CITY OF NORTH POLE WASTEWATER EFFLUENT DISCHARGE FEASIBILITY STUDY

Prepared for:
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Executive Summary

The City of North Pole discharges treated wastewater effluent to the Tanana River. While the City has a valid discharge permit for up to 500,000 gallons per day, recent seasonal variations in river flows result in periodic loss of the discharge mixing zone. This in turn results in violations of the Alaska Department of Environmental Conservation (ADEC) discharge permit. It is not clear if the loss of mixing zone will be a regular event, but it is a valid concern. ADEC has directed the City to investigate alternatives for correcting the potential discharge permit violations.

Previous work on this issue is summarized in the *Preliminary Wastewater Effluent Discharge Study and Environmental Summary Report* prepared by Stantec Consulting Services Inc. in March of 2015. *The Preliminary Study* provided an initial evaluation of multiple alternates, including feasibility, permit requirements, and potential costs. Two alternates were found to be potentially feasible. ADEC directed the City to complete the evaluations necessary to select a final course of action. This current Feasibility Report provides the detailed evaluation of the two alternates:

- Alternate 1 - Construct New Discharge to Tanana River
- Alternate 2 - Construct Effluent Infiltration Pond

Both alternates have been found to be feasible, although each has various degrees of permitting and design challenges.

Alternate 1, alignment variation "C" is the recommended alternate. Alternate 1C was found to be the alternate most likely to provide a permittable discharge with a capacity of at least 1.0 MGD to accommodate future growth, while also having the least impact to wetlands, the lowest total project cost, the least operating costs, and the fewest uncertainties. Alternate 1C will require easements on state land, and permits from a number of agencies, including ADEC, DNR, USACE, and Fish and Wildlife. Permitting is expected to be time consuming, taking from 9 to 12 months, potentially more. Total project cost, including construction, design, permitting and other associated costs is estimated at approximately $5.9 million. It is likely the project will be phased to address funding limitations. Phase 1, consisting of approximately 4,320 feet of 12 inch pipe construction is estimated to cost about $4.3 million in total project costs. Phase 1 will be sufficient to address the ADEC permit violations.

Subject to availability of funding, permitting and design engineering are expected to take place between January and December of 2016. Construction will also be subject to availability of funding, but ideally will begin in spring of 2017, with completion in 2018.

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Abbreviations and Acronyms

2012 PER	City of North Pole Wastewater Treatment Plant Rehabilitation Preliminary Engineering Report
AAC	Alaska Administrative Code
ACGP	APDES Construction General Permit
ACWF	Alaska Clean Water Fund
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AFB	Air Force Base
APDES	Alaska Pollutant Discharge Elimination System
BFE	Base Flood Elevation
bgs	below ground surface
BMP	best management practices
BOD	biological oxygen demand
BOD_5	biological oxygen demand at 5 days
C	Centigrade
CONP	City of North Pole
CWA	Clean Water Act
CY	Cubic yards
deg	degrees
EPA	U.S. Environmental Protection Agency
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FNSB	Fairbanks North Star Borough
FTE	full-time equivalent
GIS	geographic information system
gmp	gallons per minute
gpd	gallons per day
GPS	global positioning system
HDPE	high-density polyethylene

I&I	Infiltration and Inflow
lbs./day	pounds per day
LF	linear feet
LIDAR	light detection and ranging
LOMR	Letter of Map Revision
LOMR-F	LOMR Based on Fill
MCL	maximum contaminant limit
mg/L	milligrams per liter
MGD	million gallons per day
MMG	ADEC Municipal Matching Grant
MS4	municipal separate storm sewer system
NOV	notice of violation
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PEM	Palustrine Emergent
PER	Preliminary Engineering Report
PFO	Palustrine Forested
Preliminary Study	Preliminary Wastewater Effluent Discharge Study and Environmental Summary Report
PSS	Palustrine Scrub Shrub
QAP	quality assurance plan
R2UB	Riverine
RHA	Rivers and Harbors Act
S&W	Shannon & Wilson, Inc.
SFHA	Special Flood Hazard Area
Stantec	Stantec Consulting Services Inc. (formerly USKH Inc.)
SWPPP	storm water pollution prevention plan
TKN	Total Kjeldahl Nitrogen
TSS	total suspended solids
UPC	Uniform Plumbing Code
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WET	whole effluent toxicity
WWTP	wastewater treatment plant

1.0 INTRODUCTION

The City of North Pole (CONP) has retained Stantec Consulting Services Inc. (Stantec) to investigate means of correcting a non-compliant wastewater discharge to the Tanana River. While the CONP has a valid discharge permit, recent and seasonal variations in river flows result in periodic loss of the discharge mixing zone. This in turn results in violations of the Alaska Department of Environmental Conservation (ADEC) discharge permit.

Previous work on this issue resulted in a *Preliminary Wastewater Effluent Discharge Study* and *Environmental Summary Report* (*Preliminary Study*)[1] that provided an initial evaluation of multiple alternates – examining their potential feasibility, study needs, permitting requirements, and potential construction costs. The *Preliminary Study* reduced the scope of this current report to focus on only two primary alternates selected after consultation with relevant agencies and stakeholders.

This purpose of this current feasibility study is to further evaluate the best means for CONP to address the non-compliant effluent discharge. The schematic design presented in this report will be further developed for the procurement and construction of the selected alternate. The two alternates being considered are listed in Section 1.1.1and detailed in Section 3.0.

1.1 PROJECT BACKGROUND

The CONP operates a wastewater treatment plant (WWTP) with four, partially mixed, aerated lagoons for treatment, and with chlorination / de-chlorination. The ADEC Alaska Pollutant Discharge Elimination System (APDES) discharge permit for the CONP WWTP allows the utility to discharge treated wastewater to a channel of the Tanana River within a mixing zone. Naturally changing geomorphic conditions upstream and elsewhere in the river have caused the discharge channel to experience periodic reduction and / or loss of flow on multiple occasions since May 2012. During these low flow periods, the mixing zone is compromised, and the predominant flow in the channel is treated effluent from the WWTP. Following a series of meetings and other discussions, the ADEC issued a notice of violation (NOV) in October 2014[2]. As an initial response to the NOV, the *Preliminary Study* was submitted to ADEC in March 2015. In April, ADEC responded requiring the CONP to[3]:

a. *Complete the evaluations necessary to select a final course of action between alternatives 3 and 4;*

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1 Stantec. City of North Pole *Preliminary Wastewater Effluent Discharge Study and Environmental Summary Report*. Dated 6 March 2015)

2 Larson, Tiffany. *Notice of Violation*, Enforcement Tracking No 14-0154-50-0001, File. No. 100.45.012. Dated 30 October 2014.

3 Larson, Tiffany. City of North Pole (CONP) *Response to Notice of Violation* Enforcement Tracking. No. 14-0154-50-0001. Dated 7 April 2015.

b. *Provide a timeline for executing the chosen course of action, to include all phases of construction, agency approvals, and other limiting factors as outlined in the March 6, 2015 response;*

c. *Provide a projected project completion date.*

This feasibility study is to address these requirements.

1.1.1 Agency and Stakeholder Scoping

As part of the *Preliminary Study* a number of scoping activities were performed including solicitation for comments from applicable federal, state, and local agencies and other stakeholders on five alternates:

1. Reestablishing Channel Flow
2. Modify and/or Re-permit Existing Outfall
3. Construct New Discharge to Tanana River *(For purposes of current report, this is now **Alternate 1**)*
4. Construct Effluent Infiltration Pond *(For purposes of current report, this is now **Alternate 2)***
5. Modify WWTP to Meet Water Quality Standards at Discharge

As reported in the *Preliminary Study*, the December 15, 2014 scoping letter provided project background information, preliminary research results, and overview of the alternates under consideration. Follow-up in the form of emails and calls was done with non-responsive letter recipients, and a teleconference was held with ADEC as the primary permitting agency for the wastewater facilities in February 2015. Results from these efforts are summarized with each alternate; any additional agency contacts gathered since the *Preliminary Study* are documented in Appendix A.

1.1.2 Investigations

In support of this feasibility study, the Stantec team has conducted a number of investigations and site visits. Of particular note are geotechnical investigations conducted within the infiltration pond alterative area, and survey to support conceptual design development.

1.1.2.1 Geotechnical Investigations

In July 2015, Shannon and Wilson, Inc. (S&W) drilled nine soil borings and three percolation test boreholes. Soil boring depths ranged from 20 to 26.5 feet below ground surface (bgs). The surface tundra was found to be 1 to nearly 2.5 feet thick in areas, overlaying silt and silty sand overbank deposits to depths of 5 to 7 feet bgs. Beneath the overbank deposits, as is typical for the Tanana Lowlands, the exploration found slightly silty to relatively clean, alluvial sands and gravel. No permafrost was encountered. Groundwater was found at 2.5 to 6 feet bgs during boring. Groundwater depths were taken at PT-03 July 17 (after construction) and November 10 with groundwater measured at 7.5 and 7.4 feet bgs respectively.

Percolation tests were conducted adjacent to the soil borings at depths of 3.5 and 10 feet bgs. These two depths represent two soil conditions, the near surface silts (3.5 feet bgs in PT-01 and PT-02) with measured percolations rates of 14 and 30 minutes per inch (min/in); and at the surface of the underlying gravel aquifer (10 feet bgs in PT-03) with a rate of 0.12 min/in. Large scale infiltration pit testing was unsuccessful because of perched water in seasonally frozen silt 2.5 to 5.5 bgs infiltrating into the pit and causing uncontrolled sloughing of the pit walls. In lieu of pit testing, a constant head permeability test (ASTM D2434) was performed on the soils beneath the silt, resulting in a permeability of 2.1×10^{-3} centimeters per second (cm/s). This is a high permeability and indicates the water table should freely accept application of effluent. Hydraulic capacity of the soils is discussed in Section 3.2, relative to the development of disposal alternates and a groundwater "Mounding Analysis".

During the investigation, S&W sampled groundwater at two borings (15-01 and 15-06) for nitrite/nitrate and fecal coliform. Only the fecal coliform result at boring 15-06 (186 µg/l) was above method detection limits. The potential impacts of nitrate loading on the aquifer were considered by S&W, with results provided in a separate report and discussed in the related alternate (Alternate 2) in Section 3.2.

Reports from S&W on the geotechnical investigation, mounding and nitrate analysis are provided in Appendix B.

1.1.2.2 Survey

Stantec performed a limited survey to collect data on controlling elevations and guide alternate evaluation. Survey was limited in scope and included gathering water and bank elevations at the existing and Alternate 1A (Section 3.1.1.1) discharge locations; occasional elevations points along the access road and route into the Alternate 1A discharge point (Section3.1); as well as limited survey in the area of the pond considered in Alternate 2 (Section 3.2). Survey was only sufficient for evaluation of alternates; additional design survey will be required to prepare final construction plans. Note that in order to coordinate with information on previous WWTP designs the vertical datum is NGVD 1929. In areas where it is available (Fairbanks North Star Borough [FNSB] limits), LIDAR[4] aerial survey information was also used to estimate quantities and road elevations, although it had to be adjusted to the older (1929) datum.

1.1.2.3 Laboratory Analysis

To supplement the testing conducted by the WWTP for process control and regulatory compliance, two sampling events were conducted. The first event sampled the effluent for metals and nutrients on October 6, 2015. Metals are a potential impact to water quality and fish health and habitat. Metal content and discharge limits may impact permitting and mixing zone requirements. Nutrients are not presently regulated in surface water discharges, but excess levels can impact water quality. Some forms of nutrients, specifically nitrates, can be a health risk if consumed in drinking water; for this reason, nitrate discharges to groundwater are regulated.

A second sampling event was conducted on October 29, 2015 to collect additional nutrient data in the effluent, and within the individual lagoons, after cells 2, 3 and 4.

Sample results are provided in Appendix C and discussed further discussed with its related alternate (Alternate 1) in Section 3.1.

1.2 PROJECT PLANNING AREA

CONP is a Home Rule Charter City, incorporated in 1953, within the FNSB. It is governed by a strong mayor and six city council members as the place "where the spirit of Christmas lives year round." CONP provides residents with street maintenance, police, fire, and emergency medical services. In limited areas of the community, primarily south of the Richardson Highway, municipal water and wastewater services are also available (see Figure 1). The CONP has an annual operating budget of approximately $7.7 million, which is funded largely by a 4 percent sales tax and 3.5 mil property tax, with the utility funded separately by water and sewer service rates.

