%	\$	48,301
Local Capital Con	tribution			\$	-
Total Revenue				\$	225,000



Koyukuk, Alaska

Community Information & Existing Infrastructure

The Community of Koyukuk is an Athabascan community of 92 people located on the Yukon River near the mouth of the Koyukuk River. There are 50 residential units, 10 commercial/public facilities and one school for a total of 61 services. The existing water and sewer services provided in Koyukuk consist of self-haul system from the washeteria and honey buckets/pit privies. The existing water and sewer infrastructure consists of the following:

- Well Water 14 gpm transfer pump
- Treated Water Storage 5,000 gallons
- Water Treatment Plant/Washeteria –
 1,200 SF, built in 1975, renovated in 1987
- Water Treatment Greensand filters, oxidation chamber, carbon filter, chlorine
- Sewage Lagoon Single Cell, 0.28 acres

Soils around Koyukuk consist of dark brown peaty silt approximately 1.5-3 feet, and sand mixed with silt below 3 feet. The community is in a continuous permafrost zone with varying depths between 6-15 feet.

Piped System Description

The piped water and pressure sewer system will be a buried system. The water system will consist of approximately 15,500 feet of pipe, and the pressure sewer system approximately 12,000 feet of pipe. The water system will consist of two circulating loops. The pressure sewer system would require individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	8	14	-
Water Storage (gallons)	74,900	5,000	69,900
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	2.0	0.3	1.7
Required Foundation System for WTP and/or WST			
Thermosyphon stabilized gravel pad (sf)	2,300	-	2,300
Water Distribution System			
Circulating Water Main with Pitorifices (If)	15,500	-	15,500
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	12,000	-	12,000
Individual Grinder Pump Stations (GPS) (ea)	61	-	61
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	4,600	-	4,600
Pressure Sewer Service Lines (If)	4,600	-	4,600

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Koyukuk. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

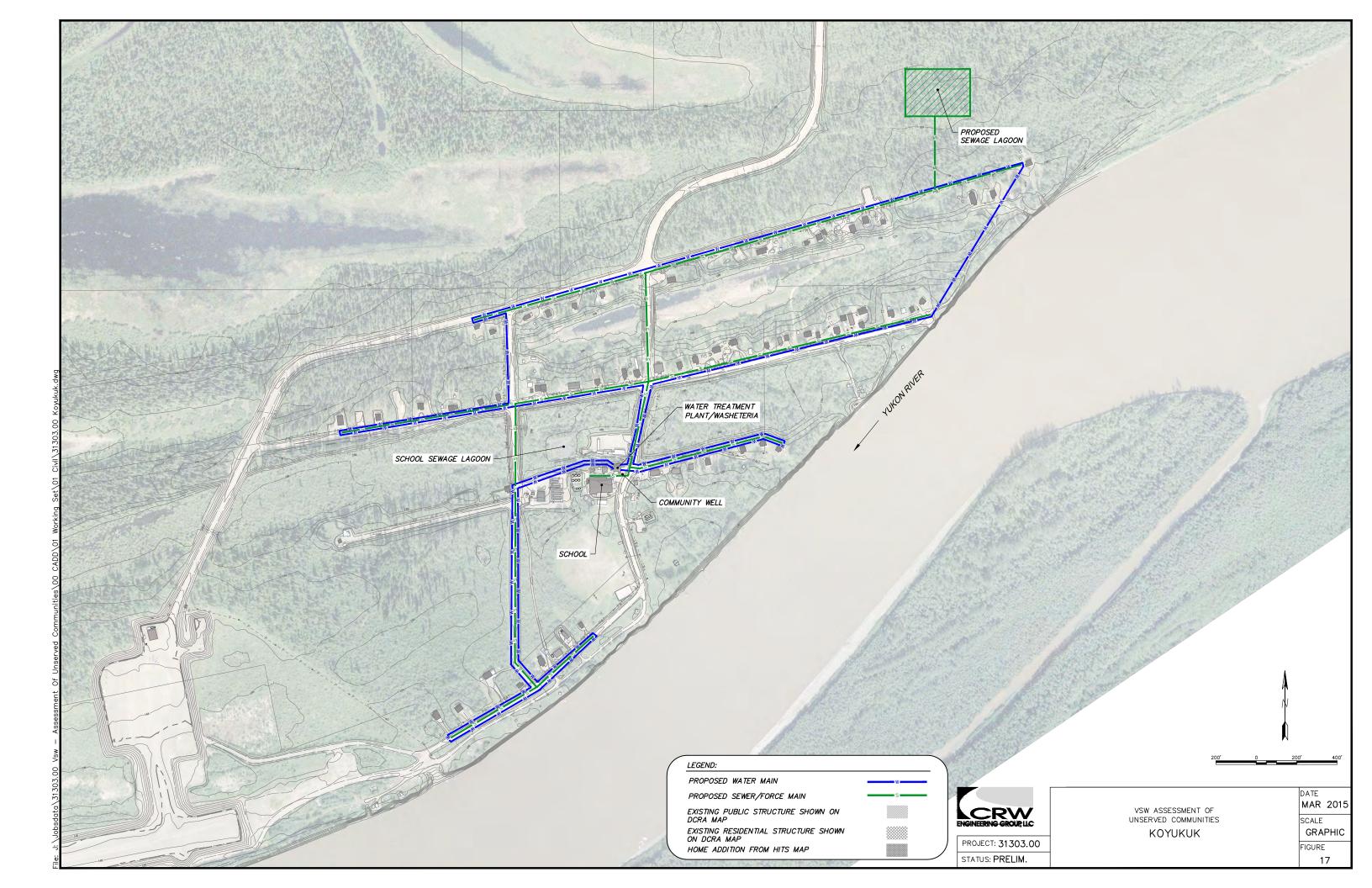
				Village	
	Estimated Capital Costs			Koyukuk	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	61	\$26,403.25	\$1,610,598
3	Sewage collection mains or services (gravity or force), above ground	LF	16,600	\$202.45	\$3,360,590
10	Sewage lagoon, barrow, local material	Acre	2	\$847,406.81	\$1,440,592
12	Water distribution, mains or services, above ground	LF	20,100	\$332.88	\$6,690,809
14	Water storage tank, no foundation	Gal	69,900	\$4.97	\$347,198
15	Water treatment plant, no foundation	SF	1,200	\$1,660.79	\$1,992,952
19	Foundation - thermosyphen stablized gravel pad	SF	2,300	\$344.23	\$791,733
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$16,234,000
	Total v	vith Infl	ation (3% pei	year for 6 years)	\$19,384,200
27	Individual Grinder Pump Stations	EA	61	\$30,000	\$1,830,000
28	Electrical Service Upgrades	EA	61	\$5,500	\$335,500
		•		Subtotal	\$21,549,700
29	Construction Contingency (15%)	LS	1	\$3,232,500	\$3,232,500
30	Design & Construction Administration Services (20%)	LS	1	\$4,309,900	\$4,309,900
				Total	\$29,092,100

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$25,000			
Fuel	\$80,100			
Electricity	\$19,800			
Other (R&R, Training, etc.)	\$16,000			
Total	\$147,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Koyukuk are listed below.

Estimated User Fees						
Revenue Source	Мо	nthly Rate	# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	170	50	85%	\$ 86,471	
Public/Commercial Service	\$	187	10	100%	\$ 22,381	
School Service	\$	4,239	1	100%	\$ 38,149	
Local Capital Contribution					\$ -	
Total Revenue					\$ 147,000	



VSW Unserved Communities - Piped Water & Sewer System Type and Sizing Model						
Date	-	3/22/2016				
Community		Koyukuk				
Input						
Existing Community & System Data						
2015 Population		92				
2015 Number of Services		61				
HITS Database (E1 & H1-H7)		50				
DCED Mapping Commerical/Public Facilities/School		11				
Type (surface water or groundwater)		GW				
Water quality (Poor or Good) Water Storage Tank		Poor 5000				
Water Treatment Capacity		14				
Existing Sewage Lagoon Size		0.28				
Soil Conditions (check only one)		0.20				
Soft poorly drained soils or discontinuous permafrost						
Firm soils, or continuous permafrost		х				
Stiff soils, no permafrost						
Piping Configurations (check all that apply)			Sewer Main Length	Water Main		
			(ft)	Length (ft)		
Buried system with no permafrost Above ground system or buried with permafrost		х	12000	15500		
Gravity Sewer Main		۸	12000	13300		
Pressure Sewer Main		Х	12000			
Typical Service Line Length (ea)			75	75		
Piped System Requirements	Community	Koyukuk				
Output for Cost Model (calculated)						
			Foundatio	n Size		
Water Treatment Capacity (gpm)		8	4.400	,		
Req Water Storage (gallons) (less existing) Req W&S Utility Bldg/Water Treatment Plant/Additio	n (cf)	69,900 1,200	1,100 1,200			
Req Sewage Lagoon Size (acre) (less existing)	11 (31)	1.7	1,200	31		
ned sewage ragoon size (acre) (ress existing)		1.7	Quantity	Notes		
			Quantity			
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad	1,200			
,		(sf)	2,200			
Water Distribution System		Circulating Water Main with	45.55			
		Pitorifices (If)	15,500			
		Sower Main with Glycol Heat Trace				
		Sewer Main with Glycol Heat Trace	12,000			
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	12,000			
Wastewater Collection System		(If)	12,000			
Wastewater Collection System		(lf) Individual Grinder Pump Stations	12,000			
Wastewater Collection System		(If)	· ·			
Wastewater Collection System		(lf) Individual Grinder Pump Stations	· ·			
		(lf) Individual Grinder Pump Stations	· ·			
Wastewater Collection System Water & Sewer Service Lines		(lf) Individual Grinder Pump Stations (GPS) (ea)	61			
		(lf) Individual Grinder Pump Stations (GPS) (ea)	61			
		(lf) Individual Grinder Pump Stations (GPS) (ea)	61			
		(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	4,600			
		(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	4,600			
	Piped System Need	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	4,600			
Water & Sewer Service Lines	Piped System Need	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	4,600 4,600			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 8 74,900	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	4,600 4,600 Net Need			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 8 74,900 1,200	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000	4,600 4,600 Net Need 			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 8 74,900	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000	4,600 4,600 Net Need			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	8 74,900 1,200 2.0	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000	4,600 Net Need - 69,900 1,200 1.7			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 8 74,900 1,200	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000 0.3	4,600 4,600 Net Need 			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	8 74,900 1,200 2.0	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000 0.3	4,600 Net Need - 69,900 1,200 1.7			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 8 74,900 1,200 2.0 2,300 15,500	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000 0.3	4,600 4,600 Net Need			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if)	Need 8 74,900 1,200 2.300 15,500 12,000 1	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000 0.3	4,600 Net Need - 69,900 1,200 1.7 2,300 15,500			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 8 74,900 1,200 2.0 2,300 15,500	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000 0.3	4,600 4,600 Net Need			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 8 74,900 1,200 2.300 15,500 12,000 61	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000 0.3	4,600 Net Need			
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 8 74,900 1,200 2.300 15,500 12,000 1	(If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 14 5,000 0.3	4,600 Net Need - 69,900 1,200 1.7 2,300 15,500			

Date	scorned Communities Bi	Mater O Carre	Sustan Tuna and Sizing Madel
		u water & Sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		<u>y</u> ears	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services Growth Rate (i)	19	services	1%
2035 Design Population (Capita)		° ? people	Px(1+i)^n
			. ,
Water Demand Estimates		a	
Existing Capacity Average Day (ADD)		gpm gpd	50 gallons per Capita
Max Day (MDD)	11,226		2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	8	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GV	/	
Required Capacity	8	gpm	MDD
Water Starger Toul Sining			
Water Storage Tank Sizing Existing Water Storage Tank	5.000	gallons	
Demand Based Volume (if source is GW)	Applicable	_3	
Daily Operation (DO) (gallons)		gallons	Max Day (MDDx1 day)
Fire Flow (FF)		gallons	500 gpm for 60 minutes
Reserve Volume (RV) Water Storage Tank Volume		gallons gallons	3 days x DO DO + FF + RV
CT Based Volume (min if source is SW)	Not Required	000.13	
Chlorine Residual Concentration (RC)	0.	1 mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T) pH (PH)		1 C 7	4.4 celsius/40 F 7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.		0.1
Required Volume to meet CT*		gallons	CT/RCxPeak Hour/BF
Required Water Storage		gallons	
Required Additional Storage Estimate of Min Platform Size (3' clearance		gallons	0
around)	1,100	sf	D = $0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
,			0
Water Treatment Plant Requirements*		٦	D W . O I' (05 D5) 4000 (
Water Quality Minimum WTP Size	Poor 1,200	cf	Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf
William Will Size	1,200	-,	dood water quality (no treatment other than e2) = 000 si
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	0		Pile Foundation
permafrost Firm soils, or continuous permafrost	x	Thermosyphon	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)	0	1	Static Water Maine
Water Distribution (Check either or both) Buried system with no permafrost	0	Circulatina	Static Water Mains
		Circulating Water Main	
Buried system with no permafrost	0 x	Water Main with Pitorifices	Static Water Mains Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with		Water Main	
Buried system with no permafrost Above ground system or buried with permafrost		Water Main with Pitorifices	
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	х	Water Main with Pitorifices	Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with permafrost		Water Main with Pitorifices (lf)	
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	x 0	Water Main with Pitorifices (lf) Sewer Main	Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	х	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x 0 x 0 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x 0 x 0 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main	0 x 0 x 0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 x 0 x 0 0 x 0 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 x 0 x 0 x 0 0.2	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 0 x 0 x 0 x 0 1.1 165.	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres of acres of acres (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	x 0 x 0 x 0 x 0 x 0 1.1 165.	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 0 x 0 x 0 x 0 x 2 1.165.	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres of acres of acres (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Koyukuk	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	61	\$26,403.25	\$1,610,598
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	16,600	\$202.45	\$3,360,590
4	Sewage lift station	EA	0	#DIV/0!	\$0
	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	1.7	\$847,406.81	\$1,440,592
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	20,100	\$332.88	\$6,690,809
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	69,900	\$4.97	\$347,198
	Water treatment plant, no foundation	SF	1,200	\$1,660.79	\$1,992,952
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	2,300	\$344.23	\$791,733
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$16,234,472

Community:	Koyukuk	
General Community Dat	a	
Current population Average number Service Connect	of people per house	92 persons 1.8
Number of he Number of po Number of so	ublic/commerical buildings chools	50 10 1
Burdened labor r	Total number of service	e connections 61 \$15 hr
Electricity cost (F	Public facilty) Residential service)	\$0.49 kWh \$0.46 kWh \$6.50 gal
Water consumpt Wastewater gene	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source	Characteristics	
Type of syste Length of rav Water line he	em (Surface(SW) or Groundwater(GW)) v water line eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	GW 30 ft No AG
	treatment plant building uality (Good or Poor)	2400 sf Poor
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) /ater line (Above ground (AG) or Buried)	74,900 gallons 25 ft No Buried
Number of ci Total length o Water mains Location of th	n em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) rice line length	Circ 2 15500 ft Yes Buried 75 ft
Wastewater Colle Type of syste Number of in Number of co Number of Number of Number of Number of Number of Number of Number of Number of		Pressure
Total length of Sewer mains Number of ci Location of the	t stations of sewer mains heated for freeze protection (Yes or No) rculating glycol loops ne mains (Above ground (AG) or Buried) rice line length	500 sf 12000 ft Yes 2 Buried 75 ft
Location of fo		360 ft Yes Buried Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
	40	1113/WCCK
Fuel (Heating)	100,000	PTI la/gallen
Available energy per gallon of heating fuel	100,000	BTUs/gallon months
Heating season (above ground components)	-	
Heating season (buried components)	12 7	months
Buildings	40	BTU/hr/sf
Raw water heat addition (5F)	• •	BTU/gallon
Water storage tank	0.5	BTU/gal-day BTU/hr/ft
Above ground mains	5 3	BTU/nr/ft
Buried mains (permafrost conditions)	3	BTO/III/II
<u>Electricity</u>		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
	φ.,σσσ	F)-w

Labor (WTP Operator) 32 hrs/week \$24.	Estimated O& M Costs				Annual Cost
Fuel (Heating Demand) Water system	Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Water system WTP building \$797 /month \$6,373 Raw water line \$0 /month \$0,373 Raw water line \$0 /month \$0,373 Raw water line \$0 /month \$2,908 Maw water line \$0 /month \$2,908 May water storage tank line \$0 /month \$0,908 May water storage tank line \$0 /month \$1,707 /month	Labor (WTP Operator)	32	hrs/week		\$24,960
WTP building \$797 /month \$6,373 Raw water line \$30 /month \$2,908 Raw water heat addition \$334 /month \$2,908 Water storage tank \$74 /month \$509 Water storage tank \$0 /month \$26,4 \$2,005 /month \$20,4 \$2,005 /month \$20,4 \$2,005 /month \$20,4 \$2,005 /month \$3,005 /month \$4,005	Fuel (Heating Demand)				
Raw water line	Water system				
Raw water heat addition	WTP building	\$797	/month		\$6,373.79
Water storage tank \$74 month \$592	Raw water line	\$0	/month		\$0.00
Water storage tank line \$0 /month \$0 Water mains \$2,205 /month \$25,25 /month \$25,25 /month \$25,4 /month \$27,5 /month \$27,5 /month \$7,5 /month \$7,5 /month \$7,5 /month \$20,4 /month \$4,7 /month \$1,0,5 /month \$4,7 /month \$1,0,5 /month	Raw water heat addition	\$364	/month		\$2,908.67
Water mains \$2,205 /month \$26,4 Service lines \$651 /month \$7,5 Wastewater system \$1,707 /month \$20,4 Service lines \$651 /month \$7,5 Lift/pump station buildings \$0 /month \$7,6 Force main to lagoon \$51 /month \$0 Force main to lagoon \$51 /month \$0 Water system \$34 /month \$0 WTP building \$34 /month \$4,7 Lights and controls \$34 /month \$4,7 Water treatment \$34 /month \$4,7 Wastewater system \$34 /month \$4,1 WST circulation \$66 /month \$1,4 Wastewater system \$1,053 /month \$1,2,6 Lights and controls \$0 /month \$1,2,6 Wastewater system \$1,053 /month \$1,2,6 Lights and controls \$0 /month \$1,2,6 HVAC/hydronic system \$0 /month \$1,2,6 Pumps Individual facility pump station(s) \$0 /month \$3,7	Water storage tank	\$74	/month		\$592.01
Service lines	Water storage tank line	\$0	/month		\$0.00
Sewer mains \$1,707 month \$20,4	Water mains	\$2,205	/month		\$26,463
Sewer mains	Service lines	\$651	/month		\$7,811
Service lines					
Lift/pump station buildings \$0 /month \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$. ,			\$20,487
Force main to lagoon \$51 /month \$36 \$73,1		*			\$7,811
Subtotal \$73,1	, ,	* -			\$0.00
Water system WTP building Lights and controls \$343 month \$44,	Force main to lagoon	\$51	/month	<u> </u>	\$615
Water system \$343 /month \$4,1 Lights and controls \$343 /month \$4,1 HVAC/hydronic system \$343 /month \$4,7 Water treatment \$34 /month \$1 Pumps \$34 /month \$411 Pumps \$34 /month \$411 WST circulation \$66 /month \$5 Pressure/booster \$51 /month \$66 Main line circulation \$1,053 /month \$12,6 Wastewater system \$1,053 /month \$12,6 Light sand controls \$0 /month \$12,6 HVAC/hydronic system \$0 /month \$12,6 Pumps \$0 /month \$10,0 Individual facility pump stations \$0 /month \$0 Community lift/pump station(s) \$0 /month \$0 Sewer/force main glycol circulation \$263 /month \$3,1 Lagoon discharge pump \$494 /year \$6,2 Subtotal \$26,5 Subtotal \$26,5 Wasseling to the costs \$1,000 \$1,000 \$1,000				Subtotal	\$73,100
WTP building	Electricity				
Lights and controls	Water system				
HVAC/hydronic system	WTP building				
Water treatment \$34 /month \$4 Pumps 10 10 10 10 10 10 10 10	Lights and controls	\$343	/month		\$4,118
Pumps	HVAC/hydronic system	\$343	/month		\$4,118
Intake or well	Water treatment	\$34	/month		\$411
WST circulation \$66 /month \$51 Pressure/booster \$51 /month \$616 Main line circulation \$1,053 /month \$12,6 Wastewater system Lift /pump station buildings Lights and controls \$0 /month Lights and controls \$0 /month Pumps Individual facility pump stations \$0 /month \$0 /month Community lift/pump station(s) \$0 /month \$0 Sewer/force main glycol circulation \$263 /month \$3,7 Lagoon discharge pump \$494 /year \$2 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7	Pumps				
Pressure/booster \$51 /month \$616 Main line circulation \$1,053 /month \$12,6 Wastewater system Lift /pump station buildings Lights and controls \$0 /month HVAC/hydronic system \$0 /month Pumps Individual facility pump stations \$0 /month Community lift/pump station(s) \$0 /month \$0 Sewer/force main glycol circulation \$263 /month \$3,7 Lagoon discharge pump \$494 /year \$4 Subtotal \$26,5 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7	Intake or well	\$34	/month		\$411.13
Main line circulation \$1,053 /month \$12,6 Wastewater system Liff /pump station buildings Lights and controls \$0 /month HVAC/hydronic system \$0 /month Pumps Individual facility pump stations \$0 /month Community lift/pump station(s) \$0 /month \$0 Sewer/force main glycol circulation \$263 /month \$3,7 Lagoon discharge pump \$494 /year \$4 Subtotal \$26,5 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7	WST circulation	\$66	/month		\$529
Wastewater system Lift /pump station buildings \$0 /month Lights and controls \$0 /month HVAC/hydronic system \$0 /month Pumps Individual facility pump stations \$0 /month Community lift/pump station(s) \$0 /month \$0 Sewer/force main glycol circulation \$263 /month \$3,1 Lagoon discharge pump \$494 /year \$4 Subtotal \$26,5 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7	Pressure/booster	\$51	/month		\$616.69
Lift /pump station buildings \$0 /month Lights and controls \$0 /month HVAC/hydronic system \$0 /month Pumps Individual facility pump stations Community lift/pump station(s) \$0 /month Sewer/force main glycol circulation \$263 /month \$3,1 Lagoon discharge pump \$494 /year \$6 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7	Main line circulation	\$1,053	/month		\$12,630
Lights and controls \$0 /month HVAC/hydronic system \$0 /month Pumps Individual facility pump stations \$0 /month Community lift/pump station(s) \$0 /month \$0 Sewer/force main glycol circulation \$263 /month \$3,1 Lagoon discharge pump \$494 /year \$6 Subtotal \$26,5 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7					
HVAC/hydronic system \$0 /month Pumps \$0 /month Individual facility pump stations \$0 /month Community lift/pump station(s) \$0 /month Sewer/force main glycol circulation \$263 /month Lagoon discharge pump \$494 /year \$2 Subtotal \$26,5 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7					
Pumps \$0 /month Individual facility pump stations \$0 /month Community lift/pump station(s) \$0 /month Sewer/force main glycol circulation \$263 /month \$3,1 Lagoon discharge pump \$494 /year \$26,5 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7	· · · · · · · · · · · · · · · · · · ·	·			\$0
Individual facility pump stations	· · · · · · · · · · · · · · · · · · ·	\$0	/month		\$0
Community lift/pump station(s) \$0 /month \$0 Sewer/force main glycol circulation \$263 /month \$3,1 Lagoon discharge pump \$494 /year \$4 Subtotal \$26,5 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7	•	••	, ,,		••
Sewer/force main glycol circulation \$263 /month \$3,1 Lagoon discharge pump \$494 /year \$494 /year \$494 /year \$26,5 Other Costs Equipment R&R \$6,228 /year \$6,2 Miscellaneous materials & supplies \$3,737 /year \$3,7	*	* -			\$0
Lagoon discharge pump \$494 /year \$2 / Subtotal \$26,5 Other Costs Equipment R&R / Miscellaneous materials & supplies \$6,228 /year / year \$6,2 / year \$6,2 / year \$3,7 / year	, , , , , , , , , , , , , , , , , , , ,	* -			\$0.00
Subtotal\$26,5Other CostsEquipment R&R\$6,228 /year\$6,2Miscellaneous materials & supplies\$3,737 /year\$3,7	· · · · · · · · · · · · · · · · · · ·	*			\$3,152
Other Costs Equipment R&R Miscellaneous materials & supplies \$6,228 /year \$6,237 /year \$3,737	Lagoon discnarge pump	\$494	/year	Subtotal	\$494 \$26,500
Equipment R&R \$6,228 /year \$6,7 Miscellaneous materials & supplies \$3,737 /year \$3,7	Other Costs				+,
Miscellaneous materials & supplies \$3,737 /year \$3,7		\$6 228	/vear		\$6,228
	• •		•		\$3,737
Water quality testing \$2,000 /year \$2,0	Water quality testing		•		\$2,000
	· · ·		•		\$2,500
			•		\$1,500
		Ţ ·, 000	y	Subtotal	\$16,000

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$73,100
Electricity	\$26,500
Other	\$16,000
Total	\$147,000

Revenue	Monthly	# of		,	Yearly
Source	Source Rate		Collection Rate	Re	evenues
Residential Serv	\$ 170	50	85%	\$	86,471
Public/Commerc	\$ 186.51	10	100%	\$	22,381
School Service (\$ 4,238.75	1	100%	\$	38,149
Local Capital Cor	ntribution			\$	-
Total Revenue	_	_	_	\$	147,000

Kwigillingok, Alaska

Community Information & Existing Infrastructure

The Community of Kwigillingok is a Yupik community of 364 people located on the western shore of Kuskokwim Bay near the mouth of the Kuskokwim River. There are 95 residential units, 29 commercial/public facilities and one K-12 school for a total of 125 services. The existing water and sewer services provided in Kwigillingok consist of a self-haul system. Raw water is stored in a reservoir that supplies water year round. The raw water reservoir is replenished by a combination of surface water runoff, rain, and snow. The existing water and sewer infrastructure consists of the following:

- Reservoir 40 gpm (Year round supply)
- Treated Water Storage 215,000 gallons
- Water Treatment Plant 2,760 SF, built in 2008
- Water Treatment Soda ash, potassium permanganate, cationic polymer, greensand filtration, and chlorine
- Sewage Lagoon Single Cell, 0.57 acres

Soils around Kwigillingok consist of a thin organic mat with peat and ice up to approximately 4 inches thick. There is ice-rich organic silt 25-30 feet deep, overlaying sandy silt. Permafrost is present sporadically.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 37,700 feet of pipe, and the pressure sewer system approximately 27,000 feet of pipe. The water system will consist of four circulating loops. The pressure sewer system would require three sewer main lift stations, individual grinder pump stations at each house, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, two new 1,200 sf facilities are included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment. The existing water storage tank is sufficient to meet CT requirements (157,400 gallons) and provide reserve for fire flows.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	31	40	-		
Water Storage (gallons)	207,700	215,000	-		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	2,400	-	2,400		
Sewage Lagoon Size (acre)	7.8	0.6	7.2		
Required Foundation System for WTP and/or WST	Required Foundation System for WTP and/or WST				
Pile Foundation	2,400	-	2,400		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	37,700	-	37,700		
Wastewater Collection System					
Sewer Main with Glycol Heat Trace (If)	27,000	-	27,000		
Individual Grinder Pump Stations (GPS) (ea)	125	-	125		
Water & Sewer Service Lines					
Circulating Water Service Lines (If)	9,400		9,400		
Pressure Sewer Service Lines (If)	9,400	-	9,400		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Kwigillingok. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

				Village	
	Estimated Capital Costs			Kwigillingok	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	125	\$26,342.77	\$3,292,847
3	Sewage collection mains or services (gravity or force), above ground	LF	36,400	\$193.47	\$7,042,309
4	Sewage lift station	EA	2	\$ 563,234.80	\$ 1,126,470
10	Sewage lagoon, barrow, local material	Acre	7	\$686,271.14	\$4,941,152
12	Water distribution, mains or services, above ground	LF	47,100	\$325.73	\$15,342,081
15	Water treatment plant, no foundation	SF	2,400	\$1,583.60	\$3,800,638
18	Foundation - freeze back piles	SF	2,400	\$344.81	\$827,554
Total Estimated Cost in 2010 dollars (rounded):					\$36,373,000
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$43,431,300
27	Individual Grinder Pump Stations	EA	125	\$30,000	\$3,750,000
28	Electrical Service Upgrades	EA	125	\$5,500	\$687,500
	Subtotal				
29	Construction Contingency (15%)	LS	1	\$7,180,300	\$7,180,300
30	Design & Construction Administration Services (20%)	LS	1	\$9,573,800	\$9,573,800
				Total	\$64,622,900

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs	
Description	Cost
Administration	\$6,000
Labor	\$33,300
Fuel	\$138,800
Electricity	\$41,900
Other (R&R, Training, etc.)	\$23,100
Total	\$243,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Kwigillingok are listed below.

Estimated User Fees						
Revenue Source	Monthly Rate		# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	146	95	85%	\$ 141,269	
Public/Commercial Service	\$	160	29	100%	\$ 55,808	
School Service	\$	5,103	1	100%	\$ 45,923	
Local Capital Contribution					\$ -	
Total Revenue					\$ 243,000	

VSW Unserved Communi	ties - Dined W	ater & Sewer System Type and Si	zing Model	
Date	-	3/22/2016	zing iviouei	
Community		Kwigillingok		
Inpu	t			
Existing Community & System Data				
2015 Population		364		
2015 Number of Services		125		
HITS Database (E1 & H1-H7) DCED Mapping Commerical/Public Facilities/School		95 30		
Type (surface water or groundwater)		SW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		215000		
Water Treatment Capacity		40		
Existing Sewage Lagoon Size		0.57		
Soil Conditions (check only one) Soft poorly drained soils or discontinuous permafrost		Х		
Firm soils, or continuous permafrost		^		
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length	Water Main
			(ft)	Length (ft)
Buried system with no permafrost Above ground system or buried with permafrost		X	27000	37700
Gravity Sewer Main		.,		2.700
Pressure Sewer Main		х	27000	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Kwigillingok		
Output for Cost Model (calculated)	Community	Kwigiiiiigok		
(Foundatio	n Size
Water Treatment Capacity (gpm)		31		
Req Water Storage (gallons) (less existing)		(7,300)	-	sf
Req W&S Utility Bldg/Water Treatment Plant/Addition	n (sf)	2,400	2,400	sf
Req Sewage Lagoon Size (acre) (less existing)		7.2	Quantity	Notes
			Quantity	Notes
		Pile Foundation (sf)		
Required Foundation System for WTP and/or WST			2,400	
			·	
Water Distribution System		Circulating Water Main with	37,700	
		Pitorifices (If)	37,700	
		Sewer Main with Glycol Heat Trace	27,000	
Wastewater Collection System		(If)	27,000	
		Individual Grinder Pump Stations	125	
		(GPS) (ea)	125	
1				
		Circulating Water Service Lines (If)	9,400	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	9,400	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	9,400	
Water & Sewer Service Lines		Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	9,400	
Water & Sewer Service Lines			· ·	
Water & Sewer Service Lines	Ini	Pressure Sewer Service Lines (If)	· ·	
Water & Sewer Service Lines System Description	Piped System Need	Pressure Sewer Service Lines (If)	· ·	
		Pressure Sewer Service Lines (If)	9,400	
System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 31 207,700	Pressure Sewer Service Lines (If) Existing Facility 40 215,000	9,400 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 31 207,700 2,400	Pressure Sewer Service Lines (If) Existing Facility 40 215,000	9,400 Net Need - - - 2,400	
System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 31 207,700	Pressure Sewer Service Lines (If) Existing Facility 40 215,000	9,400 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 31 207,700 2,400	Pressure Sewer Service Lines (If) Existing Facility 40 215,000	9,400 Net Need - - - 2,400	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System	Need 31 207,700 2,400 7.8	Pressure Sewer Service Lines (If) Existing Facility 40 215,000 - 0.6	9,400 Net Need 2,400 7.2 2,400	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (if)	Need 31 207,700 2,400 7.8	Pressure Sewer Service Lines (If) Existing Facility 40 215,000	9,400 Net Need 2,400 7.2	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System	Need 31 207,700 2,400 7.8	Pressure Sewer Service Lines (If) Existing Facility 40 215,000 - 0.6	9,400 Net Need 2,400 7.2 2,400	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System	Need 31 207,700 2,400 7.8 2,400 37,700	Pressure Sewer Service Lines (If) Existing Facility 40 215,000 - 0.6	9,400 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 31 207,700 2,400 7.8 2,400 37,700 27,000 125	Pressure Sewer Service Lines (If) Existing Facility 40 215,000 - 0.6	9,400 Net Need - 2,400 7.2 2,400 37,700 27,000 125	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 31 207,700 2,400 7.8 2,400 37,700 27,000	Pressure Sewer Service Lines (If) Existing Facility 40 215,000 - 0.6	9,400 Net Need	

1 311 0.	nserved Communities - Pined	Water & Sewer	System Type and Sizing Model
Date	•	water & Jewer	System Type and Sizing Model
Community	ı		
System Parameters	Model Results		Criteria & Calculations
Design Population	20		20 years
Duration (n) 2015 Population (P)		years people	20 years 2015 ADOL
2015 Number of Services		services	
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	444	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		gpm	"
Average Day (ADD) Max Day (MDD)	22,207 44,415		50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity		gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	SW]	
Required Capacity		gpm	MDD
Water Starger Took Siring			
Water Storage Tank Sizing Existing Water Storage Tank	215,000	gallons	
Demand Based Volume (if source is GW)	Check Min CT Requirements	Ballotis	
Daily Operation (DO) (gallons)	44,415		Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)	30,000 133,245		500 gpm for 60 minutes 3 days x DO
Water Storage Tank Volume	207,660	-	DO + FF + RV
CT Based Volume (min if source is SW)	Required		
Chlorine Residual Concentration (RC)		mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI) Temperature (T)	1.0	log inactivation C	1.0-log Inactivation 4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*	0.1 157,339	gallons	0.1 CT/RCxPeak Hour/BF
Required Water Storage	207,700		CI/NCAPEAN HOUI/DF
Required Additional Storage		gallons	0
Estimate of Min Platform Size (3' clearance	-	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			0
Water Treatment Plant Requirements*			
Water Quality	Poor		Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	x	Pile Foundation	Pile Foundation
permafrost Firm soils, or continuous permafrost	0	(sf)	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost			Gravel pad
	0		Graver pau
	0		Graver pau
Water Distribution (Check either or both)			
	0	Circulating	Static Water Mains
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with		Water Main	Static Water Mains
Water Distribution (Check either or both) Buried system with no permafrost	0	Water Main with Pitorifices	
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0	Water Main	Static Water Mains
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0	Water Main with Pitorifices	Static Water Mains
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	0 x	Water Main with Pitorifices	Static Water Mains Circulating Water Main with Pitorifices
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0	Water Main with Pitorifices	Static Water Mains
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Static Water Mains Circulating Water Main with Pitorifices
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	Static Water Mains Circulating Water Main with Pitorifices Bare Sewer main, no heat trace
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x 0 x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (Iff) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
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Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 x 0 x	Water Main with Pitorifices (Iff) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x 0 x 0 x 0 x 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
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Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x 0 0 x 0	Water Main with Pitorifices (Iff) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 x 0 0 x 0 0 x 0 0 0 x 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Gravity Sewer Main Pressure Sewer Main Gravity Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x x 0 x x 0 0 x x 0 0 x x 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x x 0 x x 0 0 x x 0 0 x x 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
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Capital Cost Estimate Piped Water & Sewer System

Village	
Kwigillingok	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	125	\$26,342.77	\$3,292,847
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	36,400	\$193.47	\$7,042,309
4	Sewage lift station	EA	2	\$563,234.80	\$1,126,470
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	7.2	\$686,271.14	\$4,941,152
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	47,100	\$325.73	\$15,342,081
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
15	Water treatment plant, no foundation	SF	2,400	\$1,583.60	\$3,800,638
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	2,400	\$344.81	\$827,554
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$36,373,051

Community:	Kwigillingok	
General Community Dat	a	
Current population Average number Service Connect	of people per house	364 persons 3.8
Number of ho	ouses ublic/commerical buildings	95 29 1 ce connections 125
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon fo	ate Public facilty) Residential service)	\$16 hr \$0.42 kWh \$0.19 kWh \$4.65 gal
Water consumpti Wastewater gene	• •	50 gpd 50 gpd
Water & Sewer System (Characteristics	
Length of rav Water line he	em (Surface(SW) or Groundwater(GW)) www.www.www.www.www.www.www.www.www.w	SW 3100 ft No AG
Raw water qu	treatment plant building lality (Good or Poor)	4560 sf Poor
Water line he	ter line to/ from tank teated for freeze protection (Yes or No) tater line (Above ground (AG) or Buried)	212,000 gallons 25 ft No AG
Number of ci Total length o Water mains Location of th	n em (Static or Circulating (Circ)) roulating water loops of Water Main heated for freeze protection (Yes or No) he mains (Above ground (AG) or Buried) rice line length	Circ 4 37700 ft Yes AG 75 ft
Number of in Number of co Number o Number o Number o Number o	ection em (Gravity or Pressure) dividual facility pump stations ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #4	Pressure 2 60 122
Sewer mains Number of ci Location of the	t stations of sewer mains heated for freeze protection (Yes or No) roulating glycol loops ne mains (Above ground (AG) or Buried) rice line length	500 sf 27000 ft Yes 4 AG 75 ft
Location of fo		4070 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

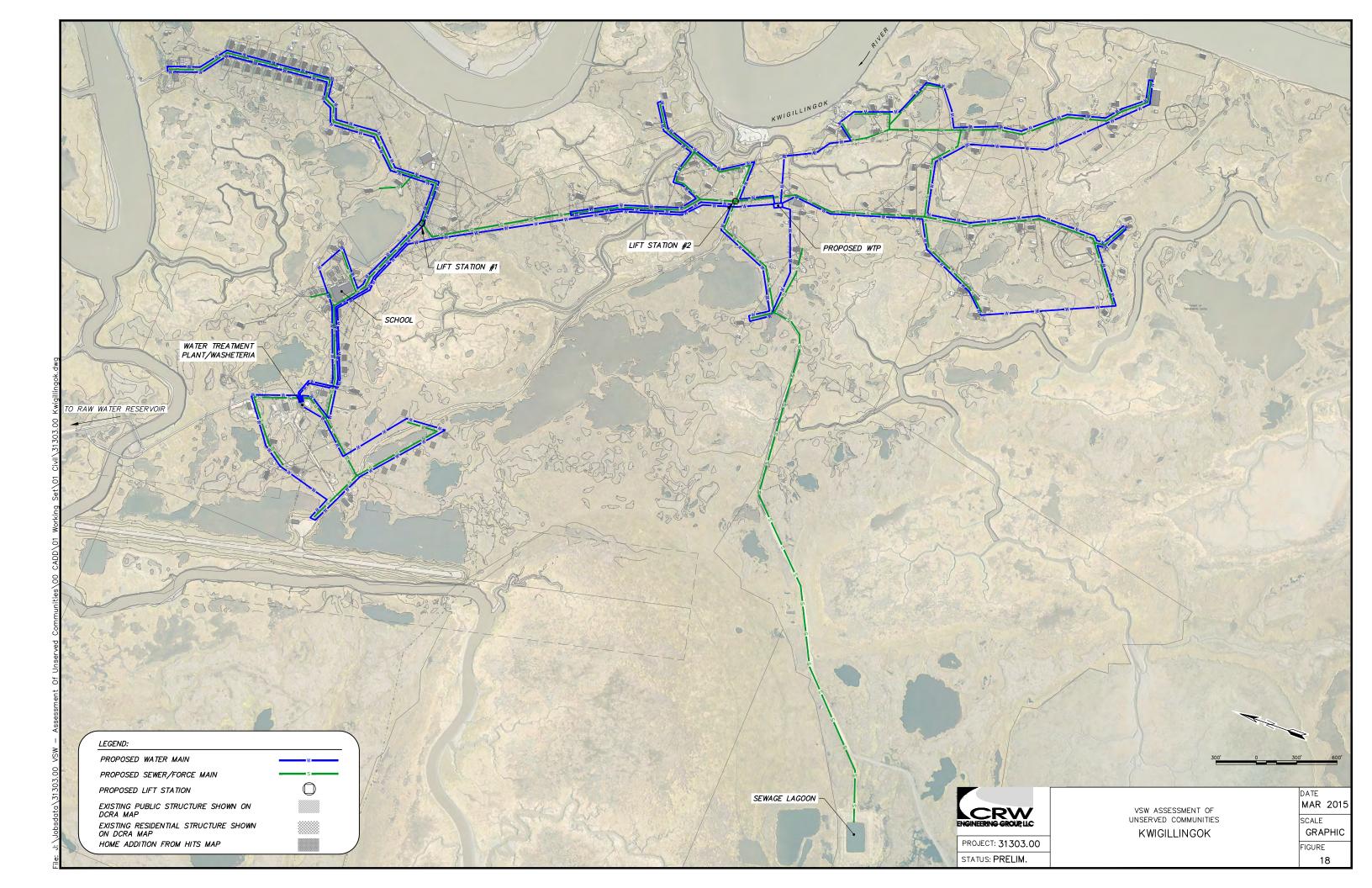
Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
	40	1113/WCCK
Fuel (Heating)	100,000	PTI la/gallen
Available energy per gallon of heating fuel	100,000	BTUs/gallon months
Heating season (above ground components)	-	
Heating season (buried components)	12 7	months
Buildings	40	BTU/hr/sf
Raw water heat addition (5F)	• •	BTU/gallon
Water storage tank	0.5	BTU/gal-day BTU/hr/ft
Above ground mains	5 3	BTU/nr/ft
Buried mains (permafrost conditions)	3	BTO/III/II
<u>Electricity</u>		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
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Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	40	hrs/week		\$33,280
Fuel (Heating Demand)				
Water system				
WTP building	\$1,083	/month		\$8,663.45
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$1,029	/month		\$8,232.81
Water storage tank	\$150	/month		\$1,198.73
Water storage tank line	\$0	/month		\$0.00
Water mains	\$6,395	/month		\$51,161
Service lines	\$1,590	/month		\$12,722
Wastewater system				
Sewer mains		/month		\$36,641
Service lines		/month		\$12,722
Lift/pump station buildings	\$237			\$1,899.88
Force main to lagoon	\$690	/month		\$5,523
			Subtotal	\$138,800
Electricity				
Water system				
WTP building				
Lights and controls	\$559	/month		\$6,707
HVAC/hydronic system	\$559	/month		\$4,471
Water treatment	\$116	/month		\$1,394
Pumps				
Intake or well	\$116	/month		\$1,394.27
WST circulation	\$57	/month		\$454
Pressure/booster	\$174	/month		\$2,091.40
Main line circulation	\$1,804	/month		\$14,435
Wastewater system				
Lift /pump station buildings				
Lights and controls	* -	/month		\$1,471
HVAC/hydronic system	\$123	/month		\$981
Pumps				
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	·	/month		\$3,205.34
Sewer/force main glycol circulation	·	/month		\$3,602
Lagoon discharge pump	\$1,674	/year	Subtotal	\$1,674 \$41,900
Other Costs			Gubiolai	Ψ-71,300
Equipment R&R	\$10,699	lvear		\$10,699
Equipment K&R Miscellaneous materials & supplies	\$10,699 \$6,419	/year		\$6,419
Water quality testing	\$0,419 \$2,000	,		\$6,419 \$2,000
Operator training		/year		\$2,000 \$2,500
Insurance	\$2,500 \$1,500	•		
inouidile	φ1,500	ryeai	Subtotal	\$1,500 \$23,100
			Sublolai	φ ∠ 3,100

Summary

Administration	\$6,000
Labor	\$33,300
Fuel	\$138,800
Electricity	\$41,900
Other	\$23,100
Total	\$243,000

Revenue M	onthly	# of		,	Yearly
Source Rate		Customers	Collection Rate	Re	evenues
Residential Serv \$	146	95	85%	\$	141,269
Public/Commerc \$	160.37	29	100%	\$	55,808
School Service (\$	5,102.59	1	100%	\$	45,923
Local Capital Contr	ibution			\$	-
Total Revenue				\$	243,000



Lime Village, Alaska

Community Information & Existing Infrastructure

Lime Village is a Denaina Athabascan Indian community of 29 people located on the south bank of the Stony River, 50 miles southeast of its junction with the Kuskokwim River. There are 11 residential units and 8 commercial/public facilities for a total of 19 services. The existing water and sewer services provided in Lime Village consist of self-haul system from the watering point attached to the washeteria and pit privies. The existing water and sewer infrastructure consists of the following:

- Well Water 20 gpm Well Capacity
- Water Treatment No treatment
- Treated Water Storage 1050 gallons
- Sewage Lagoon N/A
- Water Treatment Plant 1590 SF, built in 2006

Soils around Lime Village consist of 6 inch of vegetative mat overlying dense sandy silts Coarse sand, gravel and cobbles underneath. Moisture contents indicate seasonally frozen material is wet and soft when unfrozen.

Piped System Description

The piped water and pressure sewer system will be a buried system. The water system will consist of approximately 7,200 feet of pipe, and the pressure sewer system approximately 4,900 feet of pipe. The water system will consist of a single circulating loop. The pressure sewer system would require one sewer main lift station, individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 800 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	2	15	-	
Water Storage (gallons)	44,200	95	44,105	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	800	-	800	
Sewage Lagoon Size (acre)	0.6	-	0.6	
Required Foundation System for WTP and/or WST				
Pile Foundation	1,560	-	1,560	
Water Distribution System				
Circulating Water Main with Pitorifices (If)	7,200	-	7,200	
Wastewater Collection System				
Sewer Main with Glycol Heat Trace (If)	4,900	-	4,900	
Individual Grinder Pump Stations (GPS) (ea)	19	-	19	
Water & Sewer Service Lines				
Circulating Water Service Lines (If)	1,400	-	1,400	
Pressure Sewer Service Lines (If)	1,400	-	1,400	

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Lime Village. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

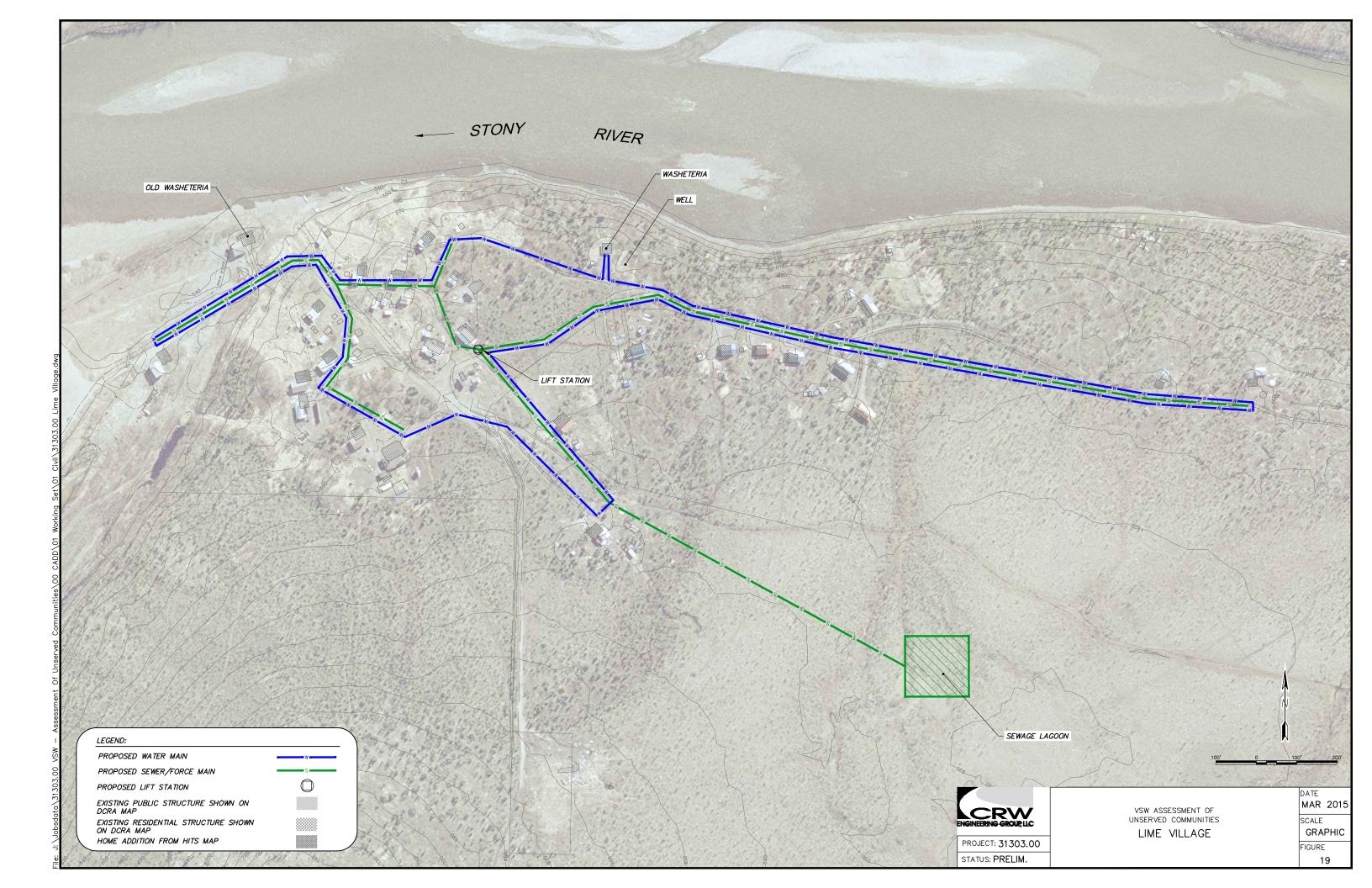
		Village			
	Estimated Capital Costs			Lime Village	
					•
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	19	\$28,096.69	\$533,837
2	Sewage collection mains or services (gravity or force), buried	LF	6,300	\$417.48	\$ 2,630,154
4	Sewage lift station	EA	1	\$ 1,397,322.77	\$ 1,397,323
10	Sewage lagoon, barrow, local material	Acre	1	\$1,675,613.17	\$1,005,368
13	Water distribution, mains or services, buried	LF	8,600	\$417.57	\$3,591,126
14	Water storage tank, no foundation	Gal	44,105	\$10.90	\$480,951
15	Water treatment plant, no foundation	SF	800	\$2,542.06	\$2,033,649
18	Foundation - freeze back piles	SF	1,560	\$720.07	\$1,123,307
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$12,796,000
	Total	with Inf	lation (3% pe	r year for 6 years)	\$15,279,100
27	Individual Grinder Pump Stations	EA	19	\$30,000	\$570,000
28	Electrical Service Upgrades	EA	19	\$5,500	\$104,500
		•		Subtotal	\$15,953,600
29	Construction Contingency (15%)	LS	1	\$2,393,000	\$2,393,000
30	Design & Construction Administration Services (20%)	LS	1	\$3,190,700	\$3,190,700
				Total	\$21,537,300

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs	
Description	Cost
Administration	\$6,000
Labor	\$25,000
Fuel	\$31,700
Electricity	\$28,800
Other (R&R, Training, etc.)	\$12,800
Total	\$104,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Lime Village are listed below.

Estimated User Fees							
Revenue Source	Month	nly Rate	# of Customers	Collection Rate		Yearly evenues	
Residential Service	\$	478	11	85%	\$	53,576	
Public/Commercial Service	\$	525	8	100%	\$	50,424	
School Service	\$	-	0	100%	\$	-	
Local Capital Contribution					\$	-	
Total Revenue					\$:	104,000	



VSW Unserved Communities - Piped Water & Sewer System Type and Sizing Model					
Date		zilig iviouei			
Community		3/23/2016 Lime Village			
Input		zime timage			
			•		
Existing Community & System Data			•		
2015 Population		29			
2015 Number of Services		19			
HITS Database (E1 & H1-H7) DCED Mapping Commerical/Public Facilities/School		11 8			
Type (surface water or groundwater)		GW			
Water quality (Poor or Good)		Good			
Water Storage Tank		95			
Water Treatment Capacity		15			
Existing Sewage Lagoon Size		0			
Soil Conditions (check only one)			•		
Soft poorly drained soils or discontinuous permafrost		x			
Firm soils, or continuous permafrost					
Stiff soils, no permafrost					
Piping Configurations (check all that apply)			Sewer Main Length	Water Main	
Buried system with no permafrost			(ft)	Length (ft)	
Above ground system or buried with permafrost		Х	4900	7200	
Gravity Sewer Main		,	.500	, 200	
Pressure Sewer Main		Х	4900		
Typical Service Line Length (ea)			75	75	
Piped System Requirements	Community	Lime Village			
Output for Cost Model (calculated)					
			Foundatio	n Size	
Water Treatment Capacity (gpm)		2	=	_	
Req Water Storage (gallons) (less existing)	(-6)	44,105	760	sf	
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (st)	0.6	800	sf	
Req Sewage Lagoon Size (acre) (less existing)		0.6	Quantity	Notes	
			Quantity	Notes	
		Pile Foundation (sf)			
Required Foundation System for WTP and/or WST			800		
nicquired i curiation cyclem for this unity or the			555		
Water Distribution System		Circulating Water Main with			
,					
	The state of the s		7,200		
		Pitorifices (If)	7,200		
			7,200		
		Pitorifices (If) Sewer Main with Glycol Heat Trace			
Wastewater Collection System		Pitorifices (If)	7,200 4,900		
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace			
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace	4,900		
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If)			
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	4,900		
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	4,900		
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	4,900		
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	4,900		
Wastewater Collection System Water & Sewer Service Lines		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	4,900 19		
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	4,900		
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	4,900 19		
	Dinad Control	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	4,900 19		
	Piped System Need	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	4,900 19		
Water & Sewer Service Lines		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	1,400 1,400		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	1,400 1,400		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 2 44,200 800	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	1,400 1,400 Net Need - 44,105 800		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 2 44,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95	1,400 1,400 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	2 44,200 800 0.6	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95 -	1,400 1,400 Net Need - 44,105 800 0.6		
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation	Need 2 44,200 800	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95	1,400 1,400 Net Need - 44,105 800		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	2 44,200 800 0.6	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95 -	1,400 1,400 Net Need - 44,105 800 0.6		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System	Need 2 44,200 800 0.6	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95 -	1,400 1,400 Net Need		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf)	Need 2 44,200 800 0.6	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95 -	1,400 1,400 Net Need		
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Need 2 44,200 800 0.6 1,560	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95	1,400 1,400 Net Need - 44,105 800 0.6 1,560 7,200		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 2 44,200 800 0.6 1,560 7,200 4,900 19	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95	1,400 1,400 Net Need - 44,105 800 0.6 1,560 7,200 4,900 19		
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Need 2 44,200 800 0.6 1,560 7,200 4,900 4,900	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 15 95	1,400 1,400 Net Need - 44,105 800 0.6 1,560 7,200		

VSW III	served Communities - Piner	Water & Sower	System Type and Sizing Model
Date	•	water & Jewer	System Type and Sizing Model
Community	Lime Village		
System Parameters	Model Results		Criteria & Calculations
Design Population			20
Duration (n) 2015 Population (P)		years people	20 years 2015 ADOL
2015 Number of Services		services	
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	35	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity Average Day (ADD)		gpm	EO gallana nos Conita
Max Day (MDD)	1,769 3,539		50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	2	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW	4	
Required Capacity	2	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW) Daily Operation (DO) (gallons)	Applicable 3 539	gallons	Max Day (MDDx1 day)
Fire Flow (FF)		gallons	500 gpm for 60 minutes
Reserve Volume (RV)	10,616	gallons	3 days x DO
Water Storage Tank Volume CT Based Volume (min if source is SW)	44,154 Not Required	gallons	DO + FF + RV
Chlorine Residual Concentration (RC)	The state of the s	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH) Contact Time Required (CT)	7	minutes	7 LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*		gallons	CT/RCxPeak Hour/BF
Required Water Storage Required Additional Storage		gallons gallons	0
Estimate of Min Platform Size (3' clearance		-	
around)	760	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
Water Treatment Plant Requirements*			0
Water Quality	Good]	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	800	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous		Pile Foundation	Pile Foundation
permafrost	x	(sf)	
Firm soils, or continuous permafrost Stiff soils, no permafrost	0		Thermosyphon stabilized gravel pad Gravel pad
Still soils, no permanost	Ů		Graver pau
Water Distribution (Check either or both)	0	1	Static Water Mains
Buried system with no permafrost	0	Circulating	Static water Mains
Above ground system or buried with	×	Water Main	Circulating Water Main with Pitorifices
permafrost	î	with Pitorifices	circulating water wain with restricts
		(lf)	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0	1	Bare sewer main, no heat trace
		Sewer Main	
Above ground or buried with permafrost	x	with Glycol	Sewer main with glycol heat trace
Gravity Sewer Main	0	Heat Trace (If)	Lift stations for gravity sewer mains, every 1,000 ft
		Individual	
Pressure Sewer Main	x	Grinder Pump Stations (GPS)	Individual Grinder Pump Stations
		Stations (GPS)	
		(ea)	
		(ea)	
Water & Sewer Services (Check all that apply)		(ea)	
	0		Static Water Service Line
Water & Sewer Services (Check all that apply) Static Water Main	0	Circulating	
Water & Sewer Services (Check all that apply)			Static Water Service Line Circulating Water Service Lines
Water & Sewer Services (Check all that apply) Static Water Main	0	Circulating Water Service	
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x	Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x	Circulating Water Service Lines (If)	Circulating Water Service Lines
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main	0 x	Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x	Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 x	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 x	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 x 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x 0 x 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x 0 0 0.3 92.9 0.6	Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Lime Village	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	19	\$28,096.69	\$533,837
2	Sewage collection mains or services (gravity or force), buried	LF	6,300	\$417.48	\$2,630,154
	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	1	\$1,397,322.77	\$1,397,323
	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
	Drainfield, community	SF	0	#DIV/0!	\$0
	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
	Sewage lagoon, barrow, local material	Acre	0.6	\$1,675,613.17	\$1,005,368
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	8,600	\$417.57	\$3,591,126
14	Water storage tank, no foundation	Gal	44,105	\$10.90	\$480,951
	Water treatment plant, no foundation	SF	800	\$2,542.06	\$2,033,649
	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	1,560	\$720.07	\$1,123,307
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$12,795,715

Community:	Lime Village
Gonoral Community Data	

General Community Data

General Community Data	
Current population Average number of people per house Service Connections	29 persons 2.6
Number of houses Number of public/commerical buildings Number of schools	11 8 0
Total number of service connections	19
Burdened labor rate Electricity cost (Public facilty) Electricity cost (Residential service) Cost per gallon for heating oil	\$20 hr \$0.82 kWh \$0.96 kWh \$6.00 gal
Water consumption per capita Wastewater generation per capita	50 gpd 50 gpd
Water & Sewer System Characteristics Water Source	
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line Water line heated for freeze protection (Yes or No)	GW 750 ft No
Location of water line (Above ground (AG) or Buried) Water Treatment	AG
Size of water treatment plant building Raw water quality (Good or Poor)	1472 sf Good
Water Storage Size of tank(s) Length of water line to/ from tank Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	44,200 gallons 50 ft No AG
Water Distribution Type of system (Static or Circulating (Circ)) Number of circulating water loops Total length of Water Main Water mains heated for freeze protection (Yes or No) Location of the mains (Above ground (AG) or Buried) Average service line length	Circ 1 7200 ft Yes Buried 75 ft
Wastewater Collection Type of system (Gravity or Pressure) Number of individual facility pump stations Number of community lift/pump stations Number of facilities served by lift/pump station #1 Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5	Pressure 1 18
Size of lift stations Total length of sewer mains Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried) Average service line length	500 sf 4900 ft Yes 2 Buried 75 ft
Wastewater Treatment / Disposal Length of force main Force main heated for freeze protection (Yes or No) Location of force main (Above ground (AG) or Buried) Lagoon discharged seasonally with pump (Yes or No)	1340 ft Yes Buried Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	24	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$451	/month		\$3,608.54
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$106	/month		\$846.34
Water storage tank	\$40	/month		\$322.48
Water storage tank line	\$0	/month		\$0.00
Water mains	\$946	/month		\$11,347
Service lines	\$187	/month		\$2,246
Wastewater system				
Sewer mains	\$644	/month		\$7,722
Service lines	\$187	/month		\$2,246
Lift/pump station buildings	\$153	/month		\$1,225.73
Force main to lagoon	\$176	/month		\$2,112
			Subtotal	\$31,700
Electricity				
<u>Water system</u>				
WTP building				
Lights and controls	·	/month		\$4,227
HVAC/hydronic system	*	/month		\$4,227
Water treatment	\$4	/month		\$43
Pumps				
Intake or well	•	/month		\$216.87
WST circulation	·	/month		\$886
Pressure/booster	·	/month		\$325.31
Main line circulation	\$881	/month		\$10,568
Wastewater system				
Lift /pump station buildings				
Lights and controls	* -	/month		\$1,436
HVAC/hydronic system	\$120	/month		\$957
Pumps				
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	·	/month		\$425.86
Sewer/force main glycol circulation	·	/month		\$5,274
Lagoon discharge pump	\$260	/year	Subtotal	\$260 \$28,800
Other Costs			Gubiolai	Ψ20,000
	¢4.070	lyoor		\$4,273
Equipment R&R	\$4,273 \$2,564	/year		. ,
Miscellaneous materials & supplies	\$2,564	•		\$2,564
Water quality testing	\$2,000	•		\$2,000
Operator training		/year		\$2,500 \$1,500
Insurance	\$1,500	ryear	Cubtatal	\$1,500
			Subtotal	\$12,800

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$31,700
Electricity	\$28,800
Other	\$12,800
Total	\$104,000

Revenue M	/lonthly	# of		,	Yearly
Source F	Rate	Customers	Collection Rate	Re	evenues
Residential Serv S	\$ 478	11	85%	\$	53,576
Public/Commerc \$	525.25	8	100%	\$	50,424
School Service (5	5 -	0	100%	\$	-
Local Capital Con	tribution			\$	-
Total Revenue				\$	104.000

Mekoryuk, Alaska

Community Information & Existing Infrastructure

The City of Mekoryuk is a Yupik community of 210 people on Nunivak Island. There are 97 residential units, 19 commercial/public facilities and one school for a total of 117 services. The existing water and sewer services provided in Mekoryuk consist of a Cowater flush, tank and haul system at each building. The existing water and sewer infrastructure consists of the following:

- River Infiltration Gallery 100 gpm transfer pump
- Water Treatment Plant/Washeteria 1540 sf, built in 1990
- Raw Water Reservoir 7.5 million gallons Treated water storage 125,000 gallons
- Direct Filtration Treatment 25 gpm
- Sewage Lagoon 4.3 acres

Soil conditions in the community generally consist of a mix of thaw stable sand and wet or ice-rich silts. Discontinuous permafrost, shallow groundwater and occasional basalt flows exist. Any new foundations should consist of driven piles or thermosyphen stabilized gravel pads.