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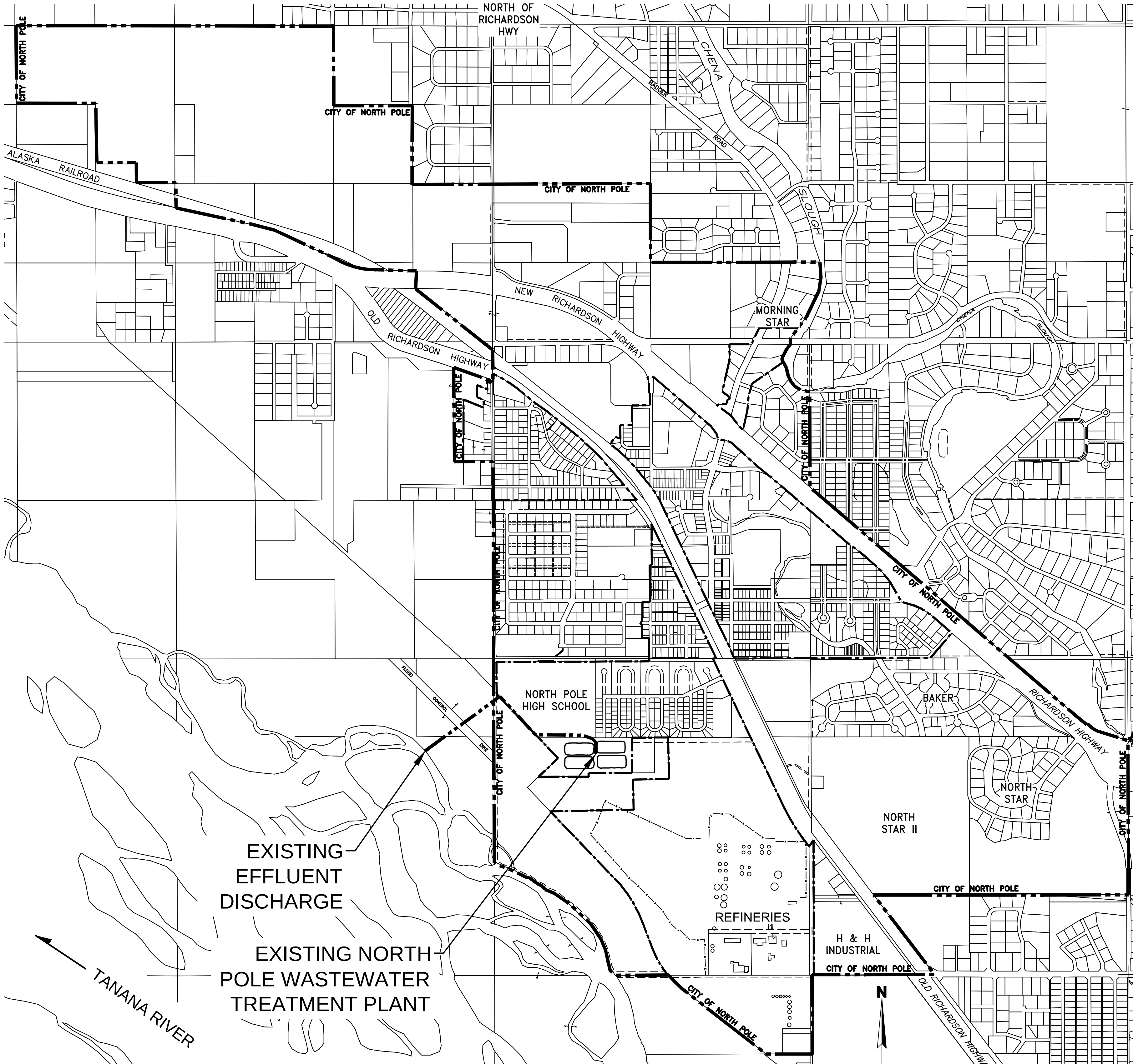
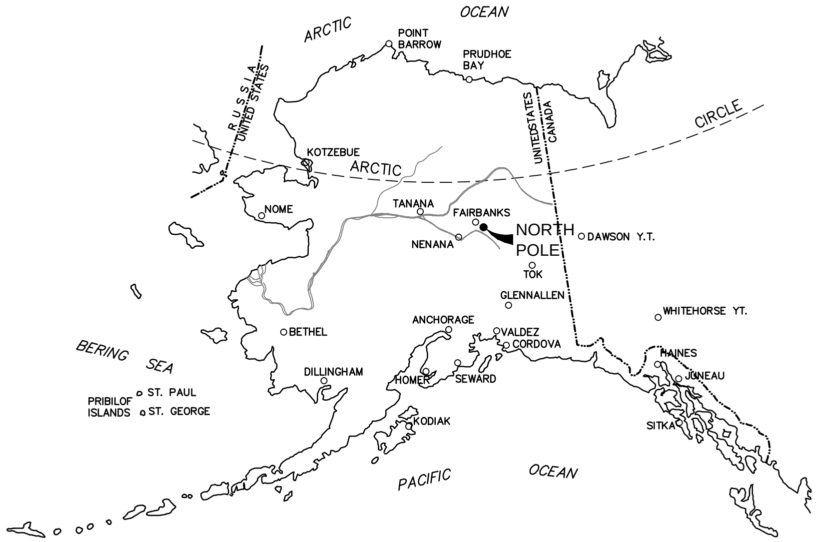
[4] LIDAR stands for light detection and ranging, a remote sensing method using light in the form of pulsed laser to measure ranges (distances).



1/1 VICINITY MAP



2/1 LOCATION MAP

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LOCATION & VICINITY

DATE	FIGURE
December 2015	1

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1.2.1 Climate

North Pole experiences a continental climate with cold winters and warm summers and extreme temperature variability. Average January temperatures range from -2.7 degrees Fahrenheit (F) for a maximum and -20.7 deg F for a minimum. Average July temperatures range from 72.9 deg F to 48.5 deg F. Extremes have ranged from -67 deg F in May 1975 to 95 deg F in June 1969. Precipitation is low. Annual precipitation averages 10.79 inches with 52 inches of snowfall[5].

1.2.2 Environmental Resources

The following is an overview of potential resources in the project area. Specific resource discussions relative to development alternates are provided in Section 3.0.

1.2.2.1 Fish and Wildlife

A variety of wildlife can be expected within the CONP municipal limits and near the WWTP including moose, squirrels, beaver, and hares, and the occasional fox and black bear. No threatened or endangered species are recorded in the area.

A variety of migratory birds can also be found in this area, such as birds of prey (bald eagle and several hawk species), waterbirds, and passerines (including the Townsend's warbler, olive-sided flycatcher, blackpoll warbler, and gray-cheeked thrush). Migratory birds are protected under the Migratory Bird Act and the bald eagle is protected under the Bald and Golden Eagle Protection Act. An aerial eagle nest survey has not been completed for the proposed project study area. At a minimum, all projects will be required to protect nesting birds, with nest surveys conducted if clearing is to occur between the dates recommended by the US Fish and Wildlife Service (USFWS) in their published *Land Clearing Timing Guidance for Alaska*, currently between May 1 and July 15[6].

Local fish include arctic char, chum, Chinook and Coho salmon, rainbow trout, and northern pike. Locations of fish spawning areas are shown in a figure provided by the Alaska Department of Fish and Game (ADF&G) (see Appendix A, Agency Correspondence). The ADF&G Fish Resource Monitor[7] identifies the Tanana River as an anadromous waterbody due to the presence of chum, Coho, and Chinook salmon and a Fish Habitat Permit will be required for work in the river. However, no Essential Fish Habitat exists for any protected species under the Magnuson-Stevens Fishery Conservation and Management Act within the proposed project area vicinity.

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5 Based on information from Western Regional Climate Center (WRCC), http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?aknorp.

6 USF&WS. *Land Clearing Timing Guidance for Alaska*, available at http://www.fws.gov/alaska/fisheries/fieldoffice/anchorage/pdf/vegetation_clearing.pdf.

7 ADF&G. *Fish Resource Monitor*, available at http://extra.sf.adfg.state.ak.us/FishResourceMonitor/?mode=awc.

1.2.2.2 Land Use

A review of the FNSB *Geographical Information System and Property Database* indicates the State of Alaska owns the bed of the Tanana River with management responsibility under the Alaska Department of Natural Resources (ADNR). Alternates crossing State land will therefore need an ADNR Land Use Permit for construction access and a permanent easement for facilities within the area (e.g. pipes, access roads). Other lands in the project vicinity are owned by the FNSB, which may require a Conditional Use Permit or easement approved by the Assembly, and the CONP, which may request a Building Permit. Construction alternates will need to comply with all FNSB and CONP zoning, permits, and best management practices. The *North Pole Land Use Plan*[8] indicates that a nearby area on the other side of the Tanana River Levee is being considered for an off highway vehicle use (recreational) area.

1.2.2.3 Wetlands and Waters of the U.S.

The following are federal laws, to which the project would be subject, related to impacts to wetlands and waters of the U.S.:

Clean Water Act (CWA) Section 404 regulates the discharge of dredged or fill material into waters of the U.S., including wetlands. No discharge of dredged or fill material will be allowed if there is a practical alternative to the proposed project that would have a lesser adverse impact on wetlands and waters of the U.S., so long as the alternative does not have other significant adverse environmental consequences. Impacts must first be avoided to the maximum extent practicable, and then minimized to the maximum extent practicable, and unavoidable impacts must be compensated.

A review of the USFWS National Wetlands Inventory showed wetlands within the proposed project study area. Wetlands types within the project area include Palustrine Emergent (PEM), Palustrine Forested (PFO), Palustrine Scrub Shrub (PSS), and Riverine (R2UB) wetlands (see Figure 2). Wetland geographic information system (GIS) data that was used to create the wetlands map was obtained from Jennifer Jenkins, who worked in conjunction with the USFWS to produce their wetlands mapping. Complete avoidance of wetlands and waters of the U.S. for construction alternates is likely not to be feasible.

USACE requires mitigation for wetland impacts through a variety of measures, including avoidance, minimization, and compensatory mitigation. Avoidance and minimization measures are required and considered in this Feasibility Study. Compensatory mitigation may also be required, if determined appropriate and practicable for the project. The preferred method of compensatory mitigation for a project in this area would be to purchase credits from an approved fee-in-lieu program or wetland mitigation bank, if one were to become available by the time this project was constructed. The cost of compensatory mitigation, if required, is

[8] 2010. FNSB. *North Pole Land Use* Plan, Available at http://co.fairbanks.ak.us/CommunityPlanning/NPLandUsePlan.pdf.

negotiated by the applicant and the mitigation provider on a per project basis. Requirements for compensatory mitigation will be discussed with the USACE at the time of permit application submittal or during a pre-application meeting, once a construction timeline is known. For estimating purposes in this report, compensatory mitigation for impacted wetlands will be assumed at $30,000 per acre.

CWA Section 401 states that no federal permit can be issued unless the state certifies that the discharge is consistent with the standards and water quality goals of that state. This includes considerations during construction to minimize sediment input into waters of the U.S. during ground disturbing activities.

Section 10 of the Rivers and Harbors Act (RHA) prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. The Tanana River has been designated as a navigable river by the U.S. Army Corps of Engineers (USACE).

Section 14 of the RHA (commonly referred to as "Section 408") authorizes the Secretary of the Army, on the recommendation of the Chief of Engineers of the USACE, to grant permission for the alteration or occupation or use of an existing USACE civil works project if determined not to be injurious to the public interest and not to impair the usefulness of the project[9]. This Section 408 review will be required for all work in and around the Tanana River Levee as the structure, though currently managed by the FNSB, was constructed as a USACE project.

The **Section 408** review for this project is expected to be one of the more complicated elements for permitting. No other USACE permit or authorization can be completed until the Section 408 decision is reached. The Alaska Section 408 program is not currently funded as a separate program and an agreement may need to be reached between the CONP and the USACE just to allow the review to occur in a timely manner, which can take from 6 to 24 months depending on the review needed. Specific requirements related to Section 408 are discussed in more detail with each alternate in Section 3.0.

[9] USACE. 2015. Engineering Circular 1165-2-216, *Policy and Procedural Guidance For Processing Requests To Alter Us Army Corps Of Engineers Civil Works Projects Pursuant To 33 USC 408*, available at http://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1165-2-216.pdf.

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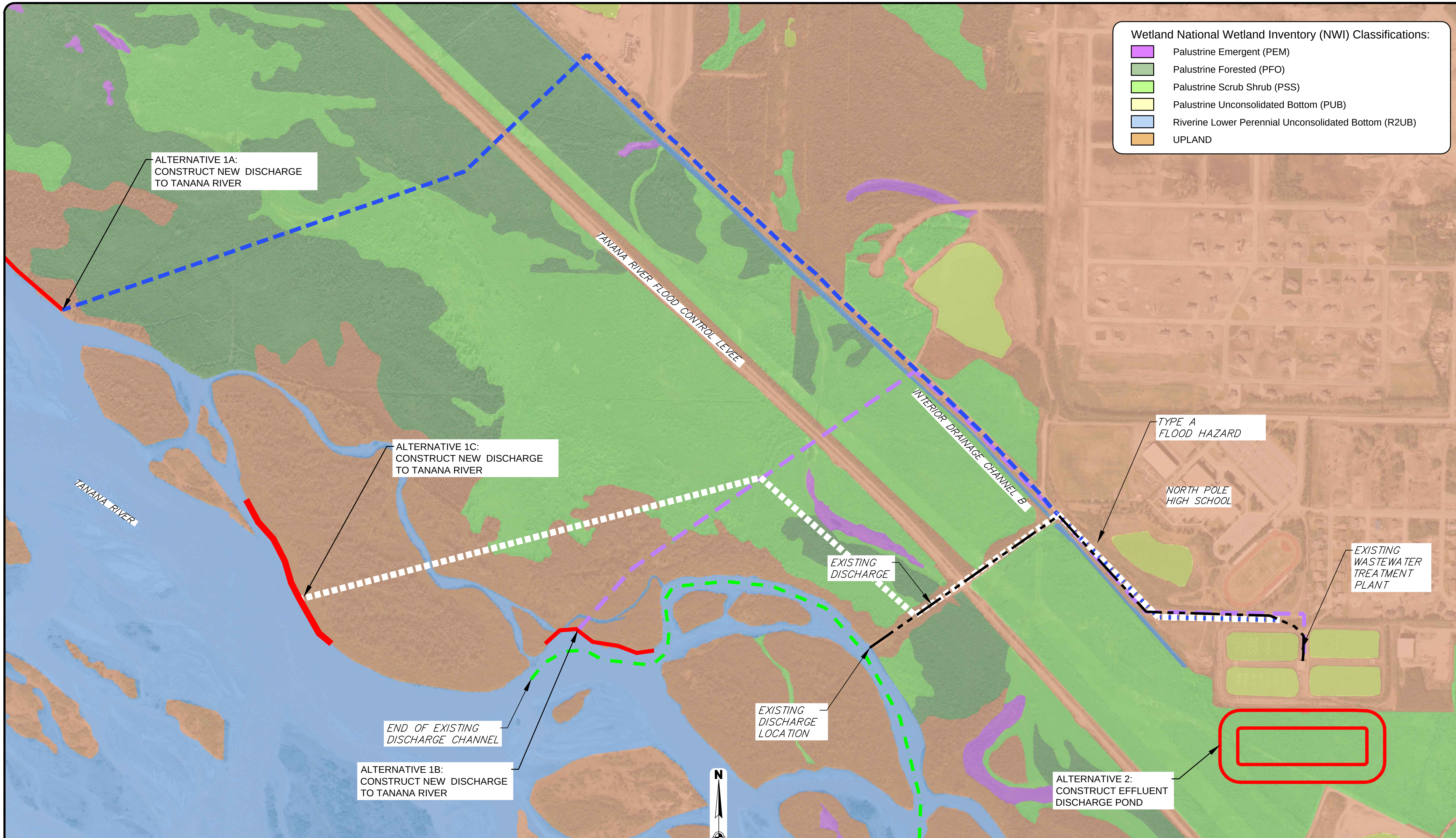

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WETLAND MAPPING

DATE December 2015

FIGURE 2

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1.2.2.4 Floodplains

North Pole is adjacent to the Tanana River, but is largely protected from flooding by the Tanana River Flood Control Levee, a 7.5-mile long levee that parallels the river from upstream of the project location all the way to the City of Fairbanks. FNSB has jurisdiction over the portion of the levee that is within the project area, but closely coordinates with the USACE to maintain the levee. Potential impacts to the levee will involve Section 408 consultation with the USACE, which has indicated that at a minimum plans must include routing pipes over or beneath (not through) the levee and features to protect against pipe rupture, seepage and/or piping. The Moose Creek Dam, which impounds and diverts water from the Chena River before it meets the Tanana, is to the northeast of the project location. The dam and levee, along with a floodway, were constructed in the 1970s as part of the Chena River Flood Control Project. North Pole's surrounding sloughs (Chena, Beaver Springs, Piledriver, and Twenty-three Mile) are now primarily fed by groundwater. Despite the levee and flood control measures, a portion of the existing facilities (lagoons) of the CONP WWTP is within a mapped flood area.

The current channel receiving discharge from the WWTP is part of the braid-plain of the Tanana River. A review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) indicates much of the project vicinity is within a mapped Special Flood Hazard Area (SFHA). A SFHA is defined as the land area subject to flooding by the 1 percent annual chance flood (100-year flood), also known as the base flood. The SFHA in this area is further broken into the following flood zones (Figure 3):

- Zone A: No base flood elevation (BFE) determined. The area adjacent to and behind the levee (to the east), including portions of the existing wastewater treatment lagoons are in this zone.
- Zone AE: Base flood elevations determined. This is a narrow area adjacent to the levee.
- Floodway: The channel of a stream plus any adjacent floodplain area that must be kept free of encroachment so that the 1 percent annual chance flood can be carried without substantial increase in flood heights. This includes the braid plain of the Tanana River.

New facilities located within any mapped regulatory floodplain will require a Floodplain Permit from the FNSB. If fill is added to any zone, a Zoning Permit is also required from the FNSB.

Any facilities located within a mapped regulatory floodway will require a no-rise analysis. This analysis must be certified by a registered professional engineer and be supported by technical data based on the standard step-backwater computer model (HEC-RAS) used to develop the 100-year floodway shown on the FIRM. This information is usually included in the Flood Insurance Study (FIS) report used to develop the FIRM. Additional river cross-sectional survey data may be needed to satisfy the model requirements. Close coordination with the FNSB Certified Floodplain Manager is necessary to obtain the technical and spatial data for the model; only some of which had been received at the writing of this report.

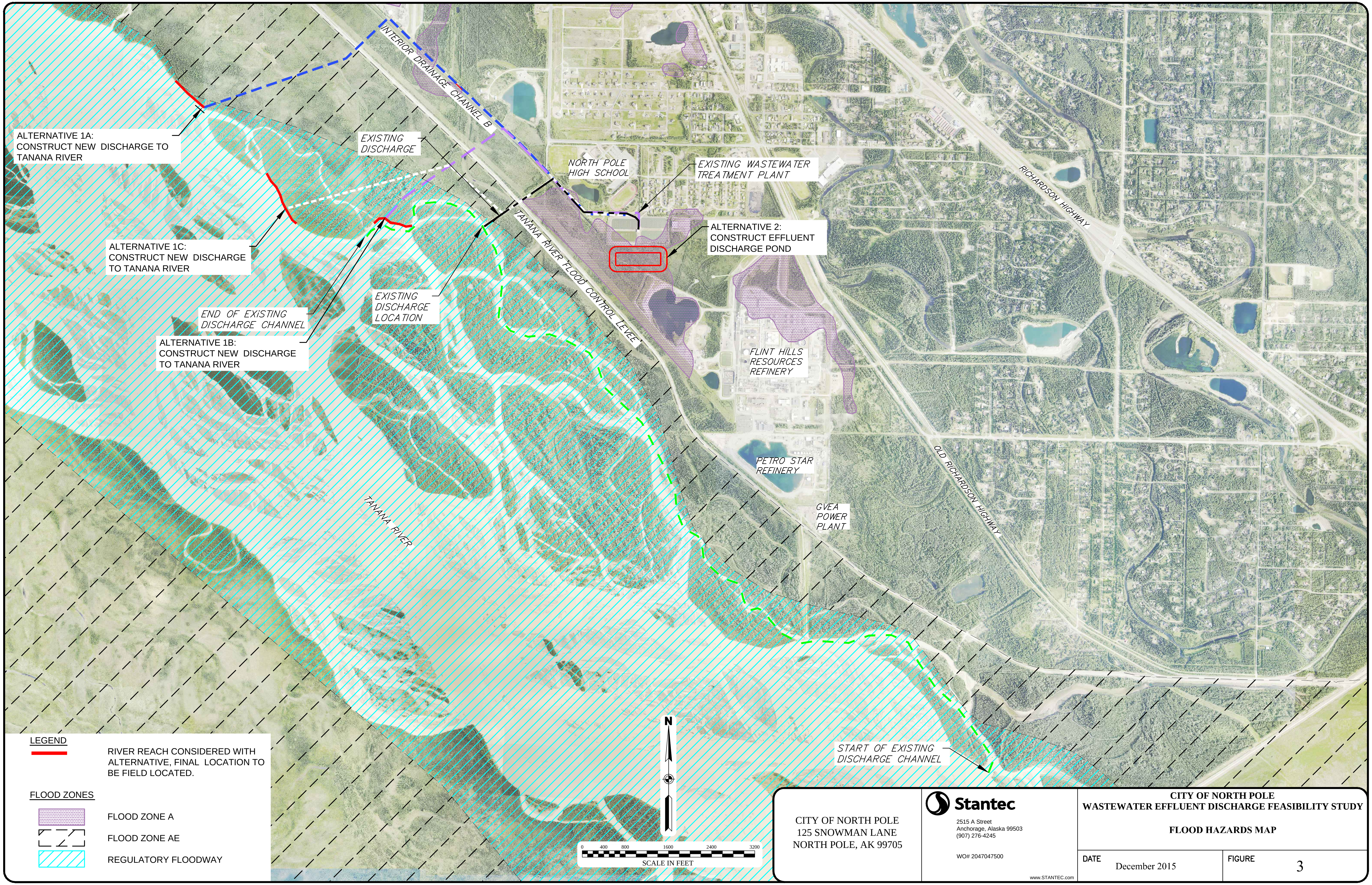
If the *No-Rise Analysis* demonstrates that new development in the floodway will not cause a rise in flood elevations during the occurrence of the base (100-year) flood discharge, and will not change the extent of the floodway boundaries, a floodplain permit is issued with the no-rise certification.

If it cannot be demonstrated that new development in the mapped regulatory floodway would have no impact on flood elevations (a no-rise certification), a FEMA Letter of Map Revision (LOMR) may be necessary. All requests that involve changes to floodways must be submitted to the FEMA Region X (Region 10) Office in Bothell, WA.

A LOMR is required to change the FEMA FIRM Map. LOMRs are generally based on the implementation of physical measures that affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway, the effective BFEs, or the SFHA. For alternates presented in this report, a no-rise determination is anticipated to be easily demonstrated and a LOMR is not anticipated.

For new facilities outside a regulatory floodway but within other designated flood zones, a LOMR Based on Fill (LOMR-F) may be required. A LOMR-F is FEMA's modification to the SFHA based on the placement of fill outside the existing regulatory floodway (zones A or AE). Fill cannot result in a floodway encroachment. FEMA reviews a request for LOMR or LOMR-F when the proposed project would justify a map revision.

A floodplain permit was previously completed for the WWTP building, but a finished construction Elevation Certificate was never submitted to receive the Certificate of Compliance.



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FLOOD HAZARDS MAP

DATE December 2015

FIGURE 3

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1.2.2.5 Contaminated Sites, Spills, Underground Storage Tanks, and Hazardous Materials

A review of the ADEC Contaminated Sites Program Database found several active contaminated sites within the overall vicinity. No contaminated sites are in the direct vicinity of the WWTP or current outfall location. There are two identified sites of interest. The Golden Valley Electric Association North Pole Power Plant (Hazard ID 2318) is listed as an active contaminated site for diesel range organics. The nearby, inactive Flint Hills Refinery south of the WWTP (Hazard ID 539) is listed as an active contaminated site and includes a groundwater sulfolane plume that has affected much of the CONP.

The sulfolane plume is an ongoing issue for the CONP and Flint Hills Resources (refinery owner) and has resulted in mapping of area wells and an extensive groundwater investigation. The groundwater plume is approximately 2 miles wide, 3.5 miles long, and over 300 feet deep[10]. Properties with impacted wells are being provided alternative drinking water supplies. The resulting mapping indicates that wells east of the WWTP (across Old Richardson Highway) have not been impacted. Wells north and to the west have detectable concentrations. As of 2014 Flint Hill Resources ceased refining operations at the North Pole facilities and uses the terminal in a reduced capacity for marketing product refined elsewhere[11].

1.2.2.6 Historic Resources

While formal consultation will be required on a final project during the permitting process, previous scoping with the ADNR Historic Division indicates that there are no primary concerns with the alternates proposed.

1.2.3 Existing Wastewater Facilities

The existing WWTP includes four partially mixed facultative wastewater lagoons and a treatment building where monitoring, chlorination, and de-chlorination occur. The facility was constructed in approximately 1985[12] and sits on a 19.8-acre parcel within a fenced enclosure of approximately 15 acres. Working with USKH Inc. (now Stantec) the CONP conducted a thorough system review of the WWTP in 2012 with the aim of proposing rehabilitation needs for an additional 20-year lifespan. The resulting *City of North Pole Wastewater Treatment Plant Rehabilitation Preliminary Engineering Report*[13] (2012 *PER*) included limited consideration of the existing outfall. Initial phases of the recommended work from the *2012 PER* were constructed in 2014/15 in the first major WWTP rehabilitation project for the CONP. The project consisted of the

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10 ADEC. 2015. North Pole Refinery – Project Home. Available at http://dec.alaska.gov/spar/csp/sites/north-pole-refinery/, as updated August 18, 2015.

11 Flint Hills Resources. 2014. Alaska News available at https://www.fhr.com/refining/alaska_news.aspx, as accessed July 15, 2015.

12 Roen Design Associates. 1989. *Lagoon Expansion Rebid*, record drawings, dated April 1985.

13 USKH Inc. *City of North Pole Wastewater Treatment Plant Rehabilitation Preliminary Engineering Report.* Dated July 2012)

addition of an emergency power generator, rehabilitation of the effluent liftstation; replacing the aeration piping supply lines, aeration blowers, and Cell 2 supply piping; replacing building heating and ventilation systems; rehabilitation of the disinfection system; upgrading the telecommunications, security and fire alarm systems, along with associated and ancillary structural repairs and other improvements.