Piped System Description

The piped water system will be an above grade system roughly 14,900 feet in length. The pressure sewer will consist of roughly 6,500 feet of pipe above grade and 3,000 below grade. Only areas east of the school can be buried due to soil conditions. The pressure sewer system would require individual grinder pump stations at each house, and glycol heat trace for freeze protection. Approximately 8,800 feet of water and sewer service piping would be required; and a third of this could be buried (2,900). For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment. The existing water storage tank is sufficient to meet CT requirements (91,000 gallons) and provide a small reserve for fire flows.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	18	25	-
Water Storage (gallons)	91,000	125,000	-
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	2.9	4	-
Required Foundation System for WTP and/or WST			
Thermosyphen stabilized gravel pad (sf)	1,200	-	1,200
Water Distribution System			
Circulating Water Main with Pitorifices (If)	14,900	-	14,900
Wastewater Collection System			
Insulated Sewer Main with Glycol Heat Trace (If)	9,500	-	9,500
Residential Grinder Pump Stations (GPS) (ea)	117	-	117
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	8,800	-	8,800
Pressure Sewer Service w GPS (If)	8,800	-	8,800

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Mekoryuk. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

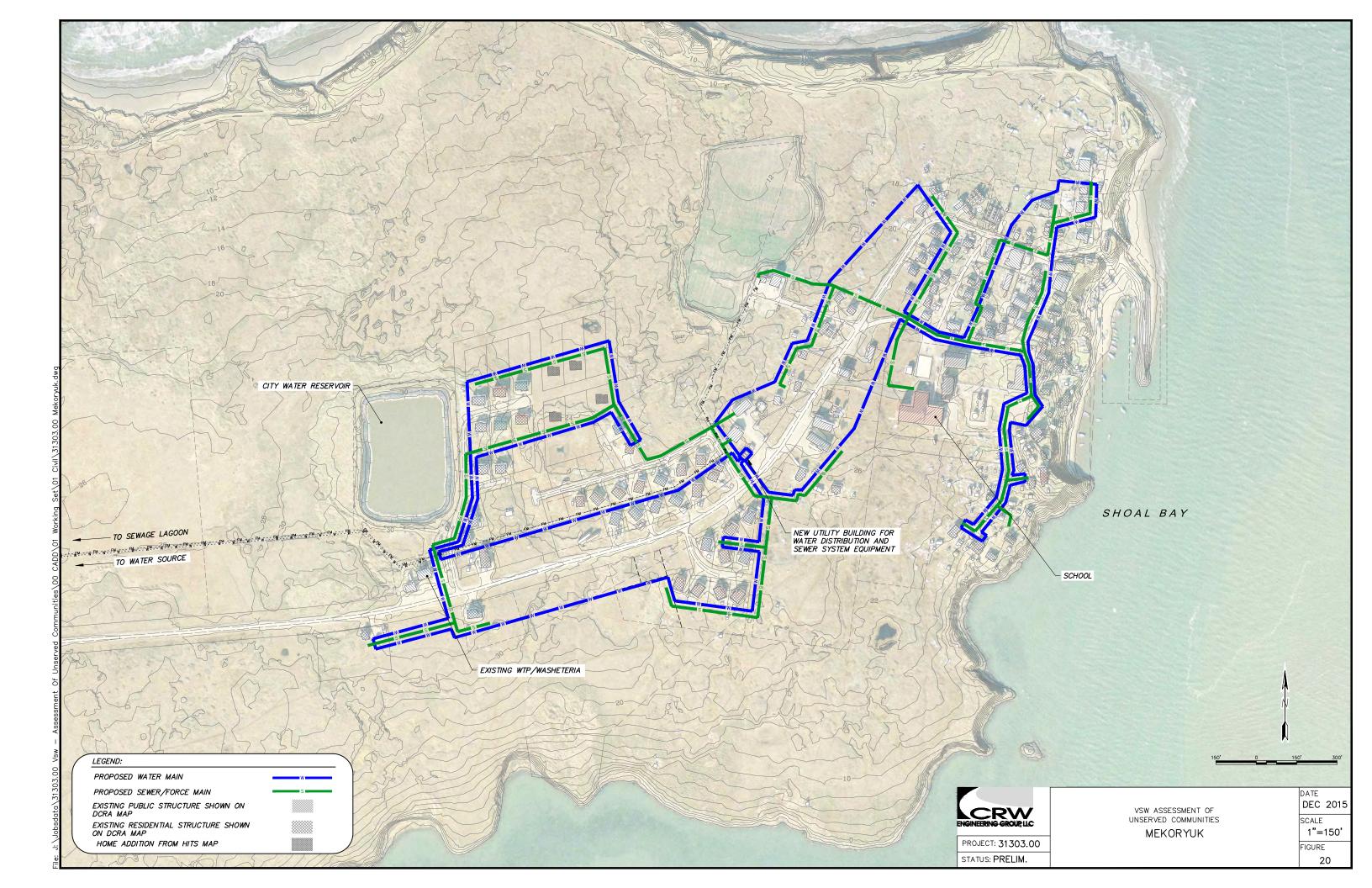
				Village	
	Estimated Capital Costs			Mekoryuk	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	117	\$ 26,342.77	\$ 3,082,104
2	Sewage collection mains or services (gravity or force), buried	LF	5,900	\$293.55	\$ 1,731,936
3	Sewage collection mains or services (gravity or force), above ground	LF	12,400	\$201.57	\$ 2,499,422
4	Sewage lift station	EA	1	\$ 746,130.80	\$ 746,131
12	Water distribution, mains or services, above ground	LF	23,700	\$328.77	\$7,791,873
15	Water treatment plant, no foundation	SF	1,200	\$1,633.35	\$1,960,015
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$513.76	\$616,510
			Total Es	timated Cost (rounded):	\$18,428,000
		Total w	rith Inflation ((3% per year for 6 years)	\$22,004,000
27	Residential Grinder Pump Stations	EA	117	\$30,000	\$3,510,000
28	Electrical Service Upgrades	EA	117	\$5,500	\$643,500
	•			Subtotal	\$26,157,500
29	Construction Contingency (15%)	LS	1	\$2,615,800	\$2,615,800
30	Design & Construction Administration Services (20%)	LS	1	\$5,231,500	\$5,231,500
				Total	\$34,004,800

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs	
Description	Annual Cost
Administration	\$6,000
Labor	\$45,800
Fuel (Heating)	\$94,800
Electricity	\$18,600
Other (R&R, Training, etc.)	\$18,700
Total	\$184,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Mekoryuk are listed below:

Estimated User Fees						
			# of	Collection		
Revenue Source	Mon	thly Rate	Customers	Rate	Yea	arly Revenues
Residential Service	\$	104	97	85%	\$	102,783
Public/Commercial Service	\$	192	19	100%	\$	43,818
School Service	\$	4,155	1	100%	\$	37,398
Local Capital Contribution					\$	-
Total Revenue					\$	184,000



VSW Unserved Commu	nities - Piped \	Nater & Sewer System Type and Siz	ing Model	
Date	•	2/9/2016		
Community		Mekoryuk		
Inpu	•	IVIEKOI YUK		
			•	
Existing Community & System Data		Γ	Ī	
2015 Population 2015 Number of Services		210 117		
HITS Database (E1 & H1-H7)		97		
DCED Mapping Commerical/Public Facilities/School		20		
Type (surface water or groundwater)		SW		
Water quality (Poor or Good)		poor		
Water Storage Tank		125000		
Water Treatment Capacity		25		
Existing Sewage Lagoon Size		4.3		
Soil Conditions (check only one) Soft poorly drained soils or discontinuous permafrost			Ī	
Firm soils, or continuous permafrost		x		
Stiff soils, no permafrost		^		
•			Sewer Main Length	Water Mair
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost			0500	4
Above ground system or buried with permafrost		X	9500 0	14900
Gravity Sewer Main Pressure Sewer Main		X	9500	
Typical Service Line Length (ea)		^	75	75
Piped System Requirements	Community	Mekoryuk		
Output for Cost Model (calculated)	Community	ivieroi yur		
output for cost model (calculated)			Foundatio	n Size
Water Treatment Capacity (gpm)		18		
Req Water Storage (gallons)		91,000	1,370	sf
Req W&S Utility Bldg/Water Treatment Plant/Addition	on (sf)	1,200	1,200	sf
	- (-)			_
Req Sewage Lagoon Size (acre)		2.9		
			Quantity	Notes
			Quarterly	
				Only need
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)		foundation fo
				bldg, not tank
Water Distribution System		Circulating Water Main with Pitorifices		
		(If)	14,900	
Mantager Callesting Contage		Sewer Main with Glycol Heat Trace (If)	9,500	
Wastewater Collection System				
		Posidential Grinder Burne Stations (CDS)		
		Residential Grinder Pump Stations (GPS) (ea)	20	
			20	
		(ea)		
Water & Sewer Service Lines			8,800	
Water & Sewer Service Lines		(ea) Circulating Water Service Lines (If)	8,800	
Water & Sewer Service Lines		(ea)		
Water & Sewer Service Lines		(ea) Circulating Water Service Lines (If)	8,800	
	Piped System	(ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If)	8,800 8,800	
Water & Sewer Service Lines System Description	Piped System Need	(ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If)	8,800	
System Description		(ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If)	8,800 8,800	
System Description Water Treatment Capacity (gpm)	Need	Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility	8,800 8,800	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 18 91,000 1,200	(ea) Circulating Water Service Lines (if) Pressure Sewer Service w/GPS (if) Existing Facility 25 125,000	8,800 8,800 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 18 91,000	Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility	8,800 8,800 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	18 91,000 1,200 2.9	Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 25 125,000 - 4.3	8,800 8,800 Net Need 1,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	Need 18 91,000 1,200	(ea) Circulating Water Service Lines (if) Pressure Sewer Service w/GPS (if) Existing Facility 25 125,000	8,800 8,800 Net Need - - - 1,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	18 91,000 1,200 2.9	Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 25 125,000 - 4.3	8,800 8,800 Net Need 1,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 18 91,000 1,200 2.9 1,200 14,900	Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 25 125,000 - 4.3	8,800 Net Need 1,200 - 1,200 14,900	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) Was Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (if)	Need 18 91,000 1,200 2.9 1,200 1,200 9,500	Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 25 125,000 - 4.3	8,800 Net Need - 1,200 - 14,900 9,500	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (lf) Residential Grinder Pump Stations (GPS) (ea)	Need 18 91,000 1,200 2.9 1,200 14,900	Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 25 125,000 - 4.3	8,800 Net Need 1,200 - 1,200 14,900	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) Was Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (if)	Need 18 91,000 1,200 2.9 1,200 1,200 9,500	Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 25 125,000 - 4.3	8,800 Net Need - 1,200 - 14,900 9,500	

VSW/IIn	served Communities	- Pined	Water & Sewer	System Type and Sizing Model
Date	2/9/2016	- ripeu	water & sewer	System Type and Sizing Model
Community	Mekoryuk			
System Parameters	Model Results	3		Criteria & Calculations
Design Population				
Duration (n) 2015 Population (P)			years people	20 years 2015 ADOL
2015 Number of Services			services	
Growth Rate (i)		1%		1%
2035 Design Population (Capita)		256	people	Px(1+i)^n
Water Demand Estimates			1	
Existing Capacity Average Day (ADD)		25 12,812	gpm	50 gallons per Capita
Max Day (MDD)		25,624		2 x ADD
Peak Hour			gpm	3 x MDD
Treatment Capacity		18	gpm	MDD
Water Source Assumptions				
Type (surface water or groundwater)		SW		SW or GW
Required Capacity		18	gpm	MDD
Water Storage Tank Sizing			1	
Existing Water Storage Tank Demand Based Volume (if source is GW)	Check Min CT Require	125000	gallons	
Daily Operation (DO) (gallons)	Check Willi CT Require	25,624	gallons	Max Day (MDDx1 day)
Fire Flow (FF)		30,000		500 gpm for 60 minutes
Reserve Volume (RV)		76,872	-	3 days x DO DO + FF + RV
Water Storage Tank Volume CT Based Volume (min if source is SW)	Required	132,496	Panons	55 · · my
Chlorine Residual Concentration (RC)			mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		1.0 4.4	-	1.0-log Inactivation 4.4 celsius/40 F
Temperature (T) pH (PH)		4.4 7		4.4 ceisius/40 F
Contact Time Required (CT)			minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)		0.1	gallans	0.1
Required Volume to meet CT* Required Water Storage (CT or demand)		90,773 91,000	-	CT/RCxPeak Hour/BF Vg = volume in gallons
Estimate of Min Platform Size (3' clearance		1,374		D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)		2,07 .	9	o sizoskig (2/2/ ii zo assamed (ii s neight or talin)
Water Treatment Plant Requirements*				
Water Quality	poor	4 000		Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size		1,200	<i>s</i> र्ग	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			1	
Soft poorly drained soils or discontinuous permafrost	0			Pile foundation
permanosc			Thermosyphon	
Firm soils, or continuous permafrost	x			Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		pad (sf)	Gravel pad
Water Distribution (Check either or both) Buried system with no permafrost	0			Static Water Mains
			Circulating	
Above ground system or buried with permafrost	x		Water Main with Pitorifices	Circulating Water Main with Pitorifices
permanose			(If)	
Wastewater Collection (Check all that apply)				
Buried system with no permafrost	0			Bare sewer main, no heat trace
Above ground or buried with permafrost	x		Sewer Main with Glycol	Insulated sewer main with glycol heat trace
5 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			Heat Trace (If)	
Gravity Sewer Main	0		Residential	Lift stations for gravity sewer mains, every 1,000 ft
Draggura Courar M-1-			Grinder Pump	Residential Crinder Rump Stations
Pressure Sewer Main	х		Stations (GPS)	Residential Grinder Pump Stations
			(ea)	
Water & Sewer Services (Check all that apply)				
Water & Sewer Services (Check all that apply)	0			Static Water Service Line
	0		Circulating	Static Water Service Line
Water & Sewer Services (Check all that apply) Water Service Type	0 x		Water Service	Static Water Service Line Circulating Water Service Lines
			_	
Water Service Type Gravity Sewer Main	x 0		Water Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Water Service Type	х		Water Service Lines (If) Pressure Sewer Service w/GPS	Circulating Water Service Lines
Water Service Type Gravity Sewer Main Pressure Sewer Main	x 0		Water Service Lines (If) Pressure Sewer	Circulating Water Service Lines Gravity Service Line
Water Service Type Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size	x 0		Water Service Lines (If) Pressure Sewer Service w/GPS (If)	Circulating Water Service Lines Gravity Service Line
Water Service Type Gravity Sewer Main Pressure Sewer Main	x 0	4.3	Water Service Lines (If) Pressure Sewer Service w/GPS	Circulating Water Service Lines Gravity Service Line
Water Service Type Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	x 0	4.3	Water Service Lines (If) Pressure Sewer Service w/GPS (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Water Service Type Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	x 0	4.3 2.2 250.0	Water Service Lines (If) Pressure Sewer Service w/GPS (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Water Service Type Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0	4.3 2.2 250.0 2.9	Water Service Lines (If) Pressure Sewer Service w/GPS (If) acres acres	Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per

Capital Cost Estimate Piped Water & Sewer System

Village	
Mekoryuk	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	117	\$26,342.77	\$3,082,104
	Sewage collection mains or services (gravity or force), buried	LF	5,900	\$293.55	\$1,731,936
3	Sewage collection mains or services (gravity or force), above ground	LF	12,400	\$201.57	\$2,499,422
4	Sewage lift station	EA	1	\$746,130.80	\$746,131
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0	#DIV/0!	\$0
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	23,700	\$328.77	\$7,791,873
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
15	Water treatment plant, no foundation	SF	1,200	\$1,633.35	\$1,960,015
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	1,200	\$513.76	\$616,510
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$18,427,991

Community:	Mekoryuk	
General Community Dat	a	
Current population Average number Service Connect	of people per house	210 persons 2.2
Number of he Number of pu Number of so	ublic/commerical buildings	97 19 1 ce connections 117
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon fo	Public facilty) Residential service)	\$22 hr \$0.42 kWh \$0.20 kWh \$6.00 gal
Water consumpti Wastewater gene	·	50 gpd 50 gpd
Water & Sewer System (Water Source	Characteristics	
Type of syste Length of rav Water line he	em (Surface(SW) or Groundwater(GW)) water line wated for freeze protection (Yes or No) water line (Above ground (AG) or Buried)	SW 22100 ft No AG
	treatment plant building lality (Good or Poor)	1200 sf Poor
Water line he	s) ter line to/ from tank ated for freeze protection (Yes or No) ater line (Above ground (AG) or Buried)	125,000 gallons 30 ft Yes AG
Number of ci Total length o Water mains Location of th Number of se	n m (Static or Circulating (Circ)) reculating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) ervice line circ pumps rice line length	Circ 2 14850 ft Yes AG 75 ft
Number of in Number of co Number of Number of Number of Number of	ection ection em (Gravity or Pressure) dividual facility pump stations ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #4	Pressure 2
Sewer mains Number of ci Location of the	t stations of sewer mains heated for freeze protection (Yes or No) roulating glycol loops ne mains (Above ground (AG) or Buried) rice line length	500 sf 9500 ft Yes 2 AG 75 ft
Location of fo		5100 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Labor (Operator)
Between 50 and 100 services 32 hrs/week More than 100 services 40 hrs/week Fuel (Heating) 32 hrs/week Available energy per gallon of heating fuel Heating season (above ground components) 100,000 BTUs/gallon months Heating season (buried components) 12 months Buildings 7 BTU/hrsf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gallon Water storage tank 0.5 BTU/hr/ft Buried mains (permafrost conditions) 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Use watts/hr/sf Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.5 watts/gallon Good quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation
More than 100 services40hrs/weekFuel (Heating)100,000BTUs/gallonAvailable energy per gallon of heating fuel Heating season (above ground components)8monthsHeating season (buried components)12monthsBuildings7BTU/hr/sfRaw water heat addition (5F)40BTU/gallonWater storage tank0.5BTU/gal-dayAbove ground mains5BTU/hr/ftBuried mains (permafrost conditions)3BTU/hr/ftElectricityWTP buildingLights and controls HVAC/hydronic system0.4watts/hr/sfWater treatment0.4watts/hr/sfWater treatment0.5watts/gallonPoor quality water0.5watts/gallonWater system pumps0.5watts/gallonIntake or well MST circulation0.5watts/gallonMsin line circulation Service line circulation Service line circulation0.75watts/gallonSewer system pumps
Fuel (Heating) Available energy per gallon of heating fuel Heating season (above ground components) Heating season (buried components) Buildings Raw water heat addition (5F) Water storage tank Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Poor quality water Poor quality water Water system pumps Intake or well WST circulation West in a circulation Service line circulation Service line circulation Sewer system pumps Into Available energy per gallon of heating fuel 100,000 BTUs/gallon BTUs/gallon BTU/hr/ft BTU
Available energy per gallon of heating fuel Heating season (above ground components) Heating season (buried components) Heating season (buried components) Buildings Raw water heat addition (5F) Water storage tank Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Good quality water Poor quality water Poor quality water Poor quality water Poor quality water Uster system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Sewe
Available energy per gallon of heating fuel Heating season (above ground components) Heating season (buried components) Heating season (buried components) Buildings Raw water heat addition (5F) Water storage tank Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Good quality water Poor quality water Poor quality water Poor quality water Poor quality water Uster system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Sewe
Heating season (above ground components) Heating season (buried components) Buildings Raw water heat addition (5F) Raw water heat addition (5F) Water storage tank Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Good quality water Poor quality water Poor quality water Poor quality water Poor quality water Nater system pumps Intake or well WST circulation Pressure/booster Main line circulation Main line circulation Sewer system pumps Sewer system pumps Into KWH/month/service Sewer system pumps Sewer system pumps Sewer system pumps Sewer system pumps Sewer system pumps
Heating season (buried components) Buildings Raw water heat addition (5F) Raw water heat addition (5F) Water storage tank Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Water treatment Good quality water Good quality water Poor quality water Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Service line circulation Service line circulation Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps
Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment Good quality water 0.1 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Service line circulation 34 kWh/month/service
Raw water heat addition (5F) Water storage tank Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Good quality water Good quality water Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Service line circulation Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps
Water storage tank Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Poor quality water Poor quality water Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps Water system pumps Sever system pumps Water system pumps Sever system pumps Water system pumps WST circulation Service line circulation Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps Sever system pumps
Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Poor quality water Poor quality water Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps Intake or well Sever system pumps Interest in a system pumps Interest in a
Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Poor quality water Poor quality water Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps Intake or well Sewer system pumps Intake or well Sewer system pumps Intake or well Sewer system pumps Intake or well In
Electricity WTP building Lights and controls HVAC/hydronic system 0.4 watts/hr/sf Water treatment Good quality water Poor quality water Poor quality water Utter to well Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps Intake or well Sewer system pumps Intake or well In
WTP building Lights and controls Lights and controls HVAC/hydronic system 0.4 watts/hr/sf Water treatment Good quality water Poor quality water 0.1 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps Intake or well WST circulation Pressure/booster 0.75 watts/gallon Wish/month Pressure/booster 0.75 watts/gallon Main line circulation Service line circulation 34 kWh/month/service Sewer system pumps
Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment Good quality water 0.1 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Service line circulation 34 kWh/month/service Sewer system pumps
HVAC/hydronic system Water treatment Good quality water Poor quality water Utater system pumps Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps 0.4 watts/hr/sf watts/gallon watts/gallon watts/gallon watts/gallon 135 kWh/month watts/gallon 135 kWh/month 135 kWh/month Wh/month/loop Service line circulation 34 kWh/month/service
Water treatment Good quality water Poor quality water United by the system pumps Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps 0.1 watts/gallon watts/gallon watts/gallon 135 kWh/month watts/gallon 135 kWh/month Wh/month/loop Wh/month/loop Wh/month/loop Wh/month/loop Wh/month/loop Wh/month/service
Good quality water Poor quality water O.5 watts/gallon Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps 0.5 watts/gallon Wth/month 135 kWh/month 135 kWh/month 135 kWh/month 135 kWh/month 137 kWh/month/loop 137 kWh/month/loop 138 kWh/month/loop 139 kWh/month/loop 140 kWh/month/service
Poor quality water Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps 0.5 watts/gallon watts/gallon 135 kWh/month watts/gallon 1074 kWh/month/loop kWh/month/loop 34 kWh/month/service
Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps 0.5 watts/gallon kWh/month 9.75 watts/gallon 1074 kWh/month/loop kWh/month/loop kWh/month/service
Intake or well WST circulation Pressure/booster Main line circulation Service line circulation Sewer system pumps 0.5 watts/gallon kWh/month watts/gallon 1074 kWh/month/loop kWh/month/service
WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Service line circulation 34 kWh/month/service Sewer system pumps
Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Service line circulation 34 kWh/month/service Sewer system pumps
Main line circulation 1074 kWh/month/loop Service line circulation 34 kWh/month/service Sewer system pumps
Service line circulation 34 kWh/month/service Sewer system pumps
Sewer system pumps
Individual facility pump stations 0.7 watts/gallon/service
3
Community lift stations 0.6 watts/gallon
Sewer main glycol circulation 268 kWh/month/loop
Force main 0.6 watts/gallon
Lagoon discharge 0.6 watts/gallon
Other Costs
Equipment R&R 5 % of labor, fuel and electricity
Miscellaneous materials & supplies 3 % of labor, fuel and electricity
Water quality testing \$2,000 per year
Operator training \$2,500 per year
Insurance \$1,500 per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	40	hrs/week		\$45,760
Fuel (Heating Demand)				
Water system				
WTP building	\$368	/month		\$2,941.75
Raw water line		/month		\$0.00
Raw water heat addition	\$766	/month		\$6,128.64
Water storage tank	\$114	/month		\$912.00
Water storage tank line	\$7	/month		\$52.53
Water mains	\$3,250	/month		\$26,003
Service lines	\$1,921	/month		\$15,365
Wastewater system				
Sewer mains	\$2,079	/month		\$16,635
Service lines	\$1,921	/month		\$15,365
Lift/pump station buildings	\$306	/month		\$2,451.46
Force main to lagoon	\$1,116	/month		\$8,930
			Subtotal	\$94,800
Electricity				
Water system				
WTP building				
Lights and controls	,	/month		\$1,765
HVAC/hydronic system	\$147	/month		\$1,177
Water treatment	\$67	/month		\$804
Pumps				
Intake or well	* -	/month		\$804.38
WST circulation	* -	/month		\$454
Pressure/booster		/month		\$1,206.58
Main line circulation		/month		\$7,217
Service line circulation	\$0	/month		\$0.00
Wastewater system				
Lift /pump station buildings	0.400	,		A
Lights and controls	·	/month		\$1,471
HVAC/hydronic system	\$123	/month		\$981
Pumps	¢ο.	/maanath		ФО.
Individual facility pump stations	·	/month		\$0 \$0.00
Community lift/pump station(s)	* -	/month		\$0.00
Sewer/force main glycol circulation	·	/month		\$1,801 \$966
Lagoon discharge pump	φθΟΟ	/year	Subtotal	\$18,600
Other Costs				
Equipment R&R	\$7,958	/year		\$7,958
Miscellaneous materials & supplies	\$4,775	•		\$4,775
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	/year		\$2,500
Insurance	\$1,500	•		\$1,500
			Subtotal	\$18,700

Summary

Administration	\$6,000
Labor	\$45,800
Fuel	\$94,800
Electricity	\$18,600
Other	\$18,700
Total	\$184,000

Revenue I	Monthly	# of		,	Yearly
Source F	Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 104	97	85%	\$	102,783
Public/Commerc :	\$ 192	19	100%	\$	43,818
School Service (\$ 4,155	1	100%	\$	37,398
Local Capital Con	tribution			\$	-
Total Revenue				\$	184,000

Mertarvik, Alaska

Community Information & Existing Infrastructure

Mertarvik is the new site for the village of Newtok. Newtok is a traditional Yupik Eskimo village of 380 people. Mertarvik is located on the Nelson Island off the coast of Baird Inlet. There will be approx. 92 residential units, 7 commercial/public facilities and one school for a total of 100 services.

Mertarvik is situated on a side of a hill where the elevation difference between the highest point and lowest point of the community is greater than 200 feet. The only existing infrastructure in Mertarvik is the Mertarvik Evacuation Center (MEC) and a mat stabilized road from the boat landing to the MEC building.

The soil in Mertarvik generally consists of approx. 18 inches of peat layer on the surface, and a layer of silt with organics under the layer of peat. Bedrock was encountered from as little as 4 feet to more than 31.5 feet below ground surface.

Piped System Description

The piped water and gravity sewer system will be a buried system. The water system will consist of approximately 16,700 feet of pipe, and the gravity sewer system approximately 19,200 feet of pipe. The water system will consist of two circulating loops. It is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	32	15	17
Water Storage (gallons)	215,500	-	215,500
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	8.1	-	8.1
Required Foundation System for WTP and/or WST			
Pile Foundation (sf)	1,200	-	1,200
Thermosyphon Stabilized Gravel Pad (sf)	2,900	-	2,900
Water Distribution System			
Circulating Water Main with Pitorifices (If)	16,700	-	16,700
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	19,200	-	19,200
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	7,500	-	7,500
Gravity Sewer Service Lines (If)	7,500	-	7,500

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Mertarvik. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30).

				Village	
	Estimated Capital Costs			Newtok	
			ı		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	100	\$26,342.77	\$2,634,277
2	Sewage collection mains or services (gravity or vacuum), buried	LF	26,700	\$248.45	\$6,633,553
4	Sewage lift station	EA	1	\$ 662,130.80	\$ 662,131
10	Sewage lagoon, barrow, local material	Acre	8.1	\$682,797.07	\$5,530,656
13	Water distribution, mains or services, buried	LF	24,200	\$276.80	\$6,698,458
14	Water storage tank, no foundation	Gal	215,500	\$2.52	\$542,212
15	Water treatment plant, no foundation	SF	1,200	\$1,608.15	\$1,929,775
18	Foundation - freeze back piles	SF	1,200	\$426.48	\$511,777
19	Foundation - thermosyphen stabilized gravel pad	SF	2,900	\$261.95	\$759,659
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$26,056,000
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$31,112,200
28	Electrical Service Upgrades	EA	100	\$5,500	\$550,000
				Subtotal	\$31,662,200
29	Construction Contingency (15%)	LS	1	\$4,749,300	\$4,749,300
30	Design & Construction Administration Services (20%)	LS	1	\$6,332,400	\$6,332,400
				Total	\$42,743,900

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs			
Barret attack	01		
Description	Cost		
Administration	\$6,000		
Labor	\$33,300		
Fuel	\$103,000		
Electricity	\$28,900		
Other (R&R, Training, etc.)	\$19,200		
Total	\$190,000		

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Mertarvik are listed below.

Estimated User Fees					
Revenue Source	Mor	nthly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	116	92	85%	\$ 108,691
Public/Commercial Service	\$	347	7	100%	\$ 29,188
School Service	\$	5,791	1	100%	\$ 52,121
Local Capital Contribution					\$ -
Total Revenue					\$ 190,000

VSW Unserved Communi	ties - Pined W	ater & Sewer System Type and Si	zing Model	
Date	-	9/9/2016	8	
Community		Mertarvik		
Inpu	t			
Existing Community & System Data				
2015 Population		380		
2015 Number of Services HITS Database (E1 & H1-H7)		100 92		
DCED Mapping Commerical/Public Facilities/School		8		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Good		
Water Storage Tank Water Treatment Capacity		0 15		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)		-		
Soft poorly drained soils or discontinuous permafrost		х		
Firm soils, or continuous permafrost		х		
Stiff soils, no permafrost			Sewer Main Length	Water Main
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost				
Above ground system or buried with permafrost Gravity Sewer Main		X X	19200 19200	16700
Pressure Sewer Main		Α	13200	
Typical Service Line Length (ea)			75	75
Pivote store Power				
Piped System Requirements Output for Cost Model (calculated)	Community	Mertarvik		
Coulput for Cost Moder (calculated)			Foundatio	n Size
Water Treatment Capacity (gpm)		32		
Req Water Storage (gallons) (less existing)		215,500	2,900	sf
Req W&S Utility Bldg/Water Treatment Plant/Addition	n (sf)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		8.1	Quantity	Notes
			-,,	Notes
		Pile Foundation (sf)	1,200	
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	2,900	
		(3.1)		
Mater Distribution System				
Water Distribution System		Circulating Water Main with	16,700	
		Pitorifices (If)		
		Sewer Main with Glycol Heat Trace (If)	19,200	
Wastewater Collection System				
		Lift Stations for Gravity Sewer	1	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	7,500	
Water & Sewer Service Lines		Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	7,500 7,500	
Water & Sewer Service Lines			,	
Water & Sewer Service Lines			,	
Water & Sewer Service Lines			,	
Water & Sewer Service Lines System Description	Piped System	Gravity Sewer Service Lines (If)	,	
System Description	Need	Gravity Sewer Service Lines (If) Existing Facility	7,500	
		Gravity Sewer Service Lines (If)	7,500 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 32 215,500 1,200	Existing Facility 15	7,500 Net Need 17 215,500 1,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 32 215,500	Gravity Sewer Service Lines (If) Existing Facility 15	7,500 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 32 215,500 1,200	Existing Facility 15	7,500 Net Need 17 215,500 1,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Thermosyphon stabilized gravel pad (sf)	Need 32 215,500 1,200 8.1	Existing Facility 15	7,500 Net Need 17 215,500 1,200 8.1	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Thermosyphon stabilized gravel pad (sf) Water Distribution System	Need 32 215,500 1,200 8.1 1,200 2,900	Existing Facility 15	7,500 Net Need 17 215,500 1,200 8.1 1,200 2,900	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Thermosyphon stabilized gravel pad (sf)	Need 32 215,500 1,200 8.1	Existing Facility 15	7,500 Net Need 17 215,500 1,200 8.1	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf)	Need 32 215,500 1,200 8.1 1,200 2,900	Existing Facility 15	7,500 Net Need 17 215,500 1,200 8.1 1,200 2,900	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Water & Sewer Service Lines	Need 32 215,500 1,200 8.1 1,200 2,900 16,700	Existing Facility 15	7,500 Net Need 17 215,500 1,200 8.1 1,200 2,900 16,700 19,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) Wass Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if)	Need 32 215,500 1,200 8.1 1,200 2,900	Existing Facility 15	7,500 Net Need 17 215,500 1,200 8.1 1,200 2,900 16,700	

= -	nserved Communities - Piped	Water & Sewer	System Type and Sizing Model
Date Community	9/9/2016 Mertarvik		
System Parameters	Model Results		Criteria & Calculations
Design Population Duration (n)	20	years	20
2015 Population (P)	380	people	20 years 2015 ADOL
2015 Number of Services Growth Rate (i)	100	services	1%
2035 Design Population (Capita)		people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity Average Day (ADD)	15 23,184	gpm gpd	50 gallons per Capita
Max Day (MDD)	46,367	gpd	2 x ADD
Peak Hour Treatment Capacity	97 32	gpm gpm	3 x MDD MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW		
Required Capacity	32	gpm	MDD
Water Storage Tank Sizing Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW)	Applicable	Iganons	
Daily Operation (DO) (gallons) Fire Flow (FF)	46,367 30,000	gallons	Max Day (MDDx1 day) 500 gpm for 60 minutes
Reserve Volume (RV)		gallons	3 days x DO
Water Storage Tank Volume		gallons	DO + FF + RV
CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC)		mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI) Temperature (T)	1.0 4.4	log inactivation	1.0-log Inactivation 4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT) Baffling Coefficient (BF)	49 0.1	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC) 0.1
Required Volume to meet CT*	164,255	gallons	CT/RCxPeak Hour/BF
Required Water Storage Required Additional Storage	215,500 215,500	gallons gallons	0
Estimate of Min Platform Size (3' clearance	2,900	-	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)	,	•	0
Water Treatment Plant Requirements* Water Quality	Good	1	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size		sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	x	Pile Foundation	Pile Foundation
permafrost		(sf) Thermosyphon	
Firm soils, or continuous permafrost	x	stabilized gravel pad (sf)	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0	, puu (9)/	Gravel pad
Water Distribution (Check either or both)		1	
Buried system with no permafrost	0		Static Water Mains
1		Circulatina	
Above ground system or buried with permafrost	x	Circulating Water Main	Circulating Water Main with Pitorifices
Above ground system or buried with permafrost	x	-	Circulating Water Main with Pitorifices
· .	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
Wastewater Collection (Check all that apply)		Water Main with Pitorifices	
Wastewater Collection (Check all that apply) Buried system with no permafrost	0	Water Main with Pitorifices (If) Sewer Main	Bare sewer main, no heat trace
Wastewater Collection (Check all that apply)		Water Main with Pitorifices (If) Sewer Main	
Wastewater Collection (Check all that apply) Buried system with no permafrost	0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat	Bare sewer main, no heat trace
Wastewater Collection (Check all that apply) Buried system with no permafrost	0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer	Bare sewer main, no heat trace
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (Iff) Sewer Main with Glycol Heat Trace (If) Lift Stations for	Bare sewer main, no heat trace Sewer main with glycol heat trace
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every	Bare sewer main, no heat trace Sewer main with glycol heat trace
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 x x 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea)	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea) Circulating Water Service	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x x 0 0 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea)	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x x 0 0 x x x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea) Circulating Water Service Lines (If)	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x x 0 0 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea) Circulating Water Service Lines (If) Gravity Sewer	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size	0 x x 0 0 x x x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x x 0 x x 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea) Circulating Water Service Lines (If) Gravity Sewer	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size	0 x x 0 x x 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x x 0 0 x x x 0 0 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x x 0 0 x x x 0 0 0 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Lift Stations for Gravity Sewer Mains, every 1,000 ft (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,

Capital Cost Estimate Piped Water & Sewer System

Village	
Newtok	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	100	\$26,342.77	\$2,634,277
2	Sewage collection mains or services (gravity or vacuum), buried	LF	26,700	\$248.45	\$6,633,553
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	1	\$662,130.80	\$662,131
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	8.1	\$682,797.07	\$5,530,656
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	24,200	\$276.80	\$6,698,458
14	Water storage tank, no foundation	Gal	215,500	\$2.52	\$542,212
15	Water treatment plant, no foundation	SF	1,200	\$1,608.15	\$1,929,775
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	1,200	\$426.48	\$511,777
19	Foundation - thermosyphen stablized gravel pad	SF	2,900	\$261.95	\$759,659
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$26,056,095

Community:	Mertarvik		
General Community Date	ta		
Current population	on	380	persons
Service Connect		4.1	
Number of h	ouses ublic/commerical buildings	92 7	
Number of se	chools	1	
	Total number of servi	ce connections 100	
Burdened labor i		\$20	
Electricity cost (F	Public facility) Residential service)	\$0.40 \$0.20	
Cost per gallon f	•	\$6.00	
Water consumpt	ion per capita	50	gpd
Wastewater gen	eration per capita	50	gpd
Water & Sewer System Water Source	Characteristics		
	em (Surface(SW) or Groundwater(GW))	GW	_
Length of rav	w water line eated for freeze protection (Yes or No)	155 Yes	tt
	vater line (Above ground (AG) or Buried)	Buried	
Water Treatmen	<u>t</u>		
	treatment plant building	1200	sf
Raw water q	uality (Good or Poor)	Good	
<u>Water Storage</u> Size of tank(e)	215,500	gallone
,	ter line to/ from tank	100	•
	eated for freeze protection (Yes or No)	Yes	
	vater line (Above ground (AG) or Buried)	Buried	
Water Distribution	on em (Static or Circulating (Circ))	Circ	
	rculating water loops	2	
•	of Water Main	16700	ft
	heated for freeze protection (Yes or No) he mains (Above ground (AG) or Buried)	Yes Buried	
	vice line length	75	ft
Wastewater Coll	ection ection		
	em (Gravity or Pressure)	Gravity	
	dividual facility pump stations ommunity lift/pump stations	0	
	of facilities served by lift/pump station #1	100	
	of facilities served by lift/pump station #2		
	of facilities served by lift/pump station #3 of facilities served by lift/pump station #4		
	of facilities served by lift/pump station #5		
	ft stations	500	
	of sewer mains s heated for freeze protection (Yes or No)	19200 Yes	π
Number of ci	rculating glycol loops	5	
	he mains (Above ground (AG) or Buried)	Buried	4
_	vice line length	75	IL
Wastewater Trea Length of for	atment / Disposal ce main	3200	ft
Force main h	neated for freeze protection (Yes or No)	No	
	orce main (Above ground (AG) or Buried)	Buried	
Septic system	m discharged seasonally with pump (Yes or No	Yes	

Operation & Maintenance Cost Assumptions

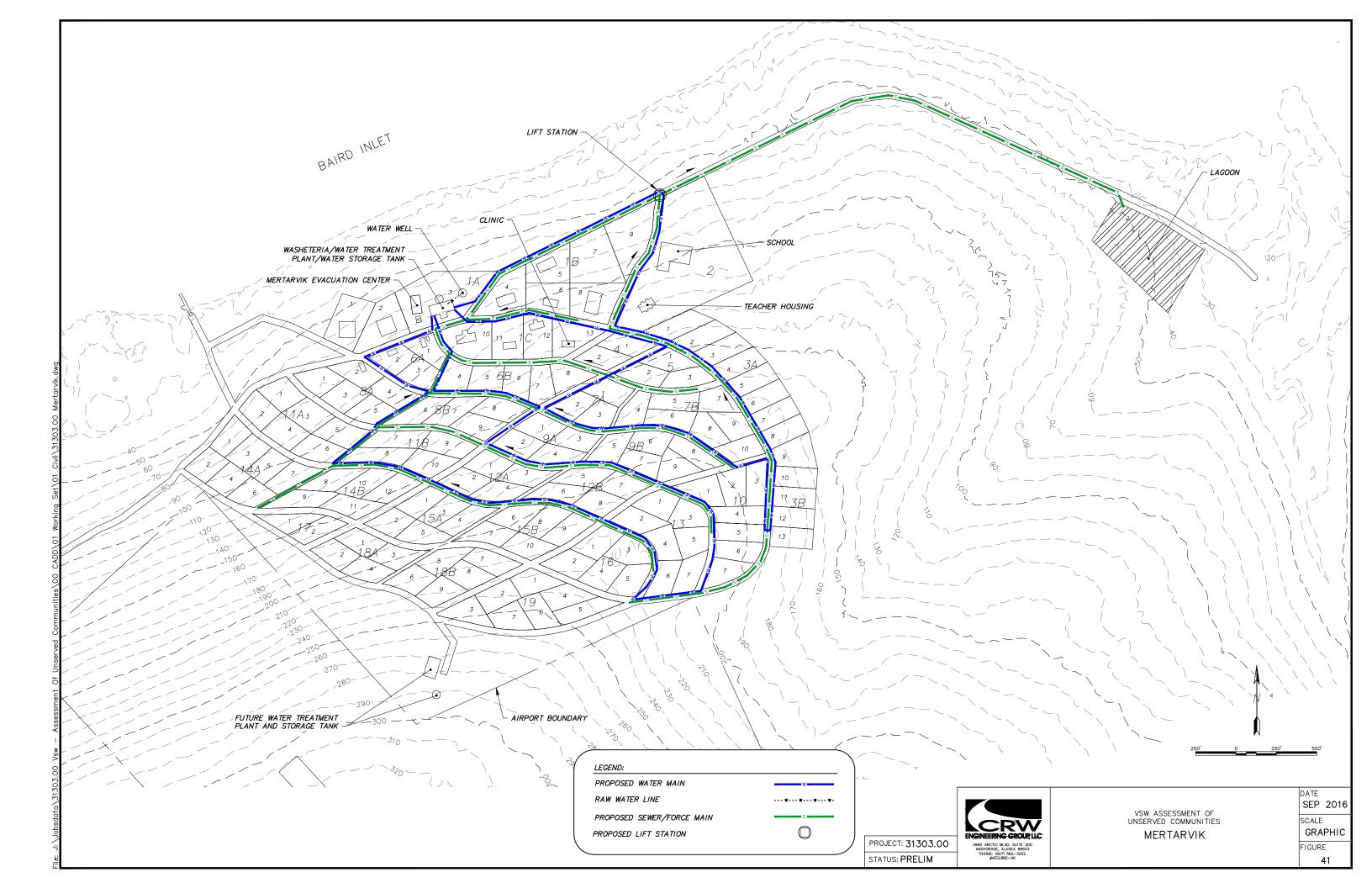
Labor (Operator)	Administration Billing, CCR and management	\$500	/month
Between 50 and 100 services 32 hrs/week More than 100 services 40 hrs/week Fuel (Heating) 100,000 BTUs/gallon Available energy per gallon of heating fuel 100,000 BTUs/gallon Heating season (buried components) 8 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building 4 watts/hr/sf Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/gallon Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Water system pumps<			
More than 100 services 40 hrs/week Fuel (Heating) Fuel (Heating) BTUs/gallon Available energy per gallon of heating fuel 100,000 BTUs/gallon Heating season (above ground components) 8 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building STU/hr/ft Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.5 watts/gallon Good quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month/loop Sewer system pumps Water system gumps Water system gumps Individual facility pump stations 0.6<	Less than 50 services	24	hrs/week
Available energy per gallon of heating fuel	Between 50 and 100 services	32	hrs/week
Available energy per gallon of heating fuel Heating season (above ground components) 8 months months months Heating season (buried components) 12 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.5 watts/gallon Good quality water 0.5 watts/gallon Water system pumps 11 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon/service Main line circulation 0.7 watts/gallon/service Sewer system pumps 0.7 watts/gallon/service Individual facility pump stations 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.	More than 100 services	40	hrs/week
Available energy per gallon of heating fuel Heating season (above ground components) 8 months months months Heating season (buried components) 12 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.5 watts/gallon Good quality water 0.5 watts/gallon Water system pumps 11 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon/service Main line circulation 0.7 watts/gallon/service Sewer system pumps 0.7 watts/gallon/service Individual facility pump stations 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.	Fuel (Heating)		
Heating season (above ground components) 8 months Heating season (buried components) 12 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gall-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 5 BTU/hr/ft Buried mains (permafrost conditions) 5 BTU/hr/ft Electricity WTP building 0.4 watts/hr/sf Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.1 watts/gallon Water treatment 0.1 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 10.5 watts/gallon Sewer system pumps 0.6 watts/gallon Individual facility pump stations 0.7		100,000	BTUs/gallon
Buildings 7 BTU/ns/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building User the controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf watts/hr/sf Water treatment 0.4 watts/gallon watts/gallon Poor quality water 0.5 watts/gallon watts/gallon Water system pumps 0.5 watts/gallon watts/gallon Intake or well 0.5 watts/gallon watts/gallon WST circulation 0.75 watts/gallon watts/gallon Pressure/booster 0.75 watts/gallon watts/gallon Sewer system pumps 0.6 watts/gallon Individual facility pump stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6		8	•
Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Lights and controls 0.4 watts/hr/sf Lights and controls 0.4 watts/hr/sf Wtex (Mate) 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/pr/sf watts/pr/sf watts/pr/sf Water treatment 0.0 watts/gallon watts/gallon watts/gallon Poor quality water 0.5 watts/gallon sewer system pumps not watts/gallon watts/gallon watts/gallon sewer system pumps not watts/gallon watts/gallon watts/gallon sewer main glycol circulation 268 kWh/month/loop watts/gallon sewer main glycol circulation 0.6 watts/gallon watts/gallon object costs wa	Heating season (buried components)	12	months
Water storage tank Above ground mains Buried mains (permafrost conditions)5 BTU/hr/ft BURIED BURIED BURIED BURIED WTP building Lights and controls HVAC/hydronic system Water treatment Good quality water Poor quality water Water system pumps Intake or well Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Seyer main glycol circulation Seyer system discharge0.7 Watts/gallon Sewer main glycol circulation Septic system discharge0.7 Watts/gallon Watts/gallon Watts/gallonOther Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training\$2,000 \$2,000 \$2,500\$2,000 \$2,000 \$2,500	Buildings	7	BTU/hr/sf
Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Water treatment Good quality water Poor quality water Poor quality water Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Sever system PT filt description Sever system ground Sever system discharge Operator training Sever system Sever system glycol circulation Sever system discharge Sever system discharge Sever system discharge Sever system discharge Sever system system discharge Sever system disch	Raw water heat addition (5F)	40	BTU/gallon
Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps 0.7 watts/gallon/service Individual facility pump stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Septic system discharge 5 % of labor, fuel and electricity Miscellaneous materials & supplies 3 % of labor, fuel and electricity Water quality testing \$2,000 per year	Water storage tank	0.5	BTU/gal-day
Electricity WTP building Lights and controls HVAC/hydronic system Outlet watts/hr/sf Water treatment Good quality water Poor quality water Outlet or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies WST cylous and controls WST circulation Main line circulation Miscellaneous materials & supplies WST circulation Miscellaneous materials & supplies WST circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Main line circulation Matts/gallon Matts/gallon Watts/gallon Watts/gallon Matts/gallon Matt	Above ground mains	5	BTU/hr/ft
WTP building Lights and controls Lights and controls HVAC/hydronic system Water treatment Good quality water Poor quality water Poor quality water O.5 watts/gallon Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water system pumps Individual facility pump stations Septic system discharge Other Costs Sequer main Septic system discharge Other Costs Sequer main system of the water system of the wate	Buried mains (permafrost conditions)	3	BTU/hr/ft
WTP building Lights and controls Lights and controls HVAC/hydronic system Water treatment Good quality water Poor quality water Poor quality water O.5 watts/gallon Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water system pumps Individual facility pump stations Septic system discharge Other Costs Sequer main Septic system discharge Other Costs Sequer main system of the water system of the wate	Electricity		
Lights and controls HVAC/hydronic system Water treatment Good quality water Poor quality water Official and system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sever main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Other Costs Individual facility testing Operator training Other Costs Sever water Sever w			
HVAC/hydronic system Water treatment Good quality water Good quality water Poor quality water Uster system pumps Intake or well WST circulation Pressure/booster Main line circulation Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sever main Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O.1 watts/gallon Watts/	G	0.4	watts/hr/sf
Water treatment Good quality water Good quality water Poor quality water Usafe system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O.1 watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon/service Watts/gallon	· ·	0.4	watts/hr/sf
Poor quality water Water system pumps Intake or well NST circulation Water system pumps Intake or well NST circulation Nain line circulation Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Natts/gallon Neatts/gallon			
Poor quality water Water system pumps Intake or well NST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Natis/gallon N	Good quality water	0.1	watts/gallon
Intake or well WST circulation Horessure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Watte, gallon Matts/gallon Matts/	Poor quality water	0.5	•
WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps Individual facility pump stations 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Septic system discharge 0.6 watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Miscellaneous materials & supplies Water quality testing Operator training \$2,000 per year	Water system pumps		J
WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps Individual facility pump stations 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Septic system discharge 0.6 watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Miscellaneous materials & supplies Water quality testing Operator training \$2,000 per year	Intake or well	0.5	watts/gallon
Main line circulation1074kWh/month/loopSewer system pumps0.7watts/gallon/serviceIndividual facility pump stations0.6watts/gallonCommunity lift stations0.6watts/gallonSewer main glycol circulation268kWh/month/loopForce main0.6watts/gallonSeptic system discharge0.6watts/gallonOther CostsEquipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year	WST circulation	135	· ·
Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Force main Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Sewer system by the stations O.6 watts/gallon watts/gallon Watts/gallon Watts/gallon **Of labor, fuel and electricity **Of labor, fuel and electricity **Special Section of the supplies of the station of the station of the supplies o	Pressure/booster	0.75	watts/gallon
Individual facility pump stations Community lift stations Sewer main glycol circulation Force main Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O,0 watts/gallon watts/gallon watts/gallon watts/gallon watts/gallon o,6 watts/gallon watts/gallon of labor, fuel and electricity \$2,000 per year \$2,000 per year	Main line circulation	1074	•
Community lift stations Sewer main glycol circulation Force main Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O.6 watts/gallon watts/gallon Wat	Sewer system pumps		•
Sewer main glycol circulation Force main Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Sewer main glycol circulation 0.6 Watts/gallon watts/gallon watts/gallon watts/gallon % of labor, fuel and electricity \$2,000 per year per year per year	Individual facility pump stations	0.7	watts/gallon/service
Sewer main glycol circulation Force main Septic system discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Sewer main glycol circulation 0.6 Watts/gallon watts/gallon watts/gallon watts/gallon % of labor, fuel and electricity \$2,000 per year per year per year	Community lift stations	0.6	watts/gallon
Force main Septic system discharge 0.6 watts/gallon watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Miscellaneous materials & supplies 3 % of labor, fuel and electricity Water quality testing \$2,000 per year Operator training \$2,500 per year		268	kWh/month/loop
Other Costs5% of labor, fuel and electricityEquipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year		0.6	watts/gallon
Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training 5 % of labor, fuel and electricity \$2,000 per year \$2,500 per year	Septic system discharge	0.6	watts/gallon
Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training 5 % of labor, fuel and electricity \$2,000 per year \$2,500 per year	Other Costs		
Water quality testing \$2,000 per year Operator training \$2,500 per year	Equipment R&R	5	% of labor, fuel and electricity
Operator training \$2,500 per year	Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Operator training \$2,500 per year	Water quality testing	\$2,000	per year
	Operator training	\$2,500	per year
	Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	32	hrs/week		\$33,280
Fuel (Heating Demand)				
Water system				
WTP building	\$368	/month		\$2,941.75
Raw water line	\$20	/month		\$244.27
Raw water heat addition	\$1,386	/month		\$16,634.88
Water storage tank	\$197	/month		\$1,572.29
Water storage tank line	\$13	/month		\$157.59
Water mains	\$2,193	/month		\$26,318
Service lines	\$985	/month		\$11,820
Wastewater system				
Sewer mains		/month		\$30,258
Service lines	*	/month		\$11,820
Lift/pump station buildings	*	/month		\$1,225.73
Force main to septic system	\$0	/month	<u> </u>	\$0
			Subtotal	\$103,000
Electricity				
Water system				
WTP building				
Lights and controls	\$140	/month		\$1,681
HVAC/hydronic system	\$140	/month		\$1,681
Water treatment	\$23	/month		\$277
Pumps				
Intake or well	\$116	/month		\$1,386.24
WST circulation	\$54	/month		\$432
Pressure/booster	\$173	/month		\$2,079.36
Main line circulation	\$859	/month		\$10,310
Wastewater system				
Lift /pump station buildings				
Lights and controls	*	/month		\$700
HVAC/hydronic system	\$58	/month		\$467
Pumps				
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	·	/month		\$1,808.14
Sewer/force main glycol circulation	·	/month		\$6,432
Septic system discharge pump	\$1,664	/year	Subtotal	\$1,664 \$28,900
Other Costs				4_0,000
Equipment R&R	\$8,259	/year		\$8,259
Miscellaneous materials & supplies	\$4,955	,		\$4,955
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	•		\$1,500
	ψ1,500	. ,	Subtotal	\$19,200
			Jubicial	Ψ10,200

Summary

Administration	\$6,000
Labor	\$33,300
Fuel	\$103,000
Electricity	\$28,900
Other	\$19,200
Total	\$190,000

Revenue M	onthly	# of	# of		Yearly
Source Ra	ate	Customers	Collection Rate	Re	evenues
Residential Serv \$	116	92	85%	\$	108,691
Public/Commerc \$	347.48	7	100%	\$	29,188
School Service (\$	5,791.27	1	100%	\$	52,121
Local Capital Contri	ibution			\$	-
Total Revenue				\$	190.000



Napakiak, Alaska

Community Information & Existing Infrastructure

Napakiak is a Yupik Eskimo community of 387 people located on the north bank of the Kuskokwim River, 15 miles southwest of Bethel. There are 98 residential units, 15 commercial/public facilities and one school for a total of 114 services. The existing water and sewer services provided in Napakiak consist of a self-haul system and honey buckets. The school and washeteria have piped sewer that discharges into the school sewage lagoon. The existing water and sewer infrastructure consists of the following:

- Well Water 20 gpm transfer pump
- Treated Water Storage 5,000 gallons
- Water Treatment Plant 480 SF, built in 1986
- Water Treatment Potassium permanganate, greensand filter, chlorination, and fluoridation
- Sewage Lagoon Single Cell, 0.9 acres

Soils around Napakiak consist of poorly drained silt and muck on top of fine silt and black mud. There is shallow groundwater in the area.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The west water system will consist of approximately 9,300 feet of pipe, and the east water system will consist of approximately 8,000 feet of pipe. The pressure sewer system will consist of approximately 14,400 feet of pipe. The west water system will consist of two circulating loops, and the east side will consist of a single loop. The pressure sewer system would require two sewer main lift stations, individual grinder pump stations at each house, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, two new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	33	20	13
Water Storage (gallons)	218,900	5,000	213,900
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	2,400	-	2,400
Sewage Lagoon Size (acre)	8.2	0.9	7.3
Required Foundation System for WTP and/or WST			
Pile Foundation	5,280	-	5,280
Water Distribution System			
Circulating Water Main with Pitorifices (If)	17,300	-	17,600
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	14,400	-	14,400
Individual Grinder Pump Stations (GPS) (ea)	114	-	114
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	8,600	-	8,600
Pressure Sewer Service Lines (If)	8,600	-	8,600

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Napakiak. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

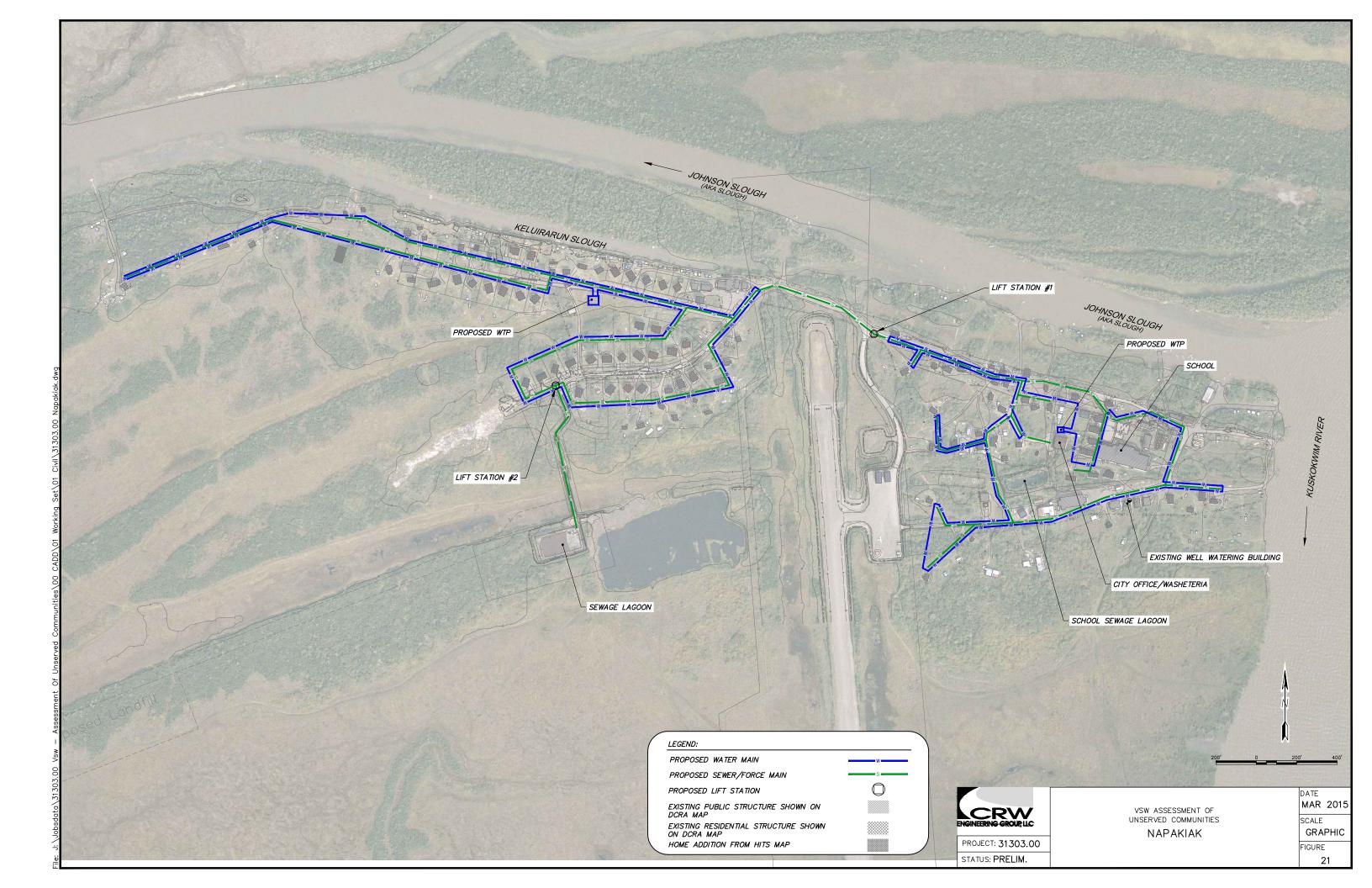
				Village	
	Estimated Capital Costs			Napakiak	
					-
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	114	\$26,403.25	\$3,009,971
3	Sewage collection mains or services (gravity or force), above ground	LF	23,000	\$198.84	\$4,573,319
4	Sewage lift station	EA	2	\$ 579,896.59	\$ 1,159,793
10	Sewage lagoon, barrow, local material	Acre	7	\$692,456.93	\$5,054,936
12	Water distribution, mains or services, above ground	LF	25,900	\$330.44	\$8,558,286
14	Water storage tank, no foundation	Gal	215,100	\$2.57	\$551,936
15	Water treatment plant, no foundation	SF	2,400	\$1,611.05	\$3,866,511
18	Foundation - freeze back piles	SF	5,280	\$309.69	\$1,635,146
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$28,563,000
Total with Inflation (3% per year for 6 years)					\$34,105,700
27	Individual Grinder Pump Stations	EA	114	\$30,000	\$3,420,000
28	Electrical Service Upgrades	EA	114	\$5,500	\$627,000
				Subtotal	\$38,152,700
29	Construction Contingency (15%)	LS	1	\$5,722,900	\$5,722,900
30	Design & Construction Administration Services (20%)	LS	1	\$7,630,500	\$7,630,500
		•	•	Total	\$51,506,100

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs	
Description	Cost
Administration	\$6,000
Labor	\$20,800
Fuel	\$91,000
Electricity	\$46,600
Other (R&R, Training, etc.)	\$18,700
Total	\$183,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Napakiak are listed below.

Estimated User Fees					
Revenue Source	M	onthly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	116	98	85%	\$ 116,100
Public/Commercial Service	\$	139	15	100%	\$ 25,088
School Service	\$	4,646	1	100%	\$ 41,813
Local Capital Contribution					\$ -
Total Revenue					\$ 183,000



Piping Configurations (check all that apply) (ft) Le: Buried system with no permafrost	ater Main ength (ft)
Existing Community & System Data 2015 Population 2015 Number of Services 114 HITS Database (E. & H.1-H7) DCED Mapping Commerical/Public Facilities/School Type (surface water or groundwater) Water quality (Poor or Good) Water Treatment Capacity Existing Sewage Lagoon Size Soil Conditions (check only one) Soft poorly drained soils or discontinuous permafrost Stiff soils, no permafrost Stiff soils, no permafrost Stiff soils, no permafrost Stiff soils, no permafrost Stiff soils, no permafrost Stiff soils, no permafrost Stiff soils, no permafrost Stiff soils, no permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or Buried with permafrost Above ground system or Buried with permafrost Above ground system or Buried with permafrost Above ground system or Buried with permafrost Above ground system or Buried with permafrost Above ground system or Buried with permafrost Above ground system or Buried Water Main with Above Ground Stiff Soil Above Provided Soil Above Soil Abo	
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Req Sewage Lagoon Size (acre) (less existing) 7.3 Quantity Notes Pile Foundation (sf) Water Distribution System for WTP and/or WST Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	
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Wastewater Collection System Sewer Main with Glycol Heat Trace 14,400	
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riessule sewel service Lilles (II) 8,000	
Piped System	
System Description Need Existing Facility Net Need	
Water Treatment Capacity (gpm) 33 20 13	
Water Storage (gallons) 218,900 5,000 213,900 W&S Litility Ridg/Water Treatment Plant / Addition (st) 2,400 - 2,400	
W&S Utility Bldg/Water Treatment Plant/Addition (sf) 2,400 - 2,400 Sewage Lagoon Size (acre) 8.2 0.9 7.3	
Required Foundation System for WTP and/or WST	
Pile Foundation 5,280 - 5,280	
Water Distribution System	
Circulating Water Main with Pitorifices (If) 17,300 - 17,300 Wastewater Collection System	
Sewer Main with Glycol Heat Trace (If) 14,400 - 14,400	
Individual Grinder Pump Stations (GPS) (ea) 114 - 114	
Water & Sewer Service Lines	
Circulating Water Service Lines (If) 8,600 - 8,600	
Pressure Sewer Service Lines (If) 8,600 - 8,600	

More	scored Communities Direct	Water 0 C	System Type and Sizing Model
VSW Ur Date Community	3/23/2016	ı water & Sewer	System Type and Sizing Model
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P) 2015 Number of Services		people services	2015 ADOL
Growth Rate (i)	1%	4	1%
2035 Design Population (Capita)	472	people	Px(1+i)^n
Water Demand Estimates		1	
Existing Capacity		gpm	FO gollons nov Conito
Average Day (ADD) Max Day (MDD)	23,611 47,221		50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	33	gpm	MDD
Water Source Assumptions		,	
Type (surface water or groundwater)	GW	gpm	MDD
Required Capacity	33	gpm	MIDD
Water Storage Tank Sizing	5.000	1	
Existing Water Storage Tank Demand Based Volume (if source is GW)	Applicable 5,000	gallons	
Daily Operation (DO) (gallons)	47,221	gallons	Max Day (MDDx1 day)
Fire Flow (FF)	30,000	-	500 gpm for 60 minutes
Reserve Volume (RV) Water Storage Tank Volume	141,664 218,885		3 days x DO DO + FF + RV
CT Based Volume (min if source is SW)	Not Required		
Chlorine Residual Concentration (RC)		mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI) Temperature (T)	1.0	log inactivation	1.0-log Inactivation 4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*	0.1 167,281		0.1 CT/RCxPeak Hour/BF
Required Water Storage	218,900		or, now controlly of
Required Additional Storage	213,900	gallons	0
Estimate of Min Platform Size (3' clearance around)	2,880	sf	$D = 0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
areana,			0
Water Treatment Plant Requirements* Water Quality	Poor	1	Poor Water Quality (CF or DE) = 1200 cf
Minimum WTP Size	Poor 1,200	sf	Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf
	·	•	
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		Pile Foundation	
permafrost	X	(sf)	Pile Foundation
Firm soils, or continuous permafrost	0		Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both) Buried system with no permafrost	0		Static Water Mains
buried system with no permanost	0	Circulating	Static Water Mains
Above ground system or buried with	x	Water Main	Circulating Water Main with Pitorifices
permafrost		with Pitorifices (If)	
		_	
Wastewater Collection (Check all that apply)		_	
Buried system with no permafrost	0	Causay Marin	Bare sewer main, no heat trace
Above ground or buried with permafrost	x	Sewer Main with Glycol	Sewer main with glycol heat trace
Gravity Sewer Main		Heat Trace (If)	Lift stations for gravity square mains over 1 000 ft
Gravity Sewer Iviain	0	Individual	Lift stations for gravity sewer mains, every 1,000 ft
Pressure Sewer Main	x	Grinder Pump	Individual Grinder Pump Stations
		Stations (GPS) (ea)	
Water & Sewer Services (Check all that apply)		_	
Static Water Main	0	Circulatia c	Static Water Service Line
Circulating Water Main	x	Circulating Water Service	Circulating Water Service Lines
	0	Lines (If)	
Gravity Sewer Main	U	Pressure Sewer	Gravity Service Line
		i ressure sewer	Pressure Service Line with GPS
Pressure Sewer Main	х	Service Lines (If)	
	x	Service Lines (If)	
Sewage Lagoon Size		Service Lines (If)	
Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0.9	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Sewage Lagoon Size Existing Sewage Lagoon	0.9	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0.9 4.0 339.4	acres	
Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0.9 4.0 339.4	acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0.9 4.0 339.4 8.2	acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Napakiak	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	114	\$26,403.25	\$3,009,971
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	23,000	\$198.84	\$4,573,319
4	Sewage lift station	EA	2	\$579,896.59	\$1,159,793
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	7.3	\$692,456.93	\$5,054,936
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	25,900	\$330.44	\$8,558,286
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	215,100	\$2.57	\$551,936
15	Water treatment plant, no foundation	SF	2,400	\$1,611.05	\$3,866,511
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	5,280	\$309.69	\$1,635,146
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$28,563,495

Community:	Napakiak	
General Community Date	a	
Current population Average number Service Connect	of people per house	387 persons 3.9
Number of h Number of p Number of s	ublic/commerical buildings	98 15 1 ce connections 114
Burdened labor i		\$10 hr
Electricity cost (F	Public facilty) Residential service)	\$0.61 kWh \$0.29 kWh \$5.00 gal
Water consumpt Wastewater gen	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source	Characteristics	
Type of syste Length of rav Water line he	em (Surface(SW) or Groundwater(GW)) w water line sated for freeze protection (Yes or No) water line (Above ground (AG) or Buried)	GW 860 ft No AG
Water Treatmen	<u>t</u>	
	treatment plant building uality (Good or Poor)	2880 sf Poor
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	218,900 gallons 100 ft No AG
Water Distribution	o <u>n</u>	
Number of ci Total length	em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No)	Circ 3 17300 ft
Location of the	ne mains (Above ground (AG) or Buried) vice line length	Yes AG 75 ft
	<u>ection</u> em (Gravity or Pressure) dividual facility pump stations	Pressure
Number of co Number Number Number Number Number	ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #5	2 24 114
Size of li Total length Sewer mains Number of ci Location of ti	of facilities served by intributing station #3 if stations of sewer mains it heated for freeze protection (Yes or No) rculating glycol loops the mains (Above ground (AG) or Buried) vice line length	500 sf 14400 ft Yes 2 AG 75 ft
· · · · · · · · · · · · · · · · · · ·	atment / Disposal	750 4
Location of for	ce main neated for freeze protection (Yes or No) orce main (Above ground (AG) or Buried) narged seasonally with pump (Yes or No)	750 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u>		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	40	hrs/week		\$20,800
Fuel (Heating Demand)				
Water system				
WTP building	\$735	/month		\$5,883.49
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$1,176	/month		\$9,411.84
Water storage tank	\$166	/month		\$1,330.91
Water storage tank line	\$0	/month		\$0.00
Water mains	\$3,156	/month		\$25,244
Service lines	\$1,560	/month		\$12,476
Wastewater system				
Sewer mains		/month		\$21,012
Service lines		/month		\$12,476
Lift/pump station buildings	\$255			\$2,042.88
Force main to lagoon	\$137	/month	<u> </u>	\$1,094
			Subtotal	\$91,000
Electricity				
Water system				
WTP building				
Lights and controls	\$513	/month		\$6,152
HVAC/hydronic system	\$513	/month		\$4,102
Water treatment	\$179	/month		\$2,153
Pumps				
Intake or well	\$179	/month		\$2,152.96
WST circulation	\$82	/month		\$659
Pressure/booster	\$269	/month		\$3,229.44
Main line circulation	\$1,965	/month		\$15,723
Wastewater system				
Lift /pump station buildings				
Lights and controls	, -	/month		\$2,136
HVAC/hydronic system	\$178	/month		\$1,424
Pumps				
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	·	/month		\$3,638.06
Sewer/force main glycol circulation	·	/month		\$2,616
Lagoon discharge pump	\$2,585	/year	Subtotal	\$2,585 \$46,600
Other Costs			Gubiolai	Ψ-70,000
Equipment R&R	\$7,920	lyear		\$7,920
Equipment R&R Miscellaneous materials & supplies	\$7,920 \$4,752	•		\$7,920 \$4,752
Water quality testing	\$2,000	,		\$4,732 \$2,000
Operator training		/year		\$2,500
Insurance	\$1,500	•		\$2,500 \$1,500
modratioc	Ψ1,300	, y cai	Subtotal	\$18,700
			Subtotal	φ10,100

Summary

Administration	\$6,000
Labor	\$20,800
Fuel	\$91,000
Electricity	\$46,600
Other	\$18,700
Total	\$183,000

Revenue I	evenue Monthly			,	Yearly
Source Rate		Customers	Collection Rate	Re	evenues
Residential Serv	\$ 116	98	85%	\$	116,100
Public/Commerc	\$ 139.38	15	100%	\$	25,088
School Service (\$ 4,645.85	1	100%	\$	41,813
Local Capital Con	ntribution			\$	-
Total Revenue	_	-	_	\$	183,000

Napaskiak, Alaska

Community Information & Existing Infrastructure

Napaskiak is a Yupik Eskimo community of 451 people located on the east bank of the Kuskokwim River, along the Napaskiak Slough, 7 miles southeast of Bethel. There are 105 residential units, 22 commercial/public facilities and one school for a total of 128 services. Existing water service provided in Napaskiak consists of a self-haul system from either the primary or secondary water plant dispensing points. The existing sewer service consists of honey buckets that are disposed of in honey bucket dump stations located throughout the village. The existing water and sewer infrastructure consists of the following:

- Well Water 40 gpm
- Primary Water Storage 22,000 gallons,
 Secondary Water Storage 22,00 gallons
- Primary Water Treatment Plant 1120 SF, built in 1978, Upgraded in 2004
- Secondary Water Treatment Plant 640
 SF, built in 1994, Upgraded in 2010
- Water Treatment Potassium permanganate, filtration, chlorination
- Sewage Lagoon Two Cell, 2.8 acres

Soils around Napaskiak consist of organic mat underlain by silt and sandy silt. There is a permafrost layer approximately 2-6 feet below ground. Groundwater is present 4.5 feet below surface.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The west water system will consist of approximately 9,700 feet of pipe with two circulating loops. The east water system will consist of approximately 8,500 feet of pipe with a single circulating loop. The pressure sewer system will consist of approximately 12,800 feet of pipe. The pressure sewer system would require one additional sewer main lift station, individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility (West side) and a new 800 sf facility (East side) is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	38	40	-		
Water Storage (gallons)	250,100	44,000	206,100		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	2,000	-	2,000		
Sewage Lagoon Size (acre)	9.6	2.8	6.8		
Required Foundation System for WTP and/or WST					
Pile Foundation	4,780	-	4,780		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	18,200	-	18,200		
Wastewater Collection System					
Sewer Main with Glycol Heat Trace (If)	12,800	-	12,800		
Individual Grinder Pump Stations (GPS) (ea)	128	-	128		
Water & Sewer Service Lines					
Circulating Water Service Lines (If)	9,600	-	9,600		
Pressure Sewer Service Lines (If)	9,600	-	9,600		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Napaskiak. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

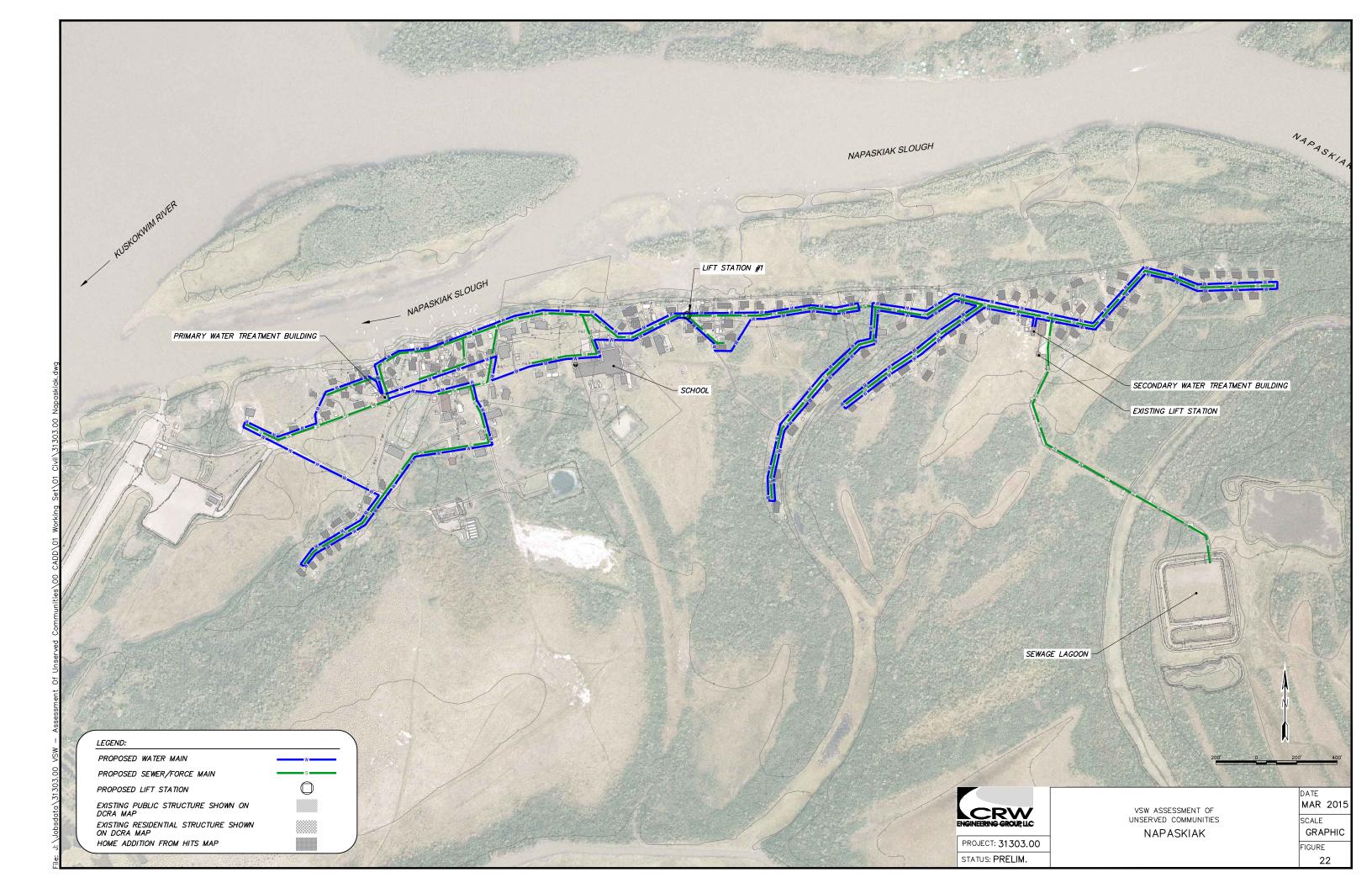
				Village	
	Estimated Capital Costs	Napaskiak			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	128	\$26,403.25	\$3,379,616
3	Sewage collection mains or services (gravity or force), above ground	LF	22,400	\$198.96	\$4,456,791
4	Sewage lift station	EA	1	\$ 678,792.59	\$ 678,793
10	Sewage lagoon, barrow, local material	Acre	7	\$694,724.45	\$4,724,126
12	Water distribution, mains or services, above ground	LF	27,800	\$330.21	\$9,179,951
14	Water storage tank, no foundation	Gal	206,100	\$2.60	\$535,497
15	Water treatment plant, no foundation	SF	2,000	\$1,615.96	\$3,231,912
18	Foundation - freeze back piles	SF	4,780	\$313.57	\$1,498,864
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$27,686,000
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$33,058,500
27	Individual Grinder Pump Stations	EA	128	\$30,000	\$3,840,000
28	Electrical Service Upgrades	EA	128	\$5,500	\$704,000
	Subtotal	\$37,602,500			
29	Construction Contingency (15%)	LS	1	\$5,640,400	\$5,640,400
30	Design & Construction Administration Services (20%)	LS	1	\$7,520,500	\$7,520,500
			-	Total	\$50,763,400

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs						
Description	Cost					
Administration	\$6,000					
Labor	\$31,200					
Fuel	\$149,900					
Electricity	\$32,200					
Other (R&R, Training, etc.)	\$23,100					
Total	\$242,000					

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Napaskiak are listed below.

Estimated User Fees					
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	137	105	85%	\$ 147,179
Public/Commercial Service	\$	172	22	100%	\$ 45,349
School Service	\$	5,497	1	100%	\$ 49,472
Local Capital Contribution					\$ -
Total Revenue					\$ 242,000



vsw Unserved Communi	ies - Piped W	ater & Sewer System Type and Si	zing Model	
Date		3/25/2016		
Community		Napaskiak		
Input				
Existing Community & System Data				
2015 Population		451		
2015 Number of Services		128		
HITS Database (E1 & H1-H7)		105		
DCED Mapping Commerical/Public Facilities/School		23		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		44000		
Water Treatment Capacity		40		
Existing Sewage Lagoon Size		2.8		
Soil Conditions (check only one)				
Soft poorly drained soils or discontinuous permafrost		х		
Firm soils, or continuous permafrost				
Stiff soils, no permafrost			Sewer Main Length	Water Main
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost			(10)	congen (III)
Above ground system or buried with permafrost		X	12800	18200
Gravity Sewer Main				
Pressure Sewer Main		х	12800	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Napaskiak		
Output for Cost Model (calculated)				
			Foundatio	n Size
Water Treatment Capacity (gpm)		38		
Req Water Storage (gallons) (less existing)		206,100	2,780	
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	2,000	2,000	sf
Req Sewage Lagoon Size (acre) (less existing)		6.8		
			Quantity	Notes
		Pile Foundation (sf)		
Required Foundation System for WTP and/or WST			2,000	
Water Distribution System		Circulating Water Main with		
		Pitorifices (If)	18,200	
		Pitorifices (If)	18,200	
			18,200	
		Sewer Main with Glycol Heat Trace	18,200	
Wastewater Collection System			·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace	·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace	12,800	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	12,800	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	12,800 128	
		Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations	12,800	
Wastewater Collection System Water & Sewer Service Lines		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	12,800 128	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	12,800 128 9,600	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	12,800 128	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	12,800 128 9,600	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	12,800 128 9,600	
Water & Sewer Service Lines	Piped System	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	12,800 128 9,600 9,600	
Water & Sewer Service Lines System Description	Need	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	12,800 128 9,600	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm)	Need 38	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	12,800 128 9,600 9,600 Net Need	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 38 250,100	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	12,800 128 9,600 9,600 Net Need	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 38 250,100 2,000	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000	12,800 128 9,600 9,600 Net Need - 206,100 2,000	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 38 250,100	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	12,800 128 9,600 9,600 Net Need	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 38 250,100 2,000	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000	12,800 128 9,600 9,600 Net Need - 206,100 2,000	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	Need 38 250,100 2,000 9.6	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000 - 2.8	12,800 128 9,600 9,600 Net Need - 206,100 2,000 6.8	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation	Need 38 250,100 2,000 9.6	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000 - 2.8	12,800 128 9,600 9,600 Net Need - 206,100 2,000 6.8	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 38 250,100 2,000 9.6 4,780	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000 - 2.8	12,800 128 9,600 9,600 Net Need 206,100 2,000 6.8 4,780	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If)	Need 38 250,100 2,000 9.6 4,780 18,200	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000 - 2.8	12,800 128 9,600 9,600 Net Need - 206,100 2,000 6.8 4,780 18,200	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 38 250,100 2,000 9.6 4,780	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000 2.8	12,800 128 9,600 9,600 Net Need 206,100 2,000 6.8 4,780	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 38 250,100 2,000 9.6 4,780 12,800 128	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000 - 2.8	12,800 128 9,600 Net Need - 206,100 2,000 6.8 4,780 18,200 12,800 128	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 38 250,100 2,000 9.6 4,780 18,200	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 40 44,000 - 2.8	12,800 128 9,600 9,600 Net Need - 206,100 2,000 6.8 4,780 18,200	

	served Communities Di	Water 9. Course	System Type and Sizing Model
Date	nserved Communities - Piped 3/25/2016	water & Sewer	System Type and Sizing Model
Community	Napaskiak		
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services	128	services	1%
Growth Rate (i) 2035 Design Population (Capita)		people	Px(1+i)^n
(11)		, ,	. ,
Water Demand Estimates	40	1	
Existing Capacity Average Day (ADD)	27,515	gpm	50 gallons per Capita
Max Day (MDD)	55,031	0.	2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	38	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW]	
Required Capacity	38	gpm	MDD
Water Storage Tank Sizing			
Water Storage Tank Sizing Existing Water Storage Tank	44,000	gallons	
Demand Based Volume (if source is GW)	Applicable	10	
Daily Operation (DO) (gallons)	55,031		Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)	30,000	_	500 gpm for 60 minutes
Water Storage Tank Volume	165,092 250,122		3 days x DO DO + FF + RV
CT Based Volume (min if source is SW)	Not Required	Ĭ	
Chlorine Residual Concentration (RC)		mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T) pH (PH)	4.4 7		4.4 celsius/40 F 7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*	194,945		CT/RCxPeak Hour/BF
Required Water Storage Required Additional Storage	250,100 206,100	-	0
Estimate of Min Platform Size (3' clearance		-	
around)	2,780	sj	D = $0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
			0
Water Treatment Plant Requirements* Water Quality	Poor	ì	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		Pile Foundation	
permafrost	x	(sf)	Pile Foundation
Firm soils, or continuous permafrost	0		Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)			
Buried system with no permafrost	0		Static Water Mains
		Circulating	
Above ground system or buried with	x	Water Main	Circulating Water Main with Pitorifices
permafrost		with Pitorifices (If)	
Wastewater Collection (Check all that apply)			
	0		Bare sewer main, no heat trace
Wastewater Collection (Check all that apply) Buried system with no permafrost	0	Sewer Main	Bare sewer main, no heat trace
	0 x	with Glycol	Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground or buried with permafrost	х		Sewer main with glycol heat trace
Buried system with no permafrost		with Glycol Heat Trace (lf)	
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	x 0	with Glycol	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground or buried with permafrost	x 0	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Sewer main with glycol heat trace
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	x 0	with Glycol Heat Trace (If) Individual Grinder Pump	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	x 0	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	x 0 x	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	x 0	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	x 0 x	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	x 0 x	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	x 0 x	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 0	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	x 0 x	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 0	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size	x 0 x 0 x 0 x 0 x	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	x 0 x 0 x 0 x 0 x 2.8	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	x 0 x 0 x 0 x 0 x 2.8	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	x 0 x 0 x 0 x 0 x 2.8	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	x 0 x 0 x 0 x 2.88 4.7 366.4	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 0 x 0 x 2.88 4.7 366.4	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 0 x 0 x 2.8 4.7 366.4 9.6	with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Napaskiak	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
	Household water and sewer plumbing	EA	128	\$26,403.25	\$3,379,616
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	22,400	\$198.96	\$4,456,791
4	Sewage lift station	EA	1	\$678,792.59	\$678,793
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	6.8	\$694,724.45	\$4,724,126
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	27,800	\$330.21	\$9,179,951
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	206,100	\$2.60	\$535,497
15	Water treatment plant, no foundation	SF	2,000	\$1,615.96	\$3,231,912
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	4,780	\$313.57	\$1,498,864
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$27,685,550

Community:	Napaskiak	
General Community Dat	a	
Current population Average number Service Connect	of people per house	451 persons 4.3
Number of he Number of po Number of so	ublic/commerical buildings chools	105 22 1
Burdened labor r	Total number of service	ee connections 128 \$15 hr
Electricity cost (F	Public facilty) Residential service)	\$0.36 kWh \$0.34 kWh \$7.65 gal
Water consumpt Wastewater gene	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source	Characteristics	
Type of syste Length of rav Water line he	em (Surface(SW) or Groundwater(GW)) v water line eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	GW 200 ft No AG
	treatment plant building uality (Good or Poor)	3760 sf Poor
Water line he	ter line to/ from tank eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	250,100 gallons 100 ft No AG
Number of ci Total length o Water mains Location of th	n em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) rice line length	Circ 3 18200 ft Yes AG 75 ft
	ection em (Gravity or Pressure) dividual facility pump stations	Pressure
Number of co Number o Number o Number o Number o	ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by existing lift/pump station of facilities served by lift/pump station #3 of facilities served by lift/pump station #4	2 67 128
Size of lit Total length o Sewer mains Number of ci Location of th	of facilities served by lift/pump station #5 t stations of sewer mains heated for freeze protection (Yes or No) rculating glycol loops ne mains (Above ground (AG) or Buried) rice line length	500 sf 12800 ft Yes 3 AG 75 ft
Length of for Force main h Location of fo	ettment / Disposal ce main leated for freeze protection (Yes or No) orce main (Above ground (AG) or Buried) harged seasonally with pump (Yes or No)	1700 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u>		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	40	hrs/week		\$31,200
Fuel (Heating Demand)				
Water system				
WTP building	\$1.469	/month		\$11,752.28
Raw water line		/month		\$0.00
Raw water heat addition	\$2,098	/month		\$16,781.53
Water storage tank	\$291	/month		\$2,326.53
Water storage tank line	\$0	/month		\$0.00
Water mains	\$5,079	/month		\$40,633
Service lines	\$2,679	/month		\$21,433
Wastewater system				
Sewer mains	\$3,572	/month		\$28,577
Service lines	\$2,679	/month		\$21,433
Lift/pump station buildings	\$391	/month		\$3,125.61
Force main to lagoon	\$474	/month		\$3,795
			Subtotal	\$149,900
Electricity				
Water system				
WTP building				
Lights and controls	\$395	/month		\$4,740
HVAC/hydronic system	\$395	/month		\$3,160
Water treatment	\$123	/month		\$1,481
Pumps				
Intake or well	\$123	/month		\$1,480.72
WST circulation	\$49	/month		\$389
Pressure/booster	\$185	/month		\$2,221.08
Main line circulation	\$1,160	/month		\$9,279
Wastewater system				
Lift /pump station buildings				
Lights and controls		/month		\$1,261
HVAC/hydronic system	\$105	/month		\$840
Pumps				
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	• -	/month		\$3,299.90
Sewer/force main glycol circulation		/month		\$2,316
Lagoon discharge pump	\$1,778	/year	Subtotal	\$1,778 \$32,200
Other Costs			Gubiolai	ψ52,200
	\$10 GGE	lyear		\$10 66E
Equipment R&R	\$10,665	•		\$10,665 \$6,300
Miscellaneous materials & supplies	\$6,399 \$2,000	•		\$6,399 \$2,000
Water quality testing Operator training	\$2,500 \$2,500	•		\$2,000
Insurance	\$2,500 \$1,500	•		\$2,500 \$1,500
III SUI AII OC	φ1,500	year	Subtotal	\$23,100
			Gubiolai	Ψ23,100

Summary

Administration	\$6,000
Labor	\$31,200
Fuel	\$149,900
Electricity	\$32,200
Other	\$23,100
Total	\$242,000

Revenue M	onthly	# of		,	Yearly
Source Ra	ate	Customers	Collection Rate	Re	evenues
Residential Serv \$	137	105	85%	\$	147,179
Public/Commerc \$	171.78	22	100%	\$	45,349
School Service (\$	5,496.88	1	100%	\$	49,472
Local Capital Contr	ibution			\$	-
Total Revenue				\$	242,000

Nightmute, Alaska

Community Information & Existing Infrastructure

Nightmute is a Yupik Eskimo community of 274 people located on the Nelson Island, in western Alaska. There are 47 residential units, 28 commercial/public facilities and one school for a total of 76 services. The existing water service provided in Nightmute consists of self-haul system from the central watering point attached to the water treatment plant, and a flush tank and haul system for sewer. The school operates a separate water and sewer system which includes a water supply well, water and wastewater piping and fixtures, three lift stations, wastewater discharging piping, and a sewage lagoon. The existing water and sewer infrastructure consists of the following:

- Summer Seasonal Spring 25 gpm peak flow
- Treated Water Storage 880 gallons
- Water Treatment Plant 480 SF, built in 1986
- Water Treatment Filtration and chlorination

The community currently utilizes a tundra pond approximately 5.6 acres to dispose of the community's waste. While not uncommon in the region, tundra ponds can be extremely difficult to quantify, properly maintain, and permit. For the purposes of this assessment, the tundra pond is not included as an existing "usable" facility.

Soils around Nightmute consist of thin layer of soft, saturated silt occasionally overlain by organic silt 1 foot thick. Permafrost is present approximately 3.5 - 14 feet deep. There is groundwater perched on underlying permafrost near ground surface.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 8,000 feet of pipe, and the pressure sewer system approximately 6,900 feet of pipe. The water system will consist of a single circulating loop. The pressure sewer system would require four sewer main lift stations, individual grinder pump stations at each house, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment. The existing water storage tank is not sufficient to meet CT requirements (118,500 gallons).

The existing water source currently produces enough water to meet the demand of a piped system; however, the water source is seasonal and only provides water during the summer. For the purposes of this assessment, a new well is included to provide year round water to the community. Since the system would rely on both surface water and groundwater sources, water storage would still be subject to meeting CT.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	23	25	-		
Water Storage (gallons)	163,700	880	162,820		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Sewage Lagoon Size (acre)	5.8	-	5.8		
Required Foundation System for WTP and/or WST					
Pile Foundation	3,460	-	3,460		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	8,000	-	8,000		
Wastewater Collection System					
Sewer Main with Glycol Heat Trace (lf)	6,900	-	6,900		
Individual Grinder Pump Stations (GPS) (ea)	76	-	76		
Water & Sewer Service Lines	Water & Sewer Service Lines				
Circulating Water Service Lines (If)	5,700	-	5,700		
Pressure Sewer Service Lines (If)	5,700	-	5,700		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Nightmute. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

				Village	
	Estimated Capital Costs				
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	76	\$26,342.77	\$2,002,051
3	Sewage collection mains or services (gravity or			\$201.39	\$2,537,532
10	Sewage lagoon, barrow, local material	Acre	6	\$709,459.65	\$4,114,866
12	Water distribution, mains or services, above ground	LF	13,700	\$332.29	\$4,552,365
14	Water storage tank, no foundation	Gal	162,820	\$3.13	\$509,024
15	Water treatment plant, no foundation	SF	1,200	\$1,633.35	\$1,960,015
18	Foundation - freeze back piles	SF	3,460	\$328.53	\$1,136,730
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$16,966,000
	Total v	vith Infl	ation (3% pe	year for 6 years)	\$20,258,300
27	Individual Grinder Pump Stations	EA	76	\$30,000	\$2,280,000
28	Electrical Service Upgrades	EA	76	\$5,500	\$418,000
Subtotal					\$22,956,300
29	Construction Contingency (15%)	LS	1	\$3,443,400	\$3,443,400
30	Design & Construction Administration Services (20%)	LS	1	\$4,591,300	\$4,591,300
				Total	\$30,991,000

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs			
Description	Cost		
Administration	\$6,000		
Labor	\$41,600		
Fuel	\$86,400		
Electricity	\$12,100		
Other (R&R, Training, etc.)	\$17,200		
Total	\$163,000		

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Nightmute are listed below.

Estimated User Fees							
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate	Yearly Revenues		
Residential Service	\$	140	47	85%	\$ 67,132		
Public/Commercial Service	\$	154	28	100%	\$ 51,757		
School Service	\$	4,901	1	100%	\$ 44,111		
Local Capital Contribution					\$ -		
Total Revenue					\$ 163,000		

VSW Unserved Communi	ties - Dined W	ater & Sewer System Type and Si	zing Model	
Date	-	3/25/2016	zing woder	
Community		Nightmute		
Input	i .			
Existing Community & System Data				
2015 Population		274		
2015 Number of Services		76		
HITS Database (E1 & H1-H7) DCED Mapping Commerical/Public Facilities/School		47 29		
Type (surface water or groundwater)		SW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		880		
Water Treatment Capacity		25		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)			ſ	
Soft poorly drained soils or discontinuous permafrost Firm soils, or continuous permafrost		Х		
Stiff soils, no permafrost				
			Sewer Main Length	Water Main
Piping Configurations (check all that apply)			(ft)	Length (ft)
Buried system with no permafrost			6000	0000
Above ground system or buried with permafrost Gravity Sewer Main		Х	6900	8000
Pressure Sewer Main		х	6900	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Nightmute		
Output for Cost Model (calculated)				
Manager Translation of Court (1977)			Foundatio	n Size
Water Treatment Capacity (gpm) Req Water Storage (gallons) (less existing)		23 162,820	2,260	cf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	1,200	1,200	
Req Sewage Lagoon Size (acre) (less existing)	(/	5.8	,	
			Quantity	Notes
		Pile Foundation (sf)		
Required Foundation System for WTP and/or WST			1,200	
Makes Dietsihuties Cuetass				
Water Distribution System		Circulating Water Main with		
			8,000	
		Pitorifices (If)	8,000	
			8,000	
		Pitorifices (If) Sewer Main with Glycol Heat Trace	·	
Wastewater Collection System		Pitorifices (If)	8,000 6,900	
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace	·	
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	6,900	
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	·	
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	6,900	
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	6,900	
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	6,900 76	
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	6,900 76	
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	6,900 76	
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	6,900 76 5,700	
		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	6,900 76 5,700	
	Piped System	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	6,900 76 5,700	
Water & Sewer Service Lines System Description	Need	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	6,900 76 5,700	
Water & Sewer Service Lines		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	6,900 76 5,700 5,700	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 23 163,700 1,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	5,700 Net Need 162,820 1,200	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 23 163,700	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	5,700 Net Need	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	Need 23 163,700 1,200 5.8	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	6,900 76 5,700 Net Need 162,820 1,200 5.8	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 23 163,700 1,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	5,700 Net Need 162,820 1,200	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation	Need 23 163,700 1,200 5.8	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	6,900 76 5,700 Net Need 162,820 1,200 5.8	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 23 163,700 1,200 5.8 3,460	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	6,900 76 5,700 Net Need 162,820 1,200 5.8 3,460 8,000	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if)	Need 23 163,700 1,200 5.8 3,460 8,000 6,900	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	6,900 76 5,700 Net Need 162,820 1,200 5.8 3,460 8,000 6,900	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Need 23 163,700 1,200 5.8 3,460	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	6,900 76 5,700 Net Need 162,820 1,200 5.8 3,460 8,000	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if)	Need 23 163,700 1,200 5.8 3,460 8,000 6,900	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	6,900 76 5,700 Net Need 162,820 1,200 5.8 3,460 8,000 6,900	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 23 163,700 1,200 5.8 3,460 8,000 76	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 25 880	6,900 76 5,700 Net Need 162,820 1,200 5.8 3,460 8,000 6,900 76	

VSW H	seemed Community - D'	Motor O C	Custom Tune and Cining PA - d-1
Date		l Water & Sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)	20	years	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services		services	40/
Growth Rate (i) 2035 Design Population (Capita)	1%	people	1% Px(1+i)^n
2005 Design repaid ton (capita)	334	реоріс	1 ((1.1) 11
Water Demand Estimates		,	
Existing Capacity		gpm	50 cellana nea Contra
Average Day (ADD) Max Day (MDD)	16,717 33,433		50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity		gpm	MDD
Water Source Assumptions Type (surface water or groundwater)	SW	7	
Required Capacity		gpm	MDD
,		- Oi-	
Water Storage Tank Sizing		,	
Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW) Daily Operation (DO) (gallons)	Check Min CT Requirements	gallons	Max Day (MDDx1 day)
Fire Flow (FF)		gallons	500 gpm for 60 minutes
Reserve Volume (RV)	100,300	-	3 days x DO
Water Storage Tank Volume	163,733	gallons	DO + FF + RV
CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC)	Required	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T)	4.4	•	4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*	0.1 118,437		0.1 CT/PCvPcak Hour/PE
Required Water Storage	163,700		CT/RCxPeak Hour/BF
Required Additional Storage	162,820	_	0
Estimate of Min Platform Size (3' clearance	2,260	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)	2,200	٠,	
Water Treatment Plant Requirements*			0
Water Quality	Poor	ן	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		Pile Foundation	
permafrost			
TOP TOTAL CONTRACT OF THE PARTY	x		Pile Foundation
Firm soils, or continuous permafrost	x 0	(sf)	Pile Foundation Thermosyphon stabilized gravel pad
li .			
Firm soils, or continuous permafrost Stiff soils, no permafrost	0		Thermosyphon stabilized gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both)	0		Thermosyphon stabilized gravel pad Gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost	0		Thermosyphon stabilized gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both)	0 0	(sf)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost	0	(sf) Circulating Water Main with Pitorifices	Thermosyphon stabilized gravel pad Gravel pad
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0 0	(sf) Circulating Water Main	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0 0	(sf) Circulating Water Main with Pitorifices	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0 0	(sf) Circulating Water Main with Pitorifices	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0 0	(sf) Circulating Water Main with Pitorifices (lf)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 0 0 x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 0 0 x	(sf) Circulating Water Main with Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 0 0 x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 0 x x 0 x x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 0 0 x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 0 x x 0 0 x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 0 x x 0 x x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 0 x x 0 0 x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 0 x x 0 0 0 x x 0 0 0 x x 0	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 0 x x 0 0 x x 0 0 x x	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 x x 0 0 0 x x 0 0 0 x x 0 0 0 x x 0	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 0 x x 0 0 x 0 0 x 0 0 x 0 0 x 0 0 x 0	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 0 x x 0 0 x x 0 0 x x 0 0 0 0 0 0 0 0	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 0 x x 0 0 x x 0 0 x x 0 0 0 0 0 0 0 0	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
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Firm soils, or continuous permafrost Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 0 0 x x 0 0 x x 0 0 x x 0 0 2.8 285.6 5.8	Circulating Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Thermosyphon stabilized gravel pad Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Nightmute	

Item	Line Item	T	Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	76	\$26,342.77	\$2,002,051
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	12,600	\$201.39	\$2,537,532
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	5.8	\$709,459.65	\$4,114,866
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	13,700	\$332.29	\$4,552,365
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	162,820	\$3.13	\$509,024
15	Water treatment plant, no foundation	SF	1,200	\$1,633.35	\$1,960,015
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	3,460	\$328.53	\$1,136,730
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$16,966,180

Community:	Nightmute		
General Community Dat	a		
Current population	on	274	persons
Service Connect		5.8	
·	ublic/commerical buildings	47 28	
Number of so	Total number of service	connections 76	
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon fo	Public facilty) Residential service)	\$25 \$0.34 \$0.20 \$8.50	kWh kWh
Water consumpti Wastewater gene	ion per capita eration per capita		gpd gpd
Water & Sewer System (Water Source	Characteristics		
	em (Surface(SW) or Groundwater(GW))	SW	_
Length of rav	v water line eated for freeze protection (Yes or No)	1150 No	ft
	vater line (Above ground (AG) or Buried)	AG	
Water Treatment	1		
	treatment plant building	1680	sf
Raw water qu	uality (Good or Poor)	Poor	
<u>Water Storage</u> Size of tank(s		163,700	gallone
	ter line to/ from tank	50	
•	eated for freeze protection (Yes or No)	No	
Location of w	ater line (Above ground (AG) or Buried)	AG	
Water Distributio		-	
j. ,	em (Static or Circulating (Circ)) rculating water loops	Circ 1	
	of Water Main	8000	ft
Water mains	heated for freeze protection (Yes or No)	Yes	
	ne mains (Above ground (AG) or Buried)	AG	£1
9	rice line length	75	π
Wastewater Colle	ection em (Gravity or Pressure)	Pressure	
Number of in	dividual facility pump stations	Piessule	
Number of co	ommunity lift/pump stations		
	of facilities served by lift/pump station #1		
	of facilities served by lift/pump station #2 of facilities served by lift/pump station #3		
	of facilities served by lift/pump station #4		
	of facilities served by lift/pump station #5		
	t stations of sewer mains	500 6900	
	heated for freeze protection (Yes or No)	Yes	11
Number of ci	rculating glycol loops	2	
	ne mains (Above ground (AG) or Buried) vice line length	AG	ft
ū	•	75	ıı
<u>Wastewater Trea</u> Length of for		915	ft
•	eated for freeze protection (Yes or No)	Yes	
Location of fo	orce main (Above ground (AG) or Buried)	AG	
Lagoon disch	narged seasonally with pump (Yes or No)	Yes	

Operation & Maintenance Cost Assumptions

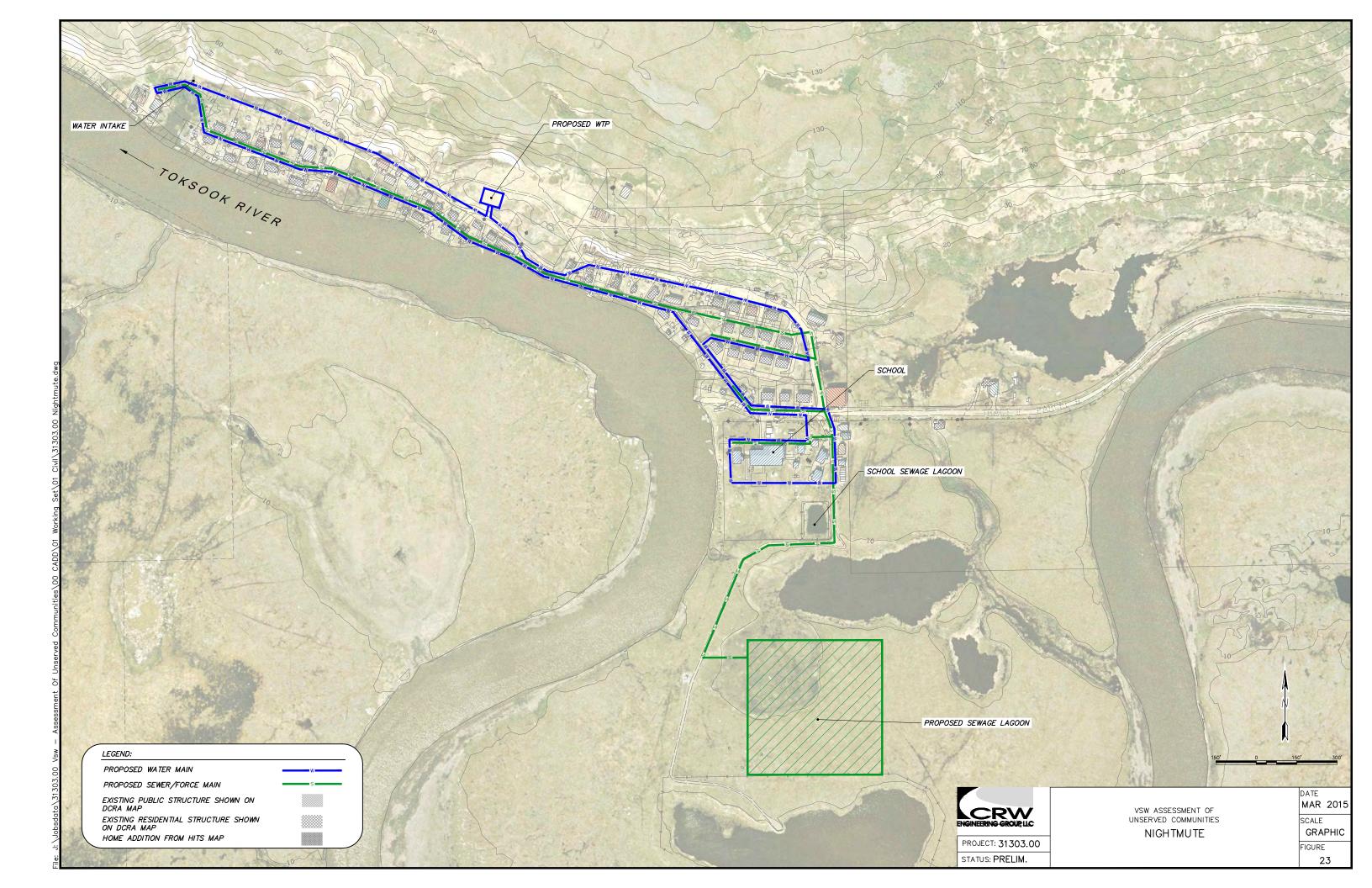
Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week	24	
Less than 50 services	24	hrs/week
Between 50 and 100 services More than 100 services	32 40	hrs/week hrs/week
More than 100 services	40	ms/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
	Ψ1,500	po. , oui

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	32	hrs/week		\$41,600
Fuel (Heating Demand)				
Water system				
WTP building	\$729	/month		\$5,834.47
Raw water line	·	/month		\$0.00
Raw water heat addition	\$1,416	/month		\$11,328.26
Water storage tank	\$212	/month		\$1,692.00
Water storage tank line	\$0	/month		\$0.00
Water mains	\$2,481	/month		\$19,845
Service lines	\$1,767	/month		\$14,140
Wastewater system				
Sewer mains		/month		\$17,116
Service lines		/month		\$14,140
Lift/pump station buildings	·	/month		\$0.00
Force main to lagoon	\$284	/month		\$2,270
			Subtotal	\$86,400
Electricity				
Water system				
WTP building				
Lights and controls	, .	/month		\$2,000
HVAC/hydronic system	* -	/month		\$1,334
Water treatment	\$71	/month		\$850
Pumps				
Intake or well	·	/month		\$849.62
WST circulation	• •	/month		\$367
Pressure/booster		/month		\$1,274.43
Main line circulation	\$365	/month		\$2,921
Wastewater system				
Lift /pump station buildings				
Lights and controls	·	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps				
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	* -	/month		\$0.00
Sewer/force main glycol circulation	, -	/month		\$1,458
Lagoon discharge pump	\$1,020	/year	Subtotal	\$1,020 \$12,100
Other Costs				Ţ. 2 ,100
Equipment R&R	\$7,005	/year		\$7,005
Miscellaneous materials & supplies	\$4,203	•		\$4,203
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	•		\$2,500 \$1,500
modified	ψ1,300	, your	Subtotal	\$17,200
			Cablolai	ψ17,200

Summary

Administration	\$6,000
Labor	\$41,600
Fuel	\$86,400
Electricity	\$12,100
Other	\$17,200
Total	\$163,000

Revenue I	Monthly	# of		,	Yearly
Source I	ource Rate		Collection Rate	Re	venues
Residential Serv	\$ 140	47	85%	\$	67,132
Public/Commerc	\$ 154.04	28	100%	\$	51,757
School Service (\$ 4,901.20	1	100%	\$	44,111
Local Capital Con	ntribution			\$	-
Total Revenue	_	-	_	\$	163,000



Northway Village, Alaska

Community Information & Existing Infrastructure

Northway Village is an Athabascan community of 112 people located between Nabesna River and Skate Lake, on a 9-mile spur road off of the Alaska Highway. There are 34 residential units and 3 commercial/public facilities for a total of 37 services. The existing water and sewer services provided in Northway Village consist of self-haul system and honey buckets. The washeteria/clinic/water treatment plant and the water/sewer truck haul garage have piped water and sewer services. The existing water and sewer infrastructure consists of the following:

- Well 30 gpm capacity
- Treated Water Storage 3,800 gallons
- Water Treatment Plant/Washeteria –
 2,270 SF, built in 1997
- Water Treatment Potassium permanganate, polymer, and greensand filter
- Northway Village Sewage Lagoon Two Cell, 1.84 acres

The soil conditions around Northway Village consist of an organic mat 1.5-3 feet deep with groundwater around 4 feet. Permafrost present in some areas as shallow as 2 feet deep.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 8,950 feet of pipe, and the pressure sewer system approximately 5,600 feet of pipe. The water system will consist of a single circulating loop. The pressure sewer system would require individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	9	30	-
Water Storage (gallons)	84,700	3,800	80,900
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	2.4	1.8	0.5
Required Foundation System for WTP and/or WST			
Pile Foundation	2,450	-	2,450
Water Distribution System			
Circulating Water Main with Pitorifices (If)	9,000	-	9,000
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	5,600	-	5,600
Individual Grinder Pump Stations (GPS) (ea)	37	-	37
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	2,800		2,800
Pressure Sewer Service Lines (If)	2,800		2,800

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Northway Village. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

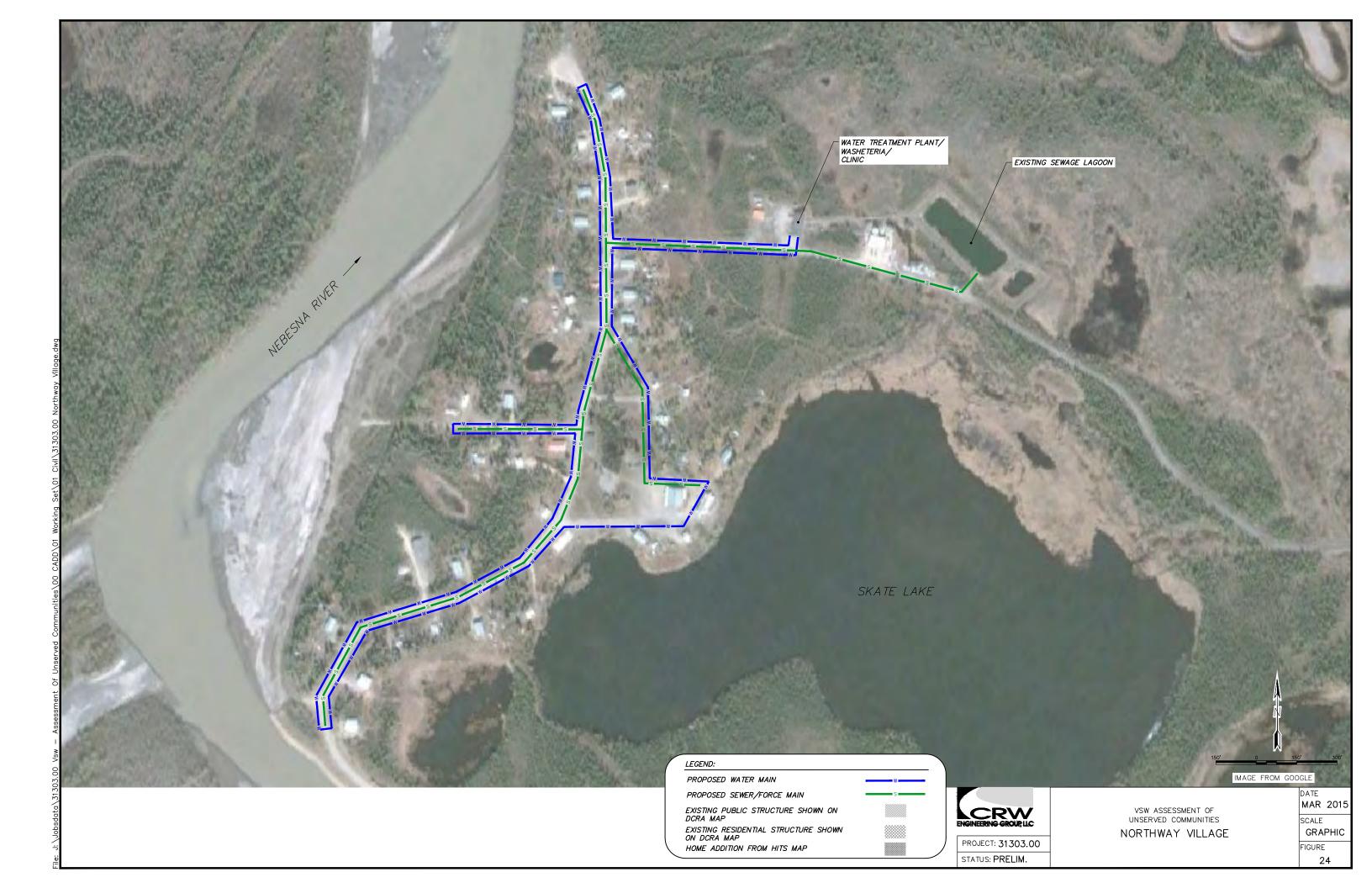
				Village	
	Estimated Capital Costs			Northway	
			<u>'</u>		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	37	\$26,191.57	\$969,088
3	Sewage collection mains or services (gravity or force), above ground	LF	8,400	\$182.10	\$1,529,638
10	Sewage lagoon, barrow, local material	Acre	0.5	\$674,757.25	\$337,379
12	Water distribution, mains or services, above ground	LF	11,800	\$316.36	\$3,733,036
14	Water storage tank, no foundation	Gal	80,900	\$1.81	\$146,129
15	Water treatment plant, no foundation	SF	1,200	\$1,495.47	\$1,794,569
18	Foundation - freeze back piles	SF	2,450	\$246.64	\$604,273
	Total Esti	mated (Cost in 2010 (dollars (rounded):	\$9,114,000
	Total v	vith Infl	ation (3% pe	year for 6 years)	\$10,882,600
27	Individual Grinder Pump Stations	EA	37	\$30,000	\$1,110,000
28	Electrical Service Upgrades	EA	37	\$5,500	\$203,500
				Subtotal	\$12,196,100
29	Construction Contingency (15%)	LS	1	\$1,829,400	\$1,829,400
30	Design & Construction Administration Services (20%)	LS	1	\$2,439,200	\$2,439,200
			-	Total	\$16,464,700

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs			
Description	Cost		
Administration	\$6,000		
Labor	\$22,500		
Fuel	\$32,600		
Electricity	\$16,200		
Other (R&R, Training, etc.)	\$11,700		
Total	\$89,000		

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Northway Village are listed below.

Estimated User Fees					
Revenue Source	Monthly	Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	204	34	85%	\$ 70,662
Public/Commercial Service	\$	509	3	100%	\$ 18,338
School Service	\$	1	0	100%	\$ -
Local Capital Contribution					\$ -
Total Revenue					\$ 89,000



veril	5		·	
		ater & Sewer System Type and Siz	ring iviodei	
Date Community		4/18/2016 Northway Village		
Input		, , , , , , , , ,		
Existing Community & System Data 2015 Population		112		
2015 Population 2015 Number of Services		37		
HITS Database (E1 & H1-H7)		34		
DCED Mapping Commerical/Public Facilities/School		3		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank Water Treatment Capacity		3800 30		
Existing Sewage Lagoon Size		1.84		
Soil Conditions (check only one)		1101		
Soft poorly drained soils or discontinuous permafrost		х		
Firm soils, or continuous permafrost				
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length	Water Main
Buried system with no permafrost			(ft)	Length (ft)
Above ground system or buried with permafrost		х	5600	8950
Gravity Sewer Main				
Pressure Sewer Main		Х	5600	75
Typical Service Line Length (ea)			75	75
Dinad System Boguiroments	Community	Northwey Village		
Piped System Requirements Output for Cost Model (calculated)	Community	Northway Village		
Contput for Cost Wioder (Carculated)			Foundatio	n Size
Water Treatment Capacity (gpm)		9		0.120
Req Water Storage (gallons) (less existing)		80,900	1,250	sf
Req W&S Utility Bldg/Water Treatment Plant/Addition	n (sf)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		0.5		
			Quantity	Notes
		Pile Foundation (sf)		
Description of the second of t				
Required Foundation System for WIP and/or WSI	Required Foundation System for WTP and/or WST		1,200	
•			1,200	
			1,200	
			1,200	
Water Distribution System			1,200	
Water Distribution System		Circulating Water Main with	9,000	
Water Distribution System		Circulating Water Main with Pitorifices (If)		
Water Distribution System		Pitorifices (If)		
Water Distribution System		Pitorifices (If) Sewer Main with Glycol Heat Trace		
Water Distribution System Wastewater Collection System		Pitorifices (If)	9,000	
·		Pitorifices (If) Sewer Main with Glycol Heat Trace	9,000	
,		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	9,000 5,600	
·		Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	9,000	
,		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	9,000 5,600	
,		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	9,000 5,600	
,		Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	9,000 5,600 37	
Wastewater Collection System		Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	9,000 5,600 37	
Wastewater Collection System		Pitorifices (lf) Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	9,000 5,600 37	
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	9,000 5,600 37 2,800	
Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	9,000 5,600 37 2,800	
Wastewater Collection System Water & Sewer Service Lines	Piped System	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	9,000 5,600 37 2,800	
Wastewater Collection System Water & Sewer Service Lines System Description	Need	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	9,000 5,600 37 2,800 2,800	
Wastewater Collection System Water & Sewer Service Lines	Need 9	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0	9,000 5,600 37 2,800	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm)	Need	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	9,000 5,600 37 2,800 Net Need	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 9 84,700	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800	9,000 5,600 37 2,800 Net Need	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) WaS Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	9 84,700 1,200 2.4	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800 - 1.8	9,000 5,600 2,800 Net Need 80,900 1,200 0.5	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation	Need 9 84,700 1,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800 -	9,000 5,600 2,800 Net Need	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) WaS Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	9 84,700 1,200 2.4	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800 - 1.8	9,000 5,600 2,800 Net Need 80,900 1,200 0.5	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System	Need 9 84,700 1,200 2.4	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800 - 1.8	9,000 5,600 2,800 Net Need 80,900 1,200 0.5 2,450	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) WaS Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if)	Need 9 84,700 1,200 2.4	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800 - 1.8	9,000 5,600 2,800 Net Need 80,900 1,200 0.5 2,450	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 9 84,700 1,200 2.4 2,450 9,000	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800 - 1.8	9,000 5,600 2,800 Net Need 80,900 1,200 0.5 2,450 9,000	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Circulating water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 9 84,700 1,200 2.4 2,450 9,000 5,600 37	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800 - 1.8	9,000 5,600 2,800 Net Need	
Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 9 84,700 1,200 2.4 2,450 9,000 5,600	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 30.0 3,800 - 1.8	9,000 5,600 2,800 Net Need 80,900 1,200 0.5 2,450 9,000 5,600	

V3W 01	served Communities - Pine	d Water & Sewer	System Type and Sizing Model
Date	·	u water & Jewer	System Type and Sizing Model
Community	Northway Village		
System Parameters	Model Results		Criteria & Calculations
Design Population		•	22
Duration (n) 2015 Population (P)		0 years 2 people	20 years 2015 ADOL
2015 Number of Services		7 services	
Growth Rate (i)	19		1%
2035 Design Population (Capita)	13	7 people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		0 gpm	50 11 0 11
Average Day (ADD) Max Day (MDD)		gpd gpd	50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity		Э дрт	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GV		
Required Capacity	9	9 gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW)	Applicable	gallans	May Day (MDDyd day)
Daily Operation (DO) (gallons) Fire Flow (FF)		gallons gallons	Max Day (MDDx1 day) 500 gpm for 60 minutes
Reserve Volume (RV)		gallons	3 days x DO
Water Storage Tank Volume		gallons	DO + FF + RV
CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC)	Not Required	4 mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		0 log inactivation	1.0-log Inactivation
Temperature (T)	4.	4 C	4.4 celsius/40 F
pH (PH)		7 9 minutes	7 LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Contact Time Required (CT) Baffling Coefficient (BF)	0.		0.1
Required Volume to meet CT*		gallons	CT/RCxPeak Hour/BF
Required Water Storage		gallons	
Required Additional Storage Estimate of Min Platform Size (3' clearance	80,900	gallons	0
around)	1,250	sf	$D = 0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
			0
Water Treatment Plant Requirements* Water Quality	Poor	7	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (to br) = 1200 sr
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		Pile Foundation	
permafrost	х	(sf)	Pile Foundation
Firm soils, or continuous permafrost	0		Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
	1		
Water Distribution (Check either or both)		_	
Water Distribution (Check either or both) Buried system with no permafrost	0	Cinquilatina	Static Water Mains
Buried system with no permafrost	0	Circulating Water Main	
	0 x	Circulating Water Main with Pitorifices	Static Water Mains Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with		Water Main	
Buried system with no permafrost Above ground system or buried with permafrost		Water Main with Pitorifices	
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with permafrost		Water Main with Pitorifices (If)	
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	x 0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main	x 0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 x 0 x 0 x 1.8 1.8	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 x 0 x 1.8	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	x 0 x 0 x 0 x 1.8 1.82	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line with GPS
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Gravity Sewer Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 0 x 0 x 1.8 1.82	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) A acres 2 acres 6	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	x 0 x 0 x 0 x 1.8 1.8 2.	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) A acres 2 acres 6	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Northway	

Item	Line Item	T	Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	37	\$26,191.57	\$969,088
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	8,400	\$182.10	\$1,529,638
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0.5	\$674,757.25	\$337,379
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	11,800	\$316.36	\$3,733,036
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	80,900	\$1.81	\$146,129
15	Water treatment plant, no foundation	SF	1,200	\$1,495.47	\$1,794,569
	Washeteria, no foundation	SF	0	#DIV/0!	\$0
	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	2,450	\$246.64	\$604,273
	Foundation - thermosyphen stabilized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$9,114,112

Community:	Northway Village	
General Community Dat	a	
Current population		112 persons
Average number Service Connect	of people per house ions	3.3
Number of he		34
Number of poly	ublic/commerical buildings chools	3
	Total number of service connection	
Burdened labor r		\$18 hr
Electricity cost (F Electricity cost (F	Residential service)	\$0.44 kWh \$0.23 kWh
Cost per gallon f	or heating oil	\$4.00 gal
Water consumpt		50 gpd
Wastewater gen	eration per capita	50 gpd
Water & Sewer System Water Source	Characteristics	
Type of syste	em (Surface(SW) or Groundwater(GW))	GW
Length of rav	v water line eated for freeze protection (Yes or No)	50 ft No
	vater line (Above ground (AG) or Buried)	AG
Water Treatmen	<u>t</u>	
	treatment plant building uality (Good or Poor)	3470 sf Poor
Water Storage	, (,	
Size of tank(•	84,700 gallons
•	ter line to/ from tank eated for freeze protection (Yes or No)	50 ft No
	vater line (Above ground (AG) or Buried)	AG
Water Distribution	_	
	em (Static or Circulating (Circ)) rculating water loops	Circ 1
	of Water Main	9000 ft
	heated for freeze protection (Yes or No)	Yes AG
	ne mains (Above ground (AG) or Buried) vice line length	75 ft
Wastewater Coll		
Type of syste	em (Gravity or Pressure) idividual facility pump stations	Pressure
	ommunity lift/pump stations	
	of facilities served by lift/pump station #1	
	of facilities served by existing lift/pump station of facilities served by lift/pump station #3	
Number	of facilities served by lift/pump station #4	
	of facilities served by lift/pump station #5 ft stations	500 sf
	of sewer mains	5600 ft
	s heated for freeze protection (Yes or No)	Yes
	rculating glycol loops ne mains (Above ground (AG) or Buried)	1 AG
	vice line length	75 ft
	atment / Disposal	670 4
Length of for Force main h	ce main neated for freeze protection (Yes or No)	670 ft Yes
Location of fo	orce main (Above ground (AG) or Buried)	AG
Lagoon disch	narged seasonally with pump (Yes or No)	Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u>		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Administration (Utility management, billings, etc.) Labor (WTP Operator)		/month	_	<u></u>
Labor (WTP Operator)	24			\$6,000
		hrs/week		\$22,464
Fuel (Heating Demand)				
Water system				
	\$709	/month		\$5,671.03
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$272	/month		\$2,179.07
Water storage tank	\$51	/month		\$411.98
Water storage tank line	\$0	/month		\$0.00
	,313	/month		\$10,506
Service lines	\$405	/month		\$3,239
Wastewater system				
Sewer mains \$	\$817	/month		\$6,537
Service lines	\$405	/month		\$3,239
Lift/pump station buildings	\$0	/month		\$0.00
Force main to lagoon	\$98	/month		\$782
			Subtotal	\$32,600
Electricity				
Water system				
WTP building				
•		/month		\$5,347
- , ,		/month		\$3,565
Water treatment	\$37	/month		\$449
Pumps				
		/month		\$449.43
WST circulation		/month		\$475
Pressure/booster		/month		\$674.15
Main line circulation	\$473	/month		\$3,780
Wastewater system				
Lift /pump station buildings	ΦO	/m. a.m.t.la		CO
Lights and controls		/month /month		\$0 \$0
HVAC/hydronic system	Φ0	/monun		φU
Pumps	ΦO	/month		\$0
Individual facility pump stations		/month		\$0.00
Community lift/pump station(s)				
,	\$118			\$943 \$540
Lagoon discharge pump \$	5 540	/year	Subtotal	\$540 \$16,200
Other Costs				,
	,563	/year		\$3,563
• •		/year		\$2,138
		/year		\$2,000
· · ·	,500	-		\$2,500
·	,500	•		\$1,500
······································	, , , , ,	. ,	Subtotal	\$11,700

Summary

Administration	\$6,000
Labor	\$22,500
Fuel	\$32,600
Electricity	\$16,200
Other	\$11,700
Total	\$89,000

Revenue	Monthly	# of)	early
Source	Rate	Customers	Collection Rate	Re	venues
Residential Serv	\$ 204	34	85%	\$	70,662
Public/Commerc	\$ 509.39	3	100%	\$	18,338
School Service (\$ -	0	100%	\$	-
Local Capital Co	ntribution			\$	-
Total Revenue	-	_	_	\$	89,000

Nunapitchuk, Alaska

Community Information & Existing Infrastructure

The City of Nunapitchuk is a Yup'ik community of 563 people located along the west and east side of Johnson River. There are 138 residential units, 21 commercial/public facilities and one school for a total of 160 services. Most of the existing water and sewer services provided in Nunapitchuk consist of a Cowater flush, tank and haul system at each building. The existing water and sewer infrastructure consists of the following:

- Groundwater well -20 gpm
- Raw water High in Fe & Mn
- Direct Filtration Treatment 20 gpm
- Water Treatment Plant/Washeteria 2,050
- sf, built in 1978
- Treated water storage 84,500 gallons
- Sewage Lagoon 3 acres (LKSD lagoon)

Soil conditions in the community consist of ice-rich silts, discontinuous permafrost and a shallow active layer. Any new foundations should consist of driven piles.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 22,500 feet of pipe, and the pressure sewer system approximately 13,700 feet of pipe. Both the west and east side of Nunapitchuk will consist of two circulating water mains, and pressure sewer systems. The pressure sewer system would require individual grinder pump stations at each service, and glycol heat trace for freeze protection. For the purposes of this assessment, a new 1200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment; a new groundwater well will be installed and an additional 220,300 gallons of water storage will be needed (304,800-84,500).