In its current configuration, treated effluent flows from the WWTP by gravity down approximately 3,600 LF of effluent main to the Tanana River. The effluent then discharges at the river in a subsurface structure that is beneath rocks in the riverbed. The outfall was constructed prior to 1985, and no design or construction drawings are available for this original construction, although notes indicate the line was a 6-inch steel pipe. After completion of the WWTP construction, the effluent main was replaced[14] from just east of the river to north of Cell 2 where it is connected to the 10-inch insulated DIP constructed with the WWTP in 1985. An effluent lift station within the WWTP building is available to convert the gravity discharge into a forcemain discharge capable of handling the increased plant flows. In practice, the lift station is used infrequently, and treated effluent flows via gravity to the river.

1.2.3.1 WWTP Permit

The WWTP discharges to the Tanana River under a permit (AK-002139-3) issued by the U.S. Environmental Protection Agency (EPA) with a Certificate of Reasonable Assurance from the ADEC. The permit was to expire May 31, 2013, and is specifically a discharge permit for the outfall at the Tanana River located at 64°44'38.042" North Latitude and 147°22'57.463" West Longitude. The permit has been administratively continued as of the writing of this report.

Under the permit, the CONP has a mixing zone located in a small side channel of the Tanana River. The permit requires the CONP to conduct surface water monitoring at the outside edge of the zone during summer conditions (June 1 through September 30) and winter conditions (October 1 through May 31). In May 2012, the CONP notified the ADEC that it could not conduct the required monitoring due to lack of river flow. In October 2013, the CONP again found that the discharge was not in compliance because of loss of river flow. Following a series of meetings and other discussions, the ADEC issued a NOV in October 2014.

Key permit conditions are summarized in Table 1. Note that for the 5 day biological oxygen demand (BOD_5), total suspended solids (TSS), and total chlorine residual, the limitation in milligrams per liter (mg/L) is the loading limit in pounds per day (lbs./day) at the maximum allowable flow of 0.5 million gallons per day (MGD).

[14] Roen Design Associates. 1985. *Lagoon Outfall Line Sewer Project*, record drawings, dated May 1989.

Table 1 – Effluent Permit Conditions

Parameter	Limitation	Comment
Flow	0.5 MGD	Maximum daily with continuous, recording meter required
BOD_5 and TSS	85% average monthly removal [1] 30 mg/L and 125.1 lbs/day average monthly[2] 45 mg/L and 187.6 lbs/day average weekly [2] 60 mg/L and 250.2 lbs/day maximum daily [2]	Influent and effluent grab sampling twice per month
Fecal Coliform Bacteria	200 / 100 ml [3] average monthly 400/ 100 ml average weekly 800/100 ml maximum daily	Effluent grab sampling twice per month
Total Residual Chlorine	0.5 mg/L and 2.1 lbs/day average monthly [2] 0.75 mg/L and 3.1 lbs/day average weekly [2] 1.00 mg/L and 4.2 lbs/day maximum daily [2]	Effluent grab sample weekly
pH	6.0 to 9.0 standard unit at all times	Effluent grab samples 5 times a week.
Dissolved Oxygen	2.0 mg/L minimum daily	Effluent grab samples 1 time a week.
Total aqueous hydrocarbons (TAqH)	15 µ/L maximum daily	
Total aromatic hydrocarbons (TAH)	10 µ/L maximum daily	

Notes:
1. Percent removal = (average monthly influent - average monthly effluent)/I average monthly influent load.
2. Loading (in lbs/day) = concentration (in mg/L) * concurrent flow (in MGD) * 8.34.
3. The monthly value is calculated as a geometric mean, i.e. the nth root of the product of the individual data points.

The permit allows for a mixing zone in the Tanana River. The mixing zone is for fecal coliform bacteria, dissolved oxygen, pH, total chlorine residual, metals, temperature, and whole effluent toxicity (WET). Based on an assumed dilution of 91:1, the mixing zone size varies between seasons with the summer mixing zone (higher flows) a maximum of 9 meters[15] downstream of the outfall and 2 meters in width (29.5 feet by 6.6 feet), and the winter area extend to a maximum of 267 meters downstream and 4 meters in width (876 feet by 13.1 feet). Surface water monitoring for potential contaminants is conducted at the outside edge of the mixing zone.

[15] State of Alaska ADEC. 2008. March 28. *Final Certificate of Reasonable Assurance*.

Parameters that must be measured at the edge of the mixing zone based on the ADEC Certificate of Reasonable Assurance for the EPA National Pollutant Discharge Elimination System (NPDES) permit are summarized in Table 2.

Table 2 – ADEC Mixing Zone Requirements

Parameter	Limitation
Size	Dilution of 91:1 Area extending downstream from outfall maximum of 9 m in length and 2 m in width, summer (June 1 to September 30) and 267 m in length and 4 m in width, winter (October 1 to May 31)
Fecal Coliform[2]	20 / 100 ml average monthly 40 / 100 ml average daily
Total Residual Chlorine	1 mg/L maximum daily 11 μ/L maximum 30 day average 19 μ/L maximum daily limit
pH	6.5 to 8.5 standard unit at all times
Dissolved Oxygen	7.0 to 17 mg/L at all times
Signage	Warning sign at discharge

Notes:

1. Parameters indicated here are for all points outside the mixing zone and are based at samples taken at the downstream edge of the mixing zone.
2. The monthly value is calculated as a geometric mean, i.e. the nth root of the product of the individual data points.

The North Pole wastewater system has additional analytical and program requirements because over 30 percent of the flow has come from industrial customers (e.g. petroleum refineries). These additional requirements include the need to develop and implement an industrial pretreatment program, operations and maintenance (O&M) plan, and a quality assurance plan (QAP). With the closure of the Flint Hills Refinery, new permit applications will need to consider the need for this program based on then current and projected industrial flows.

1.2.3.2 ADEC System Classification

The WWTP uses partially mixed, aerated facultative wastewater lagoons with chlorination and de-chlorination; resulting in an ADEC classification as a Class 1 treatment facility. In Alaska, wastewater systems are classified according to a point rating system for both treatment and collection systems. Point values are assigned for each of the various components found in the WWTP according to 18 Alaska Administrative Code (AAC) 74. The CONP's current treatment scoring is shown in Table 3 as provided by ADEC[16].

Table 3 – Existing North Pole Wastewater Treatment Classification Score

Score Category	Score
Size (Peak day design capacity, gallons per day [gpd]) - 500,001 – 1,000,000	12[1]
Secondary Treatment – Aerated Lagoon	8
Disinfection – Liquid and powdered hypochlorites	3
Disinfection – De-chlorination with de-chlorination agents other than gas	3
Effluent Discharge – Plant pumping of effluent	2
Total	**28**
Note: ADEC reports scoring using the peak day capacity shown; however, the facility is permitted for 0.5 MGD.	

Should the North Pole system complexity change, the system would be reclassified as indicated below:

- Class 1: Score 1 to 30.
- Class 2: Score 31 to 55.
- Class 3: Score 56 to 75.
- Class 4: Score greater than 75.

Generally, changes at the WWTP need to consider potential reclassification of the system as it is three points away from being listed as a Class 2 system. Changes to the system class result in additional training requirements for the WWTP operators. Current CONP staffing includes one Class 1 operator (Christopher Lindsoe), one Class 2 operator (James Donovan), and one Class 3 operator (Paul Trissel). Based on this, training costs will not be included but should be addressed if the CONP becomes aware of staffing issues that would necessitate training. Neither of the alternates considered in this study is expected to change the system classification.

16 ADEC. 2015. https://dec.alaska.gov/Applications/Water/OpCert/Home.aspx?p=SystemSearchRecord&d=376&search=North Pole

1.2.3.3 Wastewater Generation

The CONP provides service to approximately 650 customers in a portion of the incorporated City. The remaining properties are served by septic systems. The existing facility is limited to a maximum of 0.5 MGD flow by its present permit. Plant operators measure flow on a daily basis using the effluent V-notch weirs in the plant (discharge meter is included in 2015 rehabilitation project).

Average, minimum, maximum, and total annual flows recorded at the WWTP for 2008 to 2015 are shown in Table 4, while Table 5 shows average monthly flows for the same period.

Table 4 – Annual Discharge Summary 2008 to 2015

Period	Average (gpd)	Minimum (gpd)	Maximum (gpd)	Total (gallons)
2008	300,200	226,400	486,700	109,930,000
2009	280,400	195,800	354,200	102,650,000
2010	271,200	214,600	364,300	98,510,000
2011	257,900	142,600	308,200	94,133,500
Nominal Average Annual Value 2008 -2011	**280,000**	**195,000**	**380,000**	**101,000,000**
2012	235,800	141,100	299,500	86,290,000
2013	221,000	161,300	299,500	80,870,000
2014	211,400	100,800	463,700	47,760,000
2015 (thru May)	130,300	51,800	216,000	13,170,000
Nominal Average Annual Values 2012 – 2015	**200,000**	**114,000**	**320,000**	**73,000,000**

Notes:

1. Data compiled from reports provided by Jerry Pollen, Pollen Environmental, LLC (previously NTL).
2. Where daily data was not available, totals are based on an average value times the number of days in the month.

Prior to 2012, average daily flow was approximately 280,000 gpd, with peaks to 380,000 gpd. In the winter when inflow and influent (I&I) is reduced and seasonal demands are low, flows reduce to about 195,000 gpd. The WWTP occasionally reached peaks of 500,000 gpd, most likely during spring melt and rainy periods.

However, in recent years, CONP has lined portions of the sewer system, and repaired various manholes to reduce I&I. Consequently, daily flows have reduced considerably. Current average daily flow is down to 200,000 gpd, a reduction of 40 percent.

The CONP's major industrial customer, Flint Hills Refinery, ceased operations in 2014, resulting in further reductions in wastewater flow. Summer flows are expected to remain on the order of 200,000 gpd. However, data for fall / winter 2014 and 2015 shows that winter flows are trending much lower than previous years, on the order of about 95,000 to 110,000 gpd, a 50 percent reduction in flow. This is potentially problematic for the WWTP, as the plant relies upon both the flow and temperature of the incoming wastewater to mitigate freezing in the lagoons and effluent disposal pipes. Any effluent disposal alternate selected must be functional in the winter, at a flow on the order of 100,000 gpd. Freezing potential is discussed in detail in Section 3.1.

While flow is generally much less, the WWTP is permitted for a daily flow of 500,000 gpd, and during peak days, the plant does occasionally approach that figure. Flows exceeded 400,000 gpd eleven (11) times in the past 7 years. While this is an infrequent event, it should be noted that the WWTP only has an additional 180,000 gpd available for expansion, beyond current peak flows.

The *2012 PER* was a condition assessment addressing overall WWTP needs. The *2015 PER* included discussion of future flow requirements. In 2011, potential residential development projects within North Pole were projected to require about 313,000 gpd of wastewater capacity. No timeline exists for these projects, and the demand is not immediate, but once this flow is realized, the WWTP will need a capacity in excess of 633,000 gpd. The effluent disposal alternates need to be able to accommodate this future flow, or at least allow for expansion. The *2012 PER* suggests a 1.0 MGD capacity at the end of a 20-year planning period.