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	48	20	28	
Water Storage (gallons)	304,800	84,500	220,300	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200	
Sewage Lagoon Size (acre)	7.7	3.0	4.7	
Required Foundation System for WTP and/or WST				
Pile Foundation	4,150	-	4,150	
Water Distribution System				
Circulating Water Main with Pitorifices (If)	22,500	-	22,500	
Wastewater Collection System				
Insulated Sewer Main with Glycol Heat Trace (If)	13,700	-	13,700	
Residential Grinder Pump Stations (GPS) (ea)	160	-	160	
Water & Sewer Service Lines				
Circulating Water Service Lines (If)	12,000	-	12,000	
Pressure Sewer Service w GPS (If)	12,000	-	12,000	

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Nunapitchuk. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

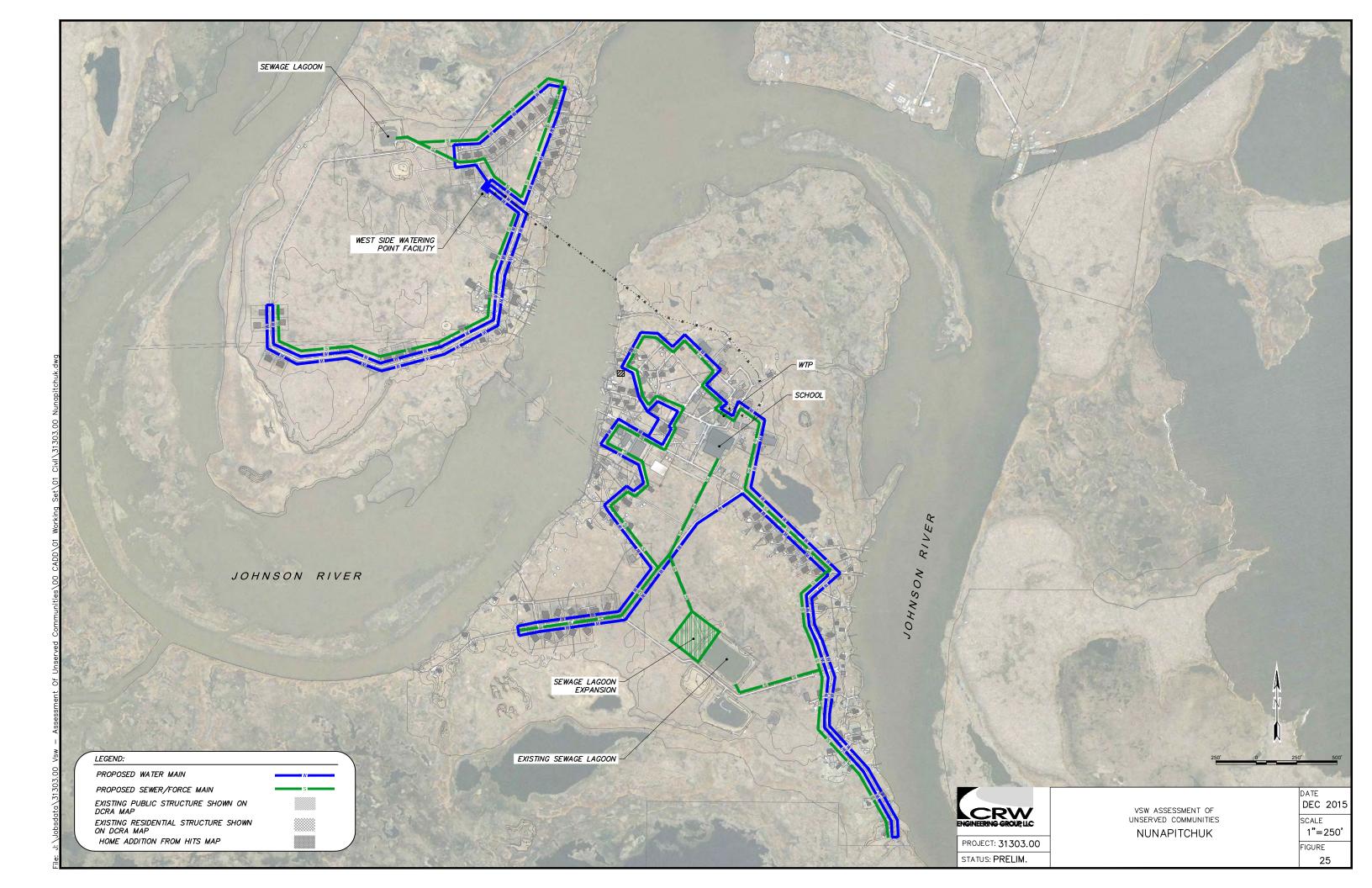
	Estimated Capital Costs	Nunapitchuk			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	160	\$26,403	\$4,224,521
3	Sewage collection mains or services (gravity or force), above ground	LF	25,700	\$198	\$5,097,696
10	Sewage lagoon, barrow, local material	Acre	4.7	\$709,516	\$3,334,727
12	Water distribution, mains or services, above ground	LF	34,500	\$330	\$11,372,141
14	Water storage tank, no foundation	Gal	220,300	\$3	\$561,434
15	Water treatment plant, no foundation	SF	1,200	\$1,636	\$1,962,712
18	Foundation - freeze back piles	SF	4,150	\$320	\$1,327,147
23	Water source - ground water well	EA	1	\$153,597	\$153,597
	\$28,033,975				
	Т	otal with	Inflation (3% pe	er year for 6 years)	\$33,474,000
27	Residential Grinder Pump Stations	EA	160	\$30,000	\$4,800,000
28	Electrical Service Upgrades	EA	160	\$5,500	\$880,000
				Subtotal	\$39,154,000
29	Construction Contingency (15%)	LS	1	\$3,915,400	\$3,915,400
30	Design & Construction Administration Services (20%)	LS	1	\$7,830,800	\$7,830,800
				Total	\$50,900,200

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Annual Cost			
Administration	\$6,000			
Labor	\$31,200			
Fuel (Heating)	\$142,000			
Electricity	\$30,500			
Other (R&R, Training, etc.)	\$22,300			
Total	\$232,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Nunapitchuk are listed below:

Estimated User Fees						
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate	Y	early Revenues
Residential Service	\$	102	138	85%	\$	143,305
Public/Commercial Service	\$	188	21	100%	\$	47,463
School Service	\$	4,581	1	100%	\$	41,232
Local Capital Contribution					\$	-
Total Revenue					\$	232,000



2015 Foundation 563 3 3 3 3 3 3 3 3 3	VSW Unserved Communic	ties - Dined W	ater & Sewer System Type and Si	zing Model	
Community & System Data Foundation Fou		•	, ,,	zilig iviouei	
Injust					
2015 Septime of Services 1,00	-				
2015 Septime of Services 1,00					
160	Existing Community & System Data				
His Database (E1 & H.1-H7)	•				
DECD Mapping Commercial/Public Facilities/School 900					
Seware August Seware Service Lines Seware Main Length (th)					
Water Treatment Capacity (Poor or Good) Popor					
Water Distribution System Sewer Main with Glycol Heat Trace (III) 1,200					
Water Treatment Capacity 20 20 20 20 20 20 20 2					
Setting Sewage Lagoon Size 3 3 5 5 5 5 5 5 5 5	<u> </u>				
Soli Conditions (check only one) Soli Conditions (price on the condition of stock) Solid Condition of stock on the condition of stock on the condition of stock of stock on the condition of stock of stock on the condition of stock o					
Soft poorly drained soils or discontinuous permafrost Siff soils, no permafrost Siff soils, no permafrost Siff soils, no permafrost Siff soils, no permafrost Siff soils, no permafrost Shower ground system or buried with permafrost Above ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system for the ground system for State Shower ground system for State Shower ground system for State Shower ground system for State Shower ground system for WTP and/or WST Water Treatment Capacity (gpm) Req Water Storage (gallons) (less existing) Shower Sho			3		
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Piping Configurations (check all that apply) Sewer Main Length (ft) Length (ft)	i i				
Buried system with no permafrost				Sewer Main Length	Water Main
Above ground system or buried with permafrost x 13660 22488	Piping Configurations (check all that apply)			(ft)	Length (ft)
Sever Main	Buried system with no permafrost				
Pressure Sewer Main	Above ground system or buried with permafrost		х		22480
Typical Service Line Length (ea)	Gravity Sewer Main				
Piped System Requirements Output for Cost Model (calculated) Water Treatment Capacity (gpm) Req Water Storage (gallons) (less existing) Req Water Storage (gallons) (less existing) Req Water Storage (gallons) (less existing) Req Sewage Lagoon Size (acre) (less existing) Water Distribution System for WTP and/or WST Water Distribution System for WTP and/or WST Water Distribution System Water Assewer Service Lines Water & Sewer Service Lines Water & Sewer Service Lines Piped System Residential Grinder Pump Stations (BTS) (as) Residential Grinder Pump			х		75
Sever Service Lines Pile Foundation Size	Typical Service Line Length (ea)			/5	/5
Sever Service Lines Pile Foundation Size					
Sever Service Lines Pile Foundation Size					
Note Poundation Size	1	Community	Nunapitchuk		
Water Treatment Capacity (gpm)	Output for Cost Model (calculated)				
Req Wast Storage (gallons) (less existing) 220,300 2,950 sf				Foundatio	n Size
Req W&S Utility Bidg/Mater Treatment Plant/Addition (sf) 1,200 1,200 sf					
Required Foundation System for WTP and/or WST			·	•	
Pile Foundation (sf)		n (sf)	,	1,200	sf
Pile Foundation (sf)	Req Sewage Lagoon Size (acre) (less existing)		4.7		
Water Distribution System Circulating Water Main with 22,500				Quantity	Notes
Water Distribution System Circulating Water Main with 22,500			Pile Foundation (sf)		
Water Distribution System Circulating Water Main with 22,500					
Sewer Main with Glycol Heat Trace 13,700	Required Foundation System for WTP and/or WST			4,150	
Sewer Main with Glycol Heat Trace 13,700					
Sewer Main with Glycol Heat Trace 13,700					
Sewer Main with Glycol Heat Trace 13,700					
Pitorifices (If) 22,500	Water Distribution System	Water Distribution System			
(if) 13,700			Circulating Water Main with		
(if) 13,700				22,500	
(if) 13,700				22,500	
(If)			Pitorifices (If)	22,500	
Circulating Water Service Lines Circulating Water Service Lines (If) 12,000			Pitorifices (If) Sewer Main with Glycol Heat Trace	· ·	
Circulating Water Service Lines Circulating Water Service Lines (If) 12,000	Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace	· ·	
Circulating Water Service Lines Circulating Water Service Lines (If) 12,000	Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace	· ·	
Circulating Water Service Lines Circulating Water Service Lines (If) 12,000	Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	13,700	
Pressure Sewer Service Lines Pressure Sewer Service w/GPS (If) 12,000	Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations	13,700	
Pressure Sewer Service Lines Pressure Sewer Service w/GPS (If) 12,000	Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations	13,700	
Pressure Sewer Service w/GPS (If) 12,000 12,000	Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations	13,700	
System Description Piped System Existing Facility Net Need			Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea)	13,700	
System Description Piped System Existing Facility Net Need	Wastewater Collection System Water & Sewer Service Lines		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea)	13,700	
System Description Piped System Existing Facility Net Need			Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea)	13,700	
Need Existing Facility Net Need			Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	13,700 160 12,000	
Need Existing Facility Net Need			Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	13,700 160 12,000	
Need Existing Facility Net Need			Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	13,700 160 12,000	
Water Treatment Capacity (gpm) 48 20 28 Water Storage (gallons) 304,800 84,500 220,300 W&S Utility Bldg/Water Treatment Plant/Addition (sf) 1,200 - 1,200 Sewage Lagoon Size (acre) 7.7 3.0 4.7 Required Foundation System for WTP and/or WST Pile Foundation 4,150 - 4,150 Water Distribution System Circulating Water Main with Pitorifices (lf) 22,500 - 22,500 Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (lf) 13,700 - 13,700 Residential Grinder Pump Stations (GPS) (ea) 160 - 160 Water & Sewer Service Lines Circulating Water Service Lines (lf) 12,000 - 12,000			Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	13,700 160 12,000	
Water Storage (gallons) 304,800 84,500 220,300 W&S Utility Bldg/Water Treatment Plant/Addition (sf) 1,200 - 1,200 Sewage Lagoon Size (acre) 7.7 3.0 4.7 Required Foundation System for WTP and/or WST Pile Foundation 4,150 - 4,150 Water Distribution System Circulating Water Main with Pitorifices (lf) 22,500 - 22,500 Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (lf) 13,700 - 13,700 Residential Grinder Pump Stations (GPS) (ea) 160 - 160 Water & Sewer Service Lines Circulating Water Service Lines (lf) 12,000 - 12,000	Water & Sewer Service Lines		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If)	13,700 160 12,000	
W&S Utility Bldg/Water Treatment Plant/Addition (sf) 1,200 - 1,200 Sewage Lagoon Size (acre) 7.7 3.0 4.7 Required Foundation System for WTP and/or WST - 4,150 Pile Foundation 4,150 - 4,150 Water Distribution System Circulating Water Main with Pitorifices (lf) 22,500 - 22,500 Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (lf) 13,700 - 13,700 Residential Grinder Pump Stations (GPS) (ea) 160 - 160 Water & Sewer Service Lines - 12,000 - 12,000	Water & Sewer Service Lines System Description		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If)	13,700 160 12,000	
7.7 3.0 4.7	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm)	Need 48	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If)	13,700 160 12,000 Net Need	
Required Foundation System for WTP and/or WST	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 48 304,800	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500	13,700 160 12,000 12,000 Net Need 28 220,300	
Pile Foundation	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	48 304,800 1,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500	13,700 12,000 12,000 Net Need 28 220,300 1,200	
Water Distribution System Circulating Water Main with Pitorifices (If) 22,500 - 22,500 Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (If) 13,700 - 13,700 Residential Grinder Pump Stations (GPS) (ea) 160 - 160 Water & Sewer Service Lines - 12,000 - 12,000	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	48 304,800 1,200	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500	13,700 12,000 12,000 Net Need 28 220,300 1,200	
Circulating Water Main with Pitorifices (If) 22,500 - 22,500	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	48 304,800 1,200 7.7	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500 - 3.0	13,700 160 12,000 Net Need 28 220,300 1,200 4,7	
Wastewater Collection System 13,700 - 13,700 Insulated Sewer Main with Glycol Heat Trace (if) 13,700 - 160 Residential Grinder Pump Stations (GPS) (ea) 160 - 160 Water & Sewer Service Lines - 12,000 - 12,000	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation	48 304,800 1,200 7.7	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500 - 3.0	13,700 160 12,000 Net Need 28 220,300 1,200 4,7	
Insulated Sewer Main with Glycol Heat Trace (if)	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System	Need 48 304,800 1,200 7.7 4,150	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500 - 3.0	13,700 12,000 12,000 Net Need 28 220,300 1,200 4.7 4,150	
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Circulating Water Service Lines (lf) 12,000 - 12,000	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 48 304,800 1,200 7.7 4,150 22,500	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500 - 3.0	13,700 160 12,000 12,000 Net Need 28 220,300 1,200 4,7 4,150 22,500	
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Pressure Service w GPS (lf) 12,000 - 12,000	System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (lf) Residential Grinder Pump Stations (GPS) (ea)	Need	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500 - 3.0	13,700 12,000 12,000 Net Need 28 220,300 1,200 4,7 4,150 22,500 13,700	
	Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation Water Distribution System Circulating Water Main with Pitorifices (if) Wastewater Collection System Insulated Sewer Main with Glycol Heat Trace (if) Residential Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines Circulating Water Service Lines Circulating Water Service Lines (if)	Need	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Residential Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service w/GPS (If) Existing Facility 20 84,500	13,700 12,000 12,000 Net Need 28 220,300 1,200 4,7 4,150 22,500 13,700 160 12,000	

Date Community Nur Community System Parameters Moc Design Population Duration (n) 2015 Population (P) 2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DD) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	/9/2016 napitchuk del Results 20 563 160 1% 687 20 34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	years people services 138 GW people gpm gpd gpm gpm gpm	Criteria & Calculations 20 years 2015 ADOL 3 1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD MDD
System Parameters Design Population Duration (n) 2015 Population (P) 2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	20 563 160 1% 687 20 34,348 68,697 143 48 68,697 30,000 206,090	people services 138 GW people gpm gpd gpm gpm gpm	20 years 2015 ADOL 3 1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD MDD
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Duration (n) 2015 Population (P) 2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	563 160 1% 687 20 34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	people services 138 GW people gpm gpd gpm gpm gpm	2015 ADOL 3 1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD MDD
2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	160 1% 687 20 34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	services 138 GW people gpm gpd gpm gpm gpm	1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD MDD
Growth Rate (i) 2035 Design Population (Capita) Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	1% 687 20 34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	GW people gpm gpd gpm gpm gpm	1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD MDD
2035 Design Population (Capita) Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	20 34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	gpm gpd gpm gpm gpm	1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD MDD
Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	20 34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	gpm gpd gpm gpm gpm	Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD MDD
Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (ini if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	20 34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	gpd gpm gpm gpm	50 gallons per Capita 2 x ADD 3 x MDD MDD
Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DD) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	gpd gpm gpm gpm	2 x ADD 3 x MDD MDD
Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DD) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	34,348 68,697 143 48 GW 48 84,500 68,697 30,000 206,090	gpd gpm gpm gpm	2 x ADD 3 x MDD MDD
Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (in in if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	68,697 143 48 GW 48 84,500 68,697 30,000 206,090	gpm gpm gpm	2 x ADD 3 x MDD MDD
Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (in in f source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	143 48 GW 48 84,500 68,697 30,000 206,090	gpm gpm gpm	3 x MDD MDD
Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DD) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	68,697 30,000 206,090	gpm gpm	MDD
Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	6W, 48 84,500 68,697 30,000 206,090	gpm	
Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	48 84,500 68,697 30,000 206,090	gpm	MDD
Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	48 84,500 68,697 30,000 206,090	gpm	MDD
Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	84,500 68,697 30,000 206,090		WIDD
Existing Water Storage Tank Demand Based Volume (If source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	68,697 30,000 206,090	gallons	
Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	68,697 30,000 206,090	gallons	
Daily Operation (DO) (gallons) Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	30,000 206,090		Built in 2010
Fire Flow (FF) Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	30,000 206,090	gallons	Max Day (MDDx1 day)
Reserve Volume (RV) Water Storage Tank Volume CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	206,090	-	500 gpm for 60 minutes
CT Based Volume (min if source is SW) Not Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)	204 797	-	3 days x DO
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)		gallons	DO + FF + RV
Disinfection/Log Inactivation (LI)	t Required	mg/L	0.4 mg/L
		log inactivation	1.0-log Inactivation
Temperature (T)	4.4	С	4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT) Baffling Coefficient (BF)	49 0.1	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC) 0.1
Required Volume to meet CT*	243,357		CT/RCxPeak Hour/BF
Required Water Storage	304,800	-	
Required Additional Storage	220,300	gallons	0
Estimate of Min Platform Size (3' clearance	2,950	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			0
Water Treatment Plant Requirements*			
Water Quality	poor		Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	х	Pile Foundation	Pile Foundation
permafrost		(sf)	
Firm soils, or continuous permafrost Stiff soils, no permafrost	0		Thermosyphon stabilized gravel pad Gravel pad
	•		
Water Distribution (Check either or both)	•	1	0. 2. 24
Buried system with no permafrost	0	Circulating	Static Water Mains
Above ground system or buried with		Water Main	0. 1.0. 10.0. 10.0. 10.0.
permafrost	x	with Pitorifices	Circulating Water Main with Pitorifices
		(If)	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0	C	Bare sewer main, no heat trace
Above ground or buried with permafrost		Sewer Main with Glycol	Insulated sewer main with glycol heat trace
Above ground or buried with permanost	^	With Glycol Heat Trace (lf)	moduced sewer main with grycol fleat trace
Gravity Sewer Main	0		Lift stations for gravity sewer mains, every 1,000 ft
		Residential	
Pressure Sewer Main		Grinder Pump Stations (GPS)	Residential Grinder Pump Stations
		(ea)	
Water & Sewer Services (Check all that apply)			
	0		Static Water Service Line
Water Capiles Type		Circulating	State Water Service Line
Water Service Type		Water Service	Circulating Water Service Lines
Capulity Course Main	•	Lines (If)	Cravity Samina Line
Gravity Sewer Main	0	Pressure Sewer	Gravity Service Line
Pressure Sewer Main		Service w/GPS	Pressure Service Line with GPS
		(If)	
Sourage Lagoon Size			
Sewage Lagoon Size Existing Sewage Lagoon	3	acres	School lagoon only
Organic Loading Based Size		acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	409.4		
Hydraulic Loading Based Size	7.7	acres	Volume is based on ADDx365x20% factor to account for precipitation,
			Lagoon depth assumed to be 5 ft, berm slopes 3:1
Two cell lagoon, combined acreage	7.7	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Nunaptichuk	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	160	\$26,403.25	\$4,224,521
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	25,700	\$198.35	\$5,097,696
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	4.7	\$709,516.44	\$3,334,727
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	34,500	\$329.63	\$11,372,141
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	220,300	\$2.55	\$561,434
	Water treatment plant, no foundation	SF	1,200	\$1,635.59	\$1,962,712
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	4,150	\$319.79	\$1,327,147
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$28,033,975

Community:	Nunapitchuk
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General Community Data

General Community Data		
Current population	563	persons
Average number of people per house	4.1	
Service Connections		
Number of houses	138	
Number of public buildings	21	
Number of schools	1	
Total number of service connections	160	
Burdened labor rate	\$15	hr
Electricity cost (Public facilty)	\$0.35	kWh
Electricity cost (Residential service)	\$0.20	kWh
Cost per gallon for heating oil	\$6.00	gal
Water consumption per capita	50	gpd
Wastewater generation per capita		gpd
		0.
Water & Sewer System Characteristics Water Source		
Type of system (Surface(SW) or Groundwater(GW))	GW	
Length of raw water line		ft
Water line heated for freeze protection (Yes or No)	Yes	
Location of water line (Above ground (AG) or Buried)	200	
Water Treatment		
Size of water treatment plant building	3250	sf
Raw water quality (Good or Poor)	Poor	
Water Storage		
Size of tank(s)	304,800	gallons
Length of water line to/ from tank	50	
Water line heated for freeze protection (Yes or No)	Yes	
Location of water line (Above ground (AG) or Buried)	AG	
Water Distribution		
Type of system (Static or Circulating (Circ))	Circ	
Number of circulating water loops	4	
Total length of Water Main	22480	ft
Water mains heated for freeze protection (Yes or No)	Yes	
Location of the mains (Above ground (AG) or Buried)	AG	
Number of service line circ pumps		
Average service line length	75	ft
Wastewater Collection		
Type of system (Gravity or Pressure)	Pressure	
Number of individual facility pump stations		
Number of community lift/pump stations		
Number of facilities served by lift/pump station #1		
Number of facilities served by lift/pump station #2		
Number of facilities served by lift/pump station #3		
Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5		
Size of lift stations		sf
Total length of sewer mains	13660	
Sewer mains heated for freeze protection (Yes or No)	Yes	-
Number of circulating glycol loops	4	
Location of the mains (Above ground (AG) or Buried)	AG	
Average service line length	75	ft
Wastewater Treatment / Disposal		

Length of force main

Force main heated for freeze protection (Yes or No)

Location of force main (Above ground (AG) or Buried)

Lagoon discharged seasonally with pump (Yes or No)

1030 ft

Yes

AG

Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
F1 / 1 4 \		
Fuel (Heating) Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Buried mains (permanost conditions)	3	БТОЛІІЛІ
<u>Electricity</u>		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Service line circulation	34	kWh/month/service
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	40	hrs/week		\$31,200
Fuel (Heating Demand)				
Water system				
WTP building	\$996	/month		\$7,967.23
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$2,054	/month		\$24,645.89
Water storage tank	\$278	/month		\$2,223.82
Water storage tank line	\$11	/month		\$87.55
Water mains	\$4,920	/month		\$39,363
Service lines		/month		\$21,012
Wastewater system				
Sewer mains	\$2,990	/month		\$23,919
Service lines	\$2,627	/month		\$21,012
Lift/pump station buildings	\$0	/month		\$0.00
Force main to lagoon	\$225	/month		\$1,804
			Subtotal	\$142,000
Electricity				
Water system				
WTP building				
Lights and controls	\$332	/month		\$3,984
HVAC/hydronic system	\$332	/month		\$2,656
Water treatment	\$150	/month		\$1,797
Pumps				
Intake or well	\$150	/month		\$1,797.10
WST circulation	\$47	/month		\$378
Pressure/booster	\$225	/month		\$2,695.64
Main line circulation	\$1,504	/month		\$12,029
Service line circulation	\$0	/month		\$0.00
Wastewater system				
Lift /pump station buildings				
Lights and controls	\$0	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps				
Individual facility pump stations	\$0	/month		\$0
Community lift/pump station(s)	\$0	/month		\$0.00
Sewer/force main glycol circulation	\$375	/month		\$3,002
Lagoon discharge pump	\$2,158	/year	<u> </u>	\$2,158
			Subtotal	\$30,500
Other Costs				
Equipment R&R	\$10,185	,		\$10,185
Miscellaneous materials & supplies	\$6,111	•		\$6,111
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	/year		\$2,500
Insurance	\$1,500	/year	_	\$1,500
			Subtotal	\$22,300

Summary

Administration	\$6,000
Labor	\$31,200
Fuel	\$142,000
Electricity	\$30,500
Other	\$22,300
Total	\$232,000

Revenue	Monthl	у	# of		,	Yearly
Source	Rate		Customers	Collection Rate	Re	evenues
Residential Serv	\$	102	138	85%	\$	143,305
Public/Commerc	\$	188	21	100%	\$	47,463
School Service	\$	4,581	1	100%	\$	41,232
Local Capital Co	ntribution				\$	-
Total Revenue					\$	232,000

Oscarville, Alaska

Community Information & Existing Infrastructure

Oscarville is a Yupik community of 53 people located on the north bank of the Kuskokwim River, across the river from Napaskiak. There are 16 residential units, 15 commercial/public facilities and one school for a total of 32 services. The existing water and sewer services provided in Oscarville consist of self-haul system from the watering point and honey buckets. The school has a separate water treatment module for potable water, and sewer service that discharges into a timber lined wastewater lagoon. The existing water and sewer infrastructure consists of the following:

- Well 3.5 gpm transfer pump
- Treated Water Storage 2,100 gallons
- Watering Point Building 640 SF, built in 1988
- Water Treatment Potassium permanganate, greensand filter, chlorine, and fluoride
- Sewage Lagoon Two Cell, 0.25 acres

Soils in the region consist of stratified deposits of sand, silty sands, and fine silt. Permafrost is locally absent and drainage is fairly good in town, however, much of the surrounding land is poorly drained.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 4,600 feet of pipe, and the pressure sewer system approximately 3,100 feet of pipe. The water system will consist of a single circulating loop. The pressure sewer system would require individual grinder pump stations at each house, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	4	3.5	0.5
Water Storage (gallons)	55,900	2,100	53,800
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	1.1	0.3	0.9
Required Foundation System for WTP and/or WST			
Pile Foundation	2,090	-	2,090
Water Distribution System			
Circulating Water Main with Pitorifices (If)	4,600	-	4,600
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	3,100	-	3,100
Individual Grinder Pump Stations (GPS) (ea)	32	-	32
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	2,400	-	2,400
Pressure Sewer Service Lines (If)	2,400	-	2,400

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Oscarville. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

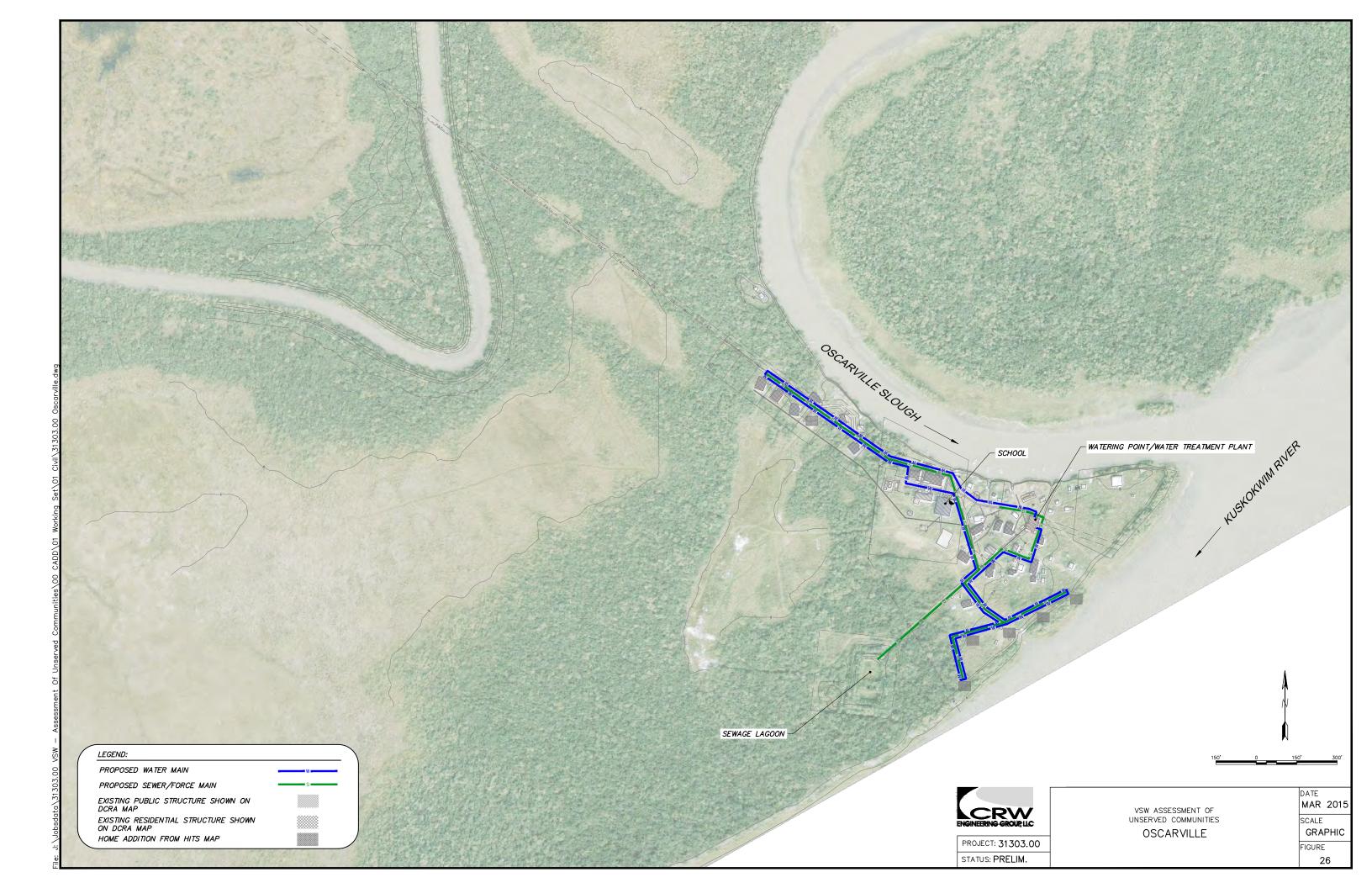
				Village	
	Estimated Capital Costs			Oscarville	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	32	\$26,403.25	\$844,904
3	Sewage collection mains or services (gravity or force), above ground	LF	5,500	\$213.56	\$1,174,576
10	Sewage lagoon, barrow, local material	Acre	1	\$911,751.90	\$820,577
12	Water distribution, mains or services, above ground	LF	7,000	\$339.19	\$2,374,347
14	Water storage tank, no foundation	Gal	53,800	\$4.78	\$257,310
15	Water treatment plant, no foundation	SF	1,200	\$1,635.59	\$1,962,712
18	Foundation - freeze back piles	SF	2,090	\$366.35	\$765,662
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$8,354,000
	Total v	vith Infl	ation (3% pei	year for 6 years)	\$9,975,100
27	Individual Grinder Pump Stations	EA	32	\$30,000	\$960,000
28	Electrical Service Upgrades	EA	32	\$5,500	\$176,000
				Subtotal	\$11,111,100
29	Construction Contingency (15%)	LS	1	\$1,666,700	\$1,666,700
30	Design & Construction Administration Services (20%)	LS	1	\$2,222,200	\$2,222,200
				Total	\$15,000,000

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$25,000			
Fuel	\$28,700			
Electricity	\$8,700			
Other (R&R, Training, etc.)	\$11,000			
Total	\$79,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Oscarville are listed below.

Estimated User Fees								
Revenue Source	Moi	nthly Rate	# of Customers	Collection Rate		evenues		
Residential Service	\$	148	16	85%	\$	24,225		
Public/Commercial Service	\$	156	15	100%	\$	28,055		
School Service	\$	2,969	1	100%	\$	26,719		
Local Capital Contribution					\$	-		
Total Revenue					\$	79,000		



1935 Number of Services 32 18 18 18 18 16 16 16 16	VSW Unserved Communit	ties - Piped W	ater & Sewer System Type and Si	zing Model	
Existing Community & System Data		•	, ,,	-	
Existing Community & System Data 2015 Foundation 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Symber of Services 2015 Service Service Symber of Services 2015 Service Service Symber of Services 2015 Service Service Symber of Symber of Services 2015 Service Service Symber of Symber of Services 2015 Service Service Symber of Symber of Services 2015 Service Se			Oscarville		
2015 From Service 10	Input				
2015 From Service 10	Existing Community & System Data				
Miles Status (EL & H.1-H7)	2015 Population		53		
16	2015 Number of Services				
Type Currice water or groundwater)	T				
Water Stranger Jank					
Water Starting (Appendix	1				
Water Treatment Capacity Same Sever Main Length (the Solt Conditions (check only one) Sever Main Length (the Solt Conditions (check all that apply) Sever Main Length (the Solt Conditions (check all that apply) Sever Main Length (the Solt Conditions (check all that apply) Sever Main Length (the Solt Conditions (check all that apply) Sever Main Length (the Solt Conditions (check all that apply) Sever Main Length (the Length (the Solt Conditions (check all that apply) Sever Main Sever Mai					
Soli Conditions (check only one) Soft Doorly drained solis or discontinuous permafrost Firm soils, or continuous permafrost Piping Configurations (check all that apply) Suried system with no permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Arrivable ground system for WTP Above Tall System Requirements Output for Cost Model (calculated) Water Treatment Capacity (gpm) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Water Storage (gallong) (less existing) Aeg Vater Storage (gallon	Water Treatment Capacity		3.5		
Soft poorly drained soils or discontinuous permafrost Siff soils, no permafrost	Existing Sewage Lagoon Size		0.25		
Firm solis, or continuous permafrost Piping Configurations (check all that apply) Suried system with no permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system or buried with permafrost Above ground system for the control of the control	Soil Conditions (check only one)				
Sulf solit no permafrost	1		х		
Piping Configurations (check all that apply) Sewer Main Length (the content of the content o					
Security Security	istiff soils, no permatrost			Sewer Main Length	Water Main
Suried system with no permafrost	Piping Configurations (check all that apply)				
Sewer Main	Buried system with no permafrost			\ .,	J- 1-7
Pressure Sewer Main	Above ground system or buried with permafrost		х	3100	4600
Typical Service Line Length (ea) Typical Service Line Length (ea) Typical Service Line Length (ea) Typical Service Line Length (ea) Typical Service Lines (If) Typical Service Lin	•		v	3100	
Piped System Requirements			X		75
Sever Main with Glycol Heat Trace Water & Sewer Service Lines					
Sever Main with Glycol Heat Trace Water & Sewer Service Lines					
Sever Main with Glycol Heat Trace Water & Sewer Service Lines Sever Service Lines (If) Sever S	Piped System Requirements	Community	Oscarville		
Water Treatment Capacity (gpm) Sage Sa	Output for Cost Model (calculated)				
Req Water Storage (gallons) (less existing)				Foundatio	n Size
Req W&S Utility Bidg/Mater Treatment Plant/Addition (sf) 1,200 sf	Water Treatment Capacity (gpm)		4		
Required Foundation System for WTP and/or WST	Req Water Storage (gallons) (less existing)		,		
Quantity Notes		n (sf)	,	1,200 sf	
Pile Foundation (sf) 1,200 1,200 1,200	Req Sewage Lagoon Size (acre) (less existing)		0.9	0	Nicko
Nater Distribution System for WTP and/or WST				Quantity	notes
Water Distribution System Circulating Water Main with 4,600			Pile Foundation (sf)		
Water Distribution System Circulating Water Main with 4,600	Boguired Foundation System for MTD and for MST			4 200	
Sewer Main with Glycol Heat Trace (if)	Required Foundation System for WTP and/or WST			1,200	
Sewer Main with Glycol Heat Trace (if)					
Sewer Main with Glycol Heat Trace (if)					
Sewer Main with Glycol Heat Trace (if)	Water Distribution System		a: 1::		
Sewer Main with Glycol Heat Trace 1,100 1,200	, , , , , , , , , , , , , , , , , , , ,			4,600	
(if)			ritornices (ii)		
(if)					
Individual Grinder Pump Stations (GPS) (ea) 32			-	3,100	
Circulating Water Service Lines (If) 2,400	Wastewater Collection System		(11)		
Circulating Water Service Lines (If) 2,400					
Circulating Water Service Lines (If) 2,400				32	
Pressure Sewer Service Lines (If) 2,400 2,400			(GPS) (ea)		
Pressure Sewer Service Lines (If) 2,400 2,400					
Pressure Sewer Service Lines (If) 2,400 2,400			Circulating Water Service Lines (If)	2,400	
System Description Piped System Need Existing Facility Net Need	Water & Sewer Service Lines		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	_,.00	
System Description Piped System Need Existing Facility Net Need					
Need Existing Facility Net Need			Pressure Sewer Service Lines (If)	2,400	
Need Existing Facility Net Need					
Need Existing Facility Net Need					
Need	System Description		Existing Facility	Net Need	
Water Storage (gallons) 55,900 2,100 53,800 W&S Utility Bldg/Water Treatment Plant/Addition (sf) 1,200 - 1,200 Sewage Lagoon Size (acre) 1.1 0.3 0.9 Required Foundation System For WTP and/or WST Pile Foundation 2,090 - 2,090 Water Distribution System Circulating Water Main with Pitorifices (lf) 4,600 - 4,600 Water & Sewer Main with Glycol Heat Trace (lf) 3,100 - 3,100 Individual Grinder Pump Stations (GPS) (ea) 32 - 32 Water & Sewer Service Lines Circulating Water Service Lines (lf) 2,400 - 2,400					
W&S Utility Bldg/Water Treatment Plant/Addition (sf) 1,200 - 1,200 Sewage Lagoon Size (acre) 1.1 0.3 0.9 Required Foundation System for WTP and/or WST Pile Foundation 2,090 - 2,090 Water Distribution System Circulating Water Main with Pitorifices (lf) 4,600 - 4,600 Water Main with Glycol Heat Trace (lf) 3,100 - 3,100 Individual Grinder Pump Stations (GPS) (ea) 32 - 32 Water & Sewer Service Lines Circulating Water Service Lines (lf) 2,400 - 2,400					
Sewage Lagoon Size (acre) 1.1 0.3 0.9 Required Foundation System for WTP and/or WST - 2,090 - 2,090 Water Distribution System - - 4,600 Circulating Water Main with Pitorifices (If) 4,600 - 4,600 Wastewater Collection System - 3,100 - 3,100 Individual Grinder Pump Stations (GPS) (ea) 32 - 32 Water & Sewer Service Lines - 2,400 - 2,400					
Pile Foundation 2,090 - 2,090			0.3		
Water Distribution System Circulating Water Main with Pitorifices (If) 4,600 - 4,600 Water Main with Pitorifices (If) 3,100 - 3,100 Sewer Main with Glycol Heat Trace (If) 3,100 - 3,100 Individual Grinder Pump Stations (GPS) (ea) 32 - 32 Water & Sewer Service Lines Circulating Water Service Lines (If) 2,400 - 2,400	Required Foundation System for WTP and/or WST				
Circulating Water Main with Pitorifices (If)		2,090	-	2,090	
Wastewater Collection System Sewer Main with Glycol Heat Trace (If) 3,100 - 3,100 Individual Grinder Pump Stations (GPS) (ea) 32 - 32 Water & Sewer Service Lines - 2,400 - 2,400	-	4 600	_ 1	4 600	
Sewer Main with Glycol Heat Trace (If) 3,100 - 3,100 Individual Grinder Pump Stations (GPS) (ea) 32 - 32 Water & Sewer Service Lines Circulating Water Service Lines (If) 2,400 - 2,400		4,000	<u> </u>	4,000	
Water & Sewer Service Lines Circulating Water Service Lines (If) 2,400 - 2,400		0.400		2 100	
Circulating Water Service Lines (lf) 2,400 - 2,400	Sewer Main with Glycol Heat Trace (If)	3,100	-	3,100	
	Individual Grinder Pump Stations (GPS) (ea)		- -		
Fressure service Lines (II)	Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	32	-	32	
	Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines Circulating Water Service Lines (If)	32 2,400	-	2,400	

VSW Ur	nserved Communities - Pipec	Water & Sewer	System Type and Sizing Model
Date	4/1/2016	Water & Jewer	System Type and Sizing Model
Community	Oscarville		
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n) 2015 Population (P)		years people	20 years 2015 ADOL
2015 Population (F) 2015 Number of Services		services	2013 ADOL
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	65	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity	3.5	gpm	
Average Day (ADD)	3,234		50 gallons per Capita
Max Day (MDD) Peak Hour	6,467	gpd gpm	2 x ADD 3 x MDD
Treatment Capacity		gpm	MDD
Water Source Assumptions Type (surface water or groundwater)	GW	7	
Required Capacity		gpm	MDD
Water Storage Tank Sizing	2 100]gallons	
Existing Water Storage Tank Demand Based Volume (if source is GW)	Applicable 2,100	gallons	
Daily Operation (DO) (gallons)	* *	gallons	Max Day (MDDx1 day)
Fire Flow (FF)	30,000	gallons	500 gpm for 60 minutes
Reserve Volume (RV)		gallons gallons	3 days x DO DO + FF + RV
Water Storage Tank Volume CT Based Volume (min if source is SW)	Not Required	Банонз	20 · 11 · 11V
Chlorine Residual Concentration (RC)	· ·	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T) pH (PH)	4.4		4.4 celsius/40 F 7
Contact Time Required (CT)		minutes	, LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*		gallons	CT/RCxPeak Hour/BF
Required Water Storage		gallons	0
Required Additional Storage Estimate of Min Platform Size (3' clearance		gallons	
around)	890	sf	D = $0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
			0
Water Treatment Plant Requirements* Water Quality	Poor	1	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		Pile Foundation	
permafrost	x	(sf)	Pile Foundation
Firm soils or continuous normafrost		1, 2,	
Firm soils, or continuous permafrost	0		Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Thermosyphon stabilized gravel pad Gravel pad
Stiff soils, no permafrost			
1 · · · · · · · · · · · · · · · · · · ·]	
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost	0	Circulating	Gravel pad
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0	Water Main	Gravel pad
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost	0	_	Gravel pad Static Water Mains
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0	Water Main with Pitorifices	Gravel pad Static Water Mains
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with	0	Water Main with Pitorifices	Gravel pad Static Water Mains
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost	0	Water Main with Pitorifices (If)	Gravel pad Static Water Mains
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 0 x	Water Main with Pitorifices (lf) Sewer Main	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	0 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol	Gravel pad Static Water Mains Circulating Water Main with Pitorifices
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 0 x	Water Main with Pitorifices (lf) Sewer Main	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x x 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x x 0 x x 0 x x 0 x x x 0 x x x x x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	0 x x 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x x 0 x x 0 x x 0 x x x 0 x x x x x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x x 0 x x 0 x x 0 0 x x 0 0 x x 0 0 x 0 0 0 x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x x 0 x x 0 x x 0 0 x x 0 0 x x 0 0 x 0 0 0 x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line with GPS
Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
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Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x x 0 0 x x 0 0 x x 0 0 0 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line with GPS
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Stiff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Gravel pad Static Water Mains Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Oscarville	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	32	\$26,403.25	\$844,904
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	5,500	\$213.56	\$1,174,576
4	Sewage lift station	EA	0	#DIV/0!	\$0
	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
	Sewage lagoon, barrow, local material	Acre	0.9	\$911,751.90	\$820,577
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	7,000	\$339.19	\$2,374,347
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
	Water storage tank, no foundation	Gal	53,800	\$4.78	\$257,310
	Water treatment plant, no foundation	SF	1,200	\$1,635.59	\$1,962,712
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	2,090	\$366.35	\$765,662
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$8,353,685

Community:	Oscarville	
General Community Dat	а	
Current population Average number Service Connect	of people per house	53 persons 3.3
Number of h Number of p Number of se	ublic/commerical buildings	16 15 1 ce connections 32
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon f	Public facilty) Residential service)	\$20 hr \$0.35 kWh \$0.15 kWh \$5.90 gal
Water consumpt Wastewater gen	ion per capita eration per capita	50 gpd 50 gpd
Length of ray Water line he	em (Surface(SW) or Groundwater(GW))	GW 50 ft No AG
Water Treatmen Size of water		1840 sf Poor
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) /ater line (Above ground (AG) or Buried)	55,900 gallons 50 ft No AG
Number of ci Total length Water mains Location of tl	n em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) vice line length	Circ 1 4600 ft Yes AG 75 ft
Number of in Number of or Number Number Number Number Number Size of lii	ection em (Gravity or Pressure) dividual facility pump stations ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #5 it stations of sewer mains	Pressure 500 sf 3100 ft
Sewer mains Number of ci Location of ti	heated for freeze protection (Yes or No) rculating glycol loops ne mains (Above ground (AG) or Buried) vice line length	Yes 1 AG 75 ft
Length of for Force main h Location of fo	atment / Disposal ce main leated for freeze protection (Yes or No) leated for freeze ground (AG) or Buried) learged seasonally with pump (Yes or No)	430 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	24	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$554	/month		\$4,435.50
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$190	/month		\$1,520.97
Water storage tank	\$50	/month		\$401.05
Water storage tank line	\$0	/month		\$0.00
Water mains	\$990	/month		\$7,921
Service lines	\$517	/month		\$4,132
Wastewater system				
Sewer mains	\$667	/month		\$5,338
Service lines	\$517	/month		\$4,132
Lift/pump station buildings	\$0	/month		\$0.00
Force main to lagoon	\$93	/month	_	\$740
			Subtotal	\$28,600
Electricity				
Water system				
WTP building				
Lights and controls	*	/month		\$2,255
HVAC/hydronic system	*	/month		\$1,504
Water treatment	\$14	/month		\$169
Pumps				
Intake or well	·	/month		\$169.18
WST circulation	*	/month		\$378
Pressure/booster	\$21			\$253.76
Main line circulation	\$376	/month		\$3,007
Wastewater system				
Lift /pump station buildings				
Lights and controls		/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps	••	,		••
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	* -	/month		\$0.00
Sewer/force main glycol circulation	\$94	/month		\$750
Lagoon discharge pump	\$203	/year	Subtotal	\$203 \$8,700
Other Costs			Jubiolai	ψο,, ου
Equipment R&R	\$3,113	/year		\$3,113
Miscellaneous materials & supplies	\$1,868	•		\$3,113 \$1,868
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	-		\$2,500
Insurance	\$2,500 \$1,500	-		\$2,500 \$1,500
insurance	φ1,300	, you	Subtotal	\$1,000
			Jubiolai	ψ11,000

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$28,600
Electricity	\$8,700
Other	\$11,000
Total	\$79,000

Revenue I	Monthly	# of		١	early
Source F	Rate	Customers	Collection Rate	Re	venues
Residential Serv	\$ 148	16	85%	\$	24,225
Public/Commerc	\$ 155.86	15	100%	\$	28,055
School Service (\$ 2,968.81	1	100%	\$	26,719
Local Capital Con	tribution			\$	-
Total Revenue				\$	79,000

Platinum, Alaska

Community Information & Existing Infrastructure

Platinum is a Yupik community of 60 people located on the Bering Sea coast, below Red Mountain on the south spit of Goodnews Bay. There are 19 residential units, 13 commercial/public facilities and one school for a total of 33 services. Piped water is distributed to approximately 7 homes, the school, and 20 yard hydrants. Residents self-haul water from the hydrants. Sewer services consist of individual septic systems and honeybuckets. The existing water and sewer infrastructure consists of the following:

- Groundwater under the direct influence of surface water – 53 gpm
- Water Storage 430 gallons

- Pump House Building 48 SF
- No Treatment
- Sewage Lagoon N/A

Soils in the region consist of loose and moist to wet. There is a layer of organics across the tundra that overlies 3-8" of poorly graded sand layer. Under the poorly graded sand layer is a layer of poor to well graded sand and gravel. Groundwater is generally present around 8 feet below ground surface. No frozen ground encountered.

Piped System Description

The piped water system will be a below grade system with static water mains. The water system will consist of approximately 7,300 feet of pipe. The sewer system for the community will consist of individual residential on-site septic systems that include septic tanks and drainfields. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment and water distribution equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	5	53	-
Water Storage (gallons)	59,300	430	58,870
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Residential On-Site Septic System (ea)	33	-	33
Required Foundation System for WTP and/or WST			
Pile Foundation	2,160	-	2,160
Water Distribution System			
Static Water Main (If)	7,300	-	7,300
Water & Sewer Service Lines			
Static Water Service Lines (If)	2,475	-	2,475
Gravity Sewer Service Lines (If)	2,475	-	2,475

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Platinum. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30).

				Village	
	Estimated Capital Costs	Platinum			
			<u>'</u>		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	33	\$26,342.77	\$869,312
2	Sewage collection mains or services (gravity or force), buried	LF	2,475	\$367.63	\$ 909,880
6	Septic tank, and drainfield, individual household	EA	33	\$125,292.93	\$4,134,667
13	Water distribution, mains or services, buried	LF	9,775	\$299.80	\$2,930,587
14	Water storage tank, no foundation	Gal	58,870	\$5.51	\$324,194
15	Water treatment plant, no foundation	SF	1,200	\$1,633.35	\$1,960,015
18	Foundation - freeze back piles	SF	2,160	\$341.96	\$738,638
	Total Estir	mated (Cost in 2010 (dollars (rounded):	\$11,867,000
	Total v	vith Infl	ation (3% pe	r year for 6 years)	\$14,169,800
28	Electrical Service Upgrades	EA	33	\$5,500	\$181,500
				Subtotal	\$14,351,300
29	Construction Contingency (15%)	LS	1	\$2,152,700	\$2,152,700
30	Design & Construction Administration Services (20%)	LS	1	\$2,870,300	\$2,870,300
				Total	\$19,374,300

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs					
Description	Cost				
Administration	\$6,000				
Labor	\$21,200				
Fuel	\$5,000				
Electricity	\$4,600				
Other (R&R, Training, etc.)	\$8,500				
Total	\$45,000				

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Platinum are listed below.

Estimated User Fees							
Revenue Source	М	onthly Rate	# of Customers	Collection Rate		evenues	
Residential Service	\$	93	19	85%	\$	17,989	
Public/Commercial Service	\$	93	13	100%	\$	14,480	
School Service	\$	1,392	1	100%	\$	12,531	
Local Capital Contribution					\$	-	
Total Revenue					\$	45,000	

VSW Unserved Commun	ities - Piped W	ater & Sewer System Type and Si	izing Model	
Dat	•	9/7/2016	•	
Communit	•	Platinum	1	
Inpu	it		J	
Existing Community & System Data				
2015 Population		60]	
2015 Number of Services		33		
HITS Database (E1 & H1-H7)		19		
DCED Mapping Commerical/Public Facilities/School		14 GW		
Type (surface water or groundwater) Water quality (Poor or Good)		Poor		
Water Storage Tank		430		
Water Treatment Capacity		53		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)			J	
Soft poorly drained soils or discontinuous permafrost		х]	
Firm soils, or continuous permafrost				
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length (ft)	Water Main Length (ft)
Buried system with no permafrost		Х	(.9	7300
Above ground system or buried with permafrost				
Gravity Sewer Main				
Pressure Sewer Main				
Typical Service Line Length (ea)			75	75
Piped System Requirements Output for Cost Model (calculated)	Community	Platinum	Foundatio	n Size
Water Treatment Capacity (gpm)		5		
Req Water Storage (gallons) (less existing)		58,870	960	
Req W&S Utility Bldg/Water Treatment Plant/Addition	on (sf)	1,200	1,200	
			Quantity	Notes
		Pile Foundation (sf)		
Required Foundation System for WTP and/or WST			1,200	
		Static Water Main (If)	7,300	
Water Distribution System		(,	,	
		Static Water Service Line (If)	2,475	
Water & Sewer Service Lines		Gravity Sewer Service Lines (If)	2,475	
			3,110	
System Description	Piped System	Existing Facility	Net Need	
	Need	· ·	ivet iveed	
Water Treatment Capacity (gpm) Water Storage (gallons)	5 59,300	53.0 430	- 58,870	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	430	1,200	
Residential On-Site Septic System (ea)	33	-	33	
Required Foundation System for WTP and/or WST				
Pile Foundation	2,160	-	2,160	
Water Distribution System	1	T	1	
Static Water Main (If)	7,300	-	7,300	
Water & Sewer Service Lines Static Water Service Line (If)	2,475		2,475	
Gravity Sewer Service Lines (If)	2,475	-	2,475	

	3/03/11-	sorued Communities Disse	Mater 9 Carr	r System Type and Sizing Madel
Designation Parameters Model Results District & Calculations			ı water & Sewei	r System Type and Sizing Model
System Parameters				
Design Population Design Population Design Population (P) 2015 increased Signatures 325 Design Population (Capital) Water Design Population (Capital) Water Design Standards Signatures S	· i			Criteria & Calculations
Doration (ri) 20 years all people or 20 years all people or 20 years all people or 20 years all people or 20 years 20 ye				
2015 Number of services		20	years	20 years
Growth Task (II) Tay Beggie Part 1-In Water Damad Edinates Calcular Capacity Average Day (ADD) 7.2.12 gpd 8.5.18 pm 8.0.16 p				2015 ADOL
Type Page				10/
Weter Demand Estimates Society Capacity Society Capacity 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.59 and 9 7.50 a				
Existing Capacity Max Day (MDO) 3.66.1 god 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 2.4 ADD 7.22.2 god 7.2 ADD 7.22.2 god 7.2 ADD 7.22.2 god 7.2 ADD 7.22.2 god 7.2 ADD 7.22.2 god 7.2 ADD 7.22.2 god 7.2 ADD				
Average Day (ADD) Post Issue 1		F.3	1	
Max Day (MDD) Pack islour 15 gpm 3 a MOD Water Source, Source water or groundwater) Required Capacity Water Source, Source Tank Staing Existing, Worker Source, Source Water Source, Tank Water Source, T	= ' '			50 gallons per Capita
Treatment Capacity Water Source Assumptions Type Gurdace water or groundwater) Acquired Capacity Water Source Fank String Editing Water Storage Tank Command Based Water Storage Tank Applicable	=			
Water Source Assumptions Type Eurorize water or groundwater) Regulard Capacity 5 gm MDD Water Storage Teach String Security Charactery or String String Security Charactery (1986) Security Charactery (1986) Security Charactery (1986) Security Charactery (1986) Security Charactery (1986) Security (1986				
Type Gurdare water or groundwater) Regulared Capacity S gpm MDD	Treatment Capacity	5	gpm	MDD
Mater Storage Tank Sizing Canada Sacratic Storage Tank Sizing Canada Sacratic Storage Tank Sizing Canada Sacratic Storage Tank Sizing Canada Sacratic Storage Tank Sizing Canada Sacratic Storage Tank Sizing Canada Sacratic Storage Tank Volume (RV) Castract Volum	Water Source Assumptions		_	
Existing Water Storage Tank Sizing Existing Water Storage Tank Daily Operation (DO) (gallons) Provided Search Volume To Search (Provided Search Volume To Searc				
Easting Water Storage Tank Cameral Stated Water Storage Tank Cameral Stated Water Storage Tank Cameral Stated Water Storage Tank Cameral Stated Water Storage Tank Applicable 7,321 gallons 30,0000 gallons 40,0000 gallons	Required Capacity	5	gpm	MDD
Demand Based Volume (Fit purce is GW) Daily Operation (Dit (pallors) Fire Flow (FF) Substitution (Water Storage Tank Sizing			
Daily Operation (DOI) (gallons) 7.321 gallons 30,000 gallons 30,00	Existing Water Storage Tank		gallons	
Size Size			gallag -	May Day (MDDyd day)
Reserve Volume (RV) 21,963 gallons 3 days x DO				
CLBBased Volume. (Imil of Source is SW)		21,963	gallons	
Chlorine Residual Concentration (RC) Disinfection (April Contact Varion (II) Temperature (T) Per (PH) Contact Time Required (CT) Bequired Volume to meet CT* Required Activitional Storage Required Additional Storage SEstimate of Mini Platform Size (3' clearance around) Static Volume (PH) Set Treatment Plant Requirements* Water Treatment Plant Requirements* Water Treatment Plant Requirements* Water Treatment Plant Requirements* Water Calality Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (CF or DF) = 1200 sf Good Water Quality (CF or DF) = 1200 sf Good Water Quality (CF or DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (CF or DF) = 1200 sf Go			gallons	DO + FF + RV
Disinfection/Log inactivation (LI) Temperature (T) pt (PH) Pt		· ·	mg/I	0.4 mg/l
Temperature (T) print (PH) (PH) (PH) (PH) (PH) (PH) (PH) (PH)	` '		-	= -
Contact Time Required (CT) 80 minutes 1	Temperature (T)	4.4	C	4.4 celsius/40 F
Bidfling Coefficient (BF) Required Values to meet CT* Required Water Storage Required Water Storage Required Adultional Storage S8,870 gallons FVALUE S9,300 gallons				
Required Valure to meet CT* Required Water Storage Required Additional Storage Required Additional Storage SS.870 gallons SS.8				
Security Sever Main Static Water Service Line (If)				
Estimate of Min Platform Size [3' clearance around) Water Treatment Plant Requirements* Water Quality Water Quality Water Quality (For DF)= 1200 sf Good Water Quality (for DF)= 1200 sf Fill Static Water Main (lf) Fill Static Water Main (lf) Fill Static Water Main (lf) Fill Static Water Main (lf) Fill Static Water Main (lf) Fill Static Water	=			
Water Treatment Plant Requirements* Water Treatment Plant Requirements* Water Quality Minimum WTP Size Foundation (WST and WTP) Soft poorly drained soils or discontinuous permafrost On poorly drained soils or discontinuous permafrost On permafrost On permafrost On permafrost Above ground system with no permafrost Above ground or buried with permafrost On permafrost On Sister Water Main On Size Sewer Main Water & Sewer Services (Check all that apply) Static Water Static Water Static Water Service Line Uift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Static Water Service Line Uift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Static Water Main On Size Sewer Services (Check all that apply) Static Water Static Water Main with pitcorifices Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line (II) Static Water Service Line Circulating Water Service Line Gravity Service Line Circulating Water Service Line Gravity Service Line On Size Septic System On Size Septic System On Size Service Line with GPS Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size Onganic Loading Based Size One Size Service University Service University Service University Service University Service University Service University Service University Ser		58,870	gallons	#VALUE!
Water Teatment Plant Requirements* Poor Poor Mater Quality (CF or DF) = 1200 sf Water Quality Minimum WTP Size J,200 sf Good Water Quality (no treatment other than CL) = 800 sf Foundation (WST and WTP) Soft poorly drained soils or discontinuous permafrost X Pille Foundation (Sf) Firm soils, or continuous permafrost 0 Thermosyphon stabilized gravel pad Gravel pad	-	960	sf	D = $0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
Poor Poor Poor Poor Poor Poor Poor Mater Quality (CF or DF) = 1200 sf	·			#VALUE!
Minimum WTP Size Foundation (WST and WTP) Soft poorly drained soils or discontinuous permafrost Firm soils, or continuous permafrost O Siff soils, no permafrost Water Distribution (Check either or both) Buried system with no permafrost Above ground system or buried with permafrost O Watewater Collection (Check all that apply) Buried system with no permafrost O Watewater Collection (Check all that apply) Buried system with no permafrost O Watewater Collection (Check all that apply) Buried system with no permafrost O Sewer main, no heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Water & Sewer Services (Check all that apply) Static Water Main O Gravity Sewer Main O Static Water Service Line Circulating Water Main O O-Site Septic System O O O-Site Septic System O O O-Site Septic System O O O-Site Septic System O O O-Site Septic System O O O-Site Sever Main O O O O-Site Sever Main O O O O O O O O O O O O O O O O O O O		Poor	1	Poor Water Quality (CE or DE) = 1200 cf
Foundation (WST and WTP) Soft poorly drained soils or discontinuous permafrost Stiff soils, no permafrost United System with no permafrost Water Distribution (Check either or both) Buried system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main O Static Water Main, no heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Water & Sewer Services (Check all that apply) Static Water Main O Static Water Main O Static Water Service Line (If) Circulating Water Main O Static Water Service Line (If) Circulating Water Service Line Gravity Sewer A Static Water Service Line Static Water Service Line Circulating Water Service Line Gravity Service Line Circulating Water Service Line C	-		sf	
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Existing Sewage Lagoon Organic Loading Based Size check 133.7 Hydraulic Loading Based Size 1.3 acres O.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per capita day x	Pressure Sewer Main	0		Pressure Service Line with GPS
Existing Sewage Lagoon Organic Loading Based Size check 133.7 Hydraulic Loading Based Size 1.3 acres O.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per capita day x				
Organic Loading Based Size 0.6 acres 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 pcheck 133.7 Volume is based on ADDx365x20% factor to account for precipitation Hydraulic Loading Based Size 1.3 acres Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for				
check 133.7 Volume is based on ADDx365x20% factor to account for precipitation Hydraulic Loading Based Size 1.3 acres Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for				0.17 lbs of PODE nov conits down Darley Branch 1 / 2011 205
Volume is based on ADDx365x20% factor to account for precipitatic Hydraulic Loading Based Size 1.3 acres Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for				0.17 IDS OF BODS per capita day x Design Population / 20 lbs BODS per
		133.7		Volume is based on ADDx365x20% factor to account for precipitation,
of berms (area to be fenced)	Hydraulic Loading Based Size	1.3	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
L				
Two cell lagoon, combined acreage 1.3 acres Either organic loading based or hydraulic, whichever is greater	Two cell lagoon, combined acreage	1.3	acres	Lither organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Platinum	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	33	\$26,342.77	\$869,312
2	Sewage collection mains or services (gravity or force), buried	LF	2,475	\$367.63	\$909,880
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	33	\$125,292.93	\$4,134,667
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0	#DIV/0!	\$0
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	9,775	\$299.80	\$2,930,587
14	Water storage tank, no foundation	Gal	58,870	\$5.51	\$324,194
15	Water treatment plant, no foundation	SF	1,200	\$1,633.35	\$1,960,015
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	2,160	\$341.96	\$738,638
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$11,867,293

Community:	Platinum	
General Community Date	a	
Current population		60 persons
Average number Service Connect	of people per house ions	3.2
Number of h		19
Number of p	ublic/commerical buildings chools	13
	Total number of servi	ce connections 33
Burdened labor i		\$17 hr
Electricity cost (F	Residential service)	\$0.40 kWh \$0.20 kWh
Cost per gallon f		\$5.00 gal
Water consumpt		50 gpd
wastewater gen	eration per capita	50 gpd
Water & Sewer System Water Source	Characteristics	
Type of syste	em (Surface(SW) or Groundwater(GW))	GW
Length of rav	v water line eated for freeze protection (Yes or No)	2200 ft No
	vater line (Above ground (AG) or Buried)	Buried
Water Treatmen	=	
	treatment plant building uality (Good or Poor)	1200 sf Poor
Water Storage	dainty (Good of 1 ool)	1 001
Size of tank(s)	59,300 gallons
· ·	ter line to/ from tank eated for freeze protection (Yes or No)	100 ft No
	vater line (Above ground (AG) or Buried)	AG
Water Distribution	<u>n</u>	
	em (Static or Circulating (Circ)) rculating water loops	Static 0
	of Water Main	7300 ft
	heated for freeze protection (Yes or No)	No Buried
	ne mains (Above ground (AG) or Buried) rice line length	75 ft
Wastewater Coll		
	em (Gravity or Pressure) dividual facility pump stations	
	ommunity lift/pump stations	
	of facilities served by lift/pump station #1	
	of facilities served by lift/pump station #2 of facilities served by lift/pump station #3	
	of facilities served by lift/pump station #4 of facilities served by lift/pump station #5	
	it stations	sf
	of sewer mains heated for freeze protection (Yes or No)	ft
	rculating glycol loops	
	ne mains (Above ground (AG) or Buried) vice line length	75 ft
· ·	· ·	/5 IL
<u>wastewater real</u> Length of for	atment / Disposal ce main	ft
	neated for freeze protection (Yes or No) orce main (Above ground (AG) or Buried)	
	orce main (Above ground (AG) or Buried) n discharged seasonally with pump (Yes or No))

Operation & Maintenance Cost Assumptions

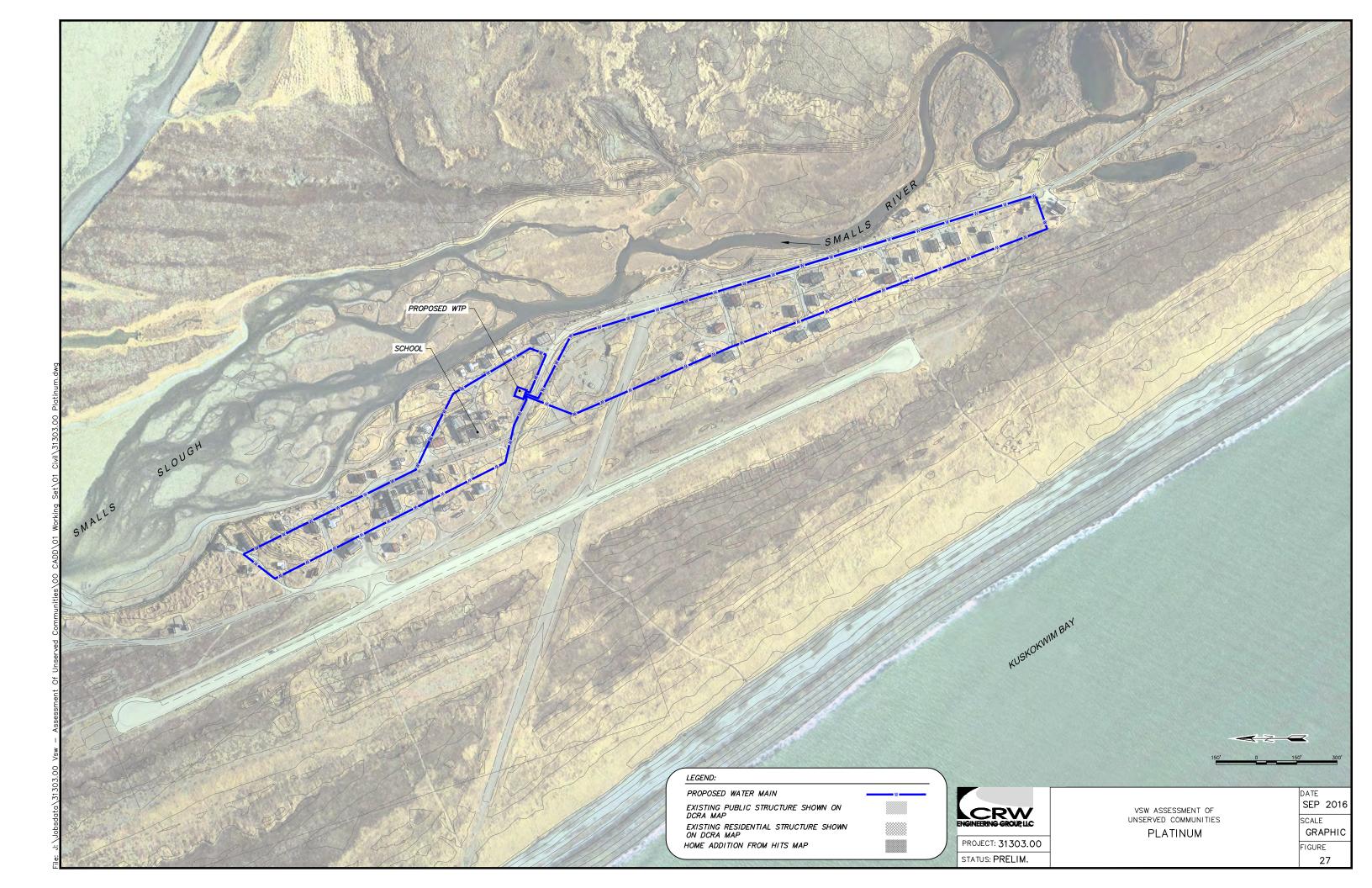
Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		· ·
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Septic system discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2.500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	24	hrs/week		\$21,216
Fuel (Heating Demand)				
Water system				
WTP building	\$306	/month		\$2,451.46
Raw water line	· ·	/month		\$0.00
Raw water heat addition	•	/month		\$2,188.80
Water storage tank	\$45	/month		\$360.54
Water storage tank line	\$0	/month		\$0.00
Water mains	·	/month		\$0
Service lines	\$0	/month		\$0
Wastewater system				
Sewer mains	\$0	/month		\$0
Service lines	\$0	/month		\$0
Lift/pump station buildings	\$0	/month		\$0.00
Force main to septic system	\$0	/month		\$0
			Subtotal	\$5,000
Electricity				
Water system				
WTP building				
Lights and controls	· ·	/month		\$1,681
HVAC/hydronic system	, .	/month		\$1,681
Water treatment	\$18	/month		\$219
Pumps				
Intake or well	·	/month		\$218.88
WST circulation	\$54	/month		\$432
Pressure/booster	*	/month		\$328.32
Main line circulation	\$0	/month		\$0
Wastewater system				
Lift /pump station buildings				
Lights and controls	\$0	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps	•	, ,,		•
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	* -	/month		\$0.00
Sewer/force main glycol circulation	\$0	/month		\$0
Septic system discharge pump	\$0	/year	Subtotal	\$0 \$4,600
Other Costs			Cablolai	ψ-1,000
Equipment R&R	\$1,541	/year		\$1,541
Miscellaneous materials & supplies		/year		\$1,541 \$924
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	-		\$2,500
Insurance	\$1,500	•		\$1,500
modration	Ψ1,500	, you	Subtotal	\$8,500
			Gubiolai	φυ,500

Summary

Administration	\$6,000
Labor	\$21,200
Fuel	\$5,000
Electricity	\$4,600
Other	\$8,500
Total	\$45,000

Revenue I	Monthly	# of		\	early/
Source F	Rate	Customers	Collection Rate	Re	venues
Residential Serv	\$ 93	19	85%	\$	17,989
Public/Commerc	\$ 92.82	13	100%	\$	14,480
School Service (\$ 1,392.33	1	100%	\$	12,531
Local Capital Con	tribution			\$	-
Total Revenue				\$	45,000



Rampart, Alaska

Community Information & Existing Infrastructure

Rampart is a Koyukon Athabascan community of 45 people located on the south bank of the Yukon River, approximately 75 miles upstream from the Tanana River junction. There are 30 residential units and 19 commercial/public facilities for a total of 49 services. The existing water services provided in Rampart consist of a self-haul system from the watering point and the community water pickup truck. The sewer services consist of outhouses. The school, washeteria, and health clinic have piped water and sewer services. The existing water and sewer infrastructure consists of the following:

- Well 13 gpm
- Treated Water Storage 4,000 gallons
- Water Treatment Plant 2,148 SF, built in 1998
- Water Treatment Potassium permanganate, greensand filter, and chlorine
- Sewage Lagoon Single cell, 0.2 acres

Soils around Rampart consist of brown to gray silt with scattered organic material and ice lenses from 1/8" to 1.2'. Material becomes coarser with depth, consisting of interbedded frozen silt and gravel, frozen gravel, and bedrock.

Piped System Description

The piped water and sewer system will be an above ground system. The water system will consist of approximately 6,900 feet of pipe. The water system will consist of two circulating loops. The sewer system will be a combination of gravity and pressure system. Homes located on the hills can likely accommodate a gravity sewer system (1,950 LF). A total of 19 services will be connected to the gravity sewer and will not require individual grinder pump stations (GPS). The remaining 30 homes and buildings on the lower portion of the community will be connected to the pressure sewer system (3,200 LF) and would require GPS units. The sewer system would require one sewer main lift station, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	4	13	-	
Water Storage (gallons)	52,000	4,000	48,000	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200	
Sewage Lagoon Size (sf)	1.0	0.2	0.8	
Required Foundation System for WTP and/or WST				
Pile Foundation (sf)	2,020	-	2,020	
Water Distribution System				
Circulating Water Main with Pitorifices (If)	6,900	-	6,900	
Wastewater Collection System				
Sewer Main with Glycol Heat Trace (If)	5,200	-	5,200	
Individual Grinder Pump Stations (GPS) (ea)	30	-	30	
Water & Sewer Service Lines				
Circulating Water Service Lines (If)	3,700	-	3,700	
Gravity Sewer Service Lines (If)	1,425	-	1,425	
Pressure Sewer Service Lines (If)	2,250	-	2,250	

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Rampart. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

	Village				
Estimated Capital Costs Rampart					
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	49	\$26,403.25	\$1,293,759
3	Sewage collection mains or services (gravity or force), above ground	LF	8,875	\$209.61	\$1,860,288
4	Sewage lift station	EA	1	\$762,792.59	\$762,793
10	Sewage lagoon, barrow, local material	Acre	0.8	\$1,056,418.57	\$845,135
12	Water distribution, mains or services, above ground	LF	10,600	\$337.97	\$3,582,480
14	Water storage tank, no foundation	Gal	48,000	\$6.40	\$307,196
15	Water treatment plant, no foundation	SF	1,200	\$1,660.79	\$1,992,952
18	Foundation - freeze back piles	SF	2,020	\$384.57	\$776,823
	Total Estimated Cost in 2010 dollars (rounded): \$11,421,000				\$11,421,000
	Total v	vith Infl	ation (3% pe	year for 6 years)	\$13,637,300
27	Individual Grinder Pump Stations	EA	30	\$30,000	\$900,000
28	Electrical Service Upgrades	EA	49	\$5,500	\$269,500
				Subtotal	\$14,806,800
29	Construction Contingency (15%)	LS	1	\$2,221,000	\$2,221,000
30	Design & Construction Administration Services (20%)	LS	1	\$2,961,400	\$2,961,400
				Total	\$19,989,200

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs					
Description	Cost				
Administration	\$6,000				
Labor	\$25,000				
Fuel	\$43,200				
Electricity	\$20,400				
Other (R&R, Training, etc.)	\$13,000				
Total	\$108,000				

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Rampart are listed below.

Estimated User Fees						
Revenue Source	Monthly Rate		# of Customers	Collection Rate		Yearly evenues
Residential Service	\$	142	30	85%	\$	43,370
Public/Commercial Service	\$	283	19	100%	\$	64,630
School Service	\$	-	0	100%	\$	-
Local Capital Contribution					\$	-
Total Revenue					\$	108,000

VSW Unserved Communi	ties - Piped W	ater & Sewer System Type and Si	zing Model	
Date		9/29/2016		
Community		Rampart		
Input	:			
Existing Community & System Data				
2015 Population		45		
2015 Number of Services		49		
HITS Database (E1 & H1-H7)		30		
DCED Mapping Commerical/Public Facilities/School		19		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good) Water Storage Tank		Poor 4000		
Water Treatment Capacity		13		
Existing Sewage Lagoon Size		0.2		
Soil Conditions (check only one)		•		
Soft poorly drained soils or discontinuous permafrost		х		
Firm soils, or continuous permafrost				
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length	Water Main
			(ft)	Length (ft)
Buried system with no permafrost Above ground system or buried with permafrost		X	5150	6900
Gravity Sewer Main		X X	1950	0300
Pressure Sewer Main		X	3200	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Rampart		
Output for Cost Model (calculated)				
			Foundatio	n Size
Water Treatment Capacity (gpm)		4		
Req Water Storage (gallons) (less existing)		48,000	820	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		0.8		
			Quantity	Notes
		Pile Foundation (sf)		
Required Foundation System for WTP and/or WST			2,020	
Mateu Bistrikution Contact				
Water Distribution System		Circulating Water Main with	6,900	
		Pitorifices (If)	0,500	
		Sewer Main with Glycol Heat Trace		
Wastewater Collection System		(If)	5,200	
wastewater Conection System				
			1	
		Lift Stations for Sewer Mains	1	
		Individual Grinder Pump Stations	1	
			1	
		Individual Grinder Pump Stations	1	
		Individual Grinder Pump Stations	30 3,700	
Water & Sewer Service Lines		Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	3,700	
Water & Sewer Service Lines		Individual Grinder Pump Stations (GPS) (ea)		
Water & Sewer Service Lines		Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	3,700	
Water & Sewer Service Lines		Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	3,700 1,425	
Water & Sewer Service Lines		Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	3,700 1,425	
	Piped System	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If)	3,700 1,425 2,250	
System Description	Need	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	3,700 1,425	
System Description Water Treatment Capacity (gpm)	Need 4	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	3,700 1,425 2,250 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons)	Need 4 52,000	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	3,700 1,425 2,250 Net Need	
System Description Water Treatment Capacity (gpm)	Need 4	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	3,700 1,425 2,250 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 4 52,000 1,200	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000	3,700 1,425 2,250 Net Need - 48,000 1,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf)	Need 4 52,000 1,200	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000	3,700 1,425 2,250 Net Need - 48,000 1,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System	Need 4 52,000 1,200 1.0 2,020	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000 - 0.2	3,700 1,425 2,250 Net Need - 48,000 1,200 0.8	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	Need 4 52,000 1,200 1.0	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000 - 0.2	3,700 1,425 2,250 Net Need - 48,000 1,200 0.8	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 4 52,000 1,200 1.0 2,020	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000 - 0.2	3,700 1,425 2,250 Net Need - 48,000 1,200 0.8 2,020 6,900	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf)	Need 4 52,000 1,200 1.0 2,020 6,900 5,200	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000 - 0.2	3,700 1,425 2,250 Net Need - 48,000 1,200 0.8	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 4 52,000 1,200 1.0 2,020	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000 - 0.2	3,700 1,425 2,250 Net Need - 48,000 1,200 0.8 2,020 6,900 5,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 4 52,000 1,200 1.0 2,020 6,900 5,200	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000 - 0.2	3,700 1,425 2,250 Net Need - 48,000 1,200 0.8 2,020 6,900 5,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 4 52,000 1,200 2,020 6,900 5,200 30	Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 13 4,000 - 0.2	3,700 1,425 2,250 Net Need - 48,000 1,200 0.8 2,020 6,900 5,200 30	

VSW IIn	served Communities - Pined	Water & Sower	System Type and Sizing Model
Date	•	water & Sewer	System Type and Sizing Wodel
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n) 2015 Population (P)		years people	20 years 2015 ADOL
2015 Number of Services		services	2013 1000
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	55	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		gpm	
Average Day (ADD) Max Day (MDD)	2,745 5,491		50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity		gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW]	
Required Capacity	4	gpm	MDD
Mater Starage Tank Sizing			
Water Storage Tank Sizing Existing Water Storage Tank	4,000	gallons	
Demand Based Volume (if source is GW)	Applicable	8	
Daily Operation (DO) (gallons)		gallons	Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)	· ·	gallons gallons	500 gpm for 60 minutes 3 days x DO
Water Storage Tank Volume		gallons	DO + FF + RV
CT Based Volume (min if source is SW)	Not Required	Ī	
Chlorine Residual Concentration (RC)		mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI) Temperature (T)	1.0 4.4		1.0-log Inactivation 4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT* Required Water Storage		gallons gallons	CT/RCxPeak Hour/BF
Required Additional Storage		gallons	
Estimate of Min Platform Size (3' clearance	820	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			
Water Treatment Plant Requirements*			
Water Quality	Poor	<u> </u>	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf Existing WTP<800 sf and in poor condition
Foundation (WST and WTP)			Existing W 11 1000 St and in poor condition
Soft poorly drained soils or discontinuous	x	Pile Foundation	Pile Foundation
permafrost Firm soils, or continuous permafrost	0	(sf)	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)		1	Chable Weber Mains
Buried system with no permafrost	0	Circulating	Static Water Mains
Above ground system or buried with	x	Water Main	Circulating Water Main with Pitorifices
permafrost	^	with Pitorifices	circulating water Main with Fitorinices
		(If)	
Mastawater Callection (Chack all that apply)			
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0	Sewer Main	Bare sewer main, no heat trace
Above ground or buried with permafrost	x	with Glycol	Insulated sewer main with glycol heat trace
		Heat Trace (If)	8,7======
		Lift Stations for	
Gravity Sewer Main	x	Gravity Sewer	Lift stations for gravity sewer mains, every 1,000 ft
Gravity Sewer Main	^	Mains, every	Ent stations for gravity sewer mains, every 1,000 ft
		1,000 ft (ea)	
		Individual Grinder Pump	
Pressure Sewer Main	x	Stations (GPS)	Individual Grinder Pump Stations
		(ea)	
Water & Sewer Services (Check all that apply)			
Static Water Main	0		Static Water Service Line
		Circulating	
Circulating Water Main	х	Water Service Lines (If)	Circulating Water Service Lines
Gravity Sewer Main	x	Gravity Sewer Service Lines (If)	Gravity Service Line
Pressure Sewer Main	x	Pressure Sewer	Pressure Service Lines
	^	Service Lines (If)	
Sewage Lagoon Size	0.3	acres	
Existing Sewage Lagoon Organic Loading Based Size		acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
	115.7		
check			Volume is based on ADDx365x20% factor to account for precipitation,
check Hydraulic Loading Based Size	1.0	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
		acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced) Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Rampart	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	49	\$26,403.25	\$1,293,759
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	8,875	\$209.61	\$1,860,288
	Sewage lift station	EA	1	\$762,792.59	\$762,793
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	8.0	\$1,056,418.57	\$845,135
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	10,600	\$337.97	\$3,582,480
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
	Water storage tank, no foundation	Gal	48,000	\$6.40	\$307,196
15	Water treatment plant, no foundation	SF	1,200	\$1,660.79	\$1,992,952
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	2,020	\$384.57	\$776,823
19	Foundation - thermosyphen stabilized gravel pad	SF	0	#DIV/0!	\$0
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$11,421,426

Community:	Rampart (Pressure)

General Community Data

General Community Data	
Current population Average number of people per house Service Connections (Lowland)	45 persons 3.8
Number of houses Number of public/commerical buildings Number of schools Total number of service connections	12 18 0 30
Burdened labor rate Electricity cost (Public facilty) Electricity cost (Residential service) Cost per gallon for heating oil	\$20 hr \$0.40 kWh \$0.20 kWh \$6.00 gal
Water consumption per capita Wastewater generation per capita	50 gpd 50 gpd
Water & Sewer System Characteristics Water Source	
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	GW 100 ft Yes AG
Water Treatment Size of water treatment plant building Raw water quality (Good or Poor)	3348 sf Poor
Water Storage Size of tank(s) Length of water line to/ from tank Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	52,000 gallons 50 ft Yes AG
Water Distribution Type of system (Static or Circulating (Circ)) Number of circulating water loops Total length of Water Main (Lowland) Water mains heated for freeze protection (Yes or No) Location of the mains (Above ground (AG) or Buried) Average service line length	Circ 2 6900 ft Yes AG 75 ft
Wastewater Collection Type of system (Gravity or Pressure) Number of individual facility pump stations Number of community lift/pump stations Number of facilities served by lift/pump station #1 Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5	Pressure 1 42
Size of lift stations Total length of sewer mains (Pressure) Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried) Average service line length	500 sf 3200 ft Yes 2 AG 75 ft
Wastewater Treatment / Disposal Length of force main Force main heated for freeze protection (Yes or No) Location of force main (Above ground (AG) or Buried) Lagoon discharged seasonally with pump (Yes or No)	200 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment	0.4	watto/iii/oi
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps	0.0	matter gamen
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
modiano	ψ1,000	poi 300i

ted O& M Costs		Annual Cost
Administration (Utility management, billings, etc.)	\$500 /month	\$6,000
Labor (WTP Operator)	24 hrs/week	\$24,96
Fuel (Heating Demand)		
Water system		
WTP building	\$1,026 /month	\$8,207.47
Raw water line	\$22 /month	\$175.10
Raw water heat addition	\$164 /month	\$1,313.28
Water storage tank	\$47 /month	\$379.39
Water storage tank line	\$11 /month	\$87.55
Water mains	\$1,510 /month	\$12,082
Service lines	\$492 /month	\$3,940
Wastewater system		
Sewer mains	\$700 /month	\$5,603
Service lines	\$492 /month	\$3,940
	\$153 /month	
Lift/pump station buildings	•	\$1,225.73
Force main to lagoon	\$44 /month	\$350 total \$37.300
	Sub	total \$37,300
Electricity		
Water system		
WTP building		
Lights and controls	\$391 /month	\$4,690
HVAC/hydronic system	\$391 /month	\$3,127
Water treatment	\$14 /month	\$164
Pumps		
Intake or well	\$14 /month	\$164.16
WST circulation	\$54 /month	\$432
Pressure/booster	\$21 /month	\$246.24
Main line circulation	\$859 /month	\$6,874
Wastewater system		
Lift /pump station buildings		
Lights and controls	\$58 /month	\$700
HVAC/hydronic system	\$58 /month	\$467
Pumps		
Individual facility pump stations	\$0 /month	\$0
Community lift/pump station(s)	\$57 /month	\$689.47
Sewer/force main glycol circulation	\$214 /month	\$1,715
Lagoon discharge pump	\$197 /year	\$197
Eugoon disonarge pamp		total \$19,500
Other Costs		
Equipment R&R	\$4,088 /year	\$4,088
Miscellaneous materials & supplies	\$2,453 /year	\$2,453
Water quality testing	\$2,000 /year	\$2,000
Operator training	\$2,500 /year	\$2,500
Insurance	· · · · · · · · · · · · · · · · · · ·	\$1,500 total \$12,500
Summary (Pressure)	Summary (Pressure + Gravity)	, , , , , , , , , , , , , , , , , , , ,
	• .	_
Administration \$6,000	Administration \$6,0	
Labor \$25,000	Labor \$25,0	000
Fuel \$37,300	Fuel \$43,	200
Electricity \$19,500	Electricity \$20,4	400
Other \$12,500	Othor \$13.0	

Revenue		# of		,	Yearly
Source I	Monthly Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 142	30	85%	\$	43,370
Public/Commerc	\$ 283.46	19	100%	\$	64,630
School Service (3)			100%	\$	-
Local Capital Con	tribution			\$	-
Total Revenue				\$	108,000

\$13,000

\$108,000

Other

Total

Other

Total

\$12,500

\$100,000

Community:	Rampart (Gravity)
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General Community Data

General Community Data		
Current population Average number of people per house Service Connections (South Side)	0.0	persons
Number of houses Number of public/commerical buildings Number of schools Total number of service connections	18 1 0 19	
Burdened labor rate Electricity cost (Public facilty) Electricity cost (Residential service) Cost per gallon for heating oil	\$20 \$0.40 \$0.20 \$6.00	kWh kWh
Water consumption per capita Wastewater generation per capita		gpd gpd
Water & Sewer System Characteristics Water Source		
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)		ft
Water Treatment Size of water treatment plant building Raw water quality (Good or Poor)		sf
Water Storage Size of tank(s) Length of water line to/ from tank Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)		gallons ft
Water Distribution Type of system (Static or Circulating (Circ)) Number of circulating water loops Total length of Water Main Water mains heated for freeze protection (Yes or No) Location of the mains (Above ground (AG) or Buried) Average service line length		ft
Wastewater Collection Type of system (Gravity or Pressure) Number of individual facility pump stations Number of community lift/pump stations Number of facilities served by lift/pump station #1 Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5 Size of lift stations	Gravity	sf
Total length of sewer mains (Gravity) Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried) Average service line length	1950 Yes 1 AG 75	
Wastewater Treatment / Disposal		
Length of force main (Above ground (AG) or Buried) Location of force main (Above ground (AG) or Buried) Lagoon discharged seasonally with pump (Yes or No)		ft

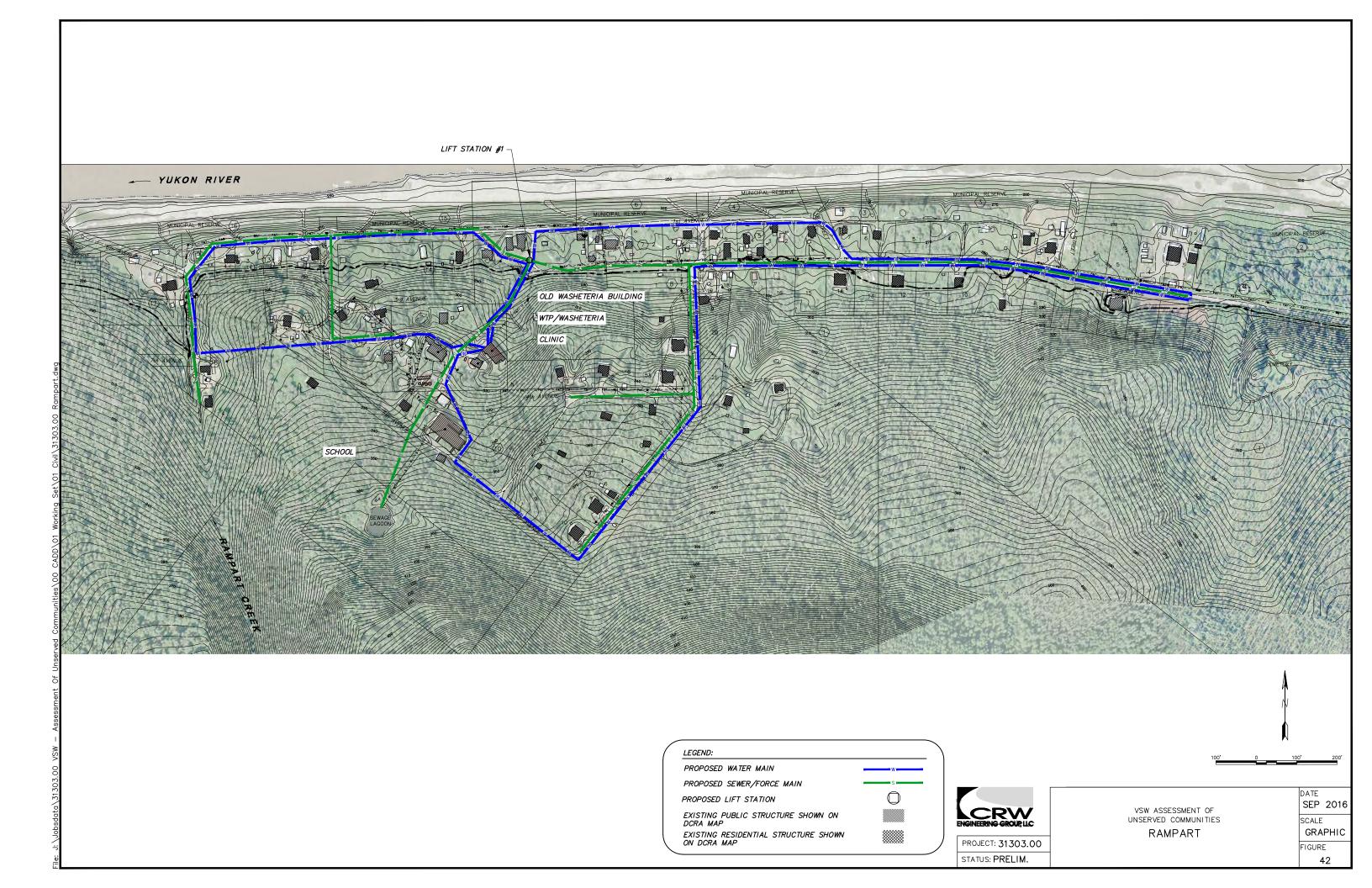
Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management		/month
Labor (Operator) Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		•
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$0	/month		\$0
Labor (WTP Operator)	24	hrs/week		\$0
Fuel (Heating Demand)				
Water system				
WTP building	\$0	/month		\$0.00
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$0	/month		\$0.00
Water storage tank	\$0	/month		\$0.00
Water storage tank line	\$0	/month		\$0.00
Water mains	\$0	/month		\$0
Service lines	\$0	/month		\$0
Wastewater system				
Sewer mains		/month		\$3,415
Service lines	·	/month		\$2,495
Lift/pump station buildings		/month		\$0.00
Force main to lagoon	\$0	/month		\$0
			Subtotal	\$5,900
Electricity				
Water system				
WTP building				
Lights and controls		/month		\$0
HVAC/hydronic system	·	/month		\$0
Water treatment	\$0	/month		\$0
Pumps				
Intake or well	* -	/month		\$0.00
WST circulation	* -	/month		\$0
Pressure/booster	* -	/month		\$0.00
Main line circulation	\$0	/month		\$0
Wastewater system				
Lift /pump station buildings				
Lights and controls	* -	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps				
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	* -	/month		\$0.00
Sewer/force main glycol circulation	* -	/month		\$858
Lagoon discharge pump	\$0	/year	Subtotal	\$0 \$900
Other Costs			Jubiolai	ΨΟΟΟ
Equipment R&R	\$340	/vear		\$340
Miscellaneous materials & supplies	-	/year		\$204
Water quality testing		/year		\$204
Operator training		/year		\$0 \$0
Insurance	\$0 \$0	/year		\$0 \$0
inguianoc	φυ	, y cai	Subtotal	\$500
			Gubiolai	ψοσο

Summary (Upland)

	•	
Administration		Covered in Pressure Estimate
Labor	\$0	Covered in Pressure Estimate
Fuel	\$5,900	
Electricity	\$900	
Other	\$500	
Total	\$7,000	



Stebbins, Alaska

Community Information & Existing Infrastructure

Stebbins is a Yupik community of 608 people located on the northwest coast of St. Michael Island, on Norton Sound. There are 133 residential units, 25 commercial/public facilities and one school for a total of 159 services. The existing water and sewer services provided in Stebbins consist of self-haul system from the washeteria or through a community watering point and honey buckets. The washeteria, school, and clinic have piped water and sewer services. The existing water and sewer infrastructure consists of the following:

- Clear Lake 70-80 gpm (Seasonal)
- Treated Water Storage 500,000 gallons (Recommended for replacement in 2010)
- School Water Storage 750,000 gallons (Also used for community)
- Water Treatment Plant 2,432 SF, built in 2015
- Water Treatment Coagulant, calcium hypo chloride
- Sewage Lagoon Honeybucket dump

Stebbins was built on discontinuously frozen beach deposits. It has silty soil and high groundwater near the coast.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 21,800 feet of pipe, and the pressure sewer system approximately 13,700 feet of pipe. The water system will consist of three circulating loops. The pressure sewer system would require four sewer main lift stations, individual grinder pump stations at each house, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. Previous analysis by ANTHC (2010 Community Development Plant) suggests that Clear Lake water source could be developed into a year-round source. Needed improvements would include a new 22,000 feet raw water transmission line, and new source intake structure. The existing water storage tank at the school is sufficient for meeting the systems CT requirements (263,000 gallons). For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	52	70	-
Water Storage (gallons)	326,800	750,000	-
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	13.0	-	13.0
Required Foundation System for WTP and/or WST			
Thermosyphon stabilized gravel pad (sf)	1,200	-	1,200
Water Distribution System			
Circulating Water Main with Pitorifices (If)	21,800	-	21,800
Raw Water Transmission Line with Heat Trace (If)	22,000	-	22,000
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	13,700	-	13,700
Individual Grinder Pump Stations (GPS) (ea)	159	-	159
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	11,900	-	11,900
Pressure Sewer Service Lines (If)	11,900	-	11,900

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Stebbins. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

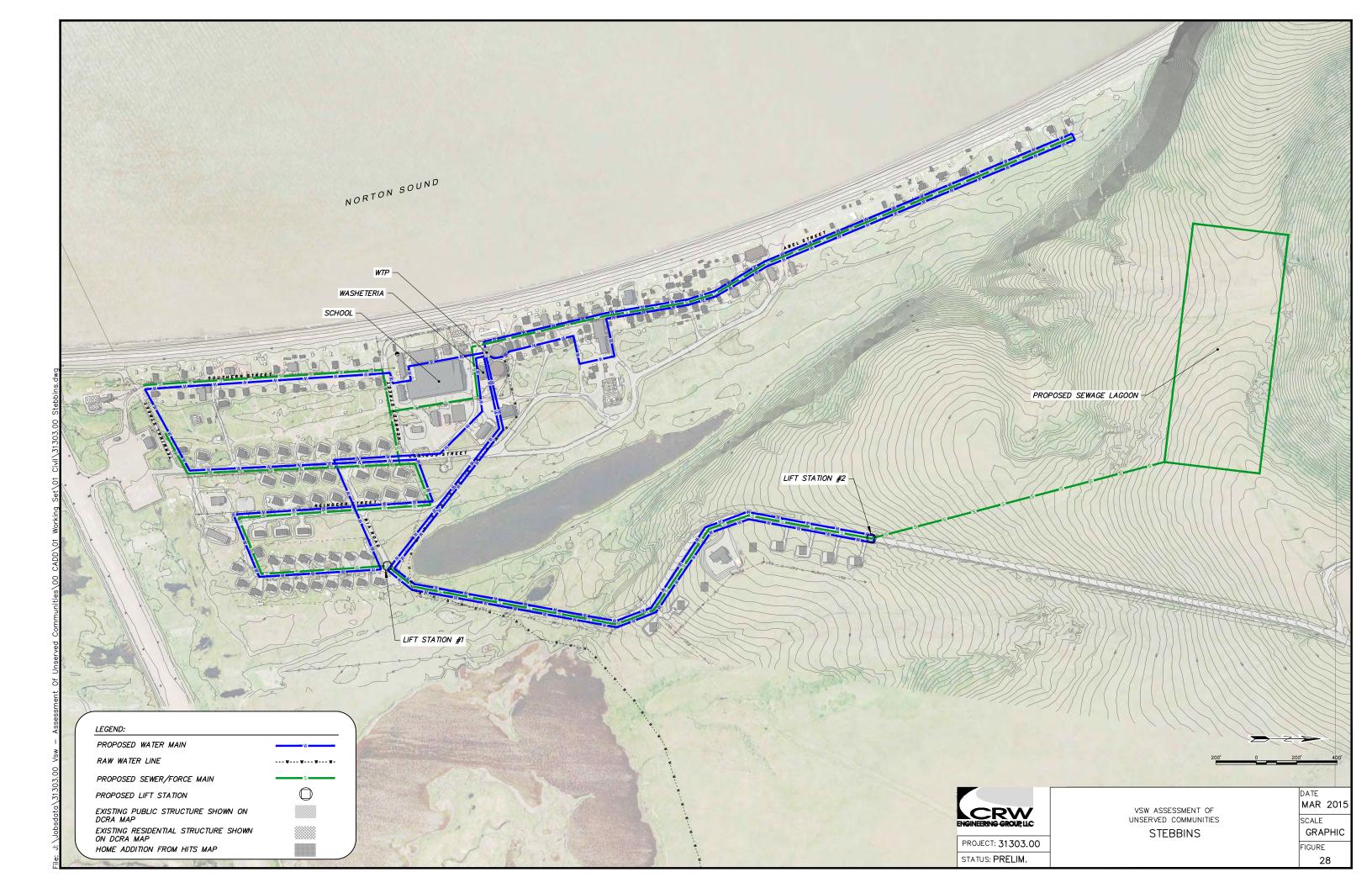
			Village	_	
Estimated Capital Costs				Stebbins	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	159	\$22,235.73	\$3,535,482
3	Sewage collection mains or services (gravity or force), above ground	LF	25,600	\$186.02	\$4,762,042
4	Sewage lift station	EA	2	\$ 581,420.38	\$ 1,162,841
10	Sewage lagoon, barrow, local material	Acre	13	\$601,528.27	\$7,819,868
12	Water distribution, mains or services, above ground	LF	55,700	\$286.52	\$15,959,332
15	Water treatment plant, no foundation	SF	1,200	\$1,465.72	\$1,758,867
19	Foundation - thermosyphen stablized gravel pad	SF	1,200	\$499.91	\$599,886
22	Water source - surface water intake	EA	1	\$482,502.97	\$482,503
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$36,081,000
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$43,082,600
27	Individual Grinder Pump Stations	EA	159	\$30,000	\$4,770,000
28	Electrical Service Upgrades	EA	159	\$5,500	\$874,500
Sub			Subtotal	\$48,727,100	
29	Construction Contingency (15%)	LS	1	\$7,309,100	\$7,309,100
30	Design & Construction Administration Services (20%)	LS	1	\$9,745,400	\$9,745,400
				Total	\$65,781,600

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs	
Description	Cost
Administration	\$6,000
Labor	\$37,400
Fuel	\$179,600
Electricity	\$40,700
Other (R&R, Training, etc.)	\$26,600
Total	\$290,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Stebbins are listed below.

Estimated User Fees						
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	148	133	85%	\$	201,070
Public/Commercial Service	\$	185	25	100%	\$	55,581
School Service	\$	3,705	1	100%	\$	33,349
Local Capital Contribution					\$	-
Total Revenue					\$	290,000



2015 Population G08	VSW Unserved Communit	ies - Piped W	ater & Sewer System Type and Si	zing Model	
Input					
2015 Foundation 508 1509 1333 2015 1500 1333 2015 1500 1333 2015 1500 1333 2015 1500 1333 2015 1500 1333 2015 1500 1333 2015 1500	1		Stenonis		
2015 Foundation 508 1509 1333 2015 1500 1333 2015 1500 1333 2015 1500 1333 2015 1500 1333 2015 1500 1333 2015 1500 1333 2015 1500	·			•	
2015 Number of Services	Existing Community & System Data		500	Ī	
133 133 133 133 133 134					
DCED Mapping Commercial/Public Facilities/School 36 35W Water quality (Poor or Good) Poor Water quality (Poor or Good) Poor Water Storage Flank 7500000 Poor Water Storage Flank 7500000 Poor Water Storage Flank Poor Water Main W	HITS Database (E1 & H1-H7)				
Water Storage Tank	DCED Mapping Commerical/Public Facilities/School				
Water Teatment Capacity Existing Sewage Lagoon Size Solf Dondry drained soils or discontinuous permafrost Firm soils, or continuous permafrost Siff soils, no permafrost Siff	Type (surface water or groundwater)				
Water Treatment Capacity Server Main Comparison (fig.) Piping Configurations (check all that apply) Suried system with no permafrost Piping Configurations (check all that apply) Suried system with no permafrost Suried system Requirements Quantity Notes Survey Main with Glycol Heat Trace (In) Survey Main with Glycol Heat Trace (In) Survey Survey Survice Lines Waster Saewer Service Lines (If) Survey Survice Survice Lines (If) Surviver Treatment Capacity (gen) Surviver Treatment Capacity (gen) Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey Survice Lines Survey					
Easting Sewage Lagoon Size Solf poorly drained soils or discontinuous permafrost Firm soils, or confineurations (check all that apply) Silf soils, no permafrost Silf soils, n	1				
Soli Conditions (check only one) Solid Conditions (price on the price of the pr					
Soft poorly drained soils or discontinuous permafrost Siff soils, no permafrost Siff soils, no permafrost Siff soils, no permafrost Siff soils, no permafrost Shower ground system or buried with permafrost Above ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system or buried with permafrost Shower ground system for with permafrost Shower ground system for with permafrost Shower ground system for with permafrost Steel Shower Service Lines (a) Steel Shower Service Lines (b) Shower Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines Shower Service Lines (b) Shower Service Lines (c) Shower Service Lines (d) Shower Service Lines (d) Shower Service Lines (d) Shower Service Lines (d) Shower Service Lines (d) Shower Service Lines Shower Service Lines (d) Shower Service Lines Shower Service Lines Shower Service Lines (d) Shower Service Lines			0		
Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Length Sewer Main Sew	1				
Piping Configurations (check all that apply) Sewer Main Length (ft) Length (ft)	Firm soils, or continuous permafrost		х		
Piping Configurations (cince at that apply) (ft) Length (ft)	Stiff soils, no permafrost				
Buried system with no permafrost Above ground system or buried with permafrost X	Piping Configurations (check all that apply)			_	
Above ground system or buried with permafrost x 13700 21800				(ft)	Length (ft)
Sever Main			y	13700	21800
Pressure Sewer Main			^	13700	21000
Piped System Requirements Output for Cost Model (calculated) Water Treatment Capacity (gpm) Req Was Utility Right (glass existing) Req Was Utility Right (glass existing) Req Was Utility Right (grave) Red Was Utility Right (grave) Red Was Utility	Pressure Sewer Main		х	13700	
Sewer Service Lines Piped System System Description System Plant/Addition (sf) 1,200	Typical Service Line Length (ea)			75	75
Sewer Service Lines Piped System System Description System Plant/Addition (sf) 1,200					
Sever Nain with Glycol Heat Trace (If) 11,900 1,200 1,	Piped System Requirements	Community	Stebbins		
Water Treatment Capacity (gpm) 52 86q Waster Storage (gallons) (less existing)	Output for Cost Model (calculated)				
Req Water Storage (gallons) (less existing)				Foundatio	n Size
Req W&S Utility Bidg/Water Treatment Plant/Addition (sf) 1,200 1,200 sf					
Required Foundation System for WTP and/or WST					
Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) 1,200		n (st)	· · · · · · · · · · · · · · · · · · ·	1,200	st
Thermosyphon stabilized gravel pad (sf) 1,200	Red Sewage Lagoon Size (acre) (less existing)		13.0	Quantitu	Notos
Sewer Main with Glycol Heat Trace (If) 11,900				Quantity	ivotes
Sewer Main with Glycol Heat Trace (If)	Required Foundation System for WTP and/or WST			1,200	
(if) 13,700					1
Circulating Water Service Lines (If) 11,900	Water Distribution System			21,800	
Circulating Water Service Lines (If) 11,900 11,900 11,900 11,900	Waster Distribution System Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	13,700	
Pressure Sewer Service Lines (If) 11,900 11,900	·		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	13,700	
Pressure Sewer Service Lines (If) 11,900	·		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	13,700	
System Description Piped System Need Existing Facility Net Need	Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	13,700 159	
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Need Existing Facility Net Need	Wastewater Collection System		Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	13,700 159 11,900	
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Sewage Lagoon Size (acre) 13.0 - 13.0 Required Foundation System for WTP and/or WST - 1,200 Thermosyphon stabilized gravel pad (sf) 1,200 - 1,200 Water Distribution System Circulating Water Main with Pitorifices (lf) 21,800 - 21,800 Raw Water Transmission Line with Heat Trace (lf) 22,000 - 22,000 Wastewater Collection System - 13,700 - 13,700 Sewer Main with Glycol Heat Trace (lf) 13,700 - 13,700 Individual Grinder Pump Stations (GPS) (ea) 159 - 159 Water & Sewer Service Lines - 11,900 - 11,900	Wastewater Collection System Water & Sewer Service Lines System Description	Need	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	13,700 159 11,900 11,900 Net Need	
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Sewer Main with Glycol Heat Trace (lf) 13,700 - 13,700 Individual Grinder Pump Stations (GPS) (ea) 159 - 159 Water & Sewer Service Lines Circulating Water Service Lines (lf) 11,900 - 11,900	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	Need 52 326,800 1,200 13.0	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 70 750,000 -	13,700 159 11,900 Net Need	
Individual Grinder Pump Stations (GPS) (ea) 159 - 159	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Raw Water Transmission Line with Heat Trace (lf)	Need 52 326,800 1,200 13.0 1,200 21,800	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 70 750,000	13,700 159 11,900 Net Need	
Water & Sewer Service Lines Circulating Water Service Lines (If) 11,900 - 11,900	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Raw Water Transmission Line with Heat Trace (if) Wastewater Collection System	Need 52 326,800 1,200 13.0 1,200 21,800 22,000	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 70 750,000	13,700 11,900 11,900 Net Need	
Circulating Water Service Lines (If) 11,900 - 11,900	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Raw Water Transmission Line with Heat Trace (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if)	\$2 326,800 1,200 13.0 1,200 22,000 22,000 13,700	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 70 750,000	13,700 11,900 11,900 Net Need	
	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (if) Raw Water Transmission Line with Heat Trace (if) Wastewater Collection System Sewer Main with Glycol Heat Trace (if) Individual Grinder Pump Stations (GPS) (ea)	\$2 326,800 1,200 13.0 1,200 22,000 22,000 13,700	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 70 750,000	13,700 11,900 11,900 Net Need	
11,500	Wastewater Collection System Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bidg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Raw Water Transmission Line with Heat Trace (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 52 326,800 1,200 13.0 1,200 21,800 22,000 13,700 159	Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 70 750,000	13,700 11,900 11,900 Net Need	

3,011.11	aconiod Communities Di	Mater o C	System Type and Sizing Madel
VSW Ui		ı water & Sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services Growth Rate (i)	159	services	1%
2035 Design Population (Capita)		people	Px(1+i)^n
Water Demand Estimates Existing Capacity	70	gpm	
Average Day (ADD)	37,094	gpd	50 gallons per Capita
Max Day (MDD)	74,188	gpd	2 x ADD
Peak Hour	155	gpm	3 x MDD
Treatment Capacity	52	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	SW	_	
Required Capacity	52	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW)	Check Min CT Requirements		Marchael (MDD 4 de)
Daily Operation (DO) (gallons) Fire Flow (FF)	74,188 30,000		Max Day (MDDx1 day) 500 gpm for 60 minutes
Reserve Volume (RV)	222,563	•	3 days x DO
Water Storage Tank Volume	326,750		DO + FF + RV
CT Based Volume (min if source is SW)	Required	/1	0.4 //
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)		mg/L log inactivation	0.4 mg/L 1.0-log Inactivation
Temperature (T)	4.4	•	4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT)	49	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*	262,809		CT/RCxPeak Hour/BF
Required Water Storage	326,800		-,,
Required Additional Storage	-	gallons	0
Estimate of Min Platform Size (3' clearance	-	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			0
Water Treatment Plant Requirements*		-	
Water Quality	Poor]	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)		_	
Soft poorly drained soils or discontinuous	0		Pile Foundation
permafrost	-	Thermosyphon	
Firm soils, or continuous permafrost	x		Thermosyphon stabilized gravel pad
		pad (sf)	
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)			
Buried system with no permafrost	0		Static Water Mains
		Circulating	
Above ground system or buried with permafrost	x	Water Main	Circulating Water Main with Pitorifices
		with Pitorifices (If)	
		1197	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0	1	Bare sewer main, no heat trace
2320 System than no permanost	•	Sewer Main	
Above ground or buried with permafrost	x	-	Sewer main with glycol heat trace
Gravity Sower Main	0	Trace (If)	Lift stations for gravity source major, over 1,000 ft
Gravity Sewer Main	0	Individual	Lift stations for gravity sewer mains, every 1,000 ft
Pressure Sewer Main	x	Grinder Pump	Individual Grinder Pump Stations
riessure sewer ividiii	^	Stations (GPS)	individual Officer Fullip Stations
		(ea)	
Water 9 Carrey Control (St. 1)			
Water & Sewer Services (Check all that apply)			
Static Water Main	0	Circulati :	Static Water Service Line
Circulating Water Main	x	Circulating Water Service	Circulating Water Service Lines
		Lines (If)	
Gravity Sewer Main	0		Gravity Service Line
Pressure Sewer Main	v	Pressure Sewer	Pressure Service Line with GPS
i ressure sewer ividili	x	Service Lines (If)	Tressure Service Line with GF3
			-
Sewage Lagoon Size		1	
Existing Sewage Lagoon Organic Loading Based Size		acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	425.4		2.2 or bobb per capita day a besign i opulation / 20 ios bobb per
			Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size	13.0	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
Turn cell leaves as a first of a se			of berms (area to be fenced)
Two cell lagoon, combined acreage	13.0	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Stebbins	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	159	\$22,235.73	\$3,535,482
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	25,600	\$186.02	\$4,762,042
4	Sewage lift station	EA	2	\$581,420.38	\$1,162,841
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	13	\$601,528.27	\$7,819,868
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	55,700	\$286.52	\$15,959,332
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
15	Water treatment plant, no foundation	SF	1,200	\$1,465.72	\$1,758,867
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	1,200	\$499.91	\$599,886
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	1	\$482,502.97	\$482,503
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$36,080,821

Community:	Stebbins	
General Community Date	ta	
Current population Average number Service Connect	of people per house	608 persons 4.6
Number of h Number of p Number of se	ublic/commerical buildings	133 25 1
	Total number of service	connections 159
Burdened labor i Electricity cost (I Electricity cost (I Cost per gallon f	Public facilty) Residential service)	\$18 hr \$0.40 kWh \$0.20 kWh \$6.00 gal
Water consumpt Wastewater gen	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source	Characteristics	
Length of ray Water line he	em (Surface(SW) or Groundwater(GW)) w water line eated for freeze protection (Yes or No) water line (Above ground (AG) or Buried)	SW 22000 ft Yes AG
	<u>t</u> r treatment plant building uality (Good or Poor)	3632 sf Poor
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	750,000 gallons 50 ft No AG
Water Distribution Type of system Number of common Total length Water mains Location of the		Circ 3 21800 ft Yes AG 75 ft
Number of in Number of co Number Number Number Number Number	ection em (Gravity or Pressure) idividual facility pump stations ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #4	Pressure 2 150 159
Total length Sewer mains Number of ci Location of ti	ft stations of sewer mains is heated for freeze protection (Yes or No) irculating glycol loops he mains (Above ground (AG) or Buried) vice line length	500 sf 13700 ft Yes 3 AG 75 ft

Wastewater Treatment / Disposal Length of force main

Force main heated for freeze protection (Yes or No)

Location of force main (Above ground (AG) or Buried)

Lagoon discharged seasonally with pump (Yes or No)

1500 ft

Yes

AG

Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
	40	1113/WCCK
Fuel (Heating)	100,000	PTI la/gallen
Available energy per gallon of heating fuel	100,000	BTUs/gallon months
Heating season (above ground components)	-	
Heating season (buried components)	12 7	months
Buildings	40	BTU/hr/sf
Raw water heat addition (5F)	• •	BTU/gallon
Water storage tank	0.5	BTU/gal-day BTU/hr/ft
Above ground mains	5 3	BTU/nr/ft
Buried mains (permafrost conditions)	3	BTO/III/II
<u>Electricity</u>		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
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Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	40	hrs/week		\$37,440
Fuel (Heating Demand)				
Water system				
WTP building	\$1,113	/month		\$8,903.69
Raw water line	\$4,815	/month		\$38,522.88
Raw water heat addition	\$2,218	/month		\$17,743.87
Water storage tank	\$684	/month		\$5,472.00
Water storage tank line	\$0	/month		\$0.00
Water mains	\$4,772	/month		\$38,173
Service lines	\$2,610	/month		\$20,881
Wastewater system				
Sewer mains		/month		\$23,989
Service lines		/month		\$20,881
Lift/pump station buildings	*	/month		\$2,451.46
Force main to lagoon	\$328	/month	<u> </u>	\$2,627
			Subtotal	\$179,600
Electricity				
Water system				
WTP building				
Lights and controls	\$424	/month		\$5,088
HVAC/hydronic system	\$424	/month		\$3,392
Water treatment	\$185	/month		\$2,218
Pumps				
Intake or well	\$185	/month		\$2,217.98
WST circulation	\$54	/month		\$432
Pressure/booster	\$277	/month		\$3,326.98
Main line circulation	\$1,289	/month		\$10,310
Wastewater system				
Lift /pump station buildings				
Lights and controls	,	/month		\$1,401
HVAC/hydronic system	\$117	/month		\$934
Pumps				
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	·	/month		\$6,183.67
Sewer/force main glycol circulation	· ·	/month		\$2,573
Lagoon discharge pump	\$2,663	/year	Subtotal	\$2,663 \$40,700
Other Costs			Gubiolai	ψ-τυ, τ υυ
	¢12 007	lyear		\$12,887
Equipment R&R	\$12,887 \$7,732	•		\$12,887 \$7,732
Miscellaneous materials & supplies		,		. ,
Water quality testing	\$2,000 \$2,500	•		\$2,000 \$2,500
Operator training Insurance		/year		\$2,500 \$1,500
IIIouiaiiot	\$1,500	/year	Subtotal	\$1,500 \$26,600
			Sublulai	Ψ20,000

Summary

Administration	\$6,000
Labor	\$37,400
Fuel	\$179,600
Electricity	\$40,700
Other	\$26,600
Total	\$290,000

Revenue I	Monthly	# of		,	Yearly
Source I	Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 148	133	85%	\$	201,070
Public/Commerc	\$ 185.27	25	100%	\$	55,581
School Service (\$ 3,705.41	1	100%	\$	33,349
Local Capital Con	ntribution			\$	-
Total Revenue	_	_	_	\$	290,000

Stevens Village, Alaska

Community Information & Existing Infrastructure

Stevens Village is a Kutchin Native community of 46 people located on the north bank of the Yukon River, 17 miles upstream of the Dalton Highway bridge crossing. There are 41 residential units and 10 commercial/public facilities for a total of 51 services. The existing water and sewer services provided in Stevens Village consist of self-haul system from the watering point located at the WTP and honey buckets/outhouses. The existing water and sewer infrastructure consists of the following:

- Well 40 gpm
- Treated Water Storage 7,000 gallons
- Water Treatment Plant 2,000 SF, built in 1981, Upgraded in 1993
- Water Treatment Calcium hypochlorite, sand filter, and onemicron cartridge filter
- Sewage Lagoon Single Cell, 0.7 acres

The area around Stevens Village is generally underlain by continuous permafrost. Frozen soils observed near clinic and at power plant location. Thaw bulbs observed at slough near the school.

Piped System Description

The piped water and sewer system will be a below grade system. The water system will consist of approximately 13,900 feet of pipe, and the gravity sewer system approximately 8,500 feet of pipe. The water system will consist of two circulating loops. The gravity sewer system would require 2 sewer main lift stations and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	4	40	-		
Water Storage (gallons)	52,500	7,000	45,500		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Sewage Lagoon Size (acre)	1.0	0.7	0.3		
Required Foundation System for WTP and/or WST					
Thermosyphon stabilized gravel pad (sf)	1,980	-	1,980		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	13,900	-	13,600		
Wastewater Collection System	Wastewater Collection System				
Sewer Main with Glycol Heat Trace (If)	8,500	-	8,800		
Water & Sewer Service Lines	Water & Sewer Service Lines				
Circulating Water Service Lines (If)	3,800	-	3,800		
Gravity Sewer Service Lines (If)	3,825	-	3,825		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Stevens Village. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30).

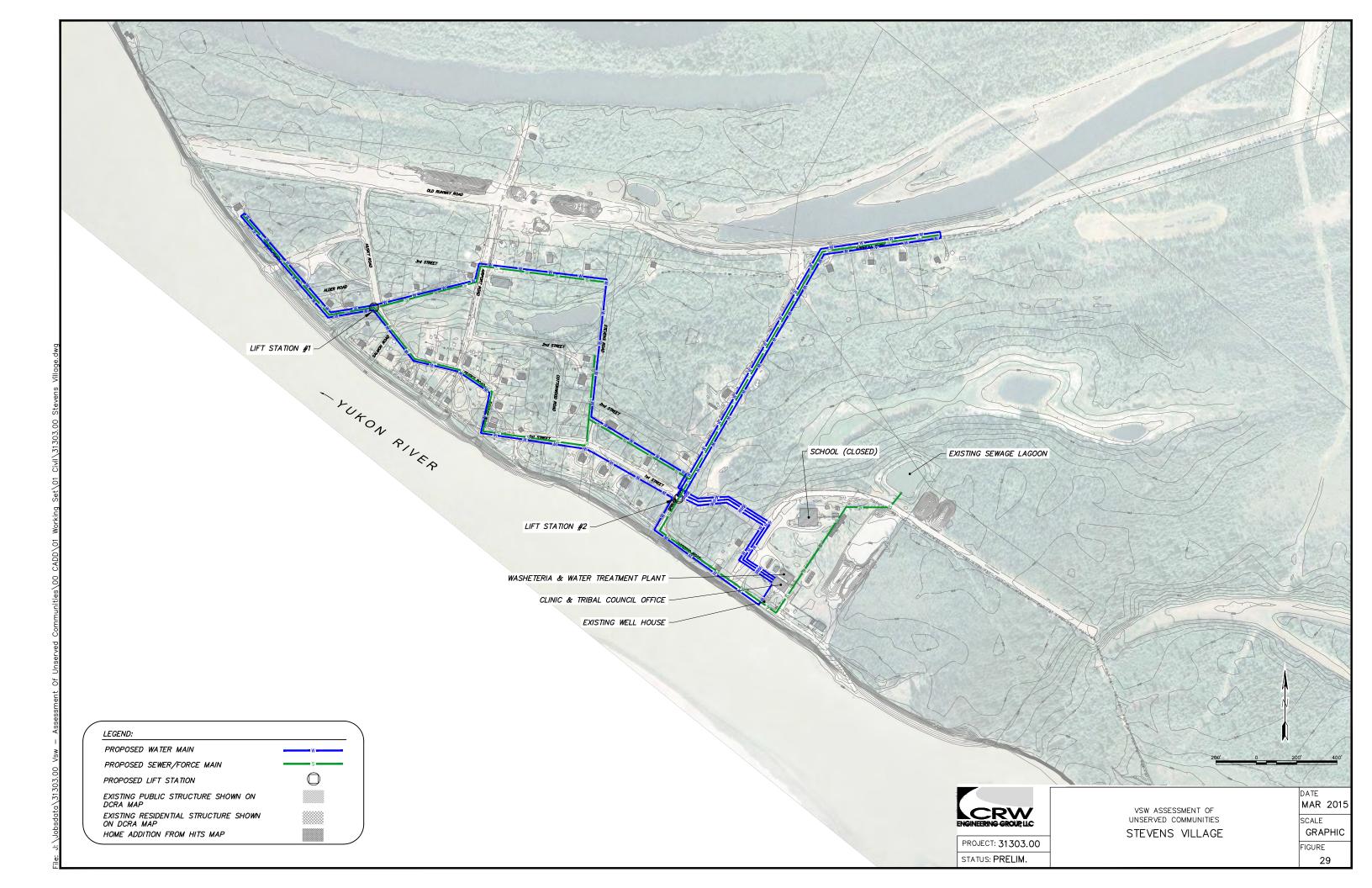
				Village	
	Estimated Capital Costs				
					•
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	51	\$28,096.69	\$1,432,931
2	Sewage collection mains or services (gravity or force), buried	LF	12,325	\$568.35	\$ 7,004,890
4	Sewage lift station	EA	2	\$ 1,172,426.77	\$ 2,344,854
10	Sewage lagoon, barrow, local material	Acre	0.3	\$2,504,413.17	\$751,324
13	Water distribution, mains or services, buried	LF	17,700	\$581.77	\$10,297,270
14	Water storage tank, no foundation	Gal	45,500	\$10.67	\$485,394
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
19	Foundation - thermosyphen stabilized gravel pad	SF	1,980	\$549.34	\$1,087,693
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$26,380,000
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$31,499,100
28	Electrical Service Upgrades	EA	51	\$5,500	\$280,500
	Subtotal				
29	Construction Contingency (15%)	LS	1	\$4,766,900	\$4,766,900
30	Design & Construction Administration Services (20%)	LS	1	\$6,355,900	\$6,355,900
				Total	\$42,902,400

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs			
Description	Cost		
Administration	\$6,000		
Labor	\$26,600		
Fuel	\$83,400		
Electricity	\$32,100		
Other (R&R, Training, etc.)	\$17,400		
Total	\$166,000		

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Stevens Village are listed below.

Estimated User Fees						
Revenue Source	Monthly R	late	# of Customers	Collection Rate		Yearly evenues
Residential Service	\$	277	41	85%	\$	116,050
Public/Commercial Service	\$	416	10	100%	\$	49,950
School Service	\$	-	0	100%	\$	-
Local Capital Contribution					\$	-
Total Revenue					\$	166,000



VSW Unserved Communities - Piped Water & Sewer System Type and Sizing Model					
Date Community Input		4/5/2016 Stevens Village	I		
Прис			ı		
Existing Community & System Data		A.C.	İ		
2015 Population 2015 Number of Services		46 51			
HITS Database (E1 & H1-H7)		41			
DCED Mapping Commerical/Public Facilities/School		10			
Type (surface water or groundwater)		GW			
Water quality (Poor or Good)		Poor			
Water Storage Tank		7000			
Water Treatment Capacity		40			
Existing Sewage Lagoon Size		0.7			
Soil Conditions (check only one)			·		
Soft poorly drained soils or discontinuous permafrost					
Firm soils, or continuous permafrost		х			
Stiff soils, no permafrost					
Piping Configurations (check all that apply)			Sewer Main Length (ft)	Water Main Length (ft)	
Buried system with no permafrost			(14)		
Above ground system or buried with permafrost		х	8500	13900	
Gravity Sewer Main Pressure Sewer Main		X	8500		
Typical Service Line Length (ea)			75	75	
Piped System Requirements Output for Cost Model (calculated)	Community	Stevens Village			
Output for Cost Model (calculated)			Foundatio	n Size	
Water Treatment Capacity (gpm)		4	Todildatio	11 3126	
Req Water Storage (gallons) (less existing)		45,500	780	sf	
Req W&S Utility Bldg/Water Treatment Plant/Addition	n (sf)	1,200	1,200		
Req Sewage Lagoon Size (acre) (less existing)	(,	0.3	,		
.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			Quantity	Notes	
				•	
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	1,200		
Water Distribution System		Circulating Water Main with	13,900		
		Pitorifices (If)	13,500		
		Sewer Main with Glycol Heat Trace (If)	8,500		
Wastewater Collection System		Lift Stations for Gravity Sewer Main	2		
			_		
		Circulating Water Service Lines (If)	3,800		
Water & Sewer Service Lines		Gravity Sewer Service Lines (If)	3,825		
		,	5,3.25		
				•	
System Description	Piped System	Existing Facility	Net Need	•	
	Need		14CC 14CCU		
Water Treatment Capacity (gpm) Water Storage (gallons)	52,500	40.0 7,000	45,500		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	7,000	1,200		
Sewage Lagoon Size (acre)	1.0	0.7	0.3		
Required Foundation System for WTP and/or WST					
Thermosyphon stabilized gravel pad (sf)	1,980	-	1,980		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	13,900	-	13,900		
Wastewater Collection System Sower Main with Glycol Heat Trace (If)	0.500		0.500		
Sewer Main with Glycol Heat Trace (If) Water & Sewer Service Lines	8,500	-	8,500		
Circulating Water Service Lines (If)	3,800	-	3,800		
Gravity Sewer Service Lines (If)	3,825	-	3,825		

VSW U	nserved Communities - Piped	Water & Sewer	System Type and Sizing Model
Date	4/5/2016	.vater & Jewer	System Type and Sizing Model
Community	Stevens Village		
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n) 2015 Population (P)		years people	20 years 2015 ADOL
2015 Number of Services		services	2013718-02
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	56	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		gpm	
Average Day (ADD) Max Day (MDD)	2,806 5,613	gpd gpd	50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	4	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW]	
Required Capacity	4	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW)	Applicable		M. D. MDD 4 I. I
Daily Operation (DO) (gallons) Fire Flow (FF)	5,613 30,000	gallons	Max Day (MDDx1 day) 500 gpm for 60 minutes
Reserve Volume (RV)	16,839		3 days x DO
Water Storage Tank Volume	52,451	gallons	DO + FF + RV
CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC)	Not Required 0.4	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)	1.0	log inactivation	1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH) Contact Time Required (CT)	7	minutes	7 LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*	19,884		CT/RCxPeak Hour/BF
Required Water Storage Required Additional Storage	52,500 45,500	gallons gallons	0
Estimate of Min Platform Size (3' clearance		-	
around)	780	sj	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
Water Treatment Plant Requirements*			0
Water Quality	Poor]	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	0		Pile Foundation
permafrost	Ů		rie i duidation
Firm soils, or continuous permafrost	x	Thermosyphon stabilized aravel	Thermosyphon stabilized gravel pad
		pad (sf)	
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)			
Buried system with no permafrost	0		Static Water Mains
		Circulating Water Main	
Above ground system or buried with permafrost	x	with Pitorifices	Circulating Water Main with Pitorifices
		(lf)	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0	Carren Admin	Bare sewer main, no heat trace
Above ground or buried with permafrost	x	Sewer Main with Glycol Heat	Sewer main with glycol heat trace
J		Trace (If)	
		Lift Stations for	
Gravity Sewer Main	x	Gravity Sewer	Lift stations for gravity sewer mains, every 1,000 ft
,		Mains, every 1,000 ft (ea)	
2		1,000 jt (eu)	to distribute of states by the Grant's con-
Pressure Sewer Main	0		Individual Grinder Pump Stations
Water & Sewer Services (Check all that apply)			
	•	1	Static Water Service Line
Static Water Main	0	Circulating	Static water service time
Circulating Water Main	x	Water Service	Circulating Water Service Lines
		Lines (If)	
Gravity Sewer Main	x	Gravity Sewer	Gravity Service Line
		Service Lines (If)	
Pressure Sewer Main	0		Pressure Service Line with GPS
Sewage Lagoon Size			
Existing Sewage Lagoon		acres	
Organic Loading Based Size check	0.5 117.0	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
CITCON	117.0		Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size	1.0	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
			of berms (area to be fenced)
Two cell lagoon, combined acreage	1.0	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village Stevens Village

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	51	\$28,096.69	\$1,432,931
2	Sewage collection mains or services (gravity or force), buried	LF	12,325	\$568.35	\$7,004,890
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	2	\$1,172,426.77	\$2,344,854
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0.3	\$2,504,413.17	\$751,324
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	17,700	\$581.77	\$10,297,270
14	Water storage tank, no foundation	Gal	45,500	\$10.67	\$485,394
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	1,980	\$549.34	\$1,087,693
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$26,380,014

Community: Stevens Village

General Community Data

Current population Average number of people per house Service Connections	46 persons 1.1
Number of houses Number of public/commerical buildings Number of schools	41 10 0
Total number of service connections	51
Burdened labor rate Electricity cost (Public facilty) Electricity cost (Residential service) Cost per gallon for heating oil	\$16 hr \$0.50 kWh \$0.25 kWh \$8.00 gal
Water consumption per capita Wastewater generation per capita	50 gpd 50 gpd
Water & Sewer System Characteristics <u>Water Source</u>	
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	GW 100 ft Yes AG
Water Treatment Size of water treatment plant building Raw water quality (Good or Poor)	3200 sf Poor
Water Storage Size of tank(s) Length of water line to/ from tank Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	52,500 gallons 50 ft Yes AG
Water Distribution Type of system (Static or Circulating (Circ)) Number of circulating water loops Total length of Water Main Water mains heated for freeze protection (Yes or No) Location of the mains (Above ground (AG) or Buried) Average service line length	Circ 2 13900 ft Yes Buried 75 ft
Wastewater Collection Type of system (Gravity or Pressure) Number of individual facility pump stations Number of community lift/pump stations Number of facilities served by lift/pump station #1 Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5	Gravity 2 12 46
Size of lift stations Total length of sewer mains Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried) Average service line length	500 sf 8500 ft Yes 2 Buried 75 ft
Wastewater Treatment / Disposal Length of force main Force main heated for freeze protection (Yes or No) Location of force main (Above ground (AG) or Buried) Lagoon discharged seasonally with pump (Yes or No)	1830 ft Yes Buried Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u>		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	32	hrs/week		\$26,624
Fuel (Heating Demand)				
Water system				
WTP building	\$1,307	/month		\$10,459.55
Raw water line	\$29	/month		\$233.47
Raw water heat addition	\$224	/month		\$1,789.95
Water storage tank	\$64	/month		\$510.72
Water storage tank line	\$15	/month		\$116.74
Water mains	\$2,434	/month		\$29,207
Service lines	\$670	/month		\$8,037
Wastewater system				
Sewer mains	\$1,488	/month		\$17,861
Service lines	\$670	/month		\$8,037
Lift/pump station buildings	\$409			\$3,268.61
Force main to lagoon	\$320	/month	_	\$3,845
			Subtotal	\$83,400
Electricity				
Water system				
WTP building				
Lights and controls	, .	/month		\$5,603
HVAC/hydronic system	* -	/month		\$5,603
Water treatment	\$17	/month		\$210
Pumps				
Intake or well	· ·	/month		\$209.76
WST circulation	*	/month		\$540
Pressure/booster	• -	/month		\$314.64
Main line circulation	\$1,074	/month		\$12,888
Wastewater system				
Lift /pump station buildings	0440	, ,		04.754
Lights and controls		/month		\$1,751
HVAC/hydronic system	\$146	/month		\$1,167
Pumps	C O	/		00
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	*	/month		\$356.08
Sewer/force main glycol circulation	\$268	/month		\$3,216
Lagoon discharge pump	\$252	/year	Subtotal	\$252 \$32,100
Other Costs				, , _, ,
Equipment R&R	\$7,106	/year		\$7,106
Miscellaneous materials & supplies	\$4,264	•		\$4,264
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	•		\$1,500
	Ψ1,000	. ,	Subtotal	\$17,400
			Subtotal	Ψ11,100

Summary

Administration	\$6,000
Labor	\$26,600
Fuel	\$83,400
Electricity	\$32,100
Other	\$17,400
Total	\$166,000

Revenue I	Monthly	# of		,	Yearly
Source F	Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 277	41	85%	\$	116,050
Public/Commerc	\$ 416.25	10	100%	\$	49,950
School Service (\$ -	0	100%	\$	-
Local Capital Con	tribution			\$	-
Total Revenue				\$	166,000

Stony River, Alaska

Community Information & Existing Infrastructure

Stony River is a mix of Athabascan Indian and Yupik Eskimo community of 34 people located on the north bank of the Kuskokwim River, 2 miles north of its junction with the Stony River. There are 18 residential units, 7 commercial/public facilities and one school for a total of 26 services. The existing water and sewer services provided in Stony River consist of individual well and septic tanks and absorption fields. The existing water and sewer infrastructure consists of the following:

- Well 18 gpm
- Treated Water Storage 3,800 gallons
- Watering Point Building 914 SF, built in 1990
- Water Treatment Potassium permanganate, chlorination, fluoridation
- Sewage Lagoon Individual septic tanks
 & absorption fields

There is shallow groundwater in the area. The estimated maximum depth of freeze is between 7-10 feet below ground surface.

Piped System Description

The piped water and pressure sewer system will be a buried system. The water system will consist of approximately 5,800 feet of pipe, and the pressure sewer system approximately 6,400 feet of pipe. The water system will consist of a single circulating loop. The pressure sewer system would require individual grinder pump stations at each house, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	3	18	-	
Water Storage (gallons)	46,600	3,800	42,800	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200	
Sewage Lagoon Size (acre)	0.7	-	0.7	
Required Foundation System for WTP and/or WST				
Pile Foundation	1,950	-	1,950	
Water Distribution System				
Circulating Water Main with Pitorifices (If)	5,800	-	5,800	
Wastewater Collection System				
Sewer Main with Glycol Heat Trace (If)	6,400	-	6,400	
Individual Grinder Pump Stations (GPS) (ea)	26	-	26	
Water & Sewer Service Lines				
Circulating Water Service Lines (If)	2,000	-	2,000	
Pressure Sewer Service Lines (If)	2,000	-	2,000	

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Stony River. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

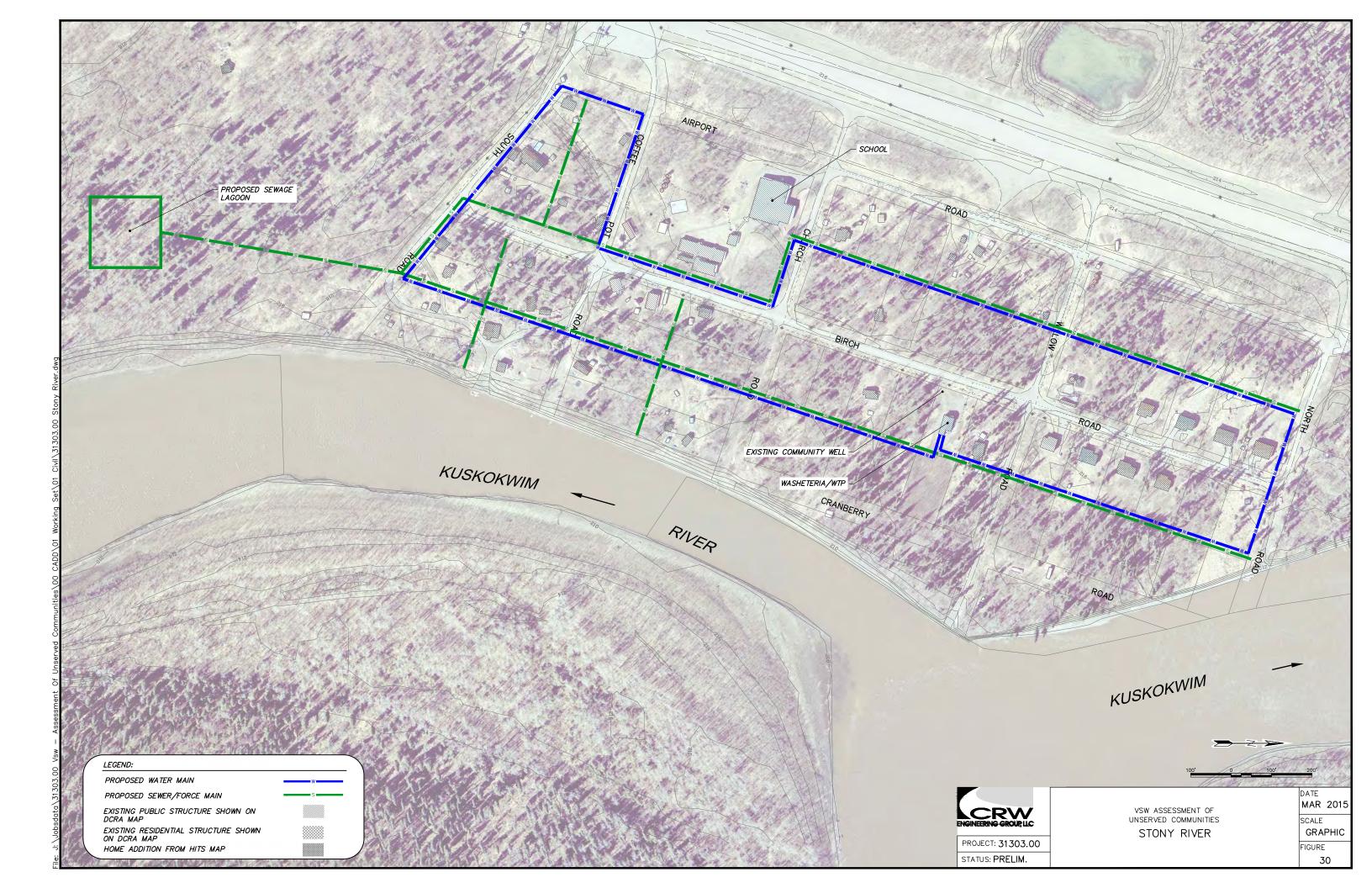
				Village	
	Estimated Capital Costs			Stony River	
			·		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	26	\$28,096.69	\$730,514
2	Sewage collection mains or services (gravity or force), buried	LF	8,400	\$397.75	\$ 3,341,112
10	Sewage lagoon, barrow, local material	Acre	0.7	\$1,557,213.17	\$1,090,049
13	Water distribution, mains or services, buried	LF	7,800	\$423.50	\$3,303,326
14	Water storage tank, no foundation	Gal	42,800	\$11.14	\$476,795
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
18	Foundation - freeze back piles	SF	1,950	\$683.31	\$1,332,454
Total Estimated Cost in 2010 dollars (rounded):					\$13,250,000
	Total v	vith Infl	ation (3% pe	r year for 6 years)	\$15,821,200
27	Individual Grinder Pump Stations	EA	26	\$30,000	\$780,000
28	Electrical Service Upgrades	EA	26	\$5,500	\$143,000
Subtotal					\$16,744,200
29	Construction Contingency (15%)	LS	1	\$2,511,600	\$2,511,600
30	Design & Construction Administration Services (20%)	LS	1	\$3,348,800	\$3,348,800
				Total	\$22,604,600

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$25,000			
Fuel	\$33,500			
Electricity	\$11,700			
Other (R&R, Training, etc.)	\$11,600			
Total	\$88,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Stony River are listed below.