Table 5 – Monthly Discharge Summary 2008 to 2015

	2008		2009		2010		2011	
Period	Total Flow (gallons)	Average Flow (gpd)	Total Flow (gallons)	Average Flow (gpd)	Total Flow (gallons)	Average Flow (gpd)	Total Flow (gallons)	Average Flow (gpd)
January	8,220,960	265,192	8,340,480	269,048	7,812,000	252,000	8,047,954	259,611
February	8,210,880	283,134	7,615,560	271,984	7,359,586	262,842	7,383,304	263,689
March	9,025,920	291,159	8,384,940	270,482	8,469,955	273,224	7,440,676	240,022
April	9,722,880	324,096	8,712,465	290,415	8,371,705	279,057	8,432,229	281,074
May	10,628,640	342,859	10,213,920	329,481	8,585,760	276,960	7,598,945	245,127
June	8,368,429	278,948	8,695,742	289,858	9,162,327	305,411		
July	9,894,499	319,177	8,956,800	288,929	9,356,138	301,811		
August	12,093,189	390,103	9,783,360	315,592	9,277,004	299,258		
September	9,011,823	300,394	9,338,400	301,239	8,064,655	268,822		
October	8,532,323	275,236	6,888,657	222,215	7,754,606	250,149		
November	8,178,960	272,632	7,475,657	249,189	7,257,600	241,920		
December	8,036,880	259,254	8,245,380	265,980	7,035,652	242,609		
	2012		2013		2014		2015	
Period	Total Flow (gallons)	Average Flow (gpd)	Total Flow (gallons)	Average Flow (gpd)	Total Flow (gallons)	Average Flow (gpd)	Total Flow (gallons)	Average Flow (gpd)
January	6,945,578	224,051	7,262,734	234,282	4,036,280	183,467	2,445,130	121,578
February	6,619,954	228,274	6,786,000	234,000	4,047,840	202,392	2,491,200	130,752
March	7,136,313	230,204	7,097,760	228,960	4,134,240	196,869	2,731,680	130,778
April	7,845,943	261,531	6,986,618	232,887	4,420,800	218,225	2,907,360	144,262
May	7,243,325	233,656	7,709,134	248,682	4,040,640	204,480	2,592,000	123,971
June	6,992,229	233,074	6,238,080	207,936	4,972,320	233,673		
July	7,840,407	252,916	6,127,325	197,656	6,511,680	328,909		
August	7,734,365	249,496	6,387,578	206,051	6,022,080	315,720		
September	7,024,320	234,144	7,557,943	251,931	1,906,740	278,303		
October	6,983,249	225,266	6,356,348	205,043	2,659,320	134,885		
November	6,692,073	223,069	6,085,029	202,834	2,460,960	123,048		
December	7,235,931	233,417	6,270,950	202,289	2,545,880	116,938		

Notes:

1. Data compiled from reports provided by Jerry Pollen, Pollen Environmental, LLC (previously NTL).
2. In July 2008 new permit conditions changed the calculation of the total volume as readings were not collected on weekends. Previously, total volumes were calculated as average daily flow (gpd) for those days measured times the number of days in the month.
3. Data for the end of 2011 was not available at the writing of this report, nor yet received for period after May 2015

1.2.3.4 Need for the Project

The CONP WWTP provides a basic sanitation service to the community with serious community health and sanitation, as well as area environmental, consequences if there are system failures. The existing outfall was constructed prior to the 1985 expansion when the CONP took over the site. While various segments of the effluent main have been upgraded at various times, it is believed the discharge at the river is original construction, and only 6 inches in size. It is of unknown condition as its location in the river bed is inaccessible. The rest of the force main to the outfall consists of both 8-inch and 10-inch ductile iron pipes (DIPs). There are several concerns related to the existing effluent line, namely:

- The line is of three different sizes, two different materials, and three different installations with the oldest exceeding 30 years;
- The condition of the pipe is unknown;
- Pipe inspection and / or repair is complicated by the lack of access with only two valves and one cleanout manhole available after leaving the WWTP (conditions of these are also unknown); and
- The outfall remains of unknown construction, but at 6 inches is undersized for projected flows, and no longer connects to a water body with consistent capacity to ensure compliance with discharge permits.

The security of the effluent discharge system is an ongoing concern. It is a recognized public and environmental health concern to have wastewater effluent discharged with contaminants at greater than permitted limits. When flows in the current discharge channel cease, or are reduced, the effluent becomes most if not the only flow in the channel, allowing the public and wildlife direct access to the flow.

Photo 1 – May 2015 of dumping of debris and carcasses at outfall

The access road that allows monitoring at the discharge point also allows public access. While a sign notifying the public of the discharge is posted, it is frequently removed. The area is also frequently used for dumping all manner of debris and carcasses.

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2.0 ALTERNATE DEVELOPMENT

2.1 DESIGN CRITERIA

The following are requirements for all construction alternates to be considered:

- The design of all wastewater facilities must comply with ADEC Wastewater Disposal regulations (18 AAC 72). Designs must be submitted to the ADEC for plan review prior to construction.
- A new discharge will require modification or a new discharge permit through ADEC. Wastewater discharges must comply with the 2003 ADEC Water Quality Standards regulations (18 AAC 70). The 2003 Water Quality Standards are the latest wastewater regulations approved by the EPA. The CONP has adopted the *City of North Pole Utility Standards of Construction* (*Utility Standards*, June 2007) that require compliance with state regulations and current Uniform Plumbing Code (UPC). The *Utility Standards* generally address the design of the wastewater collection system and the water distribution system, but do not specifically speak to wastewater treatment facilities. Where applicable the *Utility Standards* shall be followed.
- As noted in the *2012 PER* the CONP would like to develop the capacity for eventual flows of 1.0 MGD. While this is not a current design parameter, the ability to allow expansion will be considered, with 1.0 MGD as the target. Designs must accommodate the permitting flow of 0.5 MGD while protecting from freezing an overage low flow of 100,000 gpd.
- The WWTP is permitted through the ADEC. Modifications to processes and equipment may require updates to facility operations plans, as well as ADEC plan review for potential permit revisions and Approval to Construct and Operate the rehabilitated facility.
- Under Executive Order 11988, Floodplain Management, Federal agencies funding and/or permitting critical facilities are required to avoid the 0.2 percent (500-year) floodplain or protect the facilities to the 0.2% chance flood level. Wastewater treatment facilities are critical facilities. As noted in Section 1.2.2.4, the CONP WWTP, while excluded from a floodplain by its elevation, is surrounded by a federally designated Zone A flood hazard area. All new facilities will be in a floodplain and require a no-rise certification, FEMA LOMR-F, and/or other permitting as outlined in Section 1.2.2.4. When feasible, floodplain impacts shall be minimized.
- Review by the USACE will include requirements for state Section 401 certification, as well as Section 10 analysis for impacts to the Tanana River and Section 408 review for impacts to the Tanana River Levee.
- Work outside previously disturbed areas and in the water should be assumed to require a USACE Section 404 wetlands permit for unavoidable impacts to wetlands and waters of the U.S. Compensatory mitigation is assumed as discussed in Section 1.2.2.3.

- As a condition of a USACE permit, USACE will likely require following the USFWS's time periods for avoiding vegetation clearing to protect migratory birds. This would exclude clearing in the project area from May 1st to July 15th of any calendar year.

- If an eagle's nest is found to be within 1-mile of the project area, an Eagle Permit may be required from the USFWS.

- All in-water work will require both USACE 404 permits and an ADF&G Fish Habitat Permit.

- Because there is always the potential for construction sediments to reach area waterbodies, contractors will be required to implement best management practices (BMPs) for sedimentation control on all projects. This requirement will be part of construction contracts regardless of project area and coverage under APDES Construction General Permit (ACGP). ACGP coverage is required for both the contractor and the CONP when the project involves an acre or more of disturbed area. ACGP coverage involves the creation of a storm water pollution prevention plan (SWPPP). As a community with a permitted municipal separate storm sewer system (MS4), the CONP may establish additional requirements as part of their MS4 program.

2.2 ALTERNATE DEVELOPMENT

2.2.1 Alternates Considered and Not Developed

As noted in Section 1.0, the *Preliminary Study* considered five alternates, seeking agency and stakeholder input. The following three alternates were removed from consideration in this feasibility study: reestablishing channel flow; modify and/or re-permit existing outfall; and modify WWTP to meet water quality standards at discharge. For the purposes of this feasibility study report, three alternates are considered in detail: No-action; Alternate 1 - Construction of a new discharge to the Tanana River; and Alternate 2 - Construct a new effluent infiltration pond. These alternates are developed in Section 3.0.

2.3 EXISTING CONDITIONS: NO-ACTION ALTERNATE

While the option of doing nothing is not viable given the need for maintaining the system and bringing it into compliance, this alternate is outlined here for comparison with the other options developed.

2.3.1 Description

As described in Section 1.2.2.6, after disinfection, WWTP effluent is discharged through a lift station via approximately 3,600 linear feet (LF) of effluent pipe to the Tanana River. Initially, it was believed that the effluent pipe was a 6-inch pipe of unknown material from the pre-1985 Stillmeyer pond construction, prior to City ownership of the WWTP site. However, recently located record drawings for a "Lagoon Outfall Line Sewer Project", dated November 1989 show portions of the effluent pipe being upgraded to an 8-inch DIP. At this time, most of the effluent main, including the levee crossing are 8-inch DIP. There is a segment of 10-inch DIP at the WWTP itself. The final length of pipe into the river is still original, and size and condition are unknown. Only one cleanout manhole (at the levee) is believed to exist.

Under normal operations, treated effluent flows from the WWTP by gravity to the Tanana River. The effluent then discharges at the river in a structure beneath rocks in the riverbed. When the current WWTP was expanded in 1985, construction included the addition of an effluent lift station within the WWTP building to convert the gravity discharge into a forcemain discharge capable of handling the increased plant flows. In practice, the lift station is not used very much, and gravity flow is routed through the de-energized pumps and check valves in the lift station.

There is normally about 13 to 18 feet of elevation difference between the WWTP effluent discharge weirs and the existing discharge point at the Tanana River, depending upon river flows. This provides a hydraulic energy grade of roughly 0.36 to 0.50 feet per 100 feet (equivalent to a 0.36 to 0.50 percent slope). This is adequate for an effluent discharge capacity via gravity of about 170 to 220 gallons per minute (gpm) in the 6-inch pipe, depending upon the condition of the pipe. In effect, the WWTP can discharge up to about 316,000 gpd via gravity alone. During higher flow events, or if the Tanana River is flooded, the operators need to turn on the effluent discharge lift station, which boosts the flow through the effluent main. The effluent lift station was rehabilitated as part of the 2014 *Wastewater Treatment Plant Rehabilitation Project – Phase 1*, which provided structural repairs and coatings to the effluent lift station, as well as new pumps.

2.3.2 Environmental Impacts and Permitting

Continued use of the existing discharge pipe may result in violations of the CONP's effluent discharge permit, which is based on having adequate flow in the river braid to maintain a mixing zone. Discharge during periods of low or no river flow could result in exposure to treated effluent by fish, wildlife, and the public without proper dilution. While the risk is low, exposure to pollutants could have adverse impact to the health of fish, wildlife, and humans. Leaving the outstanding NOV issued by ADEC unaddressed can also result in fines, revocation of WWTP permit, or closure of the WWTP.

2.4 BASIS FOR COST COMPARISONS

2.4.1 Alternate Construction Costs

There are no construction costs associated with the "no – action" alternate.

2.4.2 O&M Costs

Costs associated with the operating the existing effluent lift station and discharge pipe are currently included in the CONP WWTP budget and not accounted for separately. To avoid discussing O&M costs associated with alternates in nebulous terms – more or less time, power, etc. – practical efforts have been made to identify and quantify the changes in O&M costs for each alternate. O&M costs may influence the overall life cycle cost of a project in significant ways, particularly in an economic climate where labor reductions have already created a shortage in time available for O&M activities. Table 6 lists the O&M tasks attributed to the No-Action Alternate for comparison with other alternates. Note that this is not the full O&M required for the WWTP, rather it is only the costs associated with the effluent disposal system. Additional detail on the development of Table 6 is provided in Appendix G.

Table 6 – No-Action Alternate Estimated O&M Costs

Work Description	Annual Labor	Annualized Equipment Replacement	Equipment Power	Misc. Annual Costs	Total Annual Costs
Effluent lift station pumps including weekly exercising, effluent pumping (10 days), and replacement every 10 years	52 hours	$2,310	$240	$0	$5,337
Monthly cleaning of the wetwell to remove accumulations and facilitate inspection	24 hours	$0	$0	$0	$1,286
Weekly outfall inspection and maintenance, signage replacement 1-2 times per year	78 hours	$0	$0	$500	$4,679
Discharge sampling twice a year	6 hours	$0	$0	$2,000	$2,321
Weekly batch mixing of chlorine solution, with replacement of chemical metering pump and batch and dosing mixers every 7 years	208 hours	$1,204	$1,357	$12,000	$25,706
Weekly batch mixing of dechlorinating solution chemical metering pump replacement every 7 years	104 hours	$250	$386	$8,000	$14,208
				Annual Total	**$53,538**

Overall, O&M activities listed here for the No-Action Alternate account for approximately 472 hours per year in labor, approximately 25 percent of a full-time equivalent (FTE) position.

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3.0 ALTERNATES

3.1 ALTERNATE 1: CONSTRUCT NEW DISCHARGE TO TANANA RIVER

3.1.1 Description

3.1.1.1 Routing

This alternate considers construction of a new discharge to a point where mixing zone compliance can be expected for the foreseeable future. As shown on figures 2, 3 and 4, there are multiple routes for consideration.

Alternate 1A

Alternate 1A is approximately 9,800 LF and routes pipe along the existing access road parallel to the flood control levee until a point where it can be routed to the Tanana River. Alternate 1A is predominantly outside of the regulatory floodway (see Table 7), does not cross any river channels, and reaches the main channel of the Tanana River. ADF&G has expressed some initial concern with this alternate, as the main channel of the Tanana River does include spawning habitat, although none have been specifically observed at this location. A complete record of the ADF&G discussions in included in Appendix A.

Table 7 – Alternate 1 Floodplain Impacts

Flood Zone	Alternate 1A Length (LF)	Alternate 1B Length (LF)	Alternate 1C Length (LF)
Flood Zone A	892	422	425
Flood Zone AE	2792	891	2360
Regulatory Floodway	225	1090	2452

Alternate 1B

Alternate route 1B was suggested by ADF&G as unlikely to present issues with spawning habitat. This route is shorter; about 5,900 feet long, with almost half of the route within the river floodway (see Table 7). This location is near the outlet of the river braid system the WWTP currently discharges into, and not on the main Tanana River channel. As such, this location is expected to experience much the same seasonal flow variation, especially in winter, affecting the current discharge. It is not clear that Alternate 1B receives the necessary flows for a mixing zone during low river flow events. For this reason, Alternate 1A is more likely to meet discharge permit requirements, but will require negotiations with ADF&G.