Estimated User Fees					
Revenue Source	Мо	nthly Rate	# of Customers	Collection Rate	Yearly Revenues
Residential Service	\$	243	18	85%	\$ 44,657
Public/Commercial Service	\$	255	7	100%	\$ 21,453
School Service	\$	2,432	1	100%	\$ 21,891
Local Capital Contribution					\$ -
Total Revenue					\$ 88,000



VSW Unserved Communit	ties - Piped W	ater & Sewer System Type and Si	zing Model		
Date		4/6/2016			
Community		Stony River	1		
Input					
Existing Community & System Data					
2015 Population		34]		
2015 Number of Services		26			
HITS Database (E1 & H1-H7)		18			
DCED Mapping Commerical/Public Facilities/School		8			
Type (surface water or groundwater)		GW			
Water quality (Poor or Good)		Poor			
Water Storage Tank		3800			
Water Treatment Capacity		18			
Existing Sewage Lagoon Size		0			
Soil Conditions (check only one)			•		
Soft poorly drained soils or discontinuous permafrost		x			
Firm soils, or continuous permafrost					
Stiff soils, no permafrost					
Dining Configurations (shock all that apply)			Sewer Main Length	Water Main	
Piping Configurations (check all that apply)			(ft)	Length (ft)	
Buried system with no permafrost					
Above ground system or buried with permafrost		х	6400	5800	
Gravity Sewer Main					
Pressure Sewer Main		х	6400		
Typical Service Line Length (ea)			75	75	
Piped System Requirements	Community	Stony River			
Output for Cost Model (calculated)					
			Foundatio	n Size	
Water Treatment Capacity (gpm)		3			
Req Water Storage (gallons) (less existing)		42,800	750	sf	
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	1,200	1,200		
Req Sewage Lagoon Size (acre) (less existing)	()	0.7	,		
ined seriale rageon one (acre) (ress existing)		0	Quantity	Notes	
			quantity	110105	
Required Foundation System for WTP and/or WST		Pile Foundation (sf)	1,200		
Water Distribution System		Circulating Water Main with	5,800		
		Pitorifices (If)	.,,,,		
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	6,400		
		Individual Grinder Pump Stations (GPS) (ea)	26		
		Circulating Water Service Lines (If)	2,000		
Water & Sewer Service Lines					
		Pressure Sewer Service Lines (If)	2,000		
-					
System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	3	18.0	-		
Water Storage (gallons)	46,600	3,800	42,800		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Sewage Lagoon Size (acre)	0.7	-	0.7		
Required Foundation System for WTP and/or WST					
Pile Foundation (sf)	1,950	-	1,950		
Water Distribution System	1				
Circulating Water Main with Pitorifices (If)	5,800	-	5,800		
Wastewater Collection System	1		ı		
Sewer Main with Glycol Heat Trace (If)	6,400	-	6,400		
Individual Grinder Pump Stations (GPS) (ea)	26	-	26		
Water & Sewer Service Lines Circulating Water Service Lines (If)	2.000	_	2.000		
Circulating Water Service Lines (If)	2,000	<u>-</u>	2,000		
Pressure Sewer Service Lines (If)	2,000	-	2,000		

System Parameters	VSW Un	<u>-</u>	Water & Sewer	System Type and Sizing Model
Debts Projection (P) 2015				
Duration (p) 20 years 20 ye	•	1		Criteria & Calculations
2015 Forgological (Crystal) (Crystal	Design Population			
2016 Number of Services (Control Rate (I) 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 41, Feepile 2015 Decign Population (Capita) 42, Feepile 2015 Decign Population (Capita) 43, Feepile 2015 Decign Population (Capita) 44, Feepile 2015 Decign Population (Capita) 45, Feepile 2015 Decign Population (Capita) 45, Feepile 2015 Decign Population (Capita) 45, Feepile 2015 Decign Population (Capita) 45, Feepile 2015 Decign Population (Capita) 45, Feepile 2015 Decign Population (Capita) 46, Feepile 2015 Decign Population (Capita) 46, Feepile 2015 Decign Population (Capita) 47, Feepile 2015 Decign Population (Capita) 48, Feepile 2015 Decign Population (Capita) 48, Feepile 2015 Decign Population (Capita) 48, Feepile 2015 Decign Population (Capita) 49, Feepile 2015 Decign Population (Capita) 40, Feepile 40,	Duration (n)			
Goods face (c) Story Seeding Capacity Water Sound Estimates Statistics Capacity Arrenge Dep (ADD) Act People	. , ,			2015 ADOL
Water Demand Estimates Listoring Capacity Listoring Capacity Listoring Capacity Pack Nour Pack Nour Death Nour Cover Demand Estimates Listoring Capacity Regular Capa	Growth Rate (i)			1%
Tising contended processing to the contended process of the contended p	2035 Design Population (Capita)	41	people	Px(1+i)^n
Tising contended processing to the contended process of the contended p	Water Demand Estimates			
Make Day (MOD) 1.19 gpd 2. x ADD 1.20 gpm MOD 1.19 gpm 3.3 MDD Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Source Assumptions Type (surface water or groundwater) Reprinted Capacity Applicable	Existing Capacity	18	gpm	
Presented (appeily) Water Source Assumptions Treptosideric water or groundwater) Required Capacity Water Storage Tank Stilling Required Copacity Applicable 1,000 pallors Applicable 1,000 pallors Applicable 1,000 pallors Applicable 1,000 pallors Applicable 1,000 pallors Applicable 1,000 pallors 1,000 pallors 1,000 pallors 1,000 participation 1,000 parti	Average Day (ADD)			
Water Source Assumptions Type uniface water or groundwatery				
Type (sparter water or groundwater) Resported Capacity 3 g pm MDD Water Storage Tank String Resported Tank String Resport Capacity Resport Resport Responsible Capacity Resport Resport Responsible Capacity Resport Responsible Responsible Capacity Resport Responsible Responsible Responsible Capacity Responsible R	Treatment Capacity			
Type (sparter water or groundwater) Resported Capacity 3 g pm MDD Water Storage Tank String Resported Tank String Resport Capacity Resport Resport Responsible Capacity Resport Resport Responsible Capacity Resport Responsible Responsible Capacity Resport Responsible Responsible Responsible Capacity Responsible R				
Water Storage Tank String Water Storage Tank String Water Storage Tank String Water Storage Tank String Water Storage Tank String Water Storage Tank String Water Storage Tank Under Water Storage Tank Volume CT Based Volume (ITV) Water Storage Tank Volume CT Based Volume (ITV) Water Storage Tank Volume CT Based Volume (ITV) Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Storage Tank Volume Water Treatment Plant Requirements* Water Quality Water Main Volume to meet CT* Poor Water Quality (General Storage Poor Poor Water Quality (General Storage Poor Poor Water Quality (General Storage Poor Water Quality (General Storage Poor Water Quality (General Storage Poor Poor Water Quality (General Storage Poor Poor Water Quality (General Storage Poor Water Quality (General Storage Poor		GW	1	
Existing Water Storage Tank Exemption (DOI (gallons) Daily Operation (DOI (gallons) Free Flow (FF) Applicable A, 149 gallons Applicable A, 149 gallons A days (MDDx1 day) Free Flow (FF) A, 124 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) F	Required Capacity			MDD
Existing Water Storage Tank Exemption (DOI (gallons) Daily Operation (DOI (gallons) Free Flow (FF) Applicable A, 149 gallons Applicable A, 149 gallons A days (MDDx1 day) Free Flow (FF) A, 124 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) A, 125 Gallons A days (MDDx1 day) Free Flow (FF) F				
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of berms (area to be fenced)		100.0		Volume is based on ADDx365x20% factor to account for precipitation,
Two cell lagoon, combined acreage 0.7 acres Either organic loading based or hydraulic, whichever is greater	Hydraulic Loading Based Size	0.7	acres	
				of berms (area to be fenced)

Capital Cost Estimate Piped Water & Sewer System

Village				
Stony River				

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	26	\$28,096.69	\$730,514
2	Sewage collection mains or services (gravity or force), buried	LF	8,400	\$397.75	\$3,341,112
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0.7	\$1,557,213.17	\$1,090,049
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	7,800	\$423.50	\$3,303,326
14	Water storage tank, no foundation	Gal	42,800	\$11.14	\$476,795
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	1,950	\$683.31	\$1,332,454
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$13,249,908

Community:	Stony River	
General Community Dat	a	
Current population Average number Service Connect	of people per house	34 persons 1.9
Number of h Number of p Number of so	ublic/commerical buildings chools	18 7 1
	Total number of service of	
Burdened labor i Electricity cost (F Electricity cost (F Cost per gallon f	Public facilty) Residential service)	\$20 hr \$0.35 kWh \$0.15 kWh \$6.00 gal
Water consumpt Wastewater gen	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source	Characteristics	
Type of syste Length of rav Water line he	em (Surface(SW) or Groundwater(GW)) v water line eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	GW 90 ft Yes Buried
	treatment plant building uality (Good or Poor)	2114 sf Poor
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) /ater line (Above ground (AG) or Buried)	46,600 gallons 50 ft Yes Buried
Number of ci Total length Water mains Location of tl	n em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) rice line length	Circ 1 5800 ft Yes Buried 75 ft
Number of in Number of or Number Number Number Number Number	em (Gravity or Pressure) dividual facility pump stations ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #4 of facilities served by lift/pump station #5	Pressure
Total length of Sewer mains Number of ci Location of the	t stations of sewer mains heated for freeze protection (Yes or No) rculating glycol loops ne mains (Above ground (AG) or Buried) vice line length	500 sf 6400 ft Yes 1 Buried 75 ft
Length of for Force main h Location of fo	atment / Disposal ce main leated for freeze protection (Yes or No) leated for freeze ground (AG) or Buried) learged seasonally with pump (Yes or No)	600 ft Yes Buried Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week	24	
Less than 50 services	24	hrs/week
Between 50 and 100 services More than 100 services	32 40	hrs/week hrs/week
More than 100 services	40	ms/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
	Ψ1,500	po. , oui

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	24	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$648	/month		\$5,182.38
Raw water line	\$12	/month		\$141.83
Raw water heat addition	\$124	/month		\$1,488.38
Water storage tank	\$42	/month		\$339.99
Water storage tank line	\$7	/month		\$78.80
Water mains	\$762	/month		\$9,140
Service lines	\$256	/month		\$3,073
Wastewater system				
Sewer mains	\$840	/month		\$10,086
Service lines	\$256	/month		\$3,073
Lift/pump station buildings	\$0	/month		\$0.00
Force main to lagoon	\$79	/month		\$946
			Subtotal	\$33,500
Electricity				
<u>Water system</u>				
WTP building				
Lights and controls		/month		\$2,591
HVAC/hydronic system		/month		\$2,591
Water treatment	\$9	/month		\$109
Pumps				
Intake or well		/month		\$108.53
WST circulation	·	/month		\$378
Pressure/booster	,	/month		\$162.79
Main line circulation	\$376	/month		\$4,511
Wastewater system				
Lift /pump station buildings	••	, ,,		••
Lights and controls	* -	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps	••	, ,,		••
Individual facility pump stations	•	/month		\$0
Community lift/pump station(s)	·	/month		\$0.00
Sewer/force main glycol circulation	·	/month		\$1,126
Lagoon discharge pump	\$130	/year	Subtotal	\$130 \$11,700
Other Costs			Judicial	ψ.1,100
Equipment R&R	\$3,508	/year		\$3,508
Equipment R&R Miscellaneous materials & supplies	\$3,508 \$2,105	•		\$3,508 \$2,105
Water quality testing	\$2,000	•		\$2,105
· · · · · · · · · · · · · · · · · · ·		•		
Operator training Insurance		/year		\$2,500 \$1,500
insulative	\$1,500	ryeai	Subtotal	\$1,500 \$11,600
			Sublolai	\$11,600

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$33,500
Electricity	\$11,700
Other	\$11,600
Total	\$88,000

Revenue I	Monthly	# of		\	early/
Source I	Rate	Customers	Collection Rate	Re	venues
Residential Serv	\$ 243	18	85%	\$	44,657
Public/Commerc	\$ 255.39	7	100%	\$	21,453
School Service (\$ 2,432.28	1	100%	\$	21,891
Local Capital Con	ntribution			\$	-
Total Revenue	_	-	_	\$	88,000

Takotna, Alaska

Community Information & Existing Infrastructure

Takotna is a mix of non-Native, Ingalik Athabascan, and Yupik community of 62 people located on the north bank of the Takotna River, 17 air miles west of McGrath. There are 16 residential units, 11 commercial/public facilities, 1 high school, and 1 community school for a total of 29 services. The existing water and sewer services provided in Takotna consist of self-haul system from the watering point and on-site septic tanks/pit privy/honey buckets for wastewater disposal. The existing water and sewer infrastructure consists of the following:

- Gold Run Creek 37 gpm
- Treated Water Storage 11,000 gallons
- Washeteria/Watering Point Building 1,800 SF, built in 1980, Upgraded in 1991
- Water Treatment Sand filters, cartridge filter, chlorine, carbon filter
- Sewage Lagoon N/A

There is discontinuous permafrost in the region with thin frozen zones reported at several locations in towns. Soils throughout most of developed community are unfrozen except for moss covered lower hills and lowlands are underlain by permafrost.

Piped System Description

The piped water and sewer system will be a below grade system. The water system will consist of approximately 11,000 feet of pipe, and the gravity sewer system approximately 8,000 feet of pipe. The water system will consist of two circulating loops. The gravity sewer system would require 2 sewer main lift stations and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment. Existing water storage tank does not meet the minimum CT requirements (26,800 gallons).

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	5	37	-	
Water Storage (gallons)	60,300	11,000	49,300	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200	
Sewage Lagoon Size (acre)	1.3	-	1.3	
Required Foundation System for WTP and/or WST				
Thermosyphon stabilized gravel pad (sf)	2,030	-	2,030	
Water Distribution System				
Circulating Water Main with Pitorifices (If)	11,000	-	11,000	
Wastewater Collection System				
Sewer Main with Glycol Heat Trace (If)	8,000	-	8,000	
Water & Sewer Service Lines				
Circulating Water Service Lines (If)	2,200	-	2,200	
Gravity Sewer Service Lines (If)	2,175	-	2,175	

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Takotna. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30).

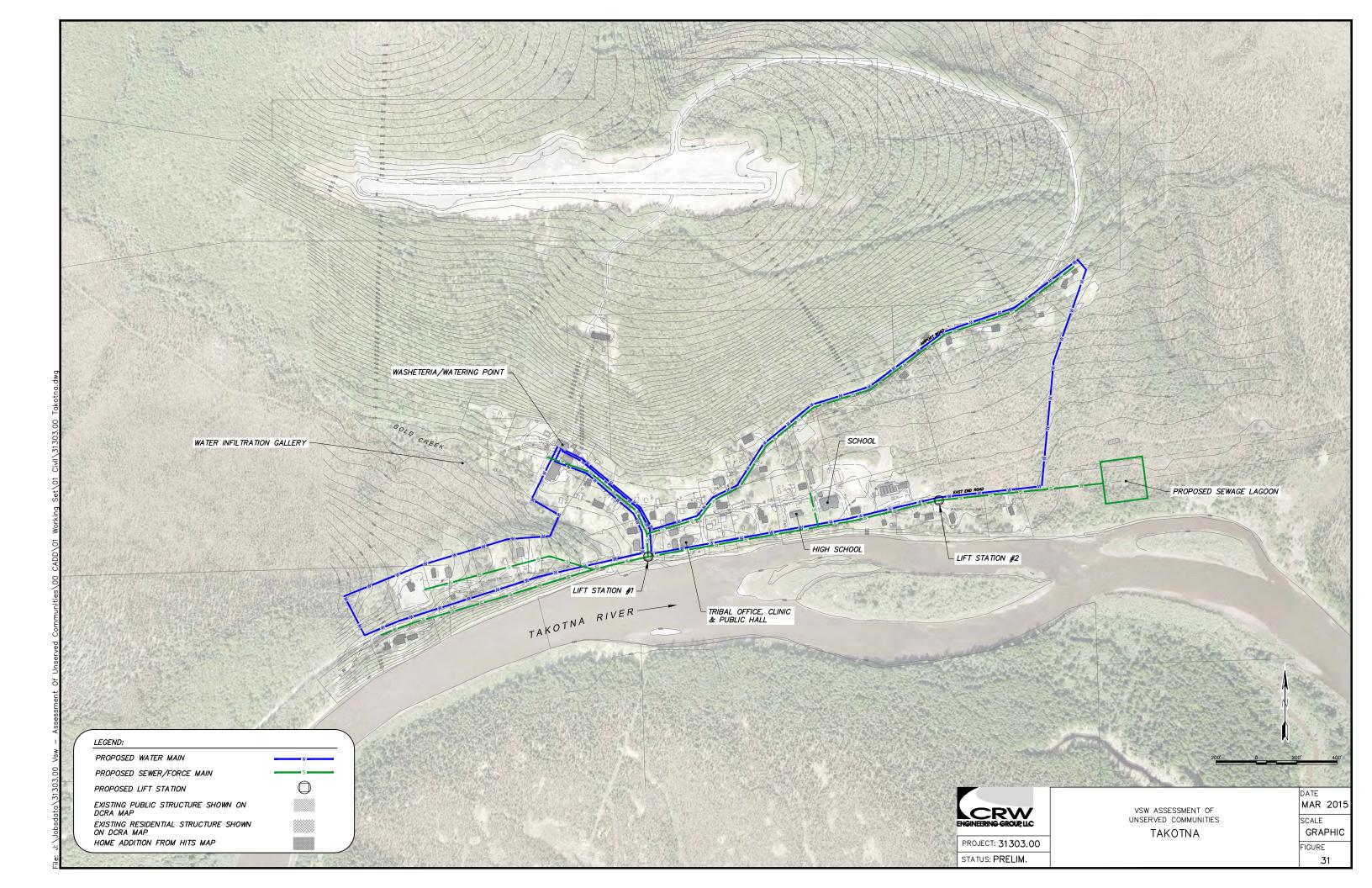
				Village	
	Estimated Capital Costs			Takotna	
			·		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	29	\$28,096.69	\$814,804
2	Sewage collection mains or services (gravity or force), buried	LF	10,175	\$581.14	\$ 5,913,061
4	Sewage lift station	EA	2	\$ 1,172,426.77	\$ 2,344,854
10	Sewage lagoon, barrow, local material	Acre	1	\$1,229,336.25	\$1,598,137
13	Water distribution, mains or services, buried	LF	13,200	\$596.13	\$7,868,960
14	Water storage tank, no foundation	Gal	49,300	\$10.09	\$497,497
15	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
19	Foundation - thermosyphen stabilized gravel pad	SF	2,030	\$540.98	\$1,098,190
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$23,111,000
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$27,595,700
28	Electrical Service Upgrades	EA	29	\$5,500	\$159,500
				Subtotal	\$27,755,200
29	Construction Contingency (15%)	LS	1	\$4,163,300	\$4,163,300
30	Design & Construction Administration Services (20%)	LS	1	\$5,551,000	\$5,551,000
			-	Total	\$37,469,500

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$25,000			
Fuel	\$49,700			
Electricity	\$41,500			
Other (R&R, Training, etc.)	\$15,300			
Total	\$138,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Takotna are listed below.

Estimated User Fees						
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate		Yearly evenues
Residential Service	\$	331	16	85%	\$	54,086
Public/Commercial Service	\$	365	11	100%	\$	48,121
School Service	\$	1,988	2	100%	\$	35,793
Local Capital Contribution					\$	-
Total Revenue					\$	138,000



	-	ater & Sewer System Type and Si	zing Model	
Date Community		4/7/2016		
Input		Takotna	1	
			<u>.</u>	
Existing Community & System Data				
2015 Population		62		
015 Number of Services		29 16		
HITS Database (E1 & H1-H7)	•			
DCED Mapping Commerical/Public Facilities/School Type (surface water or groundwater)		13 SW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		11000		
Water Treatment Capacity		37		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)				
Soft poorly drained soils or discontinuous permafrost				
Firm soils, or continuous permafrost		х		
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length	Water Main
			(ft)	Length (ft)
Buried system with no permafrost		, ,	9000	11000
Above ground system or buried with permafrost Gravity Sewer Main		X X	8000 8000	11000
Pressure Sewer Main		^	5000	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Takotna		
Output for Cost Model (calculated)				
			Foundatio	n Size
Water Treatment Capacity (gpm)		5		
Req Water Storage (gallons) (less existing)		49,300	830	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (st)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		1.3	0	Nata
			Quantity	Notes
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	1,200	
Water Distribution System		Circulating Water Main with Pitorifices (If)	11,000	
Wastewater Collection System				
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	8,000	
			8,000	
		(if)	8,000 2	
		(if)	8,000 2	
		(if)	8,000 2	
		(lf) Lift Stations for Gravity Sewer Main	2,200	
Water & Sewer Service Lines		(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if)	2,200	
Water & Sewer Service Lines		(lf) Lift Stations for Gravity Sewer Main	2	
Water & Sewer Service Lines		(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if)	2,200	
Water & Sewer Service Lines		(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if)	2,200	
Water & Sewer Service Lines	Dinate	(If) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	2,200	
Water & Sewer Service Lines System Description	Piped System Need	(If) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	2,200	
	Piped System Need	(If) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (If) Gravity Sewer Service Lines (If)	2,200 2,175	
System Description	Need	(If) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility	2,200 2,175 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 5	(If) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (If) Gravity Sewer Service Lines (If) Existing Facility 37.0	2,200 2,175 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 5 60,300	(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if) Gravity Sewer Service Lines (if) Existing Facility 37.0 11,000	2,200 2,175 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) WaS Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	Need 5 60,300 1,200 1.3	(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if) Gravity Sewer Service Lines (if) Existing Facility 37.0 11,000	2,200 2,175 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf)	Need 5 60,300 1,200	(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if) Gravity Sewer Service Lines (if) Existing Facility 37.0 11,000	2,200 2,175 Net Need 49,300 1,200	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	Need 5 60,300 1,200 1.3 2,030	(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if) Gravity Sewer Service Lines (if) Existing Facility 37.0 11,000	2,200 2,175 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf)	Need 5 60,300 1,200 1.3	(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if) Gravity Sewer Service Lines (if) Existing Facility 37.0 11,000	2,200 2,175 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System	Need 5 60,300 1,200 1.3 2,030	(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if) Gravity Sewer Service Lines (if) Existing Facility 37.0 11,000	2,200 2,175 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System	Need 5 60,300 1,200 1.3 2,030	(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if) Gravity Sewer Service Lines (if) Existing Facility 37.0 11,000	2,200 2,175 Net Need	
System Description Water Treatment Capacity (gpm) Water Storage (gallons) WaS Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) Water Distribution System Circulating Water Main with Pitorifices (If) Wastewater Collection System Sewer Main with Glycol Heat Trace (If)	Need 5 60,300 1,200 1.3 2,030	(if) Lift Stations for Gravity Sewer Main Circulating Water Service Lines (if) Gravity Sewer Service Lines (if) Existing Facility 37.0 11,000	2,200 2,175 Net Need	

VCW III	assured Communities Dined	Matar 9 Causan	Custom Time and Cining Madel
VSW Ui	-	water & Sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population	Woder Results		CITCIII & Calculations
Duration (n)	20	years	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services		services	
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	76	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity	37	gpm	
Average Day (ADD)	3,783	gpd	50 gallons per Capita
Max Day (MDD)	7,565	gpd	2 x ADD
Peak Hour Treatment Capacity	16	gpm gpm	3 x MDD MDD
пеаннен сараску	3	gpiii	MOD
Water Source Assumptions		_	
Type (surface water or groundwater)	SW	_	
Required Capacity	5	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank	11,000	gallons	
Demand Based Volume (if source is GW)	Check Min CT Requirements	Jo	
Daily Operation (DO) (gallons)	7,565		Max Day (MDDx1 day)
Fire Flow (FF)			500 gpm for 60 minutes
Reserve Volume (RV)	22,696		3 days x DO DO + FF + RV
Water Storage Tank Volume CT Based Volume (min if source is SW)	60,261 Required	gallUlis	DO TH TRV
Chlorine Residual Concentration (RC)		mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT) Baffling Coefficient (BF)	0.1	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Required Volume to meet CT*	26,800		CT/RCxPeak Hour/BF
Required Water Storage	60,300	gallons	CITICAL CURTION DI
Required Additional Storage	49,300	gallons	0
Estimate of Min Platform Size (3' clearance	830	cf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)	000	-,	
Water Treatment Plant Requirements*			0
Water Quality	Poor	1	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP) Soft poorly drained soils or discontinuous			
permafrost	0		Pile Foundation
		Thermosyphon	
Firm soils, or continuous permafrost	x	stabilized gravel	Thermosyphon stabilized gravel pad
Cutto alle anno sono finale	•	pad (sf)	Construct.
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)			
Buried system with no permafrost	0		Static Water Mains
		Circulating	
Above ground system or buried with permafrost	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
		(If)	
		4	_
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0		Bare sewer main, no heat trace
bunea system with no permanost	J	Sewer Main	Dure sewer main, no near trace
Above ground or buried with permafrost	x		Sewer main with glycol heat trace
·		Trace (If)	
		Lift Stations for	
Gravity Sower Main		Gravity Sewer	Lift stations for gravity source and a second coops
Gravity Sewer Main	x	Mains, every	Lift stations for gravity sewer mains, every 1,000 ft
		1,000 ft (ea)	
Pressure Sewer Main	0		Individual Grinder Pump Stations
		_	
Water & Sewer Services (Check all that apply)			
Static Water Main	0		Static Water Service Line
		Circulating	
Circulating Water Main	x	Water Service	Circulating Water Service Lines
		Lines (If)	
Gravity Sewer Main	x	Gravity Sewer	Gravity Service Line
State Sewer Hall	^	Service Lines (If)	Grandy Service Line
Pressure Sewer Main	0		Pressure Service Line with GPS
Sewage Lagoon Size		1	
Existing Sewage Lagoon Organic Loading Based Size		acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	135.9		0.17 103 OF BODS per capital day & Design Population / 20 IDS BODS per
	133.3		Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size	1.3	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
			of berms (area to be fenced)
Two cell lagoon, combined acreage	1.3	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Takotna	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	29	\$28,096.69	\$814,804
2	Sewage collection mains or services (gravity or force), buried	LF	10,175	\$581.14	\$5,913,061
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	2	\$1,172,426.77	\$2,344,854
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	1.3	\$1,229,336.25	\$1,598,137
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	13,200	\$596.13	\$7,868,960
14	Water storage tank, no foundation	Gal	49,300	\$10.09	\$497,497
	Water treatment plant, no foundation	SF	1,200	\$2,479.71	\$2,975,658
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	2,030	\$540.98	\$1,098,190
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$23,111,161

Community:	Takotna	
General Community Date	a	
Current population	on	62 persons
Service Connect		3.9
Number of h Number of p Number of s	ublic/commerical buildings	16 11 2
	Total number of service	
Burdened labor i Electricity cost (I Electricity cost (I Cost per gallon f	Public facilty) Residential service)	\$20 hr \$0.64 kWh \$0.38 kWh \$5.75 gal
Water consumpt Wastewater gen	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source	Characteristics	
Length of rav Water line he	em (Surface(SW) or Groundwater(GW)) v water line eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	SW 470 ft Yes Buried
	t treatment plant building uality (Good or Poor)	3000 sf Poor
Water line he	ter line to/ from tank eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	60,300 gallons 50 ft Yes Buried
Water Distribution	<u>n</u>	
Number of ci Total length Water mains Location of ti	em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) rice line length	Circ 2 11000 ft Yes Buried 75 ft
Wastewater Coll		
Number of in Number of o Number Number Number Number Number	em (Gravity or Pressure) dividual facility pump stations ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4	Gravity 2 20 27
Size of li Total length Sewer mains Number of ci Location of ti	of facilities served by lift/pump station #5 it stations of sewer mains heated for freeze protection (Yes or No) rculating glycol loops he mains (Above ground (AG) or Buried) vice line length	500 sf 8000 ft Yes 2 Buried 75 ft
Wastewater Trea	atment / Disposal	
Location of fo	ce main neated for freeze protection (Yes or No) proce main (Above ground (AG) or Buried) narged seasonally with pump (Yes or No)	820 ft Yes Buried Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment	• • • • • • • • • • • • • • • • • • • •	nation in or
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500 \$2.500	per year
Insurance	\$1,500	per year
modiano	Ψ1,000	po. 30th

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	24	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$881	/month		\$7,047.94
Raw water line	\$59	/month		\$709.83
Raw water heat addition	\$217	/month		\$2,601.02
Water storage tank	\$53	/month		\$421.62
Water storage tank line	\$6	/month		\$75.51
Water mains	\$1,384	/month		\$16,613
Service lines	\$274	/month		\$3,285
Wastewater system				
Sewer mains		/month		\$12,082
Service lines	·	/month		\$3,285
Lift/pump station buildings	\$294			\$2,349.31
Force main to lagoon	\$103	/month	_	\$1,238
			Subtotal	\$49,700
Electricity				
Water system				
WTP building				
Lights and controls	\$560	/month		\$6,724
HVAC/hydronic system	\$560	/month		\$6,724
Water treatment	\$30	/month		\$362
Pumps				
Intake or well	\$30	/month		\$361.88
WST circulation	\$86	/month		\$691
Pressure/booster	\$45	/month		\$542.82
Main line circulation	\$1,375	/month		\$16,497
Wastewater system				
Lift /pump station buildings				
Lights and controls	·	/month		\$2,241
HVAC/hydronic system	\$187	/month		\$1,494
Pumps				
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	*	/month		\$1,275.63
Sewer/force main glycol circulation	*	/month		\$4,116
Lagoon discharge pump	\$434	/year	Subtotal	\$434 \$41,500
Other Costs			Cablolai	ψ ε 1,000
Equipment R&R	\$5,808	/year		\$5,808
Miscellaneous materials & supplies	\$3,485	•		\$3,485
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	•		\$1,500
	Ψ1,000	. ,	Subtotal	\$15,300
				ψ.0,000

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$49,700
Electricity	\$41,500
Other	\$15,300
Total	\$138,000

Revenue I	Monthly	# of		,	early
Source I	Rate	Customers	Collection Rate	Re	venues
Residential Serv	\$ 331	16	85%	\$	54,086
Public/Commerc	\$ 364.55	11	100%	\$	48,121
School Service (\$ 1,988.47	2	100%	\$	35,793
Local Capital Con	ntribution			\$	-
Total Revenue	-	_	_	\$	138,000

Teller, Alaska

Community Information & Existing Infrastructure

Teller is a Kawerak Eskimo community of 256 people located on a spit between Port Clarence and Grantley Harbor on the Seward Peninsula. There are 89 residential units, 16 commercial/public facilities, one head start school, and one K-12 school for a total of 107 services. The existing water and sewer services provided in Teller consist of self-haul system from the watering point and honey buckets. The school has piped water and sewer service that discharges into the school sewage lagoon. The existing water and sewer infrastructure consists of the following:

- Coyote Creek 60 gpm (Seasonal)
- Water Treatment Sand filters, chlorine
- Treated Water Storage 1,000,000 gallons
- Honeybucket Lagoon 0.12 acres
- Watering Point Building 3,300 SF, built in 1978, Upgraded in 1993

Soils in the region consist of sands and gravelly sands low in fines and moderately well-sorted. Active zone varies from a few inches to several feet.

Piped System Description

The piped water and pressure sewer system will be a buried system. The water system will consist of approximately 12,400 feet of pipe, and the pressure sewer system approximately 10,700 feet of pipe. There will be two separate water and sewer systems for the current Townsite area and the Newsite area in the Coyote Subdivision. The existing Townsite water system will consist of two circulating loops, and the Newsite will consist of a single circulating loop. The pressure sewer system would require glycol heat trace for freeze protection. Both areas would utilize a large septic system. The Newsite would rely on gravity systems whereas the Townsite area would require a lift station. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. Based on average per capita water consumption of 50 gallons per person per day, the existing water storage capacity would need to be increased to provide sufficient water year round. Approximately 2.5 million gallons of raw water in addition to the treated water would need to be stored during the operation of the seasonal water source to provide water for the piped system when the source is nonproducing (Assume freezing season is 9 months). The existing 1,000,000 gallon tank located at the Townsite would be used as a raw water tank and a new smaller treated water tank would be installed. Newsite would also have raw water and treated water storage tanks. For the purposes of this assessment, a new 1,200 sf facility is included at both the existing Townsite and the Newsite to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	22	60	-
Raw Water Storage (gallons)	2,500,000	1,000,000	1,500,000
Treated Water Storage (gallons)	100,000	-	100,000
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	2,400	-	2,400
Septic System (sf)	40,000	-	40,000
Required Foundation System for WTP and/or WST			
Thermosyphon stabilized gravel pad (sf)	20,970	-	20,970
Water Distribution System			
Circulating Water Main with Pitorifices (If)	9,800	-	9,800
Wastewater Collection System	•		
Sewer Main with Glycol Heat Trace (If)	8,000	-	8,000
Individual Grinder Pump Stations (GPS) (ea)	79	-	79
Water & Sewer Service Lines	•		
Circulating Water Service Lines (If)	8,000	-	8,000
Gravity Sewer Service Lines (If)	2,100	-	2,100
Pressure Sewer Service Lines (If)	5,900	-	5,900

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Teller. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

	Village				
	Estimated Capital Costs			Teller	
			_		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	107	\$22,235.73	\$2,379,223
2	Sewage collection mains or services (gravity or force), buried	LF	4,000	\$274.11	\$ 1,096,424
3	Sewage collection mains or services (gravity or force), above ground	LF	12,000	\$189.55	\$2,274,557
4	Sewage lift station	EA	1	\$ 638,316.38	\$ 638,316
7	Septic tank, community	EA	2	\$293,350.26	\$586,701
8	Drainfield, community	SF	40,000	\$20.82	\$832,964
12	Water distribution, mains or services, above ground	LF	13,900	\$290.52	\$4,038,161
13	Water distribution, mains or services, buried	LF	3,900	\$294.34	\$1,147,923
14	Water storage tank, no foundation	Gal	1,600,000	\$1.79	\$2,858,965
15	Water treatment plant, no foundation	SF	2,400	\$1,415.98	\$3,398,341
19	Foundation - thermosyphen stablized gravel pad	SF	20,970	\$156.25	\$3,276,483
	Total Esti	mated	Cost in 2010	dollars (rounded):	\$22,528,000
	Total v	vith Inf	lation (3% pe	r year for 6 years)	\$26,899,600
27	Individual Grinder Pump Stations	EA	79	\$30,000	\$2,370,000
28	Electrical Service Upgrades	EA	107	\$5,500	\$588,500
				Subtotal	\$29,858,100
29	Construction Contingency (15%)	LS	1	\$4,478,700	\$4,478,700
30	Design & Construction Administration Services (20%)	LS	1	\$5,971,600	\$5,971,600
				Total	\$40,308,400

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs					
Description	Cost				
Administration	\$6,000				
Labor	\$33,300				
Fuel	\$86,500				
Electricity	\$34,200				
Other (R&R, Training, etc.)	\$18,300				
Total	\$178,000				

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Teller are listed below.

Estimated User Fees							
Revenue Source	Мо	nthly Rate	# of Customers	Collection Rate	Yearly Revenues		
Residential Service	\$	114	89	85%	\$ 103,622		
Public/Commercial Service	\$	120	16	100%	\$ 23,012		
School Service	\$	5,707	1	100%	\$ 51,366		
Local Capital Contribution					\$ -		
Total Revenue					\$ 178,000		





VSW Unserved Communit	ties - Piped W	ater & Sewer System Type and Si	zing Model	
Date		4/8/2016		
Community Input		Teller	1	
mpat				
Existing Community & System Data			•	
2015 Population		256		
2015 Number of Services HITS Database (E1 & H1-H7)		107 89		
DCED Mapping Commerical/Public Facilities/School		18		
Type (surface water or groundwater)		SW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		1000000		
Water Treatment Capacity		60		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one) Soft poorly drained soils or discontinuous permafrost			1	
Firm soils, or continuous permafrost		x		
Stiff soils, no permafrost		^		
Piping Configurations (check all that apply)			Sewer Main Length	Water Main
Buried system with no permafrost			(ft)	Length (ft)
Above ground system or buried with permafrost		X	8000	9800
Gravity Sewer Main Pressure Sewer Main		X X	1900 6100	
Typical Service Line Length (ea)		^	75	75
Piped System Requirements	Community	Teller		
Output for Cost Model (calculated)	Community	Tellel		
			Foundatio	n Size
Water Treatment Capacity (gpm)		1 600 000	40.55	-4
Req Water Storage (gallons) (less existing) Req W&S Utility Bldg/Water Treatment Plant/Additio	n (cf)	1,600,000 2,400	18,570 2,400	
Req Septic System w/ Drainfield (sf) (less existing)	11 (51)	40,000	2,400	31
Red Septic System wy Drainneid (SI) (less existing)		40,000	Quantity	Notes
			Quantity	Notes
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	2,400	
Water Distribution System		Circulating Water Main with	9,800	
		Pitorifices (If)	5,800	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	8,000	
		Individual Grinder Pump Stations (GPS) (ea)	107	
		11 / 1/		
Water & Sewer Service Lines		Circulating Water Service Lines (If)	8,000	
		Gravity Sewer Service Lines (If)	2,100	
		Pressure Sewer Service Lines (If)	5,900	
System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	22	60	-	
Raw Water Storage (gallons)	2,500,000	1,000,000	1,500,000	
Treated Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	100,000 2,400	-	100,000 2,400	
Septic System (sf)	40,000	-	40,000	
Required Foundation System for WTP and/or WST				
Thermosyphon stabilized gravel pad (sf) 20,970		-	20,970	
Water Distribution System			0.000	
Circulating Water Main with Pitorifices (If) Wastewater Collection System	9,800		9,800	
		_	8,000	
Sewer Main with Glycol Heat Trace (If)	8,000	-		
Individual Grinder Pump Stations (GPS) (ea)	8,000 79	-	79	
Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	79			
Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines Circulating Water Service Lines (If)	79 8,000		79 8,000	
Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	79	-	79	

Date Community System Parameters Mit Design Population Duration (n) 2015 Population (P) 2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank	4/8/2016 Teller 20 256 107 1% 312 60 15,618 31,237 65 22 SW 22 1,000,000 CT Requirements	years people services people	Criteria & Calculations 20 years 2015 ADOL 1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD MDD
System Parameters Mr. Design Population Duration (n) 2015 Population (P) 2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	20 256 107 1% 312 60 15,618 31,237 65 22 SW 22	people services people gpm gpd gpd gpd gpm gpm	20 years 2015 ADOL 1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD
Design Population Duration (n) 2015 Population (P) 2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	200 256 107 1% 312 60) 15,618 31,237 65 22 SWW 22	people services people gpm gpd gpd gpd gpm gpm	20 years 2015 ADOL 1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD
Duration (n) 2015 Population (P) 2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	256 107 1% 312 60 15,618 31,237 65 22 5W 22	people services people gpm gpd gpd gpd gpm gpm	2015 ADOL 1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD
2015 Number of Services Growth Rate (i) 2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (If source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	107 1% 312 60 15,618 31,237 65 22 SW 22	people gpm gpd gpd gpm gpm gpm	1% Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD
2035 Design Population (Capita) Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	60 15,618 31,237 65 22 SW 22 1,000,000 CT Requirements	gpm gpd gpd gpm gpm	Px(1+i)^n 50 gallons per Capita 2 x ADD 3 x MDD
Water Demand Estimates Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	60 15,618 31,237 65 22 SW 22	gpm gpd gpd gpm gpm	50 gallons per Capita 2 × ADD 3 × MDD
Existing Capacity Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	15,618 31,237 65 22 SW 22 1,000,000 CT Requirements	gpd gpd gpm gpm	2 x ADD 3 x MDD
Average Day (ADD) Max Day (MDD) Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	15,618 31,237 65 22 SW 22 1,000,000 CT Requirements	gpd gpd gpm gpm	2 x ADD 3 x MDD
Peak Hour Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	55 22 SW 22 1,000,000 CT Requirements	gpm gpm	3 x MDD
Treatment Capacity Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	SW 22 1,000,000 CT Requirements	gpm	
Water Source Assumptions Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	SW 22 1,000,000 CT Requirements		·
Type (surface water or groundwater) Required Capacity Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF) Check Min	1,000,000 CT Requirements	gpm	
Water Storage Tank Sizing Existing Water Storage Tank Demand Based Volume (if source is GW) Daily Operation (DO) (gallons) Fire Flow (FF)	1,000,000 CT Requirements	gpm	
Existing Water Storage Tank <u>Demand Based Volume (if source is GW)</u> Daily Operation (DO) (gallons) Fire Flow (FF)	CT Requirements		MDD
Existing Water Storage Tank <u>Demand Based Volume (if source is GW)</u> Daily Operation (DO) (gallons) Fire Flow (FF)	CT Requirements		
Daily Operation (DO) (gallons) Fire Flow (FF)		gallons	
Fire Flow (FF)		gallons	Max Day (MDDx1 day)
Reserve Volume (RV)	30,000		500 gpm for 60 minutes
	93,711		3 days x DO DO + FF + RV
Water Storage Tank Volume CT Based Volume (min if source is SW)	154,947 Required	gallons	DO + FF + KV
Chlorine Residual Concentration (RC)	0.4	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI) Temperature (T)	1.0 4.4	log inactivation	1.0-log Inactivation 4.4 celsius/40 F
pH (PH)	7.7	•	7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC
Baffling Coefficient (BF) Required Volume to meet CT*	0.1 110,656	gallons	0.1 CT/RCxPeak Hour/BF
Required Water Storage	154,900	gallons	
Required Additional Storage Estimate of Min Platform Size (3' clearance	1,600,000	gallons	0
around)	18,570	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
Water Treatment Plant Requirements*			0
Water Quality	Poor		Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	0		Pile Foundation
permafrost		Thermosyphon	The Foundation
Firm soils, or continuous permafrost	x		Thermosyphon stabilized gravel pad
		pad (sf)	
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)	_		1
Buried system with no permafrost	0	Circulating	Static Water Mains
Above ground system or buried with permafrost		Water Main	Circulating Water Main with Pitorifices
Theore ground system of buried with permanost	,	with Pitorifices (If)	Circulating Water Main Main Rominees
		(9)	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0		Bare sewer main, no heat trace
		Sewer Main with	
Above ground or buried with permafrost	x	Glycol Heat Trace (If)	Sewer main with glycol heat trace
		Lift Stations for	
Gravity Sewer Main		Gravity Sewer	Life stations for annity and an annity and a control of
Gravity Sewer Main	х	Mains, every	Lift stations for gravity sewer mains, every 1,000 ft
		1,000 ft (ea)	
		Individual Grinder Pump	
Pressure Sewer Main	X	Stations (GPS)	Individual Grinder Pump Stations
		(ea)	
Water & Sewer Services (Check all that applied			
Water & Sewer Services (Check all that apply)	0		Static Water Savige Line
Static Water Main	0	Circulating	Static Water Service Line
Circulating Water Main	x	Water Service	Circulating Water Service Lines
		Lines (If)	
Gravity Sewer Main		Gravity Sewer	Gravity Service Line
		Service Lines (If)	
Pressure Sewer Main		Pressure Sewer	Pressure Service Line with GPS
		Service Lines (If)	
Sources Lagoon Size			
Sewage Lagoon Size Existing Sewage Lagoon	0	acres	
Organic Loading Based Size	2.7	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per acre
check	276.1		Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size	5.5	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of
			berms (area to be fenced)
Two cell lagoon, combined acreage	5.5	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Teller	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	107	\$22,235.73	\$2,379,223
2	Sewage collection mains or services (gravity or force), buried	LF	4,000	\$274.11	\$1,096,424
3	Sewage collection mains or services (gravity or force), above ground	LF	12,000	\$189.55	\$2,274,557
4	Sewage lift station	EA	1	\$638,316.38	\$638,316
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	2	\$293,350.26	\$586,701
	Drainfield, community	SF	40,000	\$20.82	\$832,964
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
	Sewage lagoon, barrow, local material	Acre	0	#DIV/0!	\$0
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	13,900	\$290.52	\$4,038,161
13	Water distribution, mains or services, buried	LF	3,900	\$294.34	\$1,147,923
14	Water storage tank, no foundation	Gal	1,600,000	\$1.79	\$2,858,965
15	Water treatment plant, no foundation	SF	2,400	\$1,415.98	\$3,398,341
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	20,970	\$156.25	\$3,276,483
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$22,528,058

Community:	Teller (Newsite)
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General Community Data

General Community Data		
Current population Average number of people per house Service Connections (Newsite)	0.0	persons
Number of houses Number of public/commerical buildings Number of schools	28	
Total number of service connections	28	
Burdened labor rate Electricity cost (Public facilty) Electricity cost (Residential service) Cost per gallon for heating oil	\$20 \$0.42 \$0.20 \$6.00	kWh kWh
Water consumption per capita Wastewater generation per capita		gpd gpd
Water & Sewer System Characteristics Water Source		
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)		ft
Water Treatment Size of water treatment plant building Raw water quality (Good or Poor)		sf
Water Storage Size of tank(s) Length of water line to/ from tank Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)		gallons ft
Water Distribution Type of system (Static or Circulating (Circ)) Number of circulating water loops Total length of Water Main Water mains heated for freeze protection (Yes or No) Location of the mains (Above ground (AG) or Buried) Average service line length	Circ 1 1800 Yes Buried 75	ft
Wastewater Collection Type of system (Gravity or Pressure) Number of individual facility pump stations Number of community lift/pump stations Number of facilities served by lift/pump station #1 Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5 Size of lift stations Total length of sewer mains Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried) Average service line length	1900 Yes 1 Buried 75	
Wastewater Treatment / Disposal Length of force main Force main heated for freeze protection (Yes or No) Location of force main (Above ground (AG) or Buried) Septic system discharged seasonally with pump (Yes or No)	500 Yes Buried	ft
Septic system discharged seasonally with pump (1es of No)	Yes	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management		/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
,		
Electricity WTP building		
• • • • • • • • • • • • • • • • • • •	0.4	watts/hr/sf
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system Water treatment	0.4	watts/fif/si
	0.4	watta/aallaa
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps	0.5	wette (e.e.lle.e
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps	0.7	watta (gallan (aan isa
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Septic system discharge	0.6	watts/gallon
Other Costs	_	
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$0	/month		\$0
Labor (WTP Operator)	24	hrs/week		\$0
Fuel (Heating Demand)				
Water system				
WTP building	\$0	/month		\$0.00
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$0	/month		\$0.00
Water storage tank	\$0	/month		\$0.00
Water storage tank line	\$0	/month		\$0.00
Water mains	\$236	/month		\$2,837
Service lines	\$276	/month		\$3,309
Wastewater system				
Sewer mains	·	/month		\$2,994
Service lines	·	/month		\$3,309
Lift/pump station buildings	·	/month		\$0.00
Force main to septic system	\$66	/month		\$788
			Subtotal	\$13,200
Electricity				
Water system				
WTP building				
Lights and controls	·	/month		\$0
HVAC/hydronic system	·	/month		\$0
Water treatment	\$0	/month		\$0
Pumps				
Intake or well	* -	/month		\$0.00
WST circulation	* -	/month		\$0
Pressure/booster	* -	/month		\$0.00
Main line circulation	\$451	/month		\$5,413
Wastewater system				
Lift /pump station buildings				
Lights and controls	* -	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps	••	,		••
Individual facility pump stations	* -	/month		\$0
Community lift/pump station(s)	* -	/month		\$0.00
Sewer/force main glycol circulation	* -	/month		\$1,351
Septic system discharge pump	\$0	/year	Subtotal	\$0 \$6,800
Other Costs			Judicial	Ψ0,000
Equipment R&R	\$1,000	/year		\$1,000
Miscellaneous materials & supplies		/year		\$600
Water quality testing		/year		\$000 \$0
Operator training		/year		\$0 \$0
Insurance	\$0 \$0	/year		\$0 \$0
insurance	Φ0	, year	Subtotal	\$1,600
			Jubiolal	φ1,000

Summary (Newsite)

	()	_
Administration	\$0	Covered in Townsite Estimate
Labor	\$0	Covered in Townsite Estimate
Fuel	\$13,200	
Electricity	\$6,800	
Other	\$1,600	
Total	\$22,000	

Community:	Teller (Townsite)
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General Community Data

General Community Data	
Current population	256 persons
Average number of people per house	4.2
Service Connections (Townsite)	
Number of houses	61
Number of public/commerical buildings	16
Number of schools	2
Total number of service connections	79
Burdened labor rate	\$20 hr
Electricity cost (Public facilty)	\$0.42 kWh
Electricity cost (Residential service)	\$0.20 kWh
Cost per gallon for heating oil	\$6.00 gal
Water consumption per capita	50 gpd
Wastewater generation per capita	50 gpd
Tradionator gonoration per dapita	oo gpa
Water & Sewer System Characteristics Water Source	
Type of system (Surface(SW) or Groundwater(GW))	SW
Length of raw water line	11500 ft
Water line heated for freeze protection (Yes or No)	No
Location of water line (Above ground (AG) or Buried)	AG
Water Treatment	
Size of water treatment plant building	4500 sf
Raw water guality (Good or Poor)	Poor
Water Storage	
Water Storage Size of tank(s)	1,050,000 gallons
Length of water line to/ from tank	50 ft
Water line heated for freeze protection (Yes or No)	Yes
Location of water line (Above ground (AG) or Buried)	AG
Water Distribution Type of system (Static or Circulating (Circ))	Circ
Number of circulating water loops	2
Total length of Water Main (Lowland)	8000 ft
Water mains heated for freeze protection (Yes or No)	Yes
Location of the mains (Above ground (AG) or Buried)	AG
Average service line length	75 ft
Wastewater Collection	
Type of system (Gravity or Pressure)	Pressure
Number of individual facility pump stations	i icasuic
Number of community lift/pump stations	1
Number of facilities served by lift/pump station #1	55
Number of facilities served by lift/pump station #2	
Number of facilities served by lift/pump station #3	
Number of facilities served by lift/pump station #4	
Number of facilities served by lift/pump station #5	
Size of lift stations	500 sf
Total length of sewer mains (North Side)	6100 ft
Sewer mains heated for freeze protection (Yes or No)	Yes
Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried)	2 AG
Average service line length	75 ft
	75 11
Wastewater Treatment / Disposal	0.15
Length of force main	215 ft
Force main heated for freeze protection (Yes or No) Location of force main (Above ground (AG) or Buried)	Yes
Septic system discharged seasonally with pump (Yes or No)	AG Yes
Septic system discharged seasonally with pump (165 or 140)	1 63

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		· ·
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Septic system discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Puel (Heating Demand) Water system Standard Standar	ated O& M Costs		Annual Cost
Fuel (Heating Demand) Water system	Administration (Utility management, billings, etc.)	\$500 /month	\$6,000
Water system	Labor (WTP Operator)	32 hrs/week	\$33,280
WTP building	Fuel (Heating Demand)		
WTP building	Water system		
Raw water line S0 / month S0.00		\$1.379 /month	\$11.031.55
Raw water heat addition \$934 /month \$7,471.10 \$7,660.80 Water storage tank \$958 /month \$7,660.80 Water storage tank line \$11 /month \$10,801 \$1,0375 \$1,001 \$10,0375 \$1,0375 \$1,001 \$10,0375 \$1,000 \$1	<u> </u>	• •	
Water storage tank \$958 /month \$7,660.08 Water mains \$1.751 /month \$14,008 Service lines \$1,297 /month \$10,375 Wastewater system \$1,297 /month \$10,375 Sewer mains \$1,335 /month \$10,375 Sever mains \$1,297 /month \$10,375 Lilt/pump station buildings \$153 /month \$10,375 Force main to septic system \$47 /month \$10,375 Force main to septic system \$47 /month \$10,375 Water system \$47 /month \$1,225,73 Water system \$552 /month \$6,619 WTP building \$552 /month \$6,619 Lights and controls \$52 /month \$981 HVAC/hydronic system \$52 /month \$981 Pumps \$82 /month \$981 Intake or well \$82 /month \$940 WST circulation \$57 /month \$1,470.87 Main ine circulation \$902 /month \$1,470.87 Main ine circulation buildings \$1,170 /month \$40		•	
Water storage tank line \$11.751 /month \$14.008 Water mains \$1,751 /month \$14,008 Service lines \$1,297 /month \$10,375 Wastewater system \$1,335 /month \$10,818 Sewer mains \$1,335 /month \$10,818 Sevice lines \$1,297 /month \$10,818 Lift/pump station buildings \$153 /month \$10,818 Force main to septic system \$447 /month \$1,225,73 Water system \$447 /month \$36,619 Water system \$552 /month \$6,619 Water treatment \$82 /month \$4,413 Water treatment \$82 /month \$981 Pumps Intake or well \$82 /month \$980,58 WST circulation \$57 /month \$443 Pressure/booster \$123 /month \$980,58 Main line circulation \$902 /month \$440 Wastewater system Liftypump station buildings Lights and controls \$61 /month \$490 HVAC/hydronic system \$61 /month \$490 \$40		•	
Water mains \$11,751 month \$14,008	_	•	
Service lines		•	·
Sewer mains \$1,335 month \$10,881 \$1,297 month \$10,375 \$1,177 month \$10,375 \$1,177 month \$10,375 \$1,297 month \$1,297 \$1,297 month \$1,297 \$1,297 month \$1,297 \$1,297 month \$1,297 \$1,297 month \$1,297 \$1,297 month \$1,297 \$1,297 month \$1,297 \$1,297 month \$1,297 \$1,297 month \$1,297 \$1,297 month \$1,29		• •	\$10,375
Sewer mains \$1,335 month \$10,881	Wastewater system		
Service lines \$1,297 month \$10,375		\$1 335 /month	\$10.681
Lift/pump station buildings \$153 month \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370 \$1,225.73 \$370			
Subtotal Subtotal Subtotal Subtotal Subtotal \$73,300			
Subtotal \$73,300	• •	•	
Water system WTP building Lights and controls \$552 month \$6,619 HVAC/hydronic system \$552 month \$4,413 Water treatment \$82 month \$981.58 WST circulation \$57 month \$4454 WST circulation \$57 month \$4544 WST circulation \$57 month \$4544 Pressure/booster \$123 month \$1,470.87 Main line circulation \$902 month \$7,217 Wastewater system Lift /pump station buildings Lights and controls \$61 month \$735 HVAC/hydronic system \$61 month \$735 HVAC/hydronic system \$61 month \$490 Pumps Individual facility pump stations \$61 month \$1,060.96 \$65 Month \$1,060.96 \$65 Month \$1,060.96 \$65 Month \$1,060.96 \$65 Month \$1,070.96 \$65 Mon	Force main to septic system	•	
Water system WTP building Lights and controls \$552 /month \$6,619 HVAC/hydronic system \$552 /month \$4,413 Water treatment \$82 /month \$981 Pumps \$82 /month \$980.88 Intake or well \$82 /month \$980.88 WST circulation \$57 /month \$454 Pressure/booster \$123 /month \$1,470.87 Main line circulation \$902 /month \$7,217 Wastewater system \$11 /month \$7,217 Lights and controls \$61 /month \$490 HVAC/hydronic system \$61 /month \$490 Pumps Individual facility pump stations \$0 /month \$0 Community lift/pump station(s) \$88 /month \$1,060.96 Sewer/force main glycol circulation \$225 /month \$1,801 Septic system discharge pump \$1,177 /year \$0 Septic system discharge pump \$1,177 /year \$0 Water quality testing \$2,000 /year \$2,000 Water quality testing	Flored de	Subte	nai \$75,500
WTP building Lights and controls \$552 /month \$6,619 HVAC/hydronic system \$552 /month \$4,413 Water treatment \$82 /month \$981 Pumps			
Lights and controls \$552 /month \$4,413			
HVAC/hydronic system		\$552 /month	\$6 619
Water treatment \$82 /month \$981 Pumps \$82 /month \$980.58 Intake or well \$82 /month \$980.58 WST circulation \$57 /month \$454 Pressure/booster \$123 /month \$1,470.87 Main line circulation \$902 /month \$7,217 Wastewater system \$123 /month \$7,217 Wastewater system \$61 /month \$7,217 Wastewater system \$61 /month \$7,217 Wastewater system \$61 /month \$7,350 Lights and controls \$61 /month \$490 HVAC/hydronic system \$61 /month \$490 Pumps \$61 /month \$490 Individual facility pump stations \$0 /month \$0 Community lift/pump station(s) \$88 /month \$1,060.96 Sewer/force main glycol circulation \$225 /month \$1,300 Septic system discharge pump \$1,177 /year \$1,177 Subtotal \$6,699 /year \$6,699 Miscellaneous materials & supplies \$4,019	•	•	
Pumps	· · · · · · · · · · · · · · · · · · ·	•	
Intake or well		φο2 /ποπι	φ901
WST circulation \$57 /month \$454 Pressure/booster \$123 /month \$1,470.87 Main line circulation \$902 /month \$7,217 Wastewater system Light sand controls \$61 /month \$735 HVAC/hydronic system \$61 /month \$490 Pumps Individual facility pump stations \$0 /month \$490 Pumps Individual facility pump stations \$0 /month \$1,060.96 Sewer/force main glycol circulation \$225 /month \$1,807 Septic system discharge pump \$1,177 /year \$1,177 Subtotal \$1,177 /year \$1,177 Subtotal \$27,400 Other Costs \$0,699 /year \$6,699 Equipment R&R \$6,699 /year \$6,699 Miscellaneous materials & supplies \$4,019 /year \$2,000 Water quality testing \$2,000 /year \$2,000 Operator training \$2,500 /year \$2,500 Insurance \$1,500 \$1,500 Subtotal \$16,700	·	¢02 /manth	¢000 E0
Pressure/booster \$123 /month \$1,470.87 Main line circulation \$902 /month \$7,217		•	•
Main line circulation \$902 /month \$7,217 Wastewater system Lift /pump station buildings Lights and controls \$61 /month \$735 HVAC/hydronic system \$61 /month \$490 Pumps Individual facility pump stations \$0 /month \$0 Community lift/pump station(s) \$88 /month \$1,060,96 Sewer/force main glycol circulation \$225 /month \$1,801 Septic system discharge pump \$1,177 /year \$0 Other Costs Sequipment R&R \$6,699 /year \$6,699 Equipment R&R \$6,699 /year \$6,699 Mater quality testing \$2,500 /year \$2,000 Operator training \$2,500 /year \$2,500 Insurance \$1,500 /year \$1,500 Subtotal \$16,700 Summary (Townsite & Newsite) Administration \$6,000 Labor \$33,300 Fuel \$86,500 Electricity \$34,200		·	
Lift /pump station buildings Lights and controls \$61 /month \$735 HVAC/hydronic system \$61 /month \$490 Pumps Individual facility pump stations \$0 /month \$1,060.96 Sewer/force main glycol circulation \$225 /month \$1,177 Subtotal \$1,177 Subtotal \$27,400 Other Costs Equipment R&R \$6,699 /year \$6,699 Miscellaneous materials & supplies \$4,019 /year \$4,019 Water quality testing \$2,500 /year \$2,500 Insurance \$1,500 /year \$1,500 Summary (Townsite) Summary (Townsite & Newsite) Administration \$6,000 Labor \$33,300 Fuel \$73,300 Electricity \$27,400 Electricity \$27,400 Electricity \$34,200 Electricity \$34,010 Electricity		•	
Lift /pump station buildings Lights and controls \$61 /month \$735		\$502 /month	Ψ1,211
Lights and controls			
HVAC/hydronic system \$61 /month \$490	· · · · · · · · · · · · · · · · · · ·		
Pumps	Lights and controls	\$61 /month	\$735
Individual facility pump stations	HVAC/hydronic system	\$61 /month	\$490
Community lift/pump station(s) \$88 /month \$1,060.96 Sewer/force main glycol circulation \$225 /month \$1,801 Septic system discharge pump \$1,177 /year \$1,177 Subtotal \$27,400 Other Costs Equipment R&R \$6,699 /year \$6,699 Miscellaneous materials & supplies \$4,019 /year \$4,019 Water quality testing \$2,000 /year \$2,000 Operator training \$2,500 /year \$2,500 Insurance \$1,500 /year \$1,500 Summary (Townsite) Summary (Townsite & Newsite) Administration \$6,000 Labor \$33,300 Fuel \$73,300 Electricity \$34,200 Electricity \$27,400 Electricity \$34,200 Electricity \$34,200 Electricity \$34,200 Summary (Townsite & Newsite) S1,500 S1,500 Summary (Townsite & Newsite) S2,500 S3,300 Fuel \$86,500 Electricity \$34,200 Electricity \$34,200 Summary (Townsite & Newsite) S1,500 S3,300 Summary (Townsite & Newsite) S1,500 S1,500 Summary (Townsite & Newsite) S1,500 S1,500 Summary (Townsite & Newsite) S1,500 S1,500 Summary (Townsite & Newsite) S2,500 S2,500 Summary (Townsite & Newsite) S2,500 S2,500 Summary (Townsite & Newsite) S2,500 S2,500 S2,500 Summary (Townsite & Newsite) S2,500 S2,500 S2,500 Summary (Townsite & Newsite) S2,500 S2,500 S2,500 S2,500 Summary (Townsite & Newsite) S2,500 S2	Pumps		
Sewer/force main glycol circulation \$225 month \$1,801 \$1,177 year \$1,177 \$1,1	Individual facility pump stations	\$0 /month	\$0
Septic system discharge pump \$1,177 /year Subtotal \$27,400	Community lift/pump station(s)	\$88 /month	\$1,060.96
Septic system discharge pump \$1,177 /year \$1,177 \$1,000 \$27,400	Sewer/force main glycol circulation	\$225 /month	\$1,801
Subtotal \$27,400 Other Costs Equipment R&R \$6,699 /year \$6,699 /year \$6,699 /year \$6,699 /year \$6,699 /year \$6,699 /year \$2,000 /year \$2,000 /year \$2,000 /year \$2,500 /year \$2,500 /year \$2,500 /year \$1,500 /year \$2,500 /year			

Revenue			# of		,	Yearly
Source I	Monthly	Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$	114	89	85%	\$	103,622
Public/Commerc	\$	119.85	16	100%	\$	23,012
School Service (\$ 5	,707.32	1	100%	\$	51,366
Local Capital Cor	ntribution				\$	-
Total Revenue	•				\$	178,000

Total

\$178,000

Total

\$157,000

Tetlin, Alaska

Community Information & Existing Infrastructure

Tetlin is an Athabascan community of 131 people located along the Tetlin River, between Tetlin Lake and the Tanana River. There are 43 residential units, 10 commercial/public facilities and one school for a total of 54 services. The existing water and sewer services provided in Tetlin consist of self-haul system from the watering point located at the washeteria and pit privies/honey buckets. Few homes in the community have 350 gallon sewer holding tanks for wastewater disposal. The existing water and sewer infrastructure consists of the following:

- Well 40 gpm
- Treated Water Storage N/A
- Watering Point Building 1,500 SF, built in 1999
- Water Treatment Grit separator, bag filter
- Sewage Lagoon Two Cell, 0.25 acres

Soils in the region consist of fine, medium dense, stiff silty sands and silts. Permafrost is pervasive throughout the community; however, cleared areas were found to be thawed to depths of 5-6 feet.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 10,300 feet of pipe, and the pressure sewer system approximately 6,600 feet of pipe. The water system will consist of two circulating loops. The pressure sewer system would require individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	11	40	-
Water Storage (gallons)	93,900	-	93,900
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	2.8	0.3	2.5
Required Foundation System for WTP and/or WST			
Thermosyphon stabilized gravel pad (sf)	2,610	-	2,610
Water Distribution System			
Circulating Water Main with Pitorifices (If)	10,300	-	10,300
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	6,600	-	6,600
Individual Grinder Pump Stations (GPS) (ea)	54	-	54
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	4,100	-	4,100
Pressure Sewer Service Lines (If)	4,100	-	4,100

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Tetlin. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

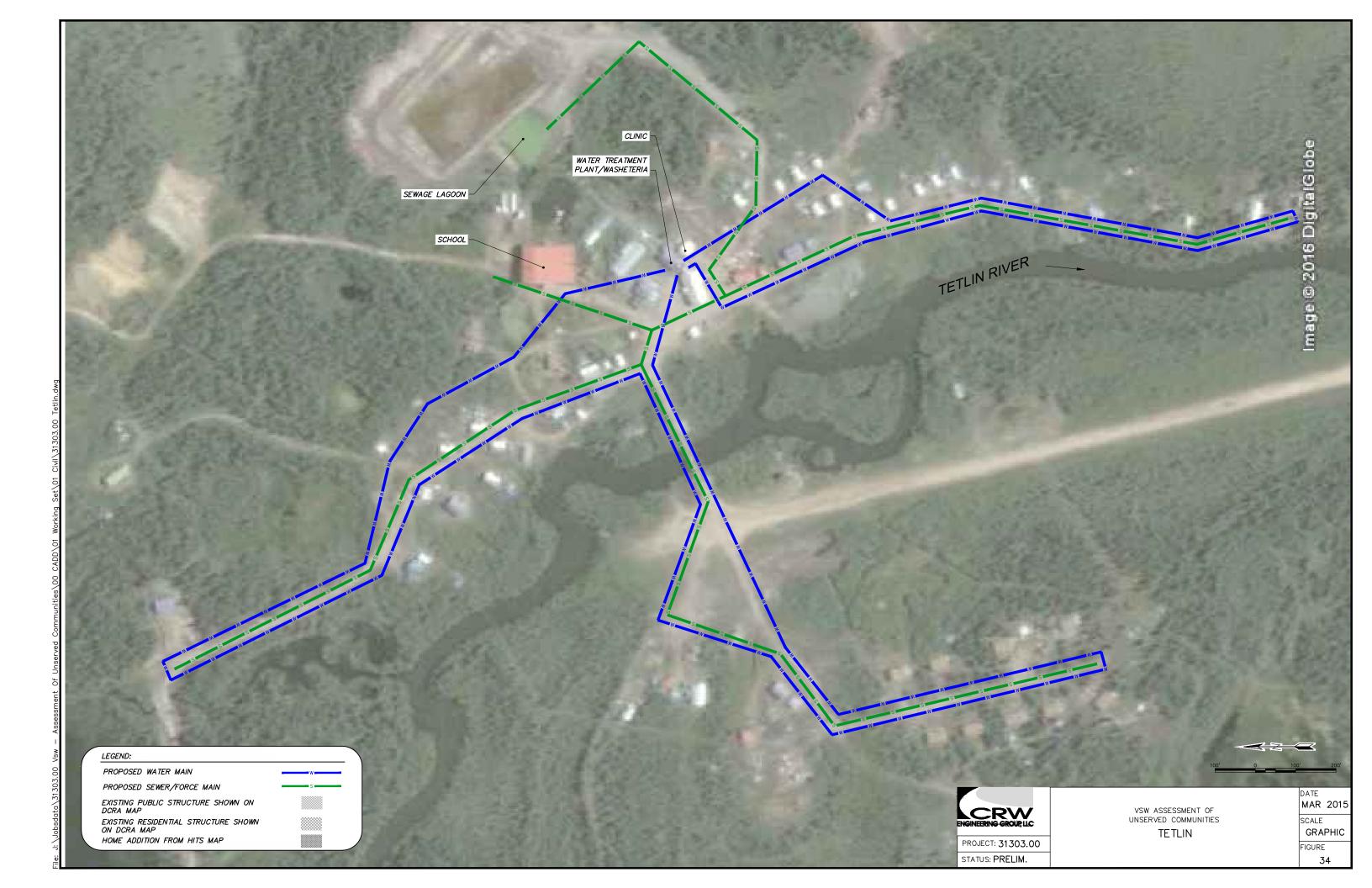
				Village	
	Estimated Capital Costs			Tetlin	
			<u>'</u>		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	54	\$28,096.69	\$1,517,221
3	Sewage collection mains or services (gravity or force), above ground	LF	10,700	\$301.01	\$3,220,820
10	Sewage lagoon, barrow, local material	Acre	2.5	\$880,950.77	\$2,202,377
12	Water distribution, mains or services, above ground	LF	14,400	\$420.25	\$6,051,565
14	Water storage tank, no foundation	Gal	93,900	\$3.84	\$360,441
15	Water treatment plant, no foundation	SF	1,200	\$2,372.01	\$2,846,410
19	Foundation - thermosyphen stablized gravel pad	SF	2,610	\$255.26	\$666,230
	Total Esti	mated (Cost in 2010 o	dollars (rounded):	\$16,865,000
	Total v	vith Infl	ation (3% pe	r year for 6 years)	\$20,137,700
27	Individual Grinder Pump Stations	EA	54	\$30,000	\$1,620,000
28	Electrical Service Upgrades	EA	54	\$5,500	\$297,000
		•		Subtotal	\$22,054,700
29	Construction Contingency (15%)	LS	1	\$3,308,200	\$3,308,200
30	Design & Construction Administration Services (20%)	LS	1	\$4,410,900	\$4,410,900
				Total	\$29,773,800

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs	
Description	Cost
Administration	\$6,000
Labor	\$28,300
Fuel	\$27,500
Electricity	\$10,500
Other (R&R, Training, etc.)	\$11,300
Total	\$84,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Tetlin are listed below.

Estimated User Fees					
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate	Yearly evenues
Residential Service	\$	109	43	85%	\$ 47,748
Public/Commercial Service	\$	114	10	100%	\$ 13,717
School Service	\$	2,504	1	100%	\$ 22,535
Local Capital Contribution					\$ -
Total Revenue					\$ 84,000



VSW Unserved Communit	ties - Piped W	ater & Sewer System Type and Si	zing Model	
Date		4/11/2016		
Community Input		Tetlin	1	
Input				
Existing Community & System Data			-	
2015 Population		131		
2015 Number of Services HITS Database (E1 & H1-H7)		54 43		
DCED Mapping Commerical/Public Facilities/School		11		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		0		
Water Treatment Capacity Existing Sewage Lagoon Size		40 0.25		
Soil Conditions (check only one)		0.25		
Soft poorly drained soils or discontinuous permafrost				
Firm soils, or continuous permafrost		x		
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length	Water Main
Buried system with no permafrost			(ft)	Length (ft)
Above ground system or buried with permafrost		Х	6600	10300
Gravity Sewer Main				
Pressure Sewer Main		х	6600	
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Tetlin		
Output for Cost Model (calculated)	Community	retiin		
output for cost Model (calculated)			Foundatio	n Size
Water Treatment Capacity (gpm)		11		
Req Water Storage (gallons) (less existing)		93,900	1,410	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		2.5		
			Quantity	Notes
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	1,200	
Water Distribution System		Circulating Water Main with Pitorifices (If)	10,300	
		,		'
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	6,600	
		Individual Grinder Pump Stations (GPS) (ea)	54	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	4,100	
		Pressure Sewer Service Lines (If)	4,100	
				l
System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	11	40	-	
Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	93,900 1,200	-	93,900 1,200	
Sewage Lagoon Size (acre)	1,200	- 0.3	1,200	
Required Foundation System for WTP and/or WST				
Thermosyphon stabilized gravel pad (sf)	2,610	-	2,610	
Water Distribution System Circulating Water Main with Pitorifices (If)	10.200		40.303	
Circulating Water Main with Pitorifices (If) Wastewater Collection System	10,300	-	10,300	
Sewer Main with Glycol Heat Trace (If)	6,600	-	6,600	
Individual Grinder Pump Stations (GPS) (ea)	54	-	54	
Water & Sewer Service Lines Circulating Water Service Lines (If)	4.400			
Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	4,100 4,100	-	4,100 4,100	

VSW U	nserved Communi	ities - Piped	Water & Sewer	System Type and Sizing Model
Date Community	4/11/201			
System Parameters	Model Res	ults		Criteria & Calculations
Design Population				
Duration (n) 2015 Population (P)			years people	20 years 2015 ADOL
2015 Number of Services		54	services	
Growth Rate (i)		1%		1%
2035 Design Population (Capita)		160	people	Px(1+i)^n
Water Demand Estimates		40	gpm	
Existing Capacity Average Day (ADD)		7,992		50 gallons per Capita
Max Day (MDD)		15,984		2 x ADD
Peak Hour Treatment Capacity		33	gpm gpm	3 x MDD MDD
Treatment Capacity		11	gpm	MIDD
Water Source Assumptions		CW	1	
Type (surface water or groundwater) Required Capacity		GW 11	gpm	MDD
			01	
Water Storage Tank Sizing			gallons	
Existing Water Storage Tank Demand Based Volume (if source is GW)	Applicable	-	ganons	
Daily Operation (DO) (gallons)			gallons	Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)		30,000		500 gpm for 60 minutes 3 days x DO
Water Storage Tank Volume		47,953 93,938		DO + FF + RV
CT Based Volume (min if source is SW)	Not Requi	red	ľ	
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)			mg/L log inactivation	0.4 mg/L 1.0-log Inactivation
Temperature (T)		4.4		4.4 celsius/40 F
pH (PH)		7		7
Contact Time Required (CT)			minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF) Required Volume to meet CT*		0.1 56,625		0.1 CT/RCxPeak Hour/BF
Required Water Storage		93,900		CI/IICAI CUR HOUI/BI
Required Additional Storage		93,900	gallons	0
Estimate of Min Platform Size (3' clearance around)		1,410	sf	$D = 0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
ar ound)				0
Water Treatment Plant Requirements*	2		1	D
Water Quality Minimum WTP Size	Poor	1,200	sf	Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf
			•	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Foundation (WST and WTP) Soft poorly drained soils or discontinuous			1	
permafrost	0			Pile Foundation
			Thermosyphon	
Firm soils, or continuous permafrost	х		stabilized gravel pad (sf)	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		puu (sj)	Gravel pad
W. S. S. S. C. (Ch. J. Sh. J. Sh. J. Sh.				
Water Distribution (Check either or both) Buried system with no permafrost	0			Static Water Mains
	-		Circulating	
Above ground system or buried with permafrost	х		Water Main	Circulating Water Main with Pitorifices
			with Pitorifices (If)	
Wastewater Collection (Check all that apply)				
Buried system with no permafrost	0			Bare sewer main, no heat trace
Above ground or busined with a constitution			Sewer Main	Source main with always heat trans
Above ground or buried with permafrost	х		with Glycol Heat Trace (If)	Sewer main with glycol heat trace
Gravity Sewer Main	0		.,,	Lift stations for gravity sewer mains, every 1,000 ft
			Individual Grinder Pump	
Pressure Sewer Main	х		Stations (GPS)	Individual Grinder Pump Stations
			(ea)	
	 			
Water & Sewer Services (Check all that apply)				
Static Water Main	0			Static Water Service Line
Circulating Water Main	x		Circulating Water Service	Circulating Water Service Lines
	^		Lines (If)	
				Gravity Service Line
Gravity Sewer Main	0			
Gravity Sewer Main			Pressure Sewer	Pressure Service Line with GPS
	0 x		Pressure Sewer Service Lines (If)	Pressure Service Line with GPS
Gravity Sewer Main Pressure Sewer Main				Pressure Service Line with GPS
Gravity Sewer Main		0.25		Pressure Service Line with GPS
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size		1.4	Service Lines (If) acres acres	Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon			Service Lines (If) acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size		1.4 197.5	Service Lines (If) acres acres	
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check		1.4 197.5	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check		1.4 197.5	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Tetlin	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	54	\$28,096.69	\$1,517,221
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	10,700	\$301.01	\$3,220,820
	Sewage lift station	EA	0	#DIV/0!	\$0
	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	2.5	\$880,950.77	\$2,202,377
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	14,400	\$420.25	\$6,051,565
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	93,900	\$3.84	\$360,441
	Water treatment plant, no foundation	SF	1,200	\$2,372.01	\$2,846,410
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	2,610	\$255.26	\$666,230
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$16,865,064

Community:	Tetlin	
General Community Dat	a	
Current population Average number Service Connecti	of people per house	131 persons 3.0
Number of ho Number of pu Number of so	blic/commerical buildings	43 10 1 ce connections 54
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon fo	rublic facilty) lesidential service)	\$17 hr \$0.24 kWh \$0.21 kWh \$2.80 gal
Water consumpti Wastewater gene	· ·	50 gpd 50 gpd
Length of raw	m (Surface(SW) or Groundwater(GW))	GW 50 ft Yes
Location of w Water Treatment	ater line (Above ground (AG) or Buried)	Buried
Size of water	treatment plant building lality (Good or Poor)	2700 sf Poor
Water line he	er line to/ from tank ated for freeze protection (Yes or No) ater line (Above ground (AG) or Buried)	93,900 gallons 50 ft Yes AG
Number of ci Total length o Water mains Location of th	1 m (Static or Circulating (Circ)) culating water loops of Water Main heated for freeze protection (Yes or No) he mains (Above ground (AG) or Buried) ice line length	Circ 2 10300 ft Yes AG 75 ft
Number of in Number of co Number of Number of Number of Number of Size of lif Total length of Sewer mains Number of cil	m (Gravity or Pressure) dividual facility pump stations mmunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #4	Pressure 500 sf 6600 ft Yes 2 AG 75 ft
Location of fo		1130 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		9
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
	. ,	• •

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	32	hrs/week		\$28,288
Fuel (Heating Demand)				
Water system				
WTP building	\$386	/month		\$3,088.83
Raw water line	\$3	/month		\$36.77
Raw water heat addition	\$223	/month		\$2,676.17
Water storage tank	\$40	/month		\$319.71
Water storage tank line	\$5	/month		\$40.86
Water mains	\$1,052	/month		\$8,417
Service lines	\$414	/month		\$3,309
Wastewater system				
Sewer mains	·	/month		\$5,393
Service lines	*	/month		\$3,309
Lift/pump station buildings	* -	/month		\$0.00
Force main to lagoon	\$115	/month		\$923
			Subtotal	\$27,500
Electricity				
Water system				
WTP building				
Lights and controls	\$189	/month		\$2,269
HVAC/hydronic system	\$189	/month		\$1,513
Water treatment	\$24	/month		\$287
Pumps				
Intake or well	\$24	/month		\$286.73
WST circulation	\$32	/month		\$259
Pressure/booster	\$36	/month		\$430.10
Main line circulation	\$516	/month		\$4,124
Wastewater system				
Lift /pump station buildings				
Lights and controls	* -	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps				
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	·	/month		\$0.00
Sewer/force main glycol circulation	\$129			\$1,029
Lagoon discharge pump	\$344	/year	Subtotal	\$344 \$10,500
Other Costs			Jubiolai	Ψ10,500
Equipment R&R	\$3,314	/year		\$3,314
Equipment R&R Miscellaneous materials & supplies	\$3,314 \$1,989	•		\$3,314 \$1,989
Water quality testing	\$1,989 \$2,000	•		\$1,989 \$2,000
Operator training	\$2,000 \$2,500	•		\$2,000 \$2,500
Insurance	\$2,500 \$1,500	•		
ilioulalio c	φ1,300	, year	Subtotal	\$1,500 \$11,300
			Gubiolai	φ11,300

Summary

Administration	\$6,000
Labor	\$28,300
Fuel	\$27,500
Electricity	\$10,500
Other	\$11,300
Total	\$84,000

Revenue I	Monthly	# of		\	early/
Source F	Rate	Customers	Collection Rate	Re	venues
Residential Serv	\$ 109	43	85%	\$	47,748
Public/Commerc	\$ 114.31	10	100%	\$	13,717
School Service (\$ 2,503.89	1	100%	\$	22,535
Local Capital Con	tribution			\$	-
Total Revenue				\$	84,000

Tuluksak, Alaska

Community Information & Existing Infrastructure

Tuluksak is a Yupik Eskimo community of 372 people located on the south bank of the Tuluksak River at its junction with the Kuskokwim River. There are 92 residential units, 21 commercial/public facilities and one school for a total of 114 services. The existing water and sewer services provided in Tuluksak consist of self-haul system from the watering point attached to the washeteria and pit privies. The existing water and sewer infrastructure consists of the following:

- Well 20 gpm
- Treated Water Storage 100,000 gallons
- Water Treatment Plant 2,048 SF, built in 1982, Upgraded in 2003
- Water Treatment Chlorine, Potassium permanganate, Greensand filter
- Sewage Lagoon Two cell, 0.52 acre

Soils around Tuluksak consist of silt with silty sand. Groundwater level is close to the level of the river.

Piped System Description

The piped water and sewer system will be a buried system. The water system will consist of approximately 13,400 feet of pipe, and the gravity sewer system approximately 12,200 feet of pipe. The water system will consist of two circulating loops. The pressure sewer system would require one sewer main lift station (existing), individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	32	20	12
Water Storage (gallons)	211,600	100,000	111,600
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Sewage Lagoon Size (acre)	7.9	0.5	7.4
Required Foundation System for WTP and/or WST			
Thermosyphon stabilized gravel pad (sf)	2,830	-	2,830
Water Distribution System			
Circulating Water Main with Pitorifices (If)	13,400	-	13,400
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (If)	12,200	-	12,200
Individual Grinder Pump Stations (GPS) (ea)	114	-	114
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	8,600	-	8,600
Gravity Sewer Service Lines (If)	8,550	-	8,550

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Tuluksak. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30).

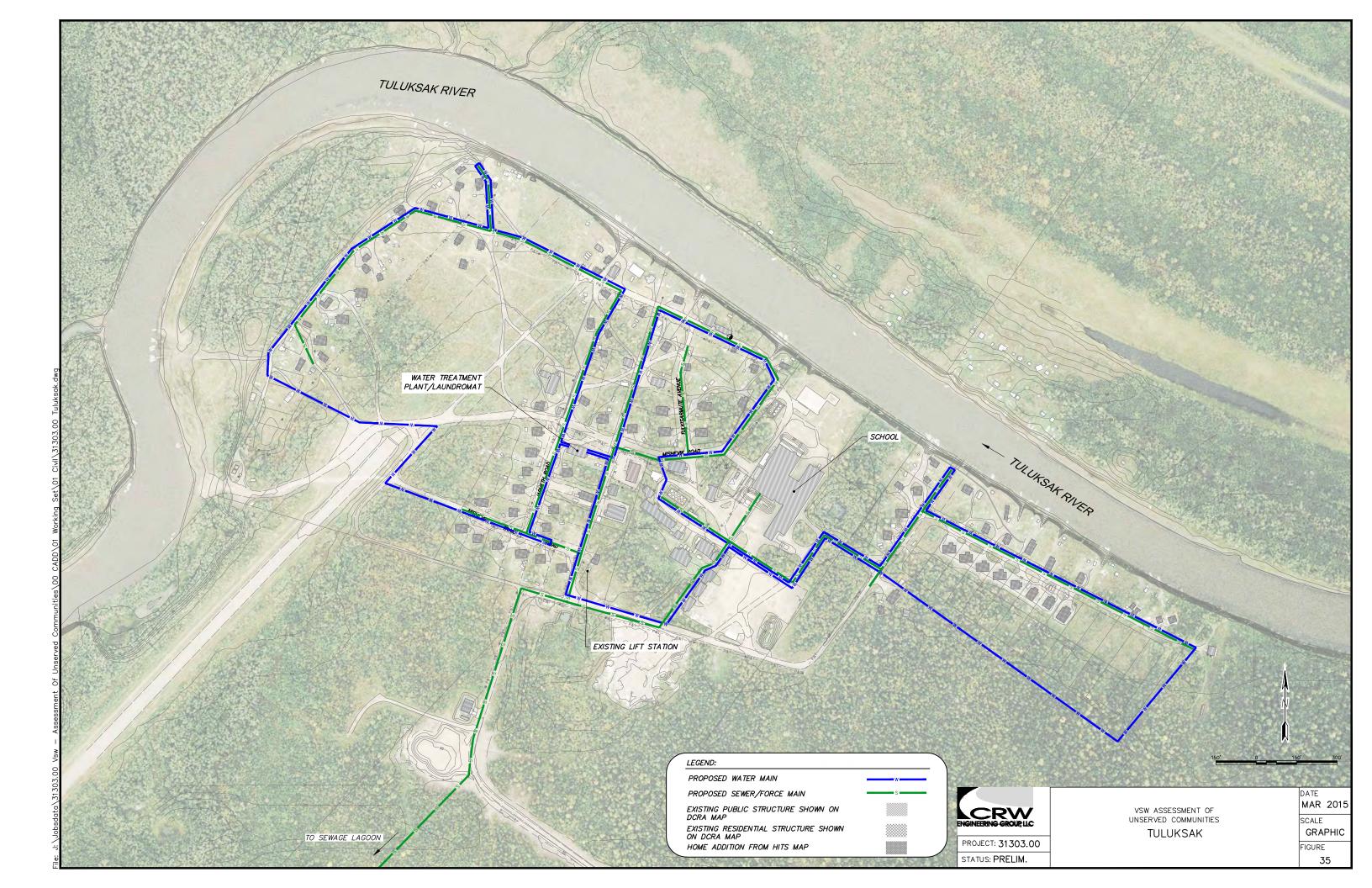
				Village	
	Estimated Capital Costs	Tuluksak			
					l
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	114	\$26,403.25	\$3,009,971
2	Sewage collection mains or services (gravity or force), buried	LF	20,750	\$254.26	\$ 5,275,960
10	Sewage lagoon, barrow, local material	Acre	7.4	\$692,040.19	\$5,121,097
13	Water distribution, mains or services, buried	LF	22,000	\$280.91	\$6,179,961
14	Water storage tank, no foundation	Gal	111,600	\$3.25	\$362,886
15	Water treatment plant, no foundation	SF	1,200	\$1,635.59	\$1,962,712
19	Foundation - thermosyphen stablized gravel pad	SF	2,830	\$266.47	\$754,111
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Estir	mated (Cost in 2010 o	dollars (rounded):	\$22,820,000
	Total v	vith Infl	ation (3% pei	year for 6 years)	\$27,248,300
27	Individual Grinder Pump Stations	EA	114	\$30,000	\$3,420,000
28	Electrical Service Upgrades	EA	114	\$5,500	\$627,000
		•		Subtotal	\$31,295,300
29	Construction Contingency (15%)	LS	1	\$4,694,300	\$4,694,300
30	Design & Construction Administration Services (20%)	LS	1	\$6,259,100	\$6,259,100
				Total	\$42,248,700

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs	
Description	Cost
Administration	\$6,000
Labor	\$26,000
Fuel	\$99,900
Electricity	\$24,000
Other (R&R, Training, etc.)	\$18,000
Total	\$174,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Tuluksak are listed below.

Estimated User Fees						
Revenue Source	Mon	thly Rate	# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	104	92	85%	\$	98,032
Public/Commercial Service	\$	115	21	100%	\$	28,958
School Service	\$	5,223	1	100%	\$	47,010
Local Capital Contribution					\$	
Total Revenue					\$	174,000



Community & System Data Tuluksak Tuluk		•	ater & Sewer System Type and Si	zing Model	
Inquit			4/19/2016		
Existing Community & System Data 2015 Foundation 2015 Symber of Services 1114 1115 Database (E1 & H1 H7) 202 1175 Control Symber of Generical Public Facilities/School 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1796 (Lordine water or groundwater) 1797 (Lordine water or groundwater) 1797 (Lordine water or groundwater) 1797 (Lordine water or groundwater) 1798 (Lordine water or groundwater) 1798 (Lordine water or groundwater) 1798 (Lordine water or water) 1798 (Lordine water	1		Tuluksak	1	
2325 Symbar of Services	·			_	
114	Existing Community & System Data			•	
MITS Database (E1 & H1 H7)	2015 Population				
1					
Type Curricks water or groundwater)	I		_		
Water Stranger Capacity 20 20 20 20 20 20 20 2					
Marter Treatment Capacity Esting					
Water Treatment Capacity 20 20 20 20 20 20 20 2					
Sesting Sewage Lagoon Size Soliconditions (check only one) Soliconditions (check only one) Soliconditions (check only one) Soliconditions (check only one) Soliconditions (check all that apply) eck all that apply (check all that apply (check all that apply (check all that apply (check all that apply (check all that apply (check all that apply (check all that apply (check all that apply (check all that apply (check all that apply (check all that apply (check all that al	_				
Soft poorly drained soils or discontinuous permafrost Siff soils, no permafrost	Existing Sewage Lagoon Size		0.52		
Section Sect	Soil Conditions (check only one)			•	
Sulf solit no permafrost	Soft poorly drained soils or discontinuous permafrost				
Piping Configurations (check all that apply) Sewer Main Length (th)	Firm soils, or continuous permafrost		x		
Vising Configurations (cincer all that apphy)	Stiff soils, no permafrost				
Buried system with no permafrost	Piping Configurations (check all that apply)				
Above ground system or buried with permafrost x 12200 13400				(ft)	Length (ft)
Sewer Main			Y	12200	13400
Pressure Sewer Main	Gravity Sewer Main				13400
Typical Service Line Length (ea) To Typical Service Line Length (ea) To Typical Service Line Length (ea) Typical Service Lines (ff) Typical Service	Pressure Sewer Main				
Sever Main with Glycol Heat Trace Water & Sewer Service Lines System Description System Service Lines System Description System Description System Service Lines System Description System Service Lines System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System Service Lines (If) System Service Lines	Typical Service Line Length (ea)			75	75
Sever Main with Glycol Heat Trace Water & Sewer Service Lines System Description System Service Lines System Description System Description System Service Lines System Description System Service Lines System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System Service Lines (If) System Service Lines					
Sever Main with Glycol Heat Trace Water & Sewer Service Lines System Description System Service Lines System Description System Description System Service Lines System Description System Service Lines System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System For WITP and/or WST System Description System Service Lines (If) System Service Lines					
Water Treatment Capacity (gpm) Search (as the content of the c	Piped System Requirements	Community	Tuluksak		
Water Treatment Capacity (gpm) 32 1,630 5	Output for Cost Model (calculated)				
Req Water Storage (gallons) (less existing)				Foundatio	n Size
Req W&S Utility Bidg/Mater Treatment Plant/Addition (sf) 1,200 sf	Water Treatment Capacity (gpm)		32		
Req Sewage Lagoon Size (acre) (less existing) 7.4	Req Water Storage (gallons) (less existing)		111,600	1,630	sf
According to the content of the co	Req W&S Utility Bldg/Water Treatment Plant/Addition	n (sf)	1,200	1,200	sf
Thermosyphon stabilized gravel pad (sf)	Req Sewage Lagoon Size (acre) (less existing)		7.4		
Mater Distribution System 1,200				Quantity	Notes
Mater Distribution System 1,200					
Mater Distribution System 1,200			Thermosyphon stabilized gravel pad		
Sewer Main with Glycol Heat Trace (If) 12,200	Required Foundation System for WTP and/or WST			1,200	
Sewer Main with Glycol Heat Trace (If) 12,200					
Sewer Main with Glycol Heat Trace (If) 12,200					
Sewer Main with Glycol Heat Trace (If) 12,200					
Prioritices (if)	Water Distribution System		Circulating Water Main with	12 400	
(if) 112,200			Pitorifices (If)	13,400	i
(if) 112,200					
(if) 112,200			Sewer Main with Glycol Heat Trace		
Lift Stations for Gravity Sewer Mains 1			•	12,200	
Circulating Water Service Lines (If)	Wastewater Collection System				
System Description Piped System Need Existing Facility Net Need			Lift Stations for Gravity Sewer Mains	1	
System Description Piped System Need Existing Facility Net Need					
System Description Piped System Need Existing Facility Net Need					•
System Description Piped System Need Existing Facility Net Need					
System Description Piped System Need Existing Facility Net Need			Circulating Water Service Lines (If)	8.600	
System Description Piped System Need Existing Facility Net Need	Water & Sewer Service Lines			3,313	
Need Existing Facility Net Need			Gravity Sewer Service Lines (If)	8,550	
Need Existing Facility Net Need					
Need Existing Facility Net Need					
Need Existing Facility Net Need					
Need Existing Facility Net Need		Dined System			•
Water Treatment Capacity (gpm) 32 20 12 Water Storage (gallons) 211,600 100,000 111,600 W&S Utility Bldg/Water Treatment Plant/Addition (sf) 1,200 - 1,200 Sewage Lagoon Size (acre) 7.9 0.5 7.4 Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) 2,830 - 2,830 Water Distribution System Circulating Water Main with Pitorifices (if) 13,400 - 13,400 Wastewater Collection System Sewer Main with Glycol Heat Trace (if) 12,200 - 12,200 Individual Grinder Pump Stations (GPS) (ea) 114 - 114 Water & Sewer Service Lines Circulating Water Service Lines (if) 8,600 - 8,600	System Description		Existing Facility	Net Need	
Water Storage (gallons) 211,600 100,000 111,600 W&S Utility Bldg/Water Treatment Plant/Addition (sf) 1,200 - 1,200 Sewage Lagoon Size (acre) 7.9 0.5 7.4 Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) 2,830 - 2,830 Water Distribution System Circulating Water Main with Pitorifices (lf) 13,400 - 13,400 Water Alian with Glycol Heat Trace (lf) 12,200 - 12,200 Individual Grinder Pump Stations (GPS) (ea) 114 - 114 Water & Sewer Service Lines Circulating Water Service Lines (lf) 8,600 - 8,600	Water Treatment Capacity (gpm)		20	12	
Sewage Lagoon Size (acre) 7.9 0.5 7.4 Required Foundation System for WTP and/or WST Thermosyphon stabilized gravel pad (sf) 2,830 - 2,830 Water Distribution System Circulating Water Main with Pitorifices (if) 13,400 - 13,400 Wastewater Collection System Sewer Main with Glycol Heat Trace (if) 12,200 - 12,200 Individual Grinder Pump Stations (GPS) (ea) 114 - 114 Water & Sewer Service Lines Circulating Water Service Lines (if) 8,600 - 8,600	Water Storage (gallons)				
Required Foundation System for WTP and/or WST		1,200	-	1,200	
Thermosyphon stabilized gravel pad (sf) 2,830 - 2,830		7.9	0.5	7.4	
Water Distribution System Circulating Water Main with Pitorifices (If) 13,400 - 13,400 Wastewater Collection System Sewer Main with Glycol Heat Trace (If) 12,200 - 12,200 Individual Grinder Pump Stations (GPS) (ea) 114 - 114 Water & Sewer Service Lines Circulating Water Service Lines (If) 8,600 - 8,600			T		
Circulating Water Main with Pitorifices (If) 13,400 - 13,400		2,830	-	2,830	
Wastewater Collection System Sewer Main with Glycol Heat Trace (If) 12,200 - 12,200 Individual Grinder Pump Stations (GPS) (ea) 114 - 114 Water & Sewer Service Lines Circulating Water Service Lines (If) 8,600 - 8,600		13 ///	_	12 400	
Sewer Main with Glycol Heat Trace (If) 12,200 - 12,200 Individual Grinder Pump Stations (GPS) (ea) 114 - 114 Water & Sewer Service Lines Circulating Water Service Lines (If) 8,600 - 8,600		13,400	<u>-</u>	15,400	
Individual Grinder Pump Stations (GPS) (ea)	-	12,200	-	12,200	
Circulating Water Service Lines (lf) 8,600 - 8,600			-		
	Water & Sewer Service Lines				
Gravity Sewer Service Lines (If) 8,550 - 8,550			-		
	Gravity Sewer Service Lines (If)	8 550	-	8.550	

VSW III	ncorved Communities Bined	Mater & Cower	System Type and Sizing Model
Date		water & Sewer	System Type and Sizing Woder
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P) 2015 Number of Services		people services	2015 ADOL
Growth Rate (i)	1%	ij .	1%
2035 Design Population (Capita)		people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity	20	gpm	
Average Day (ADD)	22,696		50 gallons per Capita
Max Day (MDD)	45,391		2 x ADD
Peak Hour Treatment Capacity	95	gpm	3 x MDD MDD
Treatment Capacity	32	gpm	MUD
Water Source Assumptions		_	
Type (surface water or groundwater)	GW	_	
Required Capacity	32	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank		gallons	
Demand Based Volume (if source is GW)	Applicable		AA- D- (AADD 4 d-)
Daily Operation (DO) (gallons) Fire Flow (FF)	45,391 30,000		Max Day (MDDx1 day) 500 gpm for 60 minutes
Reserve Volume (RV)	136,173		3 days x DO
Water Storage Tank Volume	211,564		DO + FF + RV
CT Based Volume (min if source is SW)	Not Required	ma/l	0.4 mg/l
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)		mg/L log inactivation	0.4 mg/L 1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT) Baffling Coefficient (BF)	49 0.1	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Required Volume to meet CT*	160,797		CT/RCxPeak Hour/BF
Required Water Storage			
Required Additional Storage	111,600	gallons	0
Estimate of Min Platform Size (3' clearance	1,630	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			0
Water Treatment Plant Requirements*		-	
Water Quality	Poor]	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	0		Pile Foundation
permafrost		Thermosyphon	
Firm soils, or continuous permafrost	x		Thermosyphon stabilized gravel pad
		pad (sf)	
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)			
Buried system with no permafrost	0		Static Water Mains
		Circulating	
Above ground system or buried with permafrost	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
		(If)	
		1197	
Wastewater Collection (Check all that apply)			
Buried system with no permafrost	0	1	Bare sewer main, no heat trace
		Sewer Main	
Above ground or buried with permafrost	x		Sewer main with glycol heat trace
		Trace (If)	
		Lift Stations for	
Gravity Sewer Main	x	Gravity Sewer Mains, every	Lift stations for gravity sewer mains, every 1,000 ft
		1,000 ft (ea)	
Pressure Sewer Main	0	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Individual Grinder Pump Stations
I TESSULE SEWEL IVIAITI	J		marriada officer rump stations
Water & Sewer Services (Check all that apply)			
Static Water Main	•	1	Static Water Service Line
Static water Main	0	Circulating	Static Water Service Line
Circulating Water Main	x	Water Service	Circulating Water Service Lines
		Lines (If)	
Gravity Sower Main		Gravity Sewer	Gravity Service Line
Gravity Sewer Main	х	Service Lines (If)	Gravity Service Line
Pressure Sewer Main	0		Pressure Service Line with GPS
Sewage Lagoon Size	0.53	acres	
Existing Sewage Lagoon Organic Loading Based Size		acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	332.8		
Under the Leading Court City			Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size	7.9	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top of berms (area to be fenced)
Two cell laggers, combined acress	7.0	acros	
Two cell lagoon, combined acreage	7.9	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Tuluksak	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	114	\$26,403.25	\$3,009,971
	Sewage collection mains or services (gravity or force), buried	LF	20,750	\$254.26	\$5,275,960
3	Sewage collection mains or services (gravity or force), above ground	LF	0	#DIV/0!	\$0
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	7.4	\$692,040.19	\$5,121,097
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	0	#DIV/0!	\$0
13	Water distribution, mains or services, buried	LF	22,000	\$280.91	\$6,179,961
14	Water storage tank, no foundation	Gal	111,600	\$3.25	\$362,886
	Water treatment plant, no foundation	SF	1,200	\$1,635.59	\$1,962,712
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
18	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stablized gravel pad	SF	2,830	\$266.47	\$754,111
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
24	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$22,820,295

Community:	Tuluksak		
General Community Date	a		
Current population	on	372	persons
Service Connect		4.0	
Number of h	ouses ublic/commerical buildings	92 21	
Number of se	chools	1	
	Total number of service	ce connections 114	
Burdened labor i		\$13	
Electricity cost (F	Residential service)	\$0.30 \$0.66	
Cost per gallon f	,	\$6.13	
Water consumpt	ion per capita	50	gpd
Wastewater gen	eration per capita	50	gpd
Water & Sewer System Water Source	Characteristics		
	em (Surface(SW) or Groundwater(GW))	GW	<i>-</i> .
Length of rav	wwater line eated for freeze protection (Yes or No)	50 Yes	π
	water line (Above ground (AG) or Buried)	Buried	
Water Treatmen	<u>t</u>		
	treatment plant building	3248	sf
	uality (Good or Poor)	Poor	
<u>Water Storage</u> Size of tank(s)	211,600	nallons
,	ter line to/ from tank	50	•
	eated for freeze protection (Yes or No)	Yes	
	vater line (Above ground (AG) or Buried)	AG	
Water Distribution	<u>vn</u> em (Static or Circulating (Circ))	Circ	
	rculating water loops	2	
Total length	of Water Main	13400	ft
	heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried)	Yes Buried	
	vice line length	75	ft
Wastewater Coll	<u>ection</u>		
	em (Gravity or Pressure)	Gravity	
	dividual facility pump stations ommunity lift/pump stations	1	
	of facilities served by existing lift/pump station	114	
	of facilities served by lift/pump station #2		
	of facilities served by lift/pump station #3 of facilities served by lift/pump station #4		
	of facilities served by lift/pump station #5		
	ft stations	500	
	of sewer mains heated for freeze protection (Yes or No)	12200 Yes	π
Number of ci	rculating glycol loops	2	
	he mains (Above ground (AG) or Buried)	Buried	£.
_	vice line length	75	π
Wastewater Trea Length of for	atment / Disposal	2125	ft
	neated for freeze protection (Yes or No)	Yes	
Location of for	orce main (Above ground (AG) or Buried)	Buried	
Lagoon discl	narged seasonally with pump (Yes or No)	Yes	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u>		
Hours per week	0.4	han han ala
Less than 50 services Between 50 and 100 services	24 32	hrs/week hrs/week
More than 100 services	32 40	hrs/week
Wore than 100 services	40	IIIS/WEEK
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		· ·
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500 \$2.500	per year
Insurance	\$1,500	per year
modiano	Ψ1,000	poi joui

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	40	hrs/week		\$26,000
Fuel (Heating Demand)				
Water system				
WTP building	\$1,017	/month		\$8,134.85
Raw water line	\$7	/month		\$80.50
Raw water heat addition	\$1,386	/month		\$16,637.51
Water storage tank	\$197	/month		\$1,577.28
Water storage tank line	\$11	/month		\$89.45
Water mains	\$1,798	/month		\$21,575
Service lines	\$1,147	/month		\$13,766
Wastewater system				
Sewer mains	. ,	/month		\$19,643
Service lines		/month		\$13,766
Lift/pump station buildings	\$157			\$1,252.29
Force main to lagoon	\$285	/month	_	\$3,421
			Subtotal	\$99,900
Electricity				
Water system				
WTP building				
Lights and controls	\$284	/month		\$3,412
HVAC/hydronic system	\$284	/month		\$3,412
Water treatment	\$85	/month		\$1,018
Pumps				
Intake or well	\$85	/month		\$1,017.79
WST circulation	\$41	/month		\$324
Pressure/booster	\$127	/month		\$1,526.69
Main line circulation	\$644	/month		\$7,733
Wastewater system				
Lift /pump station buildings				
Lights and controls	\$44	/month		\$525
HVAC/hydronic system	\$44	/month		\$350
Pumps				
Individual facility pump stations	\$0	/month		\$0
Community lift/pump station(s)	\$126	/month		\$1,513.41
Sewer/force main glycol circulation	\$161	/month		\$1,930
Lagoon discharge pump	\$1,222	/year	Cubtotal —	\$1,222
Others Oceanie			Subtotal	\$24,000
Other Costs	A7 10-	h		67.405
Equipment R&R	\$7,495	•		\$7,495
Miscellaneous materials & supplies	\$4,497	•		\$4,497
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	/year	0	\$1,500
			Subtotal	\$18,000

Summary

Administration	\$6,000
Labor	\$26,000
Fuel	\$99,900
Electricity	\$24,000
Other	\$18,000
Total	\$174,000

Revenue M	onthly	# of		,	early/
Source R	ate	Customers	Collection Rate	Re	venues
Residential Serv \$	104	92	85%	\$	98,032
Public/Commerc \$	114.91	21	100%	\$	28,958
School Service (; \$	5,223.34	1	100%	\$	47,010
Local Capital Contr	ibution			\$	-
Total Revenue				\$	174,000

Tuntutuliak, Alaska

Community Information & Existing Infrastructure

Tuntutuliak is a Yupik Eskimo community of 437 people located on the Qinaq River, approximately 3 miles from its confluence with the Kuskokwim River. There are 105 residential units, 19 commercial/public facilities and one school for a total of 125 services. The existing water and sewer services provided in Tuntutuliak consist of self-haul system from either the watering point attached to the washeteria or rainwater/ice collection, and pit privies/honey bucket bunkers. The existing water and sewer infrastructure consists of the following:

- Well 12 gpm
- Treated Water Storage 20,000 gallons
- Water Treatment Plant 2,240 SF, built in 1983, Upgraded in 2015
- Water Treatment Greensand filter, chlorine, potassium permanganate
- Sewage Lagoon Single cell, 1.4 acre

Soils around Tuntutuliak consist of ice rich silt. High settlement in soil is anticipated if thawed due to high ice content and fine grained and organic materials.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 17,600 feet of pipe, and the pressure sewer system approximately 14,700 feet of pipe. The water system will consist of two separate systems for the east and west sides of the community. Each system will have a single circulating loop. The pressure sewer system would require one sewer main lift station, individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, two new 1200 sf facilities are included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	37	12	25
Water Storage (gallons)	243,300	20,000	223,300
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	2,400	-	2,400
Sewage Lagoon Size (acre)	9.3	1.4	7.9
Required Foundation System for WTP and/or WST			
Pile Foundation (sf)	5,390	-	5,390
Water Distribution System			
Circulating Water Main with Pitorifices (If)	17,600	-	17,600
Wastewater Collection System			
Sewer Main with Glycol Heat Trace (lf)	14,700	-	14,700
Individual Grinder Pump Stations (GPS) (ea)	125	-	125
Water & Sewer Service Lines			
Circulating Water Service Lines (If)	9,400	-	9,400
Pressure Sewer Service Lines (If)	9,400	-	9,400

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Tuntutuliak. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

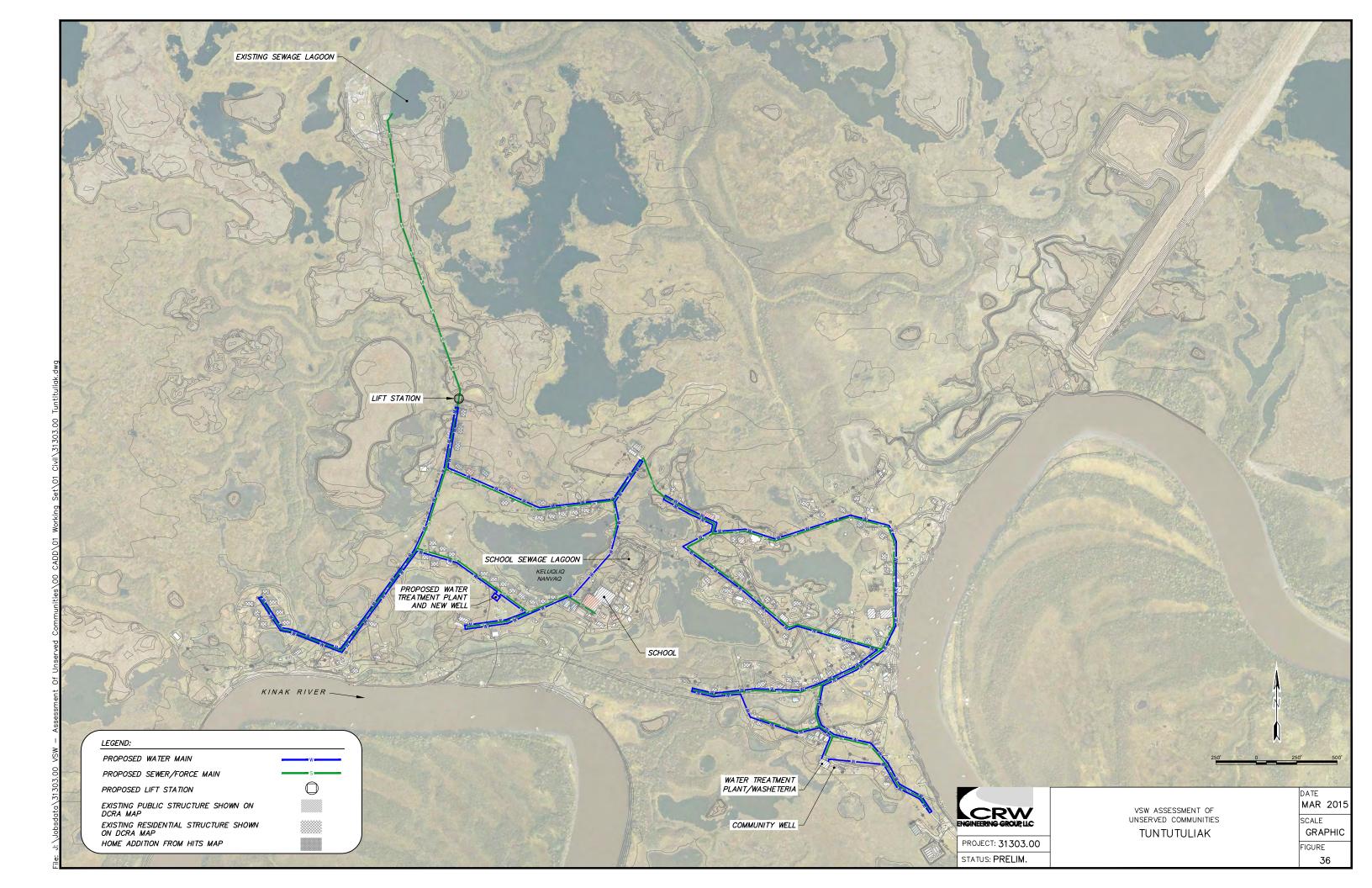
				Village	
	Estimated Capital Costs			Tuntutuliak	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	125	\$26,342.77	\$3,292,847
3	Sewage collection mains or services (gravity or force), above ground	LF	24,100	\$194.96	\$4,698,582
4	Sewage lift station	EA	1	\$ 662,130.80	\$ 662,131
10	Sewage lagoon, barrow, local material	Acre	7.9	\$683,500.68	\$5,399,655
12	Water distribution, mains or services, above ground	LF	27,000	\$327.06	\$8,830,671
14	Water storage tank, no foundation	Gal	223,300	\$2.49	\$556,081
15	Water treatment plant, no foundation	SF	2,400	\$1,583.60	\$3,800,638
18	Foundation - freeze back piles	SF	5,390	\$299.51	\$1,614,365
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Estimated Cost in 2010 dollars (rounded): \$29,009,00				
	Total v	with Inf	lation (3% pe	r year for 6 years)	\$34,638,300
27	Individual Grinder Pump Stations	EA	125	\$30,000	\$3,750,000
28	Electrical Service Upgrades	EA	125	\$5,500	\$687,500
				Subtotal	\$39,075,800
29	Construction Contingency (15%)	LS	1	\$5,861,400	\$5,861,400
30	Design & Construction Administration Services (20%)	LS	1	\$7,815,200	\$7,815,200
			•	Total	\$52,752,400

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$25,000			
Fuel	\$97,600			
Electricity	\$31,600			
Other (R&R, Training, etc.)	\$18,300			
Total	\$179,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Tuntutuliak are listed below.

Estimated User Fees					
Revenue Source	Monthly Rate	# of Customers	Collection Rate	R	Yearly evenues
Residential Service	\$ 98	105	85%	\$	105,485
Public/Commercial Service	\$ 128	19	100%	\$	29,193
School Service	\$ 4,925	1	100%	\$	44,322
Local Capital Contribution				\$	-
Total Revenue				\$	179,000



VCM Harried Communic	D:	O C C T C'-	in a Bandal	
	-	ater & Sewer System Type and Siz	ring Model	
Date Community		4/20/2016 Tuntutuliak		
Input				
Existing Community & System Data				
2015 Population		437		
2015 Number of Services		125		
HITS Database (E1 & H1-H7) DCED Mapping Commerical/Public Facilities/School		105 20		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		20000		
Water Treatment Capacity		12		
Existing Sewage Lagoon Size Soil Conditions (check only one)		1.4		
Soft poorly drained soils or discontinuous permafrost		х		
Firm soils, or continuous permafrost				
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length (ft)	Water Main
Buried system with no permafrost			(11)	Length (ft)
Above ground system or buried with permafrost		Х	14700	17600
Gravity Sewer Main Pressure Sewer Main		X	14700	
Typical Service Line Length (ea)		X	75	75
Piped System Requirements	Community	Tuntutuliak		
Output for Cost Model (calculated)			Foundatio	n Ciro
Water Treatment Capacity (gpm)		37	roundatio	11 3126
Req Water Storage (gallons) (less existing)		223,300	2,990	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	2,400	2,400	
Req Sewage Lagoon Size (acre) (less existing)		7.9		
			Quantity	Notes
		Pile Foundation (sf)		
Required Foundation System for WTP and/or WST			2,400	
, , , , , , , , , , , , , , , , , , , ,			_,.00	
Water Distribution System		Circulating Water Main with	47.000	
			17.6000	
İ		Pitorifices (If)	17,600	
		Pitorifices (If)	17,600	
		Sewer Main with Glycol Heat Trace	14,700	
Wastewater Collection System			·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	·	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If)	14,700	
Wastewater Collection System		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	14,700 125	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations	14,700	
Wastewater Collection System Water & Sewer Service Lines		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	14,700 125	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	14,700 125 9,400	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	14,700 125	
		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	14,700 125 9,400	
	Piped System	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	14,700 125 9,400	
Water & Sewer Service Lines System Description	Need	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	14,700 125 9,400 9,400 Net Need	
Water & Sewer Service Lines		Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	14,700 125 9,400 9,400	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 37 243,300 2,400	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 12 20,000 -	14,700 125 9,400 Net Need 25 223,300 2,400	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	Need 37 243,300	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility	14,700 125 9,400 9,400 Net Need 25 223,300	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf)	Need 37 243,300 2,400	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 12 20,000 -	14,700 125 9,400 Net Need 25 223,300 2,400	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System	Need 37 243,300 2,400 9.3 5,390	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 12 20,000 - 1.4	14,700 125 9,400 Net Need 25 223,300 2,400 7.9 5,390	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (if)	Need 37 243,300 2,400 9.3	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 12 20,000 -1.4	14,700 125 9,400 Net Need 25 223,300 2,400 7.9	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System	Need 37 243,300 2,400 9.3 5,390	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 12 20,000 - 1.4	14,700 125 9,400 Net Need 25 223,300 2,400 7.9 5,390	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 37 243,300 2,400 9.3 5,390	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 12 20,000 - 1.4	14,700 125 9,400 Net Need 25 223,300 2,400 7.9 5,390 17,600	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	Need 37 243,300 2,400 9.3 5,390 17,600 14,700 125	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 12 20,000 - 1.4	14,700 125 9,400 Net Need 25 223,300 2,400 7.9 5,390 17,600 14,700 125	
Water & Sewer Service Lines System Description Water Treatment Capacity (gpm) Water Storage (gallons) W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST Pile Foundation (sf) Water Distribution System Circulating Water Main with Pitorifices (lf) Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)	Need 37 243,300 2,400 9.3 5,390 17,600	Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) Existing Facility 12 20,000 -1.4	14,700 125 9,400 9,400 Net Need 25 223,300 2,400 7.9 5,390 17,600 14,700	

Date	•	Water & Sewer	System Type and Sizing Model
Community			
System Parameters	Model Results		Criteria & Calculations
Design Population			
Duration (n)		years	20 years
2015 Population (P) 2015 Number of Services		people services	2015 ADOL
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	533	people	Px(1+i)^n
Water Demand Estimates Existing Capacity	12	gpm	
Average Day (ADD)	26,661		50 gallons per Capita
Max Day (MDD)	53,322		2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	37	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW		
Required Capacity	37	gpm	MDD
Water Starage Tank Sizing			
Water Storage Tank Sizing Existing Water Storage Tank	20,000	gallons	
Demand Based Volume (if source is GW)	Applicable	Ballotis	
Daily Operation (DO) (gallons)	53,322		Max Day (MDDx1 day)
Fire Flow (FF)	30,000		500 gpm for 60 minutes
Reserve Volume (RV)	159,967	-	3 days x DO DO + FF + RV
Water Storage Tank Volume CT Based Volume (min if source is SW)	243,289 Not Required	galiulis	DO TH THY
Chlorine Residual Concentration (RC)		mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH) Contact Time Required (CT)	7	minutes	7 LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*	188,894		CT/RCxPeak Hour/BF
Required Water Storage	243,300	-	
Required Additional Storage	223,300	gallons	0
Estimate of Min Platform Size (3' clearance	2,990	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			0
Water Treatment Plant Requirements*			•
Water Quality	Poor		Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous		Pile Foundation	L
permafrost	х	(sf)	Pile Foundation
Firm soils, or continuous permafrost	0		Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
(Check either or both)			
Water Distribution (Check either or both) Buried system with no permafrost	0		Static Water Mains
Buried system with no permafrost	0	Circulating	Static Water Mains
Buried system with no permafrost Above ground system or buried with	0 x	Water Main	Static Water Mains Circulating Water Main with Pitorifices
Buried system with no permafrost		Water Main with Pitorifices	
Buried system with no permafrost Above ground system or buried with		Water Main	
Buried system with no permafrost Above ground system or buried with permafrost		Water Main with Pitorifices	
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with permafrost		Water Main with Pitorifices (lf)	
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 v	Water Main with Pitorifices (If) Sewer Main	Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply)	x	Water Main with Pitorifices (lf)	Circulating Water Main with Pitorifices
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost	0 v	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost	0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main	0 x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main	0 x 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply)	0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main	x 0 x 0 x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main	0 x 0 x 0 x 0 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x 0 0 x 0 0 x 0 0 0 0 0 0	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main	0 x 0 x 0 x 0 x 0 x x	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If)	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 x 0 x 0 x 1.4	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 x 0 x 0 x 1.4 4.5	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon	0 x 0 x 0 x 0 x 1.4	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size	0 x 0 x 0 x 1.4 4.5 360.7	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x 0 x 0 x 1.4 4.5 360.7	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation,
Buried system with no permafrost Above ground system or buried with permafrost Wastewater Collection (Check all that apply) Buried system with no permafrost Above ground or buried with permafrost Gravity Sewer Main Pressure Sewer Main Water & Sewer Services (Check all that apply) Static Water Main Circulating Water Main Gravity Sewer Main Pressure Sewer Main Sewage Lagoon Size Existing Sewage Lagoon Organic Loading Based Size check	0 x 0 x 0 x 0 x 1.4 4.5 360.7 9.3	Water Main with Pitorifices (If) Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Circulating Water Service Lines (If) Pressure Sewer Service Lines (If) acres acres	Circulating Water Main with Pitorifices Bare sewer main, no heat trace Sewer main with glycol heat trace Lift stations for gravity sewer mains, every 1,000 ft Individual Grinder Pump Stations Static Water Service Line Circulating Water Service Lines Gravity Service Line Pressure Service Line with GPS 0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top

Capital Cost Estimate Piped Water & Sewer System

Village	
Tuntutuliak	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	125	\$26,342.77	\$3,292,847
2	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	24,100	\$194.96	\$4,698,582
4	Sewage lift station	EA	1	\$662,130.80	\$662,131
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	7.9	\$683,500.68	\$5,399,655
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	27,000	\$327.06	\$8,830,671
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	223,300	\$2.49	\$556,081
15	Water treatment plant, no foundation	SF	2,400	\$1,583.60	\$3,800,638
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	5,390	\$299.51	\$1,614,365
19	Foundation - thermosyphen stablized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$29,008,567

Community:	Tuntutuliak		
General Community Date	ta		
Current population	on	437	persons
	of people per house	4.2	
Number of h		105	
•	ublic/commerical buildings	19	
Number of se	cnools Total number of service connections	125	
5			
Burdened labor i		\$12	
Electricity cost (F	Residential service)	\$0.41 \$0.24	
Cost per gallon f	•	\$4.88	
Water consumpt			gpd
wastewater gen	eration per capita	50	gpd
Water & Sewer System Water Source	Characteristics		
	em (Surface(SW) or Groundwater(GW))	GW	
Length of rav		100	
	eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	Yes AG	
Location of v	vater line (Above ground (AG) or Burled)	AG	
Water Treatmen		4040	-£
	rtreatment plant building uality (Good or Poor)	4640 Poor	
Water Storage	dulity (Cooc of 1 cor)	1 001	
Size of tank(s)	243,300	gallons
· ·	ter line to/ from tank	100	ft
	eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	Yes AG	
		AG	
Water Distribution	<u>งก</u> em (Static or Circulating (Circ))	Circ	
	irculating water loops	2	
	of Water Main	17600	ft
Water mains	heated for freeze protection (Yes or No)	Yes	
	he mains (Above ground (AG) or Buried)	AG	_
Average serv	vice line length	75	ft
Wastewater Coll			
Type of syste	em (Gravity or Pressure)	Pressure	
	idividual facility pump stations ommunity lift/pump stations	1	
	of facilities served by lift/pump station #1	125	
	of facilities served by lift/pump station #2		
	of facilities served by lift/pump station #3		
	of facilities served by lift/pump station #4		
	of facilities served by lift/pump station #5	500	a.f
	ft stations of sewer mains	500 14700	
	s heated for freeze protection (Yes or No)	Yes	
Number of ci	rculating glycol loops	2	
	he mains (Above ground (AG) or Buried)	AG	_
Average ser	vice line length	75	ft
	atment / Disposal		
Length of for		1800	ft
	neated for freeze protection (Yes or No)	Yes	
	orce main (Above ground (AG) or Buried) narged seasonally with pump (Yes or No)	AG Yes	
Lagoon disci	angod obdomany man pamp (100 or 110)	103	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment	• • • • • • • • • • • • • • • • • • • •	nation in or
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		3
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		·
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500 \$2.500	per year
Insurance	\$1,500	per year
modiano	Ψ1,000	po. 30th

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	40	hrs/week		\$24,960
Fuel (Heating Demand)				
Water system				
WTP building	\$1,156	/month		\$9,251.47
Raw water line	\$18	/month		\$142.42
Raw water heat addition	\$1,297	/month		\$10,372.77
Water storage tank	\$180	/month		\$1,443.76
Water storage tank line	\$18	/month		\$142.42
Water mains	\$3,133	/month		\$25,066
Service lines	\$1,669	/month		\$13,352
Wastewater system				
Sewer mains	, , -	/month		\$20,935
Service lines	\$1,669	/month		\$13,352
Lift/pump station buildings	\$125	/month		\$996.93
Force main to lagoon	\$320	/month	_	\$2,564
			Subtotal	\$97,600
Electricity				
Water system				
WTP building				
Lights and controls		/month		\$6,662
HVAC/hydronic system	*	/month		\$4,442
Water treatment	\$136	/month		\$1,634
Pumps				
Intake or well		/month		\$1,634.03
WST circulation	·	/month		\$443
Pressure/booster	• -	/month		\$2,451.05
Main line circulation	\$881	/month		\$7,045
Wastewater system				
Lift /pump station buildings				
Lights and controls	· ·	/month		\$718
HVAC/hydronic system	\$60	/month		\$479
Pumps				
Individual facility pump stations		/month		\$0
Community lift/pump station(s)		/month		\$2,334.33
Sewer/force main glycol circulation	\$220	/month		\$1,758
Lagoon discharge pump	\$1,962	/year	Subtotal	\$1,962 \$31,600
Other Costs			Gablolai	ΨΟ1,000
	¢7 700	hoor		¢7 700
Equipment R&R	\$7,708 \$4,625	•		\$7,708 \$4,625
Miscellaneous materials & supplies	\$4,625 \$2,000	•		\$4,625
Water quality testing	. ,	/year		\$2,000
Operator training Insurance	\$2,500 \$1,500	/year		\$2,500 \$1,500
IIISUIdIICE	\$1,500	/year	Cubtotal	\$1,500
			Subtotal	\$18,300

Summary

Administration	\$6,000
Labor	\$25,000
Fuel	\$97,600
Electricity	\$31,600
Other	\$18,300
Total	\$179,000

Revenue M	onthly	# of		,	Yearly
Source Ra	ate	Customers	Collection Rate	Re	evenues
Residential Serv \$	98	105	85%	\$	105,485
Public/Commerc \$	128.04	19	100%	\$	29,193
School Service (\$	4,924.62	1	100%	\$	44,322
Local Capital Contr	ibution			\$	-
Total Revenue	-	_	_	\$	179,000

Tununak, Alaska

Community Information & Existing Infrastructure

Tununak is a Yupik Eskimo community of 384 people located in a small bay on the northeast coast of Nelson Island. There are 99 residential units, 22 commercial/public facilities and one school for a total of 122 services. The existing water and sewer services provided in Tununak consist of self-haul system from watering points and honey buckets. There are two septic tanks in the community. One septic tank serves the water treatment plant/washeteria, school, and teacher housing. The second septic tank is used for the disposal of wastewater collected from haul system. The water treatment plant provides service to the washeteria and the clinic. The existing water and sewer infrastructure consists of the following:

- Unnamed Creek N/A
- Treated Water Storage 50,000 gallons
- Water Treatment Plant/Washeteria –
 2,048 SF, built in 1980
- Water Treatment Granular media filtration, bag filtration, chlorination
- Septic Tanks 12,000 gallons (failing)
- Sewage Lagoon N/A

The area around Tununak is underlain by discontinuous permafrost. Conditions vary considerably from toe of hill to vicinity of creek. There is a very high ice content in organic soils blanketing the area, and is very thaw unstable.

Piped System Description

The piped water and sewer system will be a combination of above and below grade piping. The lowland part of the community is flat terrain and would best be served by an above ground pressure sewer system (4,800 LF) and circulating water loop (9,300 LF). The upland part of the community is built on a hillside and can likely accommodate a buried gravity sewer system (5,100 linear feet) and circulating water main (5,800 LF). A total of 22 services will be connected to the buried gravity sewer will not require individual grinder pump stations (GPS). Approximately 100 homes and buildings on the lower portion of the community would require GPS units. The current water source is seasonal; however, many residents obtain drinking water from the school which uses a well. For the purposes of this assessment a new well is proposed. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The following table summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need
Water Treatment Capacity (gpm)	33	-	33
Water Storage (gallons)	217,400	50,000	167,400
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200
Septic System (sf)	40,000	-	40,000
Required Foundation System for WTP and/or WST	•		
Pile foundation (sf)	3,520	-	3,520
Water Distribution System	•		
Circulating Water Main with Pitorifices (If)	15,100	-	15,100
Wastewater Collection System	•		
Sewer Main with Glycol Heat Trace (If)	9,900	-	9,900
Individual Grinder Pump Stations (GPS) (ea)	100	-	100
Water & Sewer Service Lines	•		
Circulating Water Service Lines (If)	9,200	-	9,200
Pressure Sewer Service Lines (If)	7,500	-	7,500
Gravity Sewer Service Lines (If)	1,700	-	1,700

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Tununak. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

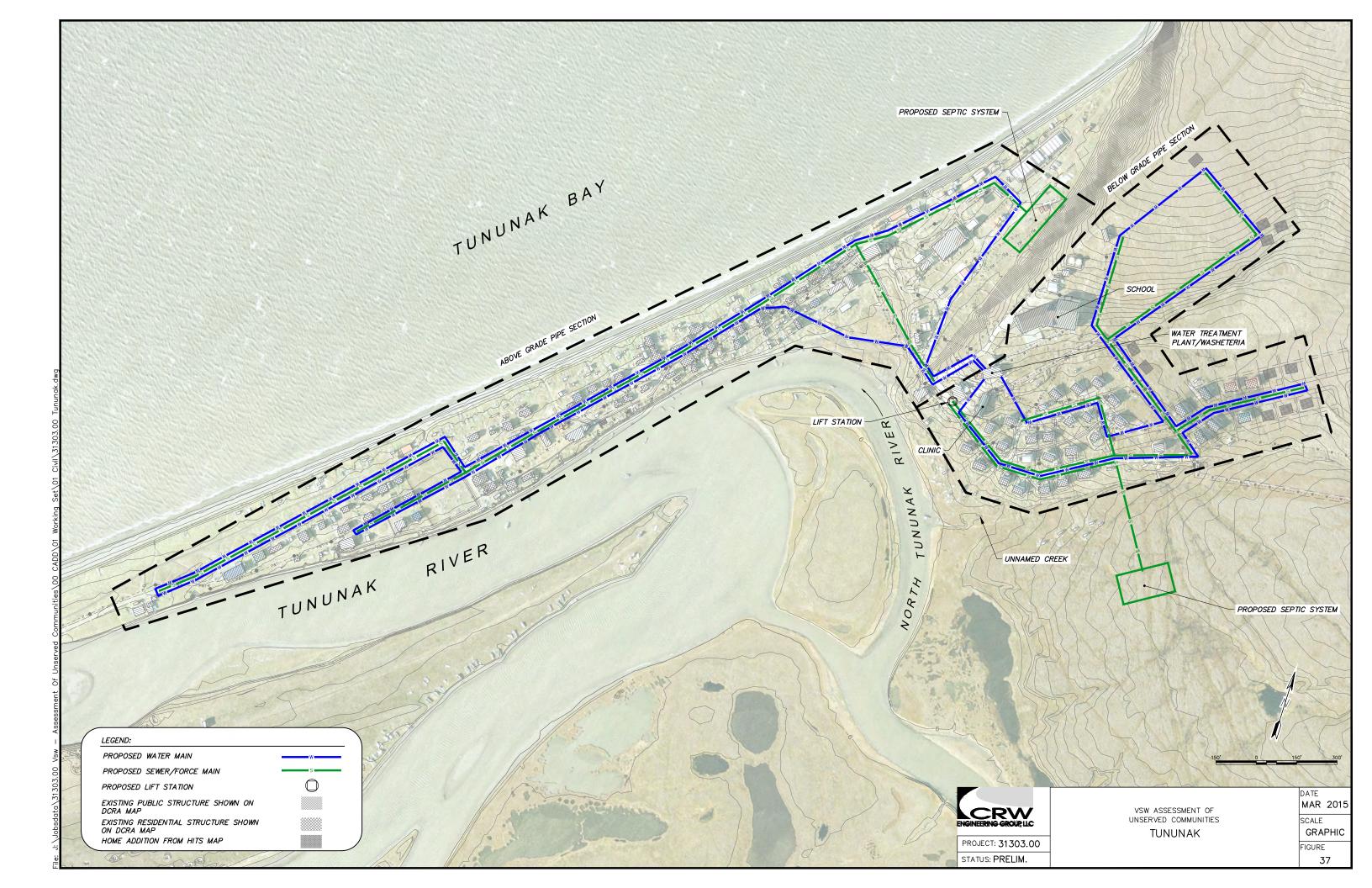
				Village	
	Estimated Capital Costs	Tununak			
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	122	\$26,342.77	\$3,213,818
2	Sewage collection mains or services (gravity or force), buried	LF	6,800	\$273.12	\$1,857,230
3	Sewage collection mains or services (gravity or force), above ground	LF	12,300	\$199.20	\$2,450,128
4	Sewage lift station	EA	1	\$662,130.80	\$662,131
7	Septic tank, community	EA	2	\$298,917.16	\$597,834
8	Drainfield, community	SF	40000	\$21.63	\$865,249
12	Water distribution, mains or services, above ground	LF	16,800	\$328.95	\$5,526,373
13	Water distribution, mains or services, buried	LF	7,500	\$297.51	\$2,231,320
15	Water treatment plant, no foundation	SF	1,200	\$1,608.15	\$1,929,775
18	Foundation - freeze back piles	SF	3,520	\$318.83	\$1,122,279
23	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Total Estir	mated (Cost in 2010 o	dollars (rounded):	\$20,610,000
	Total v	vith Infl	ation (3% per	year for 6 years)	\$24,609,400
27	Individual Grinder Pump Stations	EA	100	\$30,000	\$3,000,000
28	Electrical Service Upgrades	EA	122	\$5,500	\$671,000
Subtotal					
29	Construction Contingency (15%)	LS	1	\$4,242,100	\$4,242,100
30	Design & Construction Administration Services (20%)	LS	1	\$5,656,100	\$5,656,100
				Total	\$38,178,600

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both cost models are included with this assessment.