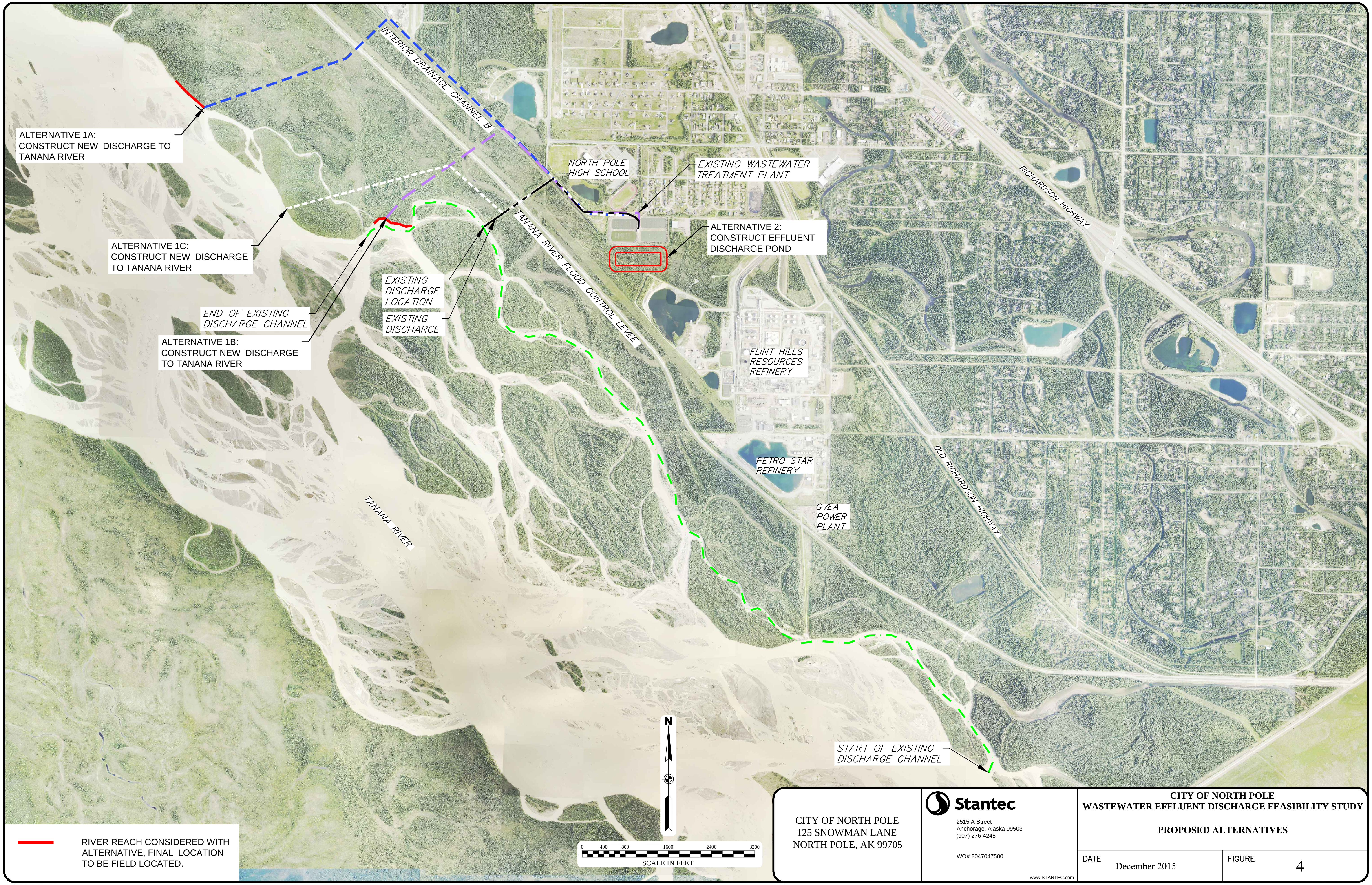
Alternate 1C

Alternate 1C was added to the FS consideration following the initial draft of this study by the CONP. CONP operators are nearly certain that when the existing outfall experiences reduced flows (i.e. a dry channel), the impacted reach extends as far as the site shown for the Alternate 1B outfall. This seasonal flow variation concern is enough to keep the ADF&G preferred Alternate 1B from being viable. Since extension of the pipeline to some location south of the Alternate 1A outfall, farther from the main channel and its spawning habitat was the concern driving the location, Alternate 1C was added.

The routing of Alternate 1C was changed late in the development of this study when record drawings were found indicating that the 6-inch effluent line from the WWTP was replaced in about 1989. At 8 inches, until right before the discharge, this line is a feasible alternate for use at lower flows, allowing its use and a phased construction approach. (A phased approach is not feasible with other routes).. The routing for Alternate 1C considered here is shown on figures 2, 3 and 4.

At 7,400 LF, Alternate 1C is substantially similar to the other two routes with the obvious change in length and the addition of an ephemeral channel crossing. The alignment follows the existing road parallel to the flood control levee and then crosses the levee using the existing discharge access road. After crossing the levee, the alignment goes northwest again paralleling the levee until it passes the river braids that are part of the existing discharge path. The route then heads straight to the river.

Photo 2 – Potential IC channel crossing (10/28/15)



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WASTEWATER EFFLUENT DISCHARGE FEASIBILITY STUDY

PROPOSED ALTERNATIVES

DATE	FIGURE
December 2015	4

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Route Comparison

Aside from river flows at the point of discharge and their length, the route alternatives are substantially similar in terms of construction feasibility. For the purposes of this report, Alternate 1A has been developed as a conceptual design and is shown in Appendix D. This alternate was used as it is the longest pipe and no concerns have been raised with respect to river flow volumes at the outfall.

While the issues associated with the routes considered with Alternate 1 are comparable, shorter is preferable, but since Alternate 1B is not expected to be viable, Alternate 1C has been used for comparison and discussion purposes in the following sections. Table 8 summarizes the differences between the three routes. Table 8 values are explained further in the following sections.

Table 8 – Alternate 1 Summary and Route Comparison

	Alternate 1A	Alternate 1B	Alternate 1C
Construction			
Pipe Length to be Constructed	9,800 LF	5,900 LF	7,400 LF
Clearing	3.5 acres	2.6 acres	4.1 acres
Access Road	3,850 LF	2,800 LF	4,320 LF
Manholes	22	14	18
Active Channel Crossing	1	1	2
Recommended Pipe Size	12"	10"	10" or 12"
Construction Cost	$4,892,640	$4,112,640	$4,339,740
Total Project Cost 2020	$6,604,956	$5,648,961	$5,942,940
Environmental Impacts			
Wetland Impact	3.26 acres	1.55 acres	2.47 acres
Length in Regulatory Floodway	225 LF	1090 LF	2452 LF
O&M			
Heating Electrical Costs	$13,340	$8,220	$10,200
Total Annual O&M Cost Projected	$71,549	$66,429	$68,409

3.1.1.2 Clearing

Construction of the pipe is expected to require clearing a 40-foot wide corridor of trees and brush for from the existing road to the discharge location. The clearing width is needed not only for the pipe trench, but also for construction access, stockpile of excavation, and subsequent maintenance access. Approximated cleared areas are provided by route in Table 8.

3.1.1.3 Access Road

Construction of a 15-foot wide, single-lane access road is required along the final length of pipe from the existing road to the new outfall. The existing road paralleling the Tanana River Levee will be sufficient to access the new pipe in some areas, so additional road construction will be limited to where the route is across the levee, drainage channel, and forested and undisturbed floodplain.

The new road will be constructed by clearing brush and vegetation down to the level of existing ground; placement of high-strength geotextile fabric over the remaining vegetation; placement of approximately 3 feet of classified fill, and 6 inches of crushed aggregate surface course. Cross-culverts, 24 inches in diameter will be provided at approximately 200-foot intervals, and at strategic locations, for drainage relief. The road will include wider pullouts at each manhole for maintenance vehicles, and vehicle turn around and passing. Note that as shown, Alternate 1C has assumed use of the existing 8-inch pipe for some period and has been routed accordingly. If funding for a direct route is available, the road and related impacts can be minimized by a more direct route with a new levee crossing.

3.1.1.4 Pipe Design and Construction, Freeze Considerations

Referring to Section 1.2.3.3 Wastewater Generation, flows can be expected to vary from a low of 100,000 gpd in winter, to a typical yearly average of 200,000 gpd, to the permitted flow of 500,000 gpd, and up to the potential ultimate future flow of 1.0 MGD. It is desired that the effluent pipe accommodate this entire range of flow, ideally under a gravity flow condition to minimize need for pumping. A number of pipe sizes were examined under the full range of flows. Table 9 summarizes the results, while the complete analysis is provided in Appendix E.

Table 9 – Alternate 1C Effluent Main Headloss

		Total Headloss / Head Required (ft)			Pumping Power Required (Hp)			Power Cost Per Day at $.16 / kwhr		
	Daily Flow (GPD)	8" Pipe	10" Pipe	12" Pipe	8" Pipe	10" Pipe	12" Pipe	8" Pipe	10" Pipe	12" Pipe
Winter Low Flow	100,000	11.2	10.39	10.17	0.0	0.0	0.0	$0	$0	$0
Average Annual Flow	200,000	14.2	11.42	10.62	0.0	0.0	0.0	$0	$0	$0
Permitted Flow	500,000	32.7	17.72	13.36	7.2	3.9	0.0	$22.97	$12.46	$0
Future Growth	1,000,000	91.7	37.85	12.10	40.2	16.6	5.3	$128.99	$53.23	$17.02

There is approximately 22 feet of elevation head available between the WWTP lagoons and the new discharge point at the Tanana River. Based on the function of the existing effluent disposal main, about 10 to 12 feet is assumed available for gravity flow, while the rest is consumed in minor losses in the piping system (estimated at 10 feet total) and additional friction due to sediment build up, etc.

Based on analysis on the various routes (see Appendix E), an 8-inch pipe is sufficient for current average flows, but required pumping energy increases with pipe length particularly for higher flows. Either a 10- or 12-inch pipe is a good choice for the expected flows and length of pipe. Costs and analysis in this report have assumed a 12-inch pipe because it can accommodate the currently permitted 500,000 gpd flow without pumping, while only requiring minor pumping energy / cost to achieve the ultimate 1 MGD flow. With Alternate 1B and possibly even Alternate 1C routes, a 10-inch pipe could be used.

Residence time in the pipe can be considerable, as much as 9.6 hours in a 12-inch pipe for Alternate1C during the low winter flows (100,000 gpd). The existing 3,600-foot, mostly 8-inch effluent main at typical flows (200,000 gpd), has a residence time of about an hour and freezing has not been a concern. Ordinary insulation is sufficient to prevent freezing in the existing condition, and no additional heat is required. The longer, larger effluent mains contemplated in Alternate 1 are expected to require some additional heat, at least on the coldest days until flow levels increase in future years. Appendix E includes thermal analysis for the 8-, 10-, and 12-inch pipes for all three alternates; Table 10 summarizes the basic findings for Alternate 1C.

Initial effluent temperature is a function of WWTP flows, air temperature, and the overall degree-days below freezing for any given winter. Most recent data for 2014/2015 reported the WWTP effluent temperature at 1.6 to 2.2 deg C, with one week where temperatures dropped below 1.0 deg C, with the lowest being 0.8 deg C.

Referring to Table 10, *Time to Reach 0 deg C* is how long it takes the effluent in the pipe to chill to the freezing point; *Time to Start of Ice Formation* is how much longer before ice begins forming on the pipe walls. However, once 0 deg C is reached, if temperature is not increased, it is very likely the pipe will freeze. The time to reach 0 deg C is a function of the initial effluent temperature. The time ranges from 6 to 10 hours at -35 deg C (-30 deg F) depending on the size of pipe. Residence time during winter flows approaches 9.6 hours for the proposed 12-inch pipe. Consequently, the effluent is on the verge of freezing. Smaller pipes are more resistant to freezing due to the shorter residence time.

Colder days do reduce the time to freeze, but not substantially as the ground surrounding the pipe moderates short temperature swings.

Table 10 – Alternate 1C Effluent Main Thermal Analysis

		Residence Time in Pipe at 10,150 LF		
	Daily Flow (GPD)	8" Pipe (Hours)	10" Pipe (Hours)	12" Pipe (Hours)
2014 - 2014 Low Flow	100,000	4.4	6.8	9.6
2012 - 2015 Average Annual Flow	200,000	2.2	3.4	4.8
Design / Permitted Flow	500,000	0.9	1.4	1.9
Future Growth	1,000,000	0.4	0.7	1.0
Effluent at 1.5 Deg C, -35 Deg C Design Temp				
Time To Reach 0 Deg C	Hours	6.3	8.4	10.4
Time to Start of Ice Formation	Hours	19.4	25.6	31.6
Minimum Flow Required to Stay Above 0 Deg C Without Added Heat	GPD	74,100	87,300	99,500
Effluent at 1.0 Degrees C, -35 Deg C Design Temp				
Time To Reach 0 Deg C	Hours	4.3	5.6	7.0
Time to Start of Ice Formation	Hours	17.3	22.9	28.3
Minimum Flow Required to Stay Above 0 Deg C Without Added Heat	GPD	114,400	134,800	153,600
Insulated Pipe				
Heat Loss Per Foot	w / ft	2.5	3.0	3.4
Total Power Required	kw	19.4	23.3	26.4
Power Cost Per Day At $0.16/ kwhr	$	$83.24	$99.88	$113.20
Approx. Cost for 120 Days Each Year	$	$9,989	$11,986	$13,584

Electrical heat trace installed within the arctic pipe jacket is commonly used to provide freeze protection. Table 10 shows the heat loss per foot for each of the pipe sizes in watts / foot. This is the amount of heat energy (electricity) that must be added to the pipe to maintain the temperature without any cooling of the effluent. As such, this is a conservative estimate of the power consumption. Since some cooling of the effluent is acceptable, provided it remains above freezing, power consumption on the order of half the listed amount is likely sufficient. In practice, the heat trace would be divided into zones, and provided with a programmable controller to cycle the heat trace on and off based on air temperature, ground temperature, initial effluent temperature, and discharge temperature. In that manner, the amount of power required is reduced. Even so, this additional operating cost must be considered during alternate selection and future budgets. Thermal considerations for each route are similar, although power consumption is lower with shorter pipes. Appendix E includes results for each alternate. Note that heat can also be added with a boiler and heat exchanger, possibly at lower cost.

If flows increase in the future, there will be less need for the heat trace. A daily flow of 99,500 to 153,600 gpd is sufficient to avoid freezing in the 12-inch pipe, depending on effluent initial temperature.

Alternate 1 includes construction of approximately of 12-inch, SDR 17 HDPE piping from the WWTP to the Tanana River. Details include:

- The new pipe alignment begins with a manhole right before the existing 10-inch discharge was connected to the 8-inch pipe. This will allow cross over, avoid conflicts near the WWTP, and allows the use of a supply pipe of known age and material. The pipe is then routed parallel to the existing discharge pipe until the existing pipe leaves the access road parallel to the Tanana River Levee and Interior Drainage Channel B. The pipe will then leave the access road to cut across to the selected discharge point.

- WWTP operations will need to continue without interruption using the existing discharge except for final cutover.

- The line can be expected to intersect the sulfolane plume, and while final pipe material selection will be made during design, high-density polyethylene (HDPE) is not contraindicated and has been assumed for estimating.

- The new pipe will be buried at a minimum depth of 5 feet below existing ground or the surface of the access road. The pipe will include 4 inches of arctic pipe urethane insulation inside of an aluminum jacket for freeze protection.

- The arctic pipe will include a heat trace channel and 4-watt / foot self-regulating heat trace. The heat trace will be divided into at least five 2,000-foot zones, for purposes of reducing and controlling power demand. The heat trace will be provided with modulating controls to reduce electric power cost by adjusting heat addition based on effluent temperature and ground temperature. As an alternative to this, heat addition at the WWTP may also be considered.

- Alignment will need to cross the existing Interior Drainage Channel B, which will require large culverts.

- The new pipe will need to cross the existing Tanana River Levee. At the levee, the crossing will require construction according to current USACE requirements. While shown in Appendix D as jacketing in a tunneled casing, consultation with the USACE has indicated that this approach while technically feasible would not be permitted under USACE standards as going under USACE levees requires directional drilling. Instead, the preferred means would be to go over the levee in a manner similar to the existing 8-inch pipe. While this may increase the long-term pumping requirements for the system, the approvals can be granted in-state and could be expected in 6 to 9 months. Routing under the levee will require approval at the national level and would be expected to take 18 to 24 months. All work in the vicinity of the levee requires FNSB and USACE authorization and permitting. All crossings will require periodic inspections to verify conditions and compliance.

3.1.1.5 Manholes

Construction of cleanout manholes every 500 feet: These will consist of a 6-foot diameter concrete manhole with force main clean outs for pipe draining and cleaning. The cleanout will include a gate valve and cam lock fitting, allowing the pipe to be serviced while still under pressure.

3.1.1.6 Outfall and Mixing Zone

Construction of a new discharge point in the Tanana River: This is expected to consist of a graded rock bed providing diffusion and erosion protection, constructed from approximately 40 cubic yards (CY) of 8- to 16-inch stone rip rap.

The new river outfall will require establishment of a new mixing zone through ADEC permitting. The new mixing zone would be expected to be smaller than the existing because the river channel should have better flow characteristics (e.g. flow volume). Part of design will include surveying and characterizing the flow at the selected outfall location and preliminary mixing zone modeling. ADEC uses CORMIX, an EPA-supported mixing zone model. Inputs to the model for the existing mixing zone are shown in Table 11. These parameters will be updated if Alternate 1 is selected after the final outfall location is surveyed. To meet project goals, the parameters in Table 11 can be taken as minimum requirements for the new location, particularly with a greater flow rate.

Table 11 – CORMIX Model Parameters

Model Input	Existing Outfall Model[17]	
	Summer	Winter
Effluent Temperature	21.5°C	0.8 °C
Flow Rate	0.5 MGD	0.5 MGD
Ambient River Depth	3.05 m	0.61 m
Depth at Discharge	2.13 m	0.61 m
River Width	30.48 m	21.34 m
River Flow Rate	169.90 m^3/s	11.89 m^3/s

[17] Existing parameters based on an email dated 9/25/13 from Marie Klingman reporting modeling done by Kenwyn George in 2007 (see Appendix A).

Marie Klingman [18]of ADEC reviewed available test results from the WWTP and determined that the parameters shown in Table 12 represent parameters that have a reasonable potential for exceeding water quality criteria at the WWTP outfall. The table is based on data from the last 4 years, although ADEC will use the most recent 5 years when permitting. This was done in recognition that a new permit is at least a year away. Based on the data in Table 12, chlorine would be the driver for the new mixing zone requiring a dilution of 80:1. This would represent a decrease in the mixing zone regardless of river flow parameters as the current mixing zone is based on dilution at 91:1.

Table 12 – Reasonable Potential Analysis

Parameter	Maximum Observed Concentration	Number of Samples	Upstream Concentration	Maximum Expected Concentration	Most Stringent Criterion	Necessary Dilution
Ammonia as Nitrogen (mg/L)	41.3	14	0.217	61.12	1.4	30:1
Arsenic (µg/L)	9.7	50	1.5	11.56	10	1:1
Copper (µg/L)	55.3	50	3.166	68.20	21.1	3:1
Cyanide (µg/L)	40.9	33	0.780	52.65	5.2	8:1
Lead (µg/L)	7.2	28	1.611	11.82	10.7	1:1
Mercury (µg/L)	0.24	31	0.002	0.42	0.012	20:1
Total Residual Chlorine (µg/L)	880	43	0	991.08	11	80:1

In the absence of an ambient pollutant concentration (e.g. chlorine), ADEC is expected to use 15 percent of the most stringent concentration. For arsenic, copper, and lead the value is hardness dependent, and based on a July 2013 Tanana River hardness value of 260.

3.1.1.7 Changes to Existing WWTP

After the new system is functional, the existing effluent discharge pipeline can be abandoned in place by filling it with sand/cement slurry for the approximately 3,200 LF from the connection point to the discharge. The pipe will need to be excavated near its discharge point so that it can be capped.

3.1.2 Environmental Impacts and Permitting

Alternate 1 pipe routes are not anticipated to have any long term impacts to fish, wildlife, or the public as these alternates would be developed in compliance with ADEC water quality standards for wastewater discharges with a mixing zone. No construction will occur in fish

[18] Based on a series of email dated 10/29/15 and 10/28/15 from Marie Klingman (see Appendix A).

spawning areas, and work in the Tanana River for construction of the outfall would need to occur during periods of low flow (late May to September) to avoid affecting migrating fish and spawning activities.

In correspondence with ADF&G (see Appendix A), ADF&G has indicated a preference for Alternate 1B because the mixing zone is farther from spawning areas; however, Alternate 1A is "permittable" and Alternate 1C was developed to address ADF&G concerns while improving flow conditions. Locating an outfall point will require consultation with ADF&G, which is likely to include a site visit with regulators during low flow prior to sending surveyors to complete a design survey.

Temporary construction impacts to water quality may result in the release of some sediments to the Tanana River despite the use of construction BMPs. Effects of minimal amounts of sedimentation are not anticipated to impact populations of any fish species or spawning areas. No impacts to migratory birds are anticipated as CONP will require clearing be done outside the nesting window of May 1st to July 15th. It is anticipated that wildlife would avoid the area during construction.

As discussed in Section 1.2.2.3, the USACE is expected to require mitigation for wetland impacts; these are approximated in Table 13. While the cost of compensatory mitigation, if required, is negotiated and not standard, it is assumed to $30,000/acre for this report and included in the capital costs discussed below.

Table 13 – Alternate 1 Wetland Impacts

Wetland Type	Wetland Code	Alternate 1A Approximate Impacted Acres	Alternate 1B Approximate Impacted Acres	Alternate 1C Approximate Impacted Acres
Freshwater Emergent	PEM	None	None	None
Freshwater Forested	PFO	2.30	None	0.47
Freshwater Scrub Shrub	PSS	0.92	1.45	1.88
Riverine	R2UB	0.05	0.10	0.12
	Alternate Total	**3.26**	**1.55**	**2.47**

In summary, these alternates will require the following permits and authorizations:

- ADEC plan review and a new discharge permit for the WWTP, including a mixing zone.
- A Certificate of Water Quality Assurance under Section 401 of the CWA from ADEC.
- The access road and pipe across State land will require a public easement from the ADNR. The remaining route not on CONP property will require an easement from the FNSB.

- Floodplain modeling and either a no rise certification or LOMR-F as discussed in Section 1.2.2.4.
- FNSB authorization and floodplain and zoning permits.
- USACE Section 408 authorization and permitting for impacts to flood control levee including protection against pipe rupture, seepage and/or piping.
- A Department of the Army permit under Section 10 of the RHA and Section 404 under the CWA for impacts to wetlands and waters of the U.S. from USACE.
- A Fish Habitat Permit from the Alaska Department of Fish and Game as discussed in Section 1.2.2.1.

Alternate 1 is potentially impacted by future changes in effluent discharge permit requirements. The WWTP is not presently regulated for nutrient discharge. As the discharge can impact fish habitat, future permit renewals will eventually include limitations on nutrients and other contaminates the WWTP does not presently remove. The WWTP will need to construct process upgrades at that time. In the meantime, any ADEC permit for Alternate 1 has been assumed to maintain the system classification and require limitations similar to the existing.

3.1.3 Design and Construction Challenges

While Alternate 1 is conventional construction, there are some minor challenges to consider:

- Pipe and road in floodplain and crossing possible ephemeral or permanent streams. As proposed the roads are not armored structures, and could possibly be damaged or washed out in high floods. This is somewhat less likely for Alternate 1A, as it is largely outside of the floodway.
- Potentially unstable ground. While the routing was selected to avoid open channels, crossing older sloughs and old channels filled in with organic matter will likely be necessary.
- Crossing flood control structures (i.e. Interior Drainage Channel B, Tanana Levee) will require special construction and a higher level of USACE permitting.
- Control of public access and trespass issues will be similar to existing outfall. At present, schematic design includes fence and gates.
- Timing construction during low river flows.

It should be possible to mitigate each of these challenges.

Knowing that the existing effluent line is 8-inch until near its outfall makes phasing Alternate 1C feasible. To address the immediate ADEC NOV, the line could be constructed in phases: First completing investigations and design; then completing permitting, easement acquisition, and clearing; and finally building the pipe in at least two phases; Phase 1 from a point after the levee crossing to the new river outfall, and Phase 2 replacing the remaining 8-inch line back to the WWTP.

3.1.4 Costs

3.1.4.1 Capital Costs

Estimated construction cost for Alternate 1C is approximately $4.3 million. The complete construction estimate is provided in Appendix F, and includes a 20 percent estimating contingency. Table 14 summarizes other project costs:

Table 14 – Alternate 1C Project Cost Summary

Estimated Probable Construction Cost - 2015	$4,339,740
Design Survey	$32,000
Geotechnical Work	$45,000
Design Engineering	$250,000
Construction Administration	$300,000
Easements	$26,000
Permitting	$75,000
Permit Fees	$25,000
Wetlands Mitigation	$75,000
Subtotal	$5,167,740
Inflation / Escalation – Five Years at 3%	$775,200
Total Project Cost – 2020	**$5,942,940**

Costs for engineering, design, permitting, etc., are approximated based on experience with similar work. They have not been estimated in detail, so additional contingency may be appropriate, especially for permitting. The table does not include CONP administrative costs.

The permitting fee item is intended to cover ADEC review fees, USACE fees, and minor permits. No cost sharing agreement with the USACE for levee permitting is included as those costs cannot be projected at this time. It has been assumed that DNR and FNSB will waive easement and permit fees to a municipal agency.