Estimated O&M Costs					
Description	Cost				
Administration	\$6,000				
Labor	\$23,300				
Fuel	\$118,000				
Electricity	\$22,200				
Other (R&R, Training, etc.)	\$19,100				
Total	\$189,000				

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Tununak are listed below:

Estimated User Fees							
Revenue Source		Monthly Rate	# of Customers	Collection Rate	Yearly Revenues		
Residential Service	\$	109	99	85%	\$ 109,875		
Public/Commercial Service	\$	114	22	100%	\$ 30,162		
School Service	\$	5,440	1	100%	\$ 48,964		
Local Capital Contribution					\$ -		
Total Revenue					\$ 189,000		



	es - Piped W	ater & Sewer System Type and Siz	ing Model	
Date Community		4/22/2016 Tununak		
Input		Tananak		
Existing Community & System Data	384			
2015 Population 2015 Number of Services		122		
HITS Database (E1 & H1-H7)		99		
DCED Mapping Commerical/Public Facilities/School		23		
Type (surface water or groundwater)		SW		
Water quality (Poor or Good)		Poor		
Water Storage Tank Water Treatment Capacity		50000		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)		ū		
Soft poorly drained soils or discontinuous permafrost		х		
Firm soils, or continuous permafrost				
Stiff soils, no permafrost				
Piping Configurations (check all that apply)			Sewer Main Length (ft)	Water Main
Buried system with no permafrost			(11)	Length (ft)
Above ground system or buried with permafrost		Х	9900	15100
Gravity Sewer Main		х	5100	
Pressure Sewer Main Typical Service Line Length (ea)		Х	4800 75	75
Typical Service Line Length (ea)			/5	/5
Piped System Requirements	Community	Tununak		
Output for Cost Model (calculated)	Community	Tullullak		
output for cost model (calculated)			Foundatio	n Size
Water Treatment Capacity (gpm)		33		
Req Water Storage (gallons) (less existing)		167,400	2,320	sf
Req W&S Utility Bldg/Water Treatment Plant/Addition	(sf)	1,200	1,200 sf	
Req Septic System w/ Drainfield (sf) (less existing)		40,000		
			Quantity	Notes
Required Foundation System for WTP and/or WST		Pile Foundation (sf)	1,200	
Water Distribution System		Circulating Water Main with Pitorifices (If)	15,100	
		Sewer Main with Glycol Heat Trace	9,900	
Wastewater Collection System		Lift Stations for Gravity Sewer Mains	1	
		Individual Grinder Pump Stations		
		(GPS) (ea)	100	
Water & Sewer Service Lines		Circulating Water Service Lines (If)	9,200	
a series service Lines		Gravity Sewer Service Lines (If)	1,700	
		Pressure Sewer Service Lines (If)	7,500	
			7,300	
System Description	Piped System Need	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	33	-	33	
Water Storage (gallons)	217,400	50,000	167,400	
W&S Utility Bldg/Water Treatment Plant/Addition (sf) Sewage Lagoon Size (acre)	1,200 40,000	-	1,200 40,000	
Required Foundation System for WTP and/or WST		<u> </u>	40,000	
Pile Foundation (sf) 3,520		-	3,520	
Water Distribution System				
Circulating Water Main with Pitorifices (If) 15,100 Wastewater Collection System		-	15,100	
Sewer Main with Glycol Heat Trace (If) 9,900		-	9,900	
 			5,500	
individual Grinder Pump Stations (GPS) (ea)	9,900	-	100	
Water & Sewer Service Lines		-	100	
Water & Sewer Service Lines Circulating Water Service Lines (If)	9,200	-	9,200	
Water & Sewer Service Lines	100	-		

Yem III	nserved Communities - Pined	Water & Sower	System Type and Sizing Model
Date	4/22/2016	water & Jewer	System Type and Sizing Model
Community	Tununak		
System Parameters	Model Results		Criteria & Calculations
Design Population Duration (n)	20	vears	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services		services	Only 55 will require GPS units
Growth Rate (i) 2035 Design Population (Capita)	1%	people	1% Px(1+i)^n
2055 Design Population (Capita)	403	реоріе	FX(171)*11
Water Demand Estimates		1	
Existing Capacity		gpm	FO callage and Conite
Average Day (ADD) Max Day (MDD)	23,428 46,855		50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity	33	gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW	1	
Required Capacity	33	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank	50,000	gallons	Built in 2010
	Applicable	10	
Daily Operation (DO) (gallons)		gallons	Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)	30,000 140,566	gallons	500 gpm for 60 minutes 3 days x DO
Water Storage Tank Volume	217,421		DO + FF + RV
CT Based Volume (min if source is SW)	Not Required	J. 1	
Chlorine Residual Concentration (RC)	0.4	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T) pH (PH)	4.4 7		4.4 celsius/40 F 7
Contact Time Required (CT)		minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*	165,984		CT/RCxPeak Hour/BF
Required Water Storage Required Additional Storage	217,400 167,400		0
Estimate of Min Platform Size (3' clearance		-	
around)	2,320	sf	D = $0.103xVg^{(1/2)}$ H=16 assumed (H is height of tank)
			0
Water Treatment Plant Requirements* Water Quality	Poor	1	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP) Soft poorly drained soils or discontinuous		Pile Foundation	
permafrost	х	(sf)	Pile Foundation
Firm soils, or continuous permafrost	0		Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0		Gravel pad
Water Distribution (Check either or both)			
Buried system with no permafrost	0		Static Water Mains
		Circulating	
Above ground system or buried with permafrost	х	Water Main	Circulating Water Main with Pitorifices
		with Pitorifices (If)	· ·
		יניו	
Wastewater Collection (Check all that apply)			
	0	1	Para sawar main, no heat trace
Buried system with no permafrost	U	Sewer Main	Bare sewer main, no heat trace
Above ground or buried with permafrost	х	with Glycol Heat	Sewer main with glycol heat trace
		Trace (If)	
		Lift Stations for	
Gravity Sewer Main	х	Gravity Sewer	Lift stations for gravity sewer mains, every 1,000 ft
		Mains, every 1,000 ft (ea)	
		Individual Grinder Pump	
Pressure Sewer Main	х	Stations (GPS)	Individual Grinder Pump Stations
		(ea)	
Water & Sewer Services (Check all that apply)			
Static Water Main	0		Static Water Service Line
		Circulating	
Circulating Water Main	x	Water Service	Circulating Water Service Lines
		Lines (If)	
Gravity Sewer Main	x	Gravity Sewer Service Lines (If)	Gravity Service Line
		Service Lines (IJ)	
Pressure Sewer Main	x	Pressure Sewer	Pressure Service Line with GPS
		Service Lines (If)	3.5
Sewage Lagoon Size]	
Existing Sewage Lagoon Organic Loading Based Size		acres acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	338.1		E.E. S. S. S. S. S. S. S. S. S. S. S. S. S.
			Volume is based on ADDx365x20% factor to account for precipitation,
Hydraulic Loading Based Size	8.2	acres	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
			of berms (area to be fenced)
Two cell lagoon, combined acreage	8.2	acres	Either organic loading based or hydraulic, whichever is greater

Capital Cost Estimate Piped Water & Sewer System

Village	
Tununak	

Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	122	\$26,342.77	\$3,213,818
	Sewage collection mains or services (gravity or force), buried	LF	6,800	\$273.12	\$1,857,230
3	Sewage collection mains or services (gravity or force), above ground	LF	12,300	\$199.20	\$2,450,128
4	Sewage lift station	EA	1	\$662,130.80	\$662,131
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	2	\$298,917.16	\$597,834
8	Drainfield, community	SF	40,000	\$21.63	\$865,249
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
	Sewage lagoon, barrow, local material	Acre	0	#DIV/0!	\$0
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	16,800	\$328.95	\$5,526,373
	Water distribution, mains or services, buried	LF	7,500	\$297.51	\$2,231,320
	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
	Water treatment plant, no foundation	SF	1,200	\$1,608.15	\$1,929,775
	Washeteria, no foundation	SF	0	#DIV/0!	\$0
	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	3,520	\$318.83	\$1,122,279
	Foundation - thermosyphen stabilized gravel pad	SF	0	#DIV/0!	\$0
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
	Water source - ground water well	EA	1	\$153,596.80	\$153,597
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$20,609,734

Community:	Tununak (Lowland)

General Community Data

General Community Data		
Current population Average number of people per house Service Connections (Lowland) Number of houses	384 7.1 54	persons
Number of public/commerical buildings Number of schools Total number of service connections	19 0 73	
Burdened labor rate Electricity cost (Public facilty) Electricity cost (Residential service) Cost per gallon for heating oil	\$14 \$0.34 \$0.20 \$6.95	kWh kWh
Water consumption per capita Wastewater generation per capita	50 <u>(</u> 50 <u>(</u>	
Water & Sewer System Characteristics <u>Water Source</u>		
Type of system (Surface(SW) or Groundwater(GW)) Length of raw water line Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	Yes Buried	ft
Water Treatment Size of water treatment plant building Raw water quality (Good or Poor)	3248 s Poor	sf
Water Storage Size of tank(s) Length of water line to/ from tank Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)	217,400 50 f Yes AG	•
Water Distribution Type of system (Static or Circulating (Circ)) Number of circulating water loops Total length of Water Main (Lowland) Water mains heated for freeze protection (Yes or No) Location of the mains (Above ground (AG) or Buried) Average service line length	Circ 1 9300 Yes AG 75	
Wastewater Collection Type of system (Gravity or Pressure) Number of individual facility pump stations Number of community lift/pump stations Number of facilities served by lift/pump station #1 Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #4 Number of facilities served by lift/pump station #5 Size of lift stations Total length of sewer mains (North Side) Sewer mains heated for freeze protection (Yes or No) Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried) Average service line length	500 s 4800 f Yes 1 AG 75 f	ft

Wastewater Treatment / Disposal

Force main heated for freeze protection (Yes or No)

Location of force main (Above ground (AG) or Buried)

Lagoon discharged seasonally with pump (Yes or No)

Length of force main

565 ft

Yes

AG

Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

red O& M Costs		Annual Cost
Administration (Utility management, billings, etc.)	\$500 /month	\$6,000
Labor (WTP Operator)	32 hrs/week	\$23,29
Fuel (Heating Demand)		
Water system		
WTP building	\$1,153 /month	\$9,223.03
Raw water line	\$0 /month	\$0.00
Raw water line Raw water heat addition	\$1,623 /month	\$19,471.56
	· •	. ,
Water storage tank	\$230 /month	\$1,837.29
Water storage tank line	\$13 /month	\$101.41
Water mains	\$2,358 /month	\$18,863
Service lines	\$1,388 /month	\$11,105
Wastewater system		
Sewer mains	\$1,217 /month	\$9,736
Service lines	\$1,388 /month	\$11,105
Lift/pump station buildings	\$0 /month	\$0.00
Force main to lagoon	\$143 /month	\$1,146
3	Subt	
Electricity		
Water system		
WTP building		
Lights and controls	\$322 /month	\$3,867
HVAC/hydronic system	\$322 /month	\$2,578
Water treatment	\$99 /month	
	\$99 /monu	\$1,191
Pumps	COO (£4.400.74
Intake or well	\$99 /month	\$1,190.71
WST circulation	\$46 /month	\$367
Pressure/booster	\$149 /month	\$1,786.06
Main line circulation	\$365 /month	\$2,921
Wastewater system		
Lift /pump station buildings		
Lights and controls	\$0 /month	\$0
HVAC/hydronic system	\$0 /month	\$0
Pumps		
Individual facility pump stations	\$0 /month	\$0
Community lift/pump station(s)	\$0 /month	\$0.00
Sewer/force main glycol circulation	•	\$729
0 ,	• • • • • • • • • • • • • • • • • • • •	•
Lagoon discharge pump	\$1,430 /year Subt	\$1,430 otal \$16,100
Other Costs	Oubt	φ10,100
	00.400	#0.400
Equipment R&R	\$6,100 /year	\$6,100
Miscellaneous materials & supplies	\$3,660 /year	\$3,660
Water quality testing	\$2,000 /year	\$2,000
Operator training	\$2,500 /year	\$2,500
Insurance	\$1,500 /year	\$1,500
	Subt	otal \$15,800
Summary (Lowland)	Summary (Lowland & Upland)	
Administration \$6,000	Administration \$6,0	000
Labor \$23,300	Labor \$23,3	son l
Laboi \$25,500 I	Labor 420,0	

Revenue		# of		,	Yearly
Source I	Monthly Rate	Customers	Collection Rate	Re	evenues
Residential Serv	\$ 109	99	85%	\$	109,875
Public/Commerc	\$ 114.25	22	100%	\$	30,162
School Service (\$ 5,440.41	1	100%	\$	48,964
Local Capital Con	tribution			\$	
Total Revenue				\$	189,000

\$22,200

\$19,100

\$189,000

Electricity

Total

Other

Electricity

Total

Other

\$16,100

\$15,800

\$144,000

General Community Data

•		
Current population Average number of people per house Service Connections (South Side)	7.1	persons
Number of houses	45	
Number of public/commerical buildings	3	
Number of schools	1	
Total number of service connections	49	
Burdened labor rate	\$14	hr
Electricity cost (Public facility)	\$0.34	
Electricity cost (Residential service)	\$0.20	
Cost per gallon for heating oil	\$6.95	gal
Water consumption per capita Wastewater generation per capita		gpd gpd
Water & Sewer System Characteristics Water Source		
Type of system (Surface(SW) or Groundwater(GW))		
Length of raw water line		ft
Water line heated for freeze protection (Yes or No)		
Location of water line (Above ground (AG) or Buried)		
Water Treatment		
Size of water treatment plant building		sf
Raw water quality (Good or Poor)		
Water Storage		
Size of tank(s)		gallons
Length of water line to/ from tank		ft
Water line heated for freeze protection (Yes or No) Location of water line (Above ground (AG) or Buried)		
Water Distribution Type of a vistom (Static or Circulating (Circ))	Circ	
Type of system (Static or Circulating (Circ)) Number of circulating water loops	1	
Total length of Water Main	5800	ft
Water mains heated for freeze protection (Yes or No)	Yes	
Location of the mains (Above ground (AG) or Buried)	Buried	
Average service line length	75	ft
Wastewater Collection		
Type of system (Gravity or Pressure)		
Number of individual facility pump stations		
Number of community lift/pump stations	1	
Number of facilities served by lift/pump station #1	22	
Number of facilities served by lift/pump station #2 Number of facilities served by lift/pump station #3		
Number of facilities served by lift/pump station #4		
Number of facilities served by lift/pump station #5		
Size of lift stations		sf
Total length of sewer mains	5100	
Sewer mains heated for freeze protection (Yes or No)	Yes	
Number of circulating glycol loops Location of the mains (Above ground (AG) or Buried)	1 Buried	
Average service line length	75	
•	10	
Wastewater Treatment / Disposal Length of force main	1167	fi
Force main heated for freeze protection (Yes or No)	Yes	
Location of force main (Above ground (AG) or Buried)	Buried	
Lagoon discharged seasonally with pump (Yes or No)	Yes	

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management		/month
Labor (Operator)		
Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
Fuel (Heating)		
Available energy per gallon of heating fuel	100,000	BTUs/gallon
Heating season (above ground components)	8	months
Heating season (buried components)	12	months
Buildings	7	BTU/hr/sf
Raw water heat addition (5F)	40	BTU/gallon
Water storage tank	0.5	BTU/gal-day
Above ground mains	5	BTU/hr/ft
Buried mains (permafrost conditions)	3	BTU/hr/ft
Electricity		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		· ·
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$0	/month		\$0
Labor (WTP Operator)	24	hrs/week		\$0
Fuel (Heating Demand)				
Water system				
WTP building	\$0	/month		\$0.00
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$0	/month		\$0.00
Water storage tank	\$0	/month		\$0.00
Water storage tank line	\$0	/month		\$0.00
Water mains	·	/month		\$10,588
Service lines	·	/month		\$6,709
Wastewater system				
Sewer mains	\$776	/month		\$9,310
Service lines	\$559	/month		\$6,709
Lift/pump station buildings	\$0	/month		\$0.00
Force main to lagoon	\$178	/month		\$2,130
·			Subtotal	\$35,400
Electricity				
Water system				
WTP building				
Lights and controls	\$0	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Water treatment	\$0	/month		\$0
Pumps				
Intake or well	\$0	/month		\$0.00
WST circulation	\$0	/month		\$0
Pressure/booster	\$0	/month		\$0.00
Main line circulation	\$365	/month		\$4,382
Wastewater system				
Lift /pump station buildings				
Lights and controls	\$0	/month		\$0
HVAC/hydronic system	\$0	/month		\$0
Pumps				
Individual facility pump stations	\$0	/month		\$0
Community lift/pump station(s)	\$48	/month		\$581.21
Sewer/force main glycol circulation	\$91	/month		\$1,093
Lagoon discharge pump	\$0	/year		\$0
			Subtotal	\$6,100
Other Costs				.
Equipment R&R	\$2,075	,		\$2,075
Miscellaneous materials & supplies	\$1,245			\$1,245
Water quality testing		/year		\$0
Operator training		/year		\$0
Insurance	\$0	/year		\$0
			Subtotal	\$3,300

Summary (Upland)

Administration	·	Covered in Lowland Estimate
Labor Fuel	\$0 \$35,400	Covered in Lowland Estimate
Electricity	\$6,100	
Other	\$3,300	
Total	\$45,000	

Venetie, Alaska

Community Information & Existing Infrastructure

Venetie is a Gwich'in community of 186 people located on the north side of the Chandalar River. There are 76 residential units, 16 commercial/public facilities and one school for a total of 93 services. The existing water and sewer services provided in Venetie consist of self-haul system from the watering point attached to the water treatment plant and pit privies/honey bucket. The school, clinic, teacher housing have piped water and sewer services. The existing water and sewer infrastructure consists of the following:

- Well 30 gpm
- Treated Water Storage 428,000 gallons
- Water Treatment Plant 1,536 SF, built in 1987, Upgraded in 2013
- Water Treatment Bag filters, hypochlorite
- Sewage Lagoon Three cell, 3.3 acre

Soils around Venetie generally consist of soft poorly drained soils with discontinuous permafrost. Sandy gravel underlies Venetie at depths of 3-7 feet and extends to depths of 30 feet or more.

Piped System Description

The piped water and pressure sewer system will be an above grade system. The water system will consist of approximately 25,900 feet of pipe, and the pressure sewer system approximately 16,000 feet of pipe. The water system will consist of three circulating loops. The pressure sewer system would require individual grinder pump stations at each house and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	16	30	-		
Water Storage (gallons)	120,800	428,000	-		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Sewage Lagoon Size (acre)	4.0	3.3	0.7		
Required Foundation System for WTP and/or WST					
Thermosyphon stabilized gravel pad (sf)	1,200	-	1,200		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	25,900	-	25,900		
Wastewater Collection System					
Sewer Main with Glycol Heat Trace (If)	16,000	-	16,000		
Individual Grinder Pump Stations (GPS) (ea)	93	-	93		
Water & Sewer Service Lines					
Circulating Water Service Lines (If)	7,000	-	7,000		
Pressure Sewer Service Lines (If)	7,000	-	7,000		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Venetie. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 27-30).

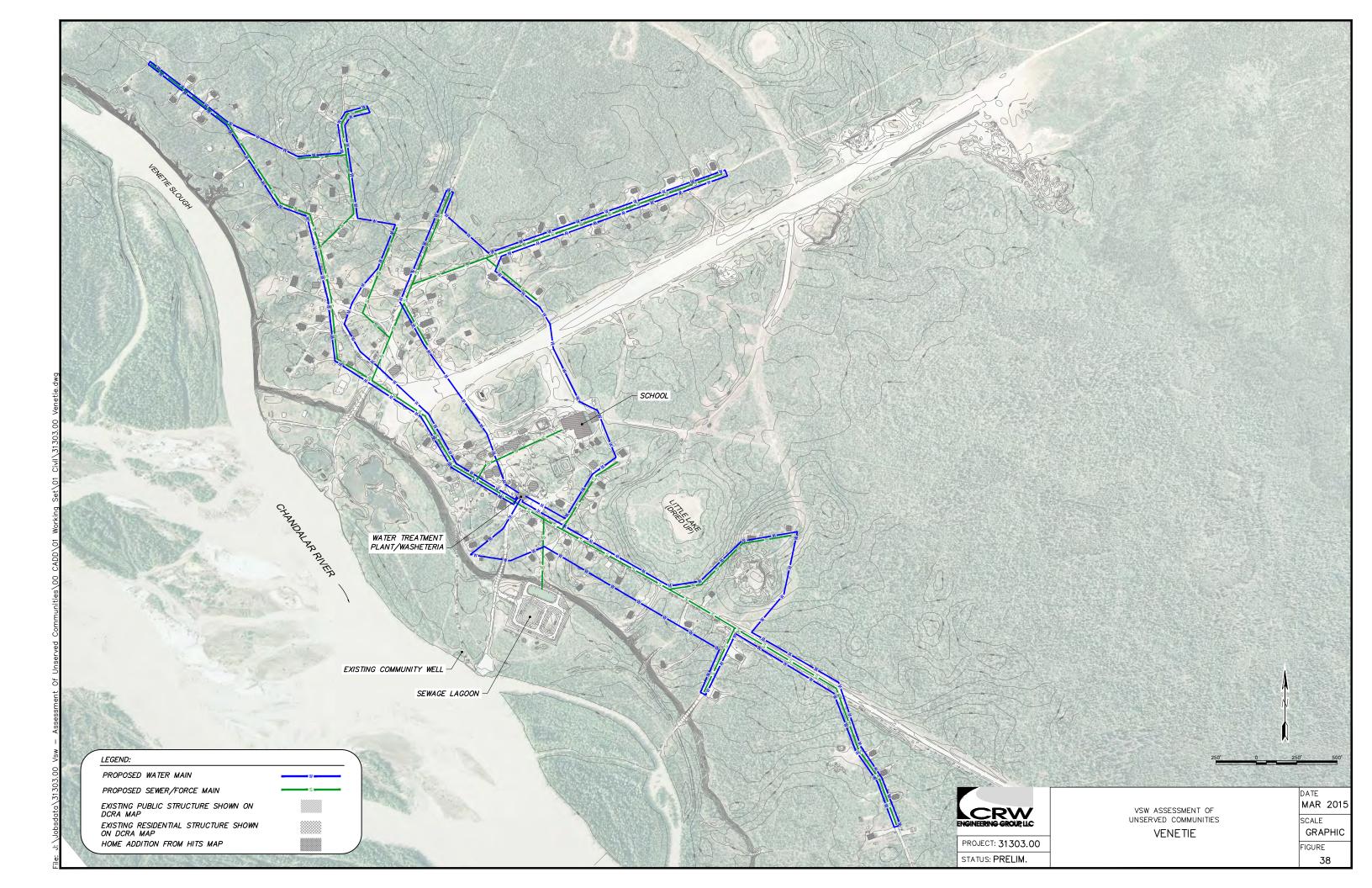
				Village	
	Estimated Capital Costs			Venetie	
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	93	\$28,096.69	\$2,612,992
3	Sewage collection mains or services (gravity or force), above ground	LF	23,000	\$303.80	\$6,987,444
10	Sewage lagoon, barrow, local material	Acre	0.7	\$1,461,213.17	\$1,022,849
12	Water distribution, mains or services, above ground	LF	32,900	\$422.45	\$13,898,753
15	Water treatment plant, no foundation	SF	1,200	\$2,467.77	\$2,961,322
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$691.55	\$829,855
Total Estimated Cost in 2010 dollars (rounded):				\$28,313,000	
	Total v	vith Infl	ation (3% pe	r year for 6 years)	\$33,807,200
27	Individual Grinder Pump Stations	EA	93	\$30,000	\$2,790,000
28	Electrical Service Upgrades	EA	93	\$5,500	\$511,500
				Subtotal	\$37,108,700
29	Construction Contingency (15%)	LS	1	\$5,566,300	\$5,566,300
30	Design & Construction Administration Services (20%)	LS	1	\$7,421,700	\$7,421,700
				Total	\$50,096,700

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs	
Description	Cost
Administration	\$6,000
Labor	\$23,300
Fuel	\$164,900
Electricity	\$30,900
Other (R&R, Training, etc.)	\$23,500
Total	\$249,000

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Venetie are listed below.

Estimated User Fees						
Revenue Source	Mont	thly Rate	# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	180	76	85%	\$	139,388
Public/Commercial Service	\$	234	16	100%	\$	44,880
School Service	\$	7,192	1	100%	\$	64,731
Local Capital Contribution					\$	•
Total Revenue					\$	249,000



V0VVV	B 114			
	-	ater & Sewer System Type and Siz	zing Model	
Date Community		4/22/2016 Venetie		
Input				
Existing Community & System Data 2015 Population		186		
2015 Population 2015 Number of Services		93		
HITS Database (E1 & H1-H7)		76		
DCED Mapping Commerical/Public Facilities/School		17		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor 428000		
Water Storage Tank Water Treatment Capacity		30		
Existing Sewage Lagoon Size		3.3		
Soil Conditions (check only one)				
Soft poorly drained soils or discontinuous permafrost				
Firm soils, or continuous permafrost		х		
Stiff soils, no permafrost			Community to the state	144-1
Piping Configurations (check all that apply)			Sewer Main Length (ft)	Water Main Length (ft)
Buried system with no permafrost			(10)	Length (It)
Above ground system or buried with permafrost		х	16000	25900
Gravity Sewer Main			45000	
Pressure Sewer Main Typical Service Line Length (ea)		X	16000 75	75
Typical Service Line Length (ea)			73	73
Piped System Requirements	Community	Venetie		
Output for Cost Model (calculated)	,	Jeneus		
			Foundatio	n Size
Water Treatment Capacity (gpm)		16		
Req Water Storage (gallons) (less existing)		-	-	sf
Req W&S Utility Bldg/Water Treatment Plant/Additio	n (sf)	1,200	1,200	sf
Req Sewage Lagoon Size (acre) (less existing)		0.7	Quantity	Notes
			Quantity	Notes
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	1,200	
				i
Water Distribution System				
Water Distribution System		Circulating Water Main with	25,900	
		Pitorifices (If)		i
		Sewer Main with Glycol Heat Trace	16,000	
Wastewater Collection System		(If)		
		Individual Grinder Pump Stations	93	
		(GPS) (ea)		i
		Circulating Water Service Lines (If)	7,000	
Water & Sewer Service Lines		. ,		
		Pressure Sewer Service Lines (If)	7,000	
				·
System Description	Piped System	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	Need 16	30	-	
Water Storage (gallons)	120,800	428,000		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200	
Sewage Lagoon Size (acre) Required Foundation System for WTP and/or WST	4.0	3.3	0.7	
Thermosyphon stabilized gravel pad (sf)	1,200	- 1	1,200	
Water Distribution System	1,200	<u> </u>	1,200	
Circulating Water Main with Pitorifices (If)	25,900	-	25,900	
Wastewater Collection System	1000-	1		
Wastewater Collection System Sewer Main with Glycol Heat Trace (If)	16,000	-	16,000	
Wastewater Collection System	16,000 93		16,000 93	
Wastewater Collection System Sewer Main with Glycol Heat Trace (lf) Individual Grinder Pump Stations (GPS) (ea)				
Wastewater Collection System Sewer Main with Glycol Heat Trace (If) Individual Grinder Pump Stations (GPS) (ea) Water & Sewer Service Lines	93	-	93	

VSW Ur	nserved Communities - Piped	Water & Sewer	System Type and Sizing Model
Date	4/22/2016		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Community System Parameters	Venetie Model Results		Criteria & Calculations
Design Population	Widdel Results		Circeita & Calculations
Duration (n)	20	years	20 years
2015 Population (P)		people	2015 ADOL
2015 Number of Services Growth Rate (i)	93	services	1%
2035 Design Population (Capita)		people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		gpm	
Average Day (ADD) Max Day (MDD)	11,348 22,696		50 gallons per Capita 2 x ADD
Peak Hour		gpm	3 x MDD
Treatment Capacity		gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW		
Required Capacity	16	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank	428,000	gallons	
Demand Based Volume (if source is GW) Daily Operation (DO) (gallons)	Applicable 22,696	gallons	Max Day (MDDx1 day)
Fire Flow (FF)	30,000		500 gpm for 60 minutes
Reserve Volume (RV)	68,087	gallons	3 days x DO
Water Storage Tank Volume	120,782 Not Required	gallons	DO + FF + RV
CT Based Volume (min if source is SW) Chlorine Residual Concentration (RC)	•	mg/L	0.4 mg/L
Disinfection/Log Inactivation (LI)		log inactivation	1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH) Contact Time Required (CT)	7	minutes	7 LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Baffling Coefficient (BF)	0.1		0.1
Required Volume to meet CT*	80,399		CT/RCxPeak Hour/BF
Required Water Storage	120,800	_	2
Required Additional Storage Estimate of Min Platform Size (3' clearance	-	gallons	
around)	-	sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
Water Treatment Plant Requirements*			0
Water Quality	Poor]	Poor Water Quality (CF or DF) = 1200 sf
Minimum WTP Size	1,200	sf	Good Water Quality (no treatment other than CL) = 800 sf
Foundation (WST and WTP)			
Soft poorly drained soils or discontinuous	0		Pile Foundation
permafrost		_, ,	
Firm soils, or continuous permafrost Stiff soils, no permafrost	0 x	Thermosyphon	Thermosyphon stabilized gravel pad Gravel pad
Water Distribution (Check either or both) Buried system with no permafrost	0		Static Water Mains
		Circulating	
Above ground system or buried with permafrost	x	Water Main with Pitorifices	Circulating Water Main with Pitorifices
		(If)	
Washington Cally 11 (Cl. 1) 11 11 11 11			
Wastewater Collection (Check all that apply)			Dana anno anno anno anno anno anno anno
Buried system with no permafrost	0	Sewer Main	Bare sewer main, no heat trace
Above ground or buried with permafrost	x	with Glycol Heat Trace (If)	Sewer main with glycol heat trace
Gravity Sewer Main	0	.,,	Lift stations for gravity sewer mains, every 1,000 ft
		Individual Grinder Pump	
Pressure Sewer Main	x	Stations (GPS)	Individual Grinder Pump Stations
		(ea)	
Water & Sewer Services (Check all that apply)			
Static Water Main	0		Static Water Service Line
		Circulating	
Circulating Water Main	х	Water Service Lines (If)	Circulating Water Service Lines
Gravity Sewer Main	0		Gravity Service Line
Pressure Sewer Main	х	Pressure Sewer Service Lines (If)	Pressure Service Line with GPS
Sewage Lagoon Size			
Existing Sewage Lagoon	3.3	acres	
Organic Loading Based Size	1.9	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	235.3		Volume is based on ADDx365x20% factor to account for precipitation,
	l	2000	Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
Hydraulic Loading Based Size	4.0	acres	of berms (area to be fenced)
Hydraulic Loading Based Size Two cell lagoon, combined acreage		acres	

Capital Cost Estimate Piped Water & Sewer System

Village	
Venetie	

Item	Line Item		Estimated	Adjusted	Total
No.	Description		Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	93	\$28,096.69	\$2,612,992
	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	23,000	\$303.80	\$6,987,444
4	Sewage lift station	EA	0	#DIV/0!	\$0
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	0	#DIV/0!	\$0
8	Drainfield, community	SF	0	#DIV/0!	\$0
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0.7	\$1,461,213.17	\$1,022,849
	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	32,900	\$422.45	\$13,898,753
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
15	Water treatment plant, no foundation	SF	1,200	\$2,467.77	\$2,961,322
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$691.55	\$829,855
	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$28,313,215

Community:	Venetie	
General Community Dat	a	
Current population	on	186 persons
Service Connecti		2.4
Number of ho Number of po Number of so	ublic/commerical buildings	76 16 1
	Total number of service connec	tions 93
Burdened labor r Electricity cost (F Electricity cost (F Cost per gallon fo	Public facilty) Residential service)	\$14 hr \$0.54 kWh \$0.36 kWh \$8.50 gal
Water consumpti Wastewater gene		50 gpd 50 gpd
Water & Sewer System (Water Source	Characteristics	
	em (Surface(SW) or Groundwater(GW)) v water line	GW 1350 ft
	eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	Yes AG
	treatment plant building uality (Good or Poor)	2736 sf Poor
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	428,000 gallons 125 ft Yes AG
Water Distributio Type of syste Number of ci Total length o Water mains Location of th		Circ 3 25900 ft Yes AG 75 ft
Wastewater Colle Type of syste Number of in Number of Number of Number of Number of Number of Number of Number of Number of Number of Number of	ection ection em (Gravity or Pressure) dividual facility pump stations ommunity lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #5	Pressure
Sewer mains Number of ci Location of the	t stations of sewer mains heated for freeze protection (Yes or No) rculating glycol loops ne mains (Above ground (AG) or Buried) rice line length	500 sf 16000 ft Yes 3 AG 75 ft
Location of fo		435 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Labor (Operator) Hours per week Less than 50 services 24 hrs/week Between 50 and 100 services 32 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 40 hrs/week More than 100 services 8 months Heating season (above ground components) 8 months Heating season (buried components) 8 months Heating season (buried components) 8 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/galday Mater storage tank 0.5 BTU/galday Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building	Administration Billing, CCR and management	\$500	/month
Less than 50 services 24 hrs/week Between 50 and 100 services 32 hrs/week More than 100 services 40 hrs/week Fuel (Heating) This/week Available energy per gallon of heating fuel 100,000 BTUs/gallon Heating season (buried components) 8 months Buildings 7 BTU/hr/sf BTU/hr/sf Raw water heat addition (5F) 40 BTU/gal-day Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/yallon Water treatment 0.5 watts/gallon Water system pumps watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kV/h/month/loop Sewer system pumps 107 watts/gallon Individual facility pump stations 0.7 watts/gallon/service Community lift stations 8 kV/h/month/loop Sewer main glycol circulation 268 kV/h/month/loop	Labor (Operator)		
Between 50 and 100 services 32 hrs/week More than 100 services 40 hrs/week Fuel (Heating) Fuel (Heating) Navailable energy per gallon of heating fuel 100,000 BTUs/gallon Heating season (above ground components) 8 months Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Buried mains (permafrost conditions) 4 watts/hr/sf WTP building V Watts/hr/sf Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/pallon Water treatment 0.5 watts/gallon Good quality water 0.5 watts/gall	Hours per week		
More than 100 services	Less than 50 services	24	hrs/week
Available energy per gallon of heating fuel	Between 50 and 100 services	32	hrs/week
Available energy per gallon of heating fuel Heating season (above ground components) 8 months	More than 100 services	40	hrs/week
Heating season (above ground components)	Fuel (Heating)		
Heating season (above ground components)	Available energy per gallon of heating fuel	100,000	BTUs/gallon
Buildings 7 BTU/hr/sf Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Use the second of th		8	months
Raw water heat addition (5F) 40 BTU/gallon Water storage tank 0.5 BTU/gal-day Above ground mains 5 BTU/hr/ft Buried mains (permafrost conditions) 3 BTU/hr/ft Electricity WTP building Use the stand controls 0.4 watts/hr/sf Lights and controls 0.4 watts/hr/sf watts/pr/sf HVAC/hydronic system 0.4 watts/gallon Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month/loop Sewer system pumps 0.7 watts/gallon Individual facility pump stations 0.7 watts/gallon /service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon	Heating season (buried components)	12	months
Water storage tank0.5BTU/gal-dayAbove ground mains5BTU/hr/ftBuried mains (permafrost conditions)3BTU/hr/ftElectricityWTP buildingLights and controls0.4watts/hr/sfHVAC/hydronic system0.4watts/hr/sfWater treatment0.1watts/gallonGood quality water0.5watts/gallonPoor quality water0.5watts/gallonWater system pumps0.5watts/gallonIntake or well0.5watts/gallonWST circulation135kWh/monthPressure/booster0.75watts/gallonMain line circulation1074kWh/month/loopSewer system pumps0.6watts/gallon/serviceIndividual facility pump stations0.7watts/gallon/serviceCommunity lift stations0.6watts/gallonSewer main glycol circulation268kWh/month/loopForce main0.6watts/gallonLagoon discharge0.6watts/gallonOther Costs5% of labor, fuel and electricityWater quality testing3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,000per year	Buildings	7	BTU/hr/sf
Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Poor quality water Poor quality water Poor quality water System pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Sever year Operator training Sever year	Raw water heat addition (5F)	40	BTU/gallon
Above ground mains Buried mains (permafrost conditions) Electricity WTP building Lights and controls HVAC/hydronic system Good quality water Poor quality water Poor quality water Poor quality water System pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Sever year Operator training Sever year	Water storage tank	0.5	BTU/gal-day
Electricity WTP building 0.4 watts/hr/sf Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Lagoon discharge 0.6 watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Water quality testing 3 % of labor, fuel and electricity		5	BTU/hr/ft
WTP building Lights and controls Lights and controls HVAC/hydronic system Water treatment Good quality water Poor quality water Poor quality water Poor quality water Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Usatts/qallon Watts/gallon Watt	Buried mains (permafrost conditions)	3	BTU/hr/ft
Lights and controls 0.4 watts/hr/sf HVAC/hydronic system 0.4 watts/hr/sf Water treatment 0.1 watts/gallon Good quality water 0.5 watts/gallon Poor quality water 0.5 watts/gallon Water system pumps 0.5 watts/gallon Intake or well 0.5 watts/gallon WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps 0.7 watts/gallon/service Individual facility pump stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Lagoon discharge 0.6 watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Water quality testing \$2,000 per year Operator training \$2,500 per year	Electricity		
HVAC/hydronic system Water treatment Good quality water Poor quality water O.5 watts/gallon Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O.1 watts/hr/sf watts/gallon Notatts/gallon Nota	WTP building		
Water treatment Good quality water Poor quality water Poor quality water User system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Ose watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon/service Watts/gallon Watts/gall	G	0.4	watts/hr/sf
Good quality water Poor quality water O.5 watts/gallon Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O.5 watts/gallon Watts/gallon Matts/gallon/service Watts/gallon/service Watts/gallon Watts/gallon Watts/gallon Autts/gallon Watts/gallon	HVAC/hydronic system	0.4	watts/hr/sf
Poor quality water Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Natts/gallon Natts/gallon Natts/gallon/service Watts/gallon Natts/gallon	Water treatment		
Water system pumps Intake or well WST circulation Pressure/booster Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Eagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water system pumps Individual facility pump stations O.7 watts/gallon/service watts/gallon Watts/gallon Sewer main glycol circulation Sewer main glycol circulation Lagoon discharge Other Costs Equipment R&R S % of labor, fuel and electricity Water quality testing Operator training \$2,000 per year Poperator training	Good quality water	0.1	watts/gallon
Intake or well WST circulation Heressure/booster Main line circulation Main line circulation Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Sewer main Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training Other Costs Sever well AWh/month/loop Watts/gallon Watts/ga	Poor quality water	0.5	watts/gallon
WST circulation 135 kWh/month Pressure/booster 0.75 watts/gallon Main line circulation 1074 kWh/month/loop Sewer system pumps Individual facility pump stations 0.7 watts/gallon/service Community lift stations 0.6 watts/gallon Sewer main glycol circulation 268 kWh/month/loop Force main 0.6 watts/gallon Lagoon discharge 0.6 watts/gallon Other Costs Equipment R&R 5 % of labor, fuel and electricity Miscellaneous materials & supplies 3 % of labor, fuel and electricity Water quality testing \$2,000 per year Operator training \$2,500 per year	Water system pumps		•
Pressure/booster Main line circulation 1074 kWh/month/loop Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Force main Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training New matts/gallon Watts/gallon Pother Costs Equipment R&R S W of labor, fuel and electricity Water quality testing S S S S S S S S S S S S S S S S S S S	Intake or well	0.5	watts/gallon
Main line circulation1074kWh/month/loopSewer system pumps0.7watts/gallon/serviceIndividual facility pump stations0.6watts/gallonCommunity lift stations0.6watts/gallonSewer main glycol circulation268kWh/month/loopForce main0.6watts/gallonLagoon discharge0.6watts/gallonOther CostsEquipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year	WST circulation	135	kWh/month
Sewer system pumps Individual facility pump stations Community lift stations Sewer main glycol circulation Force main Lagoon discharge Other Costs Equipment R&R Figuipment R&R Miscellaneous materials & supplies Water quality testing Operator training On the Sewer main glycol circulation Sewer main glycol circulation 268 kWh/month/loop watts/gallon watts/gallon watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon watts/gallon	Pressure/booster	0.75	watts/gallon
Individual facility pump stations Community lift stations Sewer main glycol circulation Force main Lagoon discharge Other Costs Equipment R&R Miscellaneous materials & supplies Water quality testing Operator training O, 0 watts/gallon Watts/gallon Watts/gallon Watts/gallon Watts/gallon Vote Costs Equipment R&R S % of labor, fuel and electricity % of labor, fuel and electricity % per year % operator training % 2,000 % per year % per year % operator training % 2,500 % operator training % per year % operator training % operator train	Main line circulation	1074	kWh/month/loop
Community lift stations Sewer main glycol circulation Force main Lagoon discharge Other Costs Equipment R&R Biguipment R&R Miscellaneous materials & supplies Water quality testing Operator training Oe watts/gallon watts/gallon watts/gallon watts/gallon Watts/gallon of labor, fuel and electricity \$2,000 per year per year per year	Sewer system pumps		
Sewer main glycol circulation268kWh/month/loopForce main0.6watts/gallonLagoon discharge0.6watts/gallonOther CostsEquipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year	Individual facility pump stations	0.7	watts/gallon/service
Force main Lagoon discharge Other Costs Equipment R&R Biguite Miscellaneous materials & supplies Water quality testing Operator training One watts/gallon Watts/gallon one watts/gallon watts/gallon watts/gallon watts/gallon watts/gallon one watts/gallon watts/gallon watts/gallon one watts/gallon watts/gallon	Community lift stations	0.6	watts/gallon
Force main Lagoon discharge Other Costs Equipment R&R Biguite Miscellaneous materials & supplies Water quality testing Operator training One watts/gallon Watts/gallon one watts/gallon watts/gallon watts/gallon watts/gallon watts/gallon one watts/gallon watts/gallon watts/gallon one watts/gallon watts/gallon	Sewer main glycol circulation	268	kWh/month/loop
Other Costs5% of labor, fuel and electricityEquipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year		0.6	watts/gallon
Equipment R&R5% of labor, fuel and electricityMiscellaneous materials & supplies3% of labor, fuel and electricityWater quality testing\$2,000per yearOperator training\$2,500per year	Lagoon discharge	0.6	watts/gallon
Miscellaneous materials & supplies Water quality testing Operator training 3 % of labor, fuel and electricity per year \$2,000 per year per year	Other Costs		
Water quality testing \$2,000 per year Operator training \$2,500 per year	Equipment R&R	5	% of labor, fuel and electricity
Operator training \$2,500 per year	Miscellaneous materials & supplies	3	% of labor, fuel and electricity
	Water quality testing	\$2,000	per year
Insurance \$1,500 per year	Operator training	\$2,500	per year
	Insurance	\$1,500	per year

Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month		\$6,000
Labor (WTP Operator)	32	hrs/week		\$23,296
Fuel (Heating Demand)				
Water system				
WTP building	\$1.188	/month		\$9,501.84
Raw water line		/month		\$3,348.86
Raw water heat addition	\$961	/month		\$7,689.98
Water storage tank	\$553	/month		\$4,423.81
Water storage tank line	\$39	/month		\$310.08
Water mains	\$8,031	/month		\$64,249
Service lines	\$2,163	/month		\$17,302
Wastewater system				
Sewer mains	\$4,961	/month		\$39,690
Service lines		/month		\$17,302
Lift/pump station buildings	\$0	/month		\$0.00
Force main to lagoon	\$135	/month	_	\$1,079
			Subtotal	\$164,900
Electricity				
Water system				
WTP building				
Lights and controls	* -	/month		\$5,174
HVAC/hydronic system	, -	/month		\$3,449
Water treatment	\$76	/month		\$916
Pumps				
Intake or well	·	/month		\$916.01
WST circulation	, -	/month		\$583
Pressure/booster		/month		\$1,374.02
Main line circulation	\$1,740	/month		\$13,919
Wastewater system				
Lift /pump station buildings	40	, ,		00
Lights and controls	·	/month		\$0 \$0
HVAC/hydronic system	\$0	/month		\$0
Pumps	# 0	/ Al-		00
Individual facility pump stations		/month		\$0 ©0.00
Community lift/pump station(s)	·	/month		\$0.00
Sewer/force main glycol circulation	·	/month		\$3,473
Lagoon discharge pump	\$1,100	/year	Subtotal	\$1,100 \$30,900
Other Costs				, ,
Equipment R&R	\$10,955	/year		\$10,955
Miscellaneous materials & supplies	\$6,573	/year		\$6,573
Water quality testing	\$2,000	/year		\$2,000
Operator training	\$2,500	/year		\$2,500
Insurance	\$1,500	/year		\$1,500
	Ψ1,000	. , ວພາ	Subtotal	\$23,500
				7,-00

Summary

Administration	\$6,000
Labor	\$23,300
Fuel	\$164,900
Electricity	\$30,900
Other	\$23,500
Total	\$249,000

Revenue Me	onthly	# of		,	Yearly
Source Ra	ate	Customers	Collection Rate	Re	evenues
Residential Serv \$	180	76	85%	\$	139,388
Public/Commerc \$	233.75	16	100%	\$	44,880
School Service (; \$	7,192.37	1	100%	\$	64,731
Local Capital Contri	bution			\$	-
Total Revenue				\$	249.000

Wales, Alaska

Community Information & Existing Infrastructure

Wales is a Kinugmiut Eskimo community of 146 people located on Cape Prince of Wales, at the western tip of the Seward Peninsula. There are 58 residential units, 9 commercial/public facilities and one school for a total of 68 services. The existing water and sewer services provided in Wales consist of self-haul system from the watering point attached to the washeteria and honey buckets. The school, teacher's housing, clinic, and the old city office has piped water service. The existing water and sewer infrastructure consists of the following:

• Well – 40 gpm

- Water Treatment No treatment
- Treated Water Storage 500,000 gallons
- Sewage Lagoon N/A
- Water Treatment Plant 2,912 SF, built in 1979

Soils around Wales consist of soft poorly drained soils near the beach and firm soils away from the beach area. Geotechnical explorations along the beach identified permafrost approximately 20-25 feet below ground surface.

Piped System Description

The piped water and sewer system will be an above ground system. The community is located in an area that is archeologically sensitive, and therefore would greatly increase the capital costs if the system was buried. The water system will consist of approximately 10,600 feet of pipe, and the gravity sewer system approximately 5,600 feet of pipe. The water system will consist of two circulating loops. The gravity sewer system would require two sewer main lift stations, and glycol heat trace for freeze protection. Additionally, it is assumed that approximately 75 feet of pipe would be required for each service line for both water and sewer services. For the purposes of this assessment, a new 1,200 sf facility is included to house the equipment needed for additional treatment, water distribution and wastewater collection equipment.

The table below summarizes the results of the Piped System Model. The full model output is attached to this assessment.

Piped System Analysis Model Results

System Description	Piped System Need	Existing Facility	Net Need		
Water Treatment Capacity (gpm)	12	40	-		
Water Storage (gallons)	101,300	500,000	-		
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200		
Septic System (sf)	20,000	-	20,000		
Required Foundation System for WTP and/or WST					
Thermosyphon stabilized gravel pad (sf)	1,200	-	1,200		
Water Distribution System					
Circulating Water Main with Pitorifices (If)	10,600	-	10,600		
Wastewater Collection System					
Sewer Main with Glycol Heat Trace (If)	5,600	-	5,600		
Water & Sewer Service Lines					
Circulating Water Service Lines (If)	5,100	-	5,100		
Gravity Sewer Service Lines (If)	5,100	-	5,100		

Project Cost Summary

The following tables summarize the estimated capital and O&M costs for a piped system in Wales. The capital costs were determined using the State-provided capital cost model. Additional items not included in the cost model are noted below (items 28-30).

				Village	
	Estimated Capital Costs				
			<u>, </u>		
Item	Line Item		Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	68	\$22,235.73	\$1,512,030
3	Sewage collection mains or services (gravity or force), above ground	LF	10,700	\$193.45	\$2,069,913
4	Sewage lift station	EA	2	\$581,420.38	\$1,162,841
7	Septic tank, community	EA	1	\$377,798.26	\$377,798
8	Drainfield, community	SF	20000	\$47.42	\$948,482
12	Water distribution, mains or services, above ground	LF	15,700	\$291.75	\$4,580,451
15	Water treatment plant, no foundation	SF	1,200	\$1,465.72	\$1,758,867
19	19 Foundation - thermosyphen stabilized gravel pad		1,200	\$499.91	\$599,886
Total Estimated Cost in 2010 dollars (rounded):					
	Total v	vith Infl	ation (3% pe	year for 6 years)	\$15,534,600
28	Electrical Service Upgrades	EA	68	\$5,500	\$374,000
Subtotal					
29	Construction Contingency (15%)	LS	1	\$2,386,300	\$2,386,300
30	Design & Construction Administration Services (20%)	LS	1	\$3,181,700	\$3,181,700
				Total	\$21,476,600

The O&M Costs were estimated based on the current population and community and system specific assumptions. Note that O&M costs are largely dependent on labor, fuel and electricity costs which can be highly variable. The assumptions and model results of both the cost models are included with this assessment.

Estimated O&M Costs				
Description	Cost			
Administration	\$6,000			
Labor	\$30,000			
Fuel	\$78,100			
Electricity	\$29,000			
Other (R&R, Training, etc.)	\$17,000			
Total	\$160,000			

The estimated user fees that would be needed to cover the costs of operating the proposed pipe system in Wales are listed below.

Estimated User Fees						
Revenue Source	Monthly Rate		# of Customers	Collection Rate	Yearly Revenues	
Residential Service	\$	156	58	85%	\$	92,474
Public/Commercial Service	\$	234	9	100%	\$	25,322
School Service	\$	4,689	1	100%	\$	42,204
Local Capital Contribution					\$	-
Total Revenue					\$	160,000

VSW Unserved Communit	ies - Piped W	ater & Sewer System Type and Si	zing Model	
Date Community Input		9/6/2016 Wales		
Existing Community & System Data				
2015 Population		146		
2015 Number of Services		68		
HITS Database (E1 & H1-H7)		58		
DCED Mapping Commerical/Public Facilities/School		10		
Type (surface water or groundwater)		GW		
Water quality (Poor or Good)		Poor		
Water Storage Tank		500000		
Water Treatment Capacity		40		
Existing Sewage Lagoon Size		0		
Soil Conditions (check only one)				
Soft poorly drained soils or discontinuous permafrost				
Firm soils, or continuous permafrost		X		
Stiff soils, no permafrost			Sewer Main Length	Water Main
Piping Configurations (check all that apply) Buried system with no permafrost			(ft)	Length (ft)
Above ground system or buried with permafrost		x	5600	10600
Gravity Sewer Main		x	5600	
Pressure Sewer Main				
Typical Service Line Length (ea)			75	75
Piped System Requirements	Community	Wales		
Output for Cost Model (calculated)				
Caspation Cost Model (Canadiates)			Foundatio	n Size
Water Treatment Capacity (gpm)		12	Touridatio	II SIZE
Req Water Storage (gallons) (less existing)		(398,700)	-	sf
Req W&S Utility Bldg/Water Treatment Plant/Addition	n (cf)	1,200	1,200	
Req Septic System w/ Drainfield (sf) (less existing)	1 (51)	20,000	1,200 31	
ned Septic System w/ Branniela (31) (1633 existing)		20,000	Quantity	Notes
			Quantity	Notes
Required Foundation System for WTP and/or WST		Thermosyphon stabilized gravel pad (sf)	1,200	
Water Distribution System		Circulating Water Main with Pitorifices (If)	10,600	
		Sewer Main with Glycol Heat Trace	5,600	
Wastewater Collection System		(lf) Lift Stations for Gravity Sewer Mains	3,600	
		Lift Stations for Gravity Sewer Mains		
Weber 9 Course Comitee Units		Circulating Water Service Lines (If)	5,100	
Water & Sewer Service Lines		Gravity Sewer Service Lines (If)	5,100	
System Description	Piped System	Existing Facility	Net Need	
Water Treatment Capacity (gpm)	Need 12	40	-	
Water Storage (gallons)	101,300	500,000	-	
W&S Utility Bldg/Water Treatment Plant/Addition (sf)	1,200	-	1,200	
Septic System (sf) 20,000		-	20,000	
Required Foundation System for WTP and/or WST				
Thermosyphon stabilized gravel pad (sf) 1,200		-	1,200	
Water Distribution System	1			
Circulating Water Main with Pitorifices (If)	10,600	-	10,600	
Wastewater Collection System Sewer Main with Glycol Heat Trace (If)	5,600	-	5,600	
Water & Sewer Service Lines	1			
Circulating Water Service Lines (If)	5,100	-	5,100	
Gravity Sewer Service Lines (If)	5,100	-	5,100	

VSW Ui	nserved Communities - Pined	Water & Sewer	System Type and Sizing Model
Date	9/6/2016	4 30461	-1
Community	I .		
System Parameters	Model Results		Criteria & Calculations
Design Population	20	warr	20 years
Duration (n) 2015 Population (P)		years people	20 years 2015 ADOL
2015 Number of Services	68	services	
Growth Rate (i)	1%		1%
2035 Design Population (Capita)	178	people	Px(1+i)^n
Water Demand Estimates			
Existing Capacity		gpm	
Average Day (ADD) Max Day (MDD)	8,907 17,815	gpd gpd	50 gallons per Capita 2 x ADD
Peak Hour	37	gpm	3 x MDD
Treatment Capacity		gpm	MDD
Water Source Assumptions			
Type (surface water or groundwater)	GW]	
Required Capacity	12	gpm	MDD
Water Storage Tank Sizing			
Existing Water Storage Tank	500,000	gallons	
Demand Based Volume (if source is GW)	Applicable	<u>.</u> -	
Daily Operation (DO) (gallons)	17,815		Max Day (MDDx1 day)
Fire Flow (FF) Reserve Volume (RV)	30,000 53,444		500 gpm for 60 minutes 3 days x DO
Water Storage Tank Volume		gallons	DO + FF + RV
CT Based Volume (min if source is SW)	Not Required		0.4
Chlorine Residual Concentration (RC) Disinfection/Log Inactivation (LI)		mg/L log inactivation	0.4 mg/L 1.0-log Inactivation
Temperature (T)	4.4		4.4 celsius/40 F
pH (PH)	7		7
Contact Time Required (CT) Baffling Coefficient (BF)	49 0.1	minutes	LI x (5.057) x (e^-0.0693T)x(e^0.361PH)x(e^0.113RC)
Required Volume to meet CT*	63,109		CT/RCxPeak Hour/BF
Required Water Storage		gallons	er, now ear nour, or
Required Additional Storage	(398,700)	gallons	0
Estimate of Min Platform Size (3' clearance around)		sf	D = 0.103xVg^(1/2) H=16 assumed (H is height of tank)
around)			0
Water Treatment Plant Requirements*	_	1	
Water Quality Minimum WTP Size	Poor 1,200	sf	Poor Water Quality (CF or DF) = 1200 sf Good Water Quality (no treatment other than CL) = 800 sf
William WTF 312E	1,200	3)	dood water Quality (no treatment other than CL) = 800 si
Foundation (WST and WTP)		1	
Soft poorly drained soils or discontinuous permafrost	0		Pile Foundation
permanost		Thermosyphon	
Firm soils, or continuous permafrost	x	_	Thermosyphon stabilized gravel pad
Stiff soils, no permafrost	0	pad (sf)	Gravel pad
		J	
Water Distribution (Check either or both)		1	Chakin Wakan Maina
Buried system with no permafrost	0	Circulating	Static Water Mains
Above ground system or buried with permafrost	x	Water Main	Circulating Water Main with Pitorifices
Above ground system or buried with permanost	^	with Pitorifices	circulating water Main with Fitornices
		(lf)	
Wastewater Collection (Check all that apply)			
			Dana sassas maia na haakkasas
Buried system with no permafrost	0	Sewer Main	Bare sewer main, no heat trace
Above ground or buried with permafrost	x		Sewer main with glycol heat trace
		Trace (If)	
		Lift Stations for	
Gravity Sewer Main	x	Gravity Sewer	Lift stations for gravity sewer mains, every 1,000 ft
,		Mains, every 1,000 ft (ea)	
2		1,000): (eu)	half that of data beautiful.
Pressure Sewer Main	0		Individual Grinder Pump Stations
Water & Sewer Services (Check all that apply)			
		1	Chakia Wighon Coming Line
Static Water Main	0	Circulating	Static Water Service Line
Circulating Water Main	x	Water Service	Circulating Water Service Lines
		Lines (If)	
Gravity Sower Main	w w	Gravity Sewer	Gravity Service Line
Gravity Sewer Main	x	Service Lines (If)	Gravity Service Line
Pressure Sewer Main	0		Pressure Service Line with GPS
Sowage Lagoon Size			
Sewage Lagoon Size Existing Sewage Lagoon	0	acres	
Organic Loading Based Size	1.5	acres	0.17 lbs of BOD5 per capita day x Design Population / 20 lbs BOD5 per
check	208.5		Volume is based on ADDv26Ev200/ feater to account feater in the control of the co
Hydraulic Loading Based Size	3.1	acres	Volume is based on ADDx365x20% factor to account for precipitation, Lagoon depth assumed to be 5 ft, berm slopes 3:1, Factor of 1.3 for top
	5.2		of berms (area to be fenced)
Two cell lagoon, combined acreage	3.1	acres	Either organic loading based or hydraulic, whichever is greater
= '			- · · · · · · · · · · · · · · · · · · ·

Capital Cost Estimate Piped Water & Sewer System

Village	
Wales	

Item	Line Item	T	Estimated	Adjusted	Total
No.	Description	Unit	Quantity	Unit Cost	Cost
1	Household water and sewer plumbing	EA	68	\$22,235.73	\$1,512,030
	Sewage collection mains or services (gravity or force), buried	LF	0	#DIV/0!	\$0
3	Sewage collection mains or services (gravity or force), above ground	LF	10,700	\$193.45	\$2,069,913
4	Sewage lift station	EA	2	\$581,420.38	\$1,162,841
5	Vacuum sewer plant, no foundation	SF	0	#DIV/0!	\$0
6	Septic tank, and drainfield, individual household	EA	0	#DIV/0!	\$0
7	Septic tank, community	EA	1	\$377,798.26	\$377,798
8	Drainfield, community	SF	20,000	\$47.42	\$948,482
9	Utilidors, above ground, including water and sewer, mains or services	LF	0	#DIV/0!	\$0
10	Sewage lagoon, barrow, local material	Acre	0	#DIV/0!	\$0
11	Sewage ocean outfall	LF	0	#DIV/0!	\$0
12	Water distribution, mains or services, above ground	LF	15,700	\$291.75	\$4,580,451
13	Water distribution, mains or services, buried	LF	0	#DIV/0!	\$0
14	Water storage tank, no foundation	Gal	0	#DIV/0!	\$0
15	Water treatment plant, no foundation	SF	1,200	\$1,465.72	\$1,758,867
16	Washeteria, no foundation	SF	0	#DIV/0!	\$0
17	Foundation - conventional, local gravel material	SF	0	#DIV/0!	\$0
	Foundation - freeze back piles	SF	0	#DIV/0!	\$0
19	Foundation - thermosyphen stabilized gravel pad	SF	1,200	\$499.91	\$599,886
20	Boardwalk	LF	0	#DIV/0!	\$0
21	Road, local gravel source	LF	0	#DIV/0!	\$0
22	Water source - surface water intake	EA	0	#DIV/0!	\$0
23	Water source - ground water well	EA	0	#DIV/0!	\$0
	Solid waste site - closure, local material	Acre	0	#DIV/0!	\$0
25	Solid waste site - development, local material w/ equipment	Acre	0	#DIV/0!	\$0
26	Shop / Garage, no foundation, concrete floor	SF	0	#DIV/0!	\$0

Total Estimated Cost: \$13,010,268

Community:	Wales	
General Community Dat	a	
Current population Average number Service Connect	of people per house	146 persons 2.5
Number of h Number of p Number of so	ublic/commerical buildings chools	58 9 1
	Total number of servi	
Burdened labor i Electricity cost (F Electricity cost (F Cost per gallon f	Public facilty) Residential service)	\$18 hr \$0.48 kWh \$0.21 kWh \$7.00 gal
Water consumpt Wastewater gen	ion per capita eration per capita	50 gpd 50 gpd
Water & Sewer System Water Source	Characteristics	
Length of ray Water line he	em (Surface(SW) or Groundwater(GW)) v water line eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	GW 6350 ft No AG
	<u>t</u> treatment plant building uality (Good or Poor)	4112 sf Poor
Water line he	s) ter line to/ from tank eated for freeze protection (Yes or No) vater line (Above ground (AG) or Buried)	500,000 gallons 50 ft Yes AG
Water Distribution		
Number of ci Total length Water mains Location of tl	em (Static or Circulating (Circ)) rculating water loops of Water Main heated for freeze protection (Yes or No) ne mains (Above ground (AG) or Buried) vice line length	Circ 2 10600 ft Yes AG 75 ft
Wastewater Coll		
Number of in Number of co Number Number Number Number	em (Gravity or Pressure) idividual facility pump stations community lift/pump stations of facilities served by lift/pump station #1 of facilities served by lift/pump station #2 of facilities served by lift/pump station #3 of facilities served by lift/pump station #4 of facilities served by lift/pump station #4	Gravity 2 21 45
Total length of Sewer mains Number of ci Location of ti	if stations of sewer mains heated for freeze protection (Yes or No) rculating glycol loops he mains (Above ground (AG) or Buried) vice line length	500 sf 5600 ft Yes 2 AG 75 ft
	atment / Disposal	
Location of fo	ce main neated for freeze protection (Yes or No) orce main (Above ground (AG) or Buried) m discharged seasonally with pump (Yes or No	100 ft Yes AG Yes

Operation & Maintenance Cost Assumptions

Administration Billing, CCR and management	\$500	/month
<u>Labor (Operator)</u> Hours per week		
Less than 50 services	24	hrs/week
Between 50 and 100 services	32	hrs/week
More than 100 services	40	hrs/week
	40	1113/WCCK
Fuel (Heating)	100,000	PTI la/gallen
Available energy per gallon of heating fuel	100,000	BTUs/gallon months
Heating season (above ground components)	-	
Heating season (buried components)	12 7	months
Buildings	40	BTU/hr/sf
Raw water heat addition (5F)	• •	BTU/gallon
Water storage tank	0.5	BTU/gal-day BTU/hr/ft
Above ground mains	5 3	BTU/nr/ft
Buried mains (permafrost conditions)	3	BTO/III/II
<u>Electricity</u>		
WTP building		
Lights and controls	0.4	watts/hr/sf
HVAC/hydronic system	0.4	watts/hr/sf
Water treatment		
Good quality water	0.1	watts/gallon
Poor quality water	0.5	watts/gallon
Water system pumps		-
Intake or well	0.5	watts/gallon
WST circulation	135	kWh/month
Pressure/booster	0.75	watts/gallon
Main line circulation	1074	kWh/month/loop
Sewer system pumps		
Individual facility pump stations	0.7	watts/gallon/service
Community lift stations	0.6	watts/gallon
Sewer main glycol circulation	268	kWh/month/loop
Force main	0.6	watts/gallon
Lagoon discharge	0.6	watts/gallon
Other Costs		
Equipment R&R	5	% of labor, fuel and electricity
Miscellaneous materials & supplies	3	% of labor, fuel and electricity
Water quality testing	\$2,000	per year
Operator training	\$2,500	per year
Insurance	\$1,500	per year
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Estimated O& M Costs				Annual Cost
Administration (Utility management, billings, etc.)	\$500	/month	_	\$6,000
Labor (WTP Operator)	32	hrs/week		\$29,952
Fuel (Heating Demand)				
Water system				
WTP building	\$1,470	/month		\$11,760.45
Raw water line	\$0	/month		\$0.00
Raw water heat addition	\$621	/month		\$4,971.01
Water storage tank	\$532	/month		\$4,256.00
Water storage tank line	\$13	/month		\$102.14
Water mains	\$2,707	/month		\$21,655
Service lines	\$1,302	/month		\$10,419
Wastewater system				
Sewer mains		/month		\$11,440
Service lines		/month		\$10,419
Lift/pump station buildings	,	/month		\$2,860.03
Force main to lagoon	\$26	/month	_	\$204
			Subtotal	\$78,100
Electricity				
Water system				
WTP building				
Lights and controls	\$576	/month		\$6,912
HVAC/hydronic system	\$576	/month		\$4,608
Water treatment	\$53	/month		\$639
Pumps				
Intake or well	\$53	/month		\$639.13
WST circulation	\$65	/month		\$518
Pressure/booster	\$80	/month		\$958.69
Main line circulation	\$1,031	/month		\$8,248
Wastewater system				
Lift /pump station buildings				
Lights and controls	, -	/month		\$1,681
HVAC/hydronic system	\$140	/month		\$1,121
Pumps				
Individual facility pump stations	·	/month		\$0
Community lift/pump station(s)	\$73	/month		\$872.74
Sewer/force main glycol circulation	·	/month		\$2,058
Lagoon discharge pump	\$767	/year	Subtotal	\$767
Other Costs			Gubilliai	\$29,000
	\$6.050	hioor		ተ ር 050
Equipment R&R	\$6,853	,		\$6,853
Miscellaneous materials & supplies	\$4,112	•		\$4,112
Water quality testing	\$2,000	•		\$2,000
Operator training	\$2,500	•		\$2,500
Insurance	\$1,500	ryear	Subtotal —	\$1,500
			Subtotal	\$17,000

Summary

Administration	\$6,000
Labor	\$30,000
Fuel	\$78,100
Electricity	\$29,000
Other	\$17,000
Total	\$160,000

Revenue M	lonthly	# of		,	Yearly
Source R	Source Rate		Collection Rate	Re	evenues
Residential Serv \$	156	58	85%	\$	92,474
Public/Commerc \$	234.47	9	100%	\$	25,322
School Service (; \$	4,689.33	1	100%	\$	42,204
Local Capital Conti	ribution			\$	-
Total Revenue				s	160,000