Variations in pipe length will affect project cost about $200 / LF.

3.1.4.2 O&M Costs

O&M costs for Alternate 1 (any route) are expected to be similar to existing, but with the addition of costs associated with heating and compliance with USACE levee crossing inspection requirements. O&M tasks attributed to this alternate are summarized in Table 15. Additional detail on the development of Table 15 is provided in Appendix G. Heating costs shown are for Alternate 1C, but do not vary significantly between the other versions of this alternate.

Table 15 –Alternate 1 Estimated O&M Costs

Work Description	Annual Labor	Annualized Equipment Replacement	Equipment Power	Misc. Annual Costs	Total Annual Costs
Effluent lift station pumps including weekly exercising, effluent pumping (10 days), and replacement every 10 years	52 hours	$2,310	$240	$0	$5,337
Monthly cleaning of the wetwell to remove accumulations and facilitate inspection	24 hours	$0	$0	$0	$1,286
Weekly outfall inspection and maintenance, signage replacement 1-2 times per year	78 hours	$0	$0	$500	$4,679
Discharge sampling twice a year	6 hours	$0	$0	$2,000	$2,321
Weekly batch mixing of chlorine solution, with replacement of chemical metering pump and batch and dosing mixers every 7 years	208 hours	$1,204	$1,357	$12,000	$25,706
Weekly batch mixing of dechlorinating solution chemical metering pump replacement every 7 years	104 hours	$250	$386	$8,000	$14,208
Heating system operations	2 hours	$501	$0	$0	$12,014
Levee crossing inspections	8 hours	$0	$0	$0	$2,858
				Annual Total	**$68,409**

Overall, O&M activities listed here for the Alternate 1 account for approximately 504 hours per year in labor, about 26 percent of an FTE. The differences in activities represent a 27.8 percent ($14,872) increase over the No-Action Alternate. Note that the costs indicated here do not depend on pipe length, with the exception of heating and pumping costs.

The potential need for heat is a considerable cost under this alternate. It is priced here as electric heat, but a fuel oil burner and heat exchanger are also feasible. About 1,800 gallons of fuel oil per year would be used if heat is needed for 90 days. Equivalent cost is $6,300/year at $3.50/gallon.

3.2 ALTERNATE 2: CONSTRUCT EFFLUENT INFILTRATION POND

3.2.1 Description

Much of the subsoils in North Pole are moderate to free-draining sands and gravels that allow surface waters to infiltrate into the groundwater. If the soils are sufficiently free draining, a pond can be used to infiltrate treated effluent into the ground. This is the approach presently used at Eielson Air Force Base (AFB). The Eielson system uses a roughly 10-acre pond constructed in a gravel quarry site to dispose of about 800,000 gpd of treated effluent to subsurface waters, this is their full discharge although the WWTP is permitted for 2.0 MGD. The quarry pit extends into the groundwater; effluent applied to the pond mixes with and dissipates into the groundwater. The depth of the pit is such that the pond does not freeze solid, and the bottom area remains open to infiltrate the mixed waters year round. An infiltration pond of this type eliminates the need for a surface discharge, and for surface discharge permitting. Note that this is not a percolating[19] stabilization pond; it is a discharge to groundwater of disinfected effluent compliant with secondary standards.

It is not feasible to construct an infiltration pond above the water table in North Pole. Such a pond would drain too freely, and never develop the depth required (8 or more feet) to prevent seasonal freezing of the aquifer interface. For that reason, the pond must be constructed below ground, and quarried into the water table. The water table then maintains the depth required to prevent freezing solid.

Roughly 14 acres of land immediately south of the WWTP, between the WWTP and adjacent Tanana River Levee, was purchased in 2014 by the CONP. The land was originally considered for future expansion of the WWTP lagoon system for capacity development, but is available for construction of effluent disposal pond(s) as considered by this Alternate 2.

Alternate 2 includes the following elements, impacts, and design / operation considerations. Refer to Appendix D for schematic drawings.

3.2.1.1 Clearing

Construction of the proposed pond will require clearing and grubbing of the new lot (14 acres more or less).

[19] Percolating stabilization ponds require a 4-foot separation between pond bottom and groundwater. Treatment is assumed to occur in the 4-foot soil column.

3.2.1.2 Pond Construction, Sizing and Freeze Considerations

Primary considerations for the design of an infiltration pond in a cold region are 1) the capacity of the receiving aquifer to accept effluent; and 2) depth of seasonal freeze.

The ability of the aquifer to accept the effluent is a function of the aquifer permeability and to a lesser extent, the depth to groundwater. As effluent is applied to the groundwater, the groundwater level rises, forming a "mound" in the water table. This mound creates a driving head to force the water into the aquifer. This mound can be only inches high, or it can be many feet depending on the permeability conditions.

As part of the geotechnical investigation (Appendix B), S&W performed infiltration and permeability testing on the aquifer. The investigation found the water table to range from 3 to 7.5 feet bgs, with the lower elevations occurring in summer and late fall. Infiltration tests at 10 feet bgs, in the water table yielded an infiltration rate of 0.12 minutes / inch. A large scale infiltration test (essentially a small pilot infiltration pond) had been planned, but was unsuccessful due to instability and slumping of surficial silts into the test pit. In lieu of the pilot test, laboratory permeability testing was then conducted, yielding a permeability of 2.1×10^{-3} cm /s.

These findings are somewhat mixed. The infiltration rate of 0.12 minutes / inch is excellent, and indicates an extremely high rate of infiltration. However, the permeability test is more typical of a moderate infiltration rate, such as for a tighter sand or gravel with silts. Even so, an infiltration pond appears feasible at this location; it will simply be a question of how high a groundwater mound is necessary.

Application rates vary with the infiltration rate and depth of mounding, but for initial estimates, using the ADEC *Greywater Treatment and Disposal System Guidelines*, application rates of between 2.0 and 4.0 gpd/ square foot of disposal area are typical. To confirm infiltration capacity of the proposed pond, S&W performed a groundwater mounding analysis. This is included in Appendix B, within Appendix D of the Geotechnical Report. Because soil permeability is highly variable, the analysis examined both a low range and high range estimate for hydraulic conductivity. Table 16 provides a summary of the groundwater mound height, in feet, for two sizes of pond. The 4.4-acre pond is close to the largest pond that will fit on the site; the 2.2-acre pond is simply half that size.

Table 16 – Summary of Mounding Analysis

	Height of Mound 2.2 Acre Pond (230 Feet x 415 Feet)		Height of Mound 4.4 Acre Pond (230 Feet x 830 Feet)	
Flow Rate	**Low End 100 ft / day**	**High End 1000/ft day**	**Low End 100 ft / day**	**High End 1000/ft day**
0.2 MGD	1.1	0.1	1.1	0.1
0.5 MGD	2.6	0.2	2.7	0.2
1.0 MGD	5.2	0.5	4.5	0.4

In simple terms, the mounding analysis found that even at the lower range of soil permeability for the site, at a flow of 1.0 MGD, the groundwater will rise only 4.5 feet for the proposed 4.4-acre pond; this remains below existing ground surface. S&W further indicates that permeability likely tends towards the higher range value, resulting in a mound of 1-foot or less in height. As such, disposal of 1.0 MGD or more is possible within the footprint. This is equivalent to about 5.2 gpd / ft^2 of pond area on the 4.4-acre pond, or 10.5 gpd / ft^2 on the 2.2-acre pond. There does not appear to be any geologic constraint on effluent infiltration.

The predicted rates are not conservative, since the mounding analysis cannot account for the effective of sediment accumulation or biological growth on the bottom of the pond reducing infiltration rates. Some "factor of safety" does need to be applied. An intermediate value of 3.0 gpd / ft^2 is the "average" range suggested in the ADEC *Greywater Manual*. Loadings in this range are conservative. For comparison, Table 17 shows the approximate loadings for a 2.2- and a 4.4-acre pond (bottom area). Table 18 shows dimensions of ponds required to meet the 3.0 gpd / ft^2 loading for various plant flows.

For initial purposes, a simple rectangular shape was selected, situated to avoid the Flint Hills property and pond to the south. Basin bottom area and basin bottom dimensions are self-explanatory, and are also shown on the Alternate 2 drawings in Appendix D. The overall footprint includes the pond/excavation side slopes, perimeter berm, and access road. Since the excavation slopes extent into the groundwater, a 4 horizontal to 1 (4:1) vertical side slope is used. The perimeter berm and access road are relatively shallow, 3 to 5 feet above existing ground, as it only needs to protect the pond from local surface water flows and shallow flooding. Perimeter berm slopes are 3:1. Excavation slopes and berms add an additional 100 to110 feet of width on each side of the basin bottom.

Table 17 – Infiltration Pond Preliminary Sizing

		2.2-Acre Basin 230 x 415 Bottom 450 x 640 Overall		4.4-Acre Basin 230 x 830 Bottom 450 x 1050 Overall	
Flow Condition	**GPD**	**Loading, GPD/FT2**	**Relative Loading %**	**Loading, GPD/FT2**	**Relative Loading %**
Average Daily Flow	200,000	2.1	70%	.95	32%
Current Permit Limits	500,000	5.2	160%	2.6	83%
Future Target	1,000,000	10.4	330%	5.2	160%

Table 18 – Infiltration Pond Preliminary Sizing (at 3.0 gpd / ft^2)

	GPD	Basin Bottom Area	Basin Bottom Dimensions	Total Foot Print	Overall Dimensions
Flow Condition	**GPD**	**Acres**	**Feet**	**Acres**	**Feet**
Average Daily Flow	200,000	1.5	230 x 288	5.2	450 x 508
Current Permit Limits	500,000	3.8	230 x 720	9.7	450 x 940
Future Target	1,000,000	7.6	230 x 1440	17	450 x 1660
Maximum Possible on Site	580,000	4.4	230 x 830	11	450 x 1050

A 2.2-acre pond bottom (5.2 total acres) should be adequate for current average daily flows and will have less than a 1-foot groundwater mound. If necessary due to budgetary or phasing considerations, the smaller pond will suffice for current flows. However, the larger, 4.4-acre pond (9.7 acres overall) will be needed to achieve the current permit limits.

It may or may not be possible to achieve the targeted 1.0 MGD on site. The largest pond that can fit within the property has an overall footprint of about 11 acres. With the application assumption of 3.0 gpd / ft^2, maximum possible effluent disposal on this site is approximately 580,000 to 600,000 gpd. This is nearly three times current flows, and exceeds current permit limits, but does fall short of the desired ultimate flow of 1.0 MDG.

However, it should be noted that the 3.0 gpd / ft^2 is a very conservative assumption, relative to the 5 to 10 gpd / ft^2 S&W has predicted. The pond analysis is also only considering infiltration through the pond bottom, when almost as much infiltration will occur through the side slopes. Given these factors, it is quite plausible the larger pond will greatly exceed 500,000 gpd, and could very well achieve the desired 1.0+ MGD. However, available data is not sufficient to prove it at this time. It would need to be determined operational, i.e., by observation and measurement once the pond is built. This lends uncertainty and risk to the pond alternate.

Depth of the infiltration basin is expected to be strictly a function of expected depth of seasonal freeze. Freeze analysis calculations are provided in Appendix E. Calculations predict depth of pond freeze ranging from 4.0 to 6.0 feet of ice, depending upon degree of snow cover. This is a conservative calculation for the 100-year return event, 7,030 freezing degree-days; a typical year for the Fairbanks area is 5,500 – 6,500 freezing degree days. The calculation also does not consider the continual addition of heat from the incoming effluent.

Maximum depth to groundwater during the investigation was at 6 feet below ground. Allowing for 6 feet of ice formation, and 3 feet of "open" or unfrozen water at the pond bottom, depth of pond has been set at 15 feet below existing ground, with a water depth of approximately 9 feet.

Details of the infiltration pond construction include:

- Excavation and disposal of surface soils to depth of water table. This will be conventional excavation.

- Excavation of an additional 9 feet of sands and gravel soils below water table to construct the depth of the pond. This excavation will all likely be done "in the wet", as it not likely to be feasible to dewater a pit of this size for construction, particularly with its proximity to the sulfolane plume. The excavation depth is well within limits of typical hydraulic excavator, but the spoils may need to be stacked and allowed to drain before trucking offsite for disposal. This additional material handling adds to the cost of excavation.

- Construction of the perimeter berm and access road from a combination of useable excavation and imported gravel.

- About 450 feet of 12-inch treated effluent main will be constructed from the existing WWTP building to the new pond. Effluent will flow from the WWTP to the pond by gravity. Arctic pipe, with 4 inches of urethane foam insulation and aluminum jacket, will be used similar to Alternate 1. Electric heat trace will be provided for emergency thaw purposes, particularly where the pipe enters the frozen zone of the pond. However, due to the short length of this pipe, residence time is brief, and regular use of the heat trace is not expected.

- A number of monitoring wells, at least four, will likely be required for periodic examination of groundwater impacts.

3.2.1.3 Access Road

Alternate 2 includes construction of a 20-foot wide, single lane access road around the pond. The access road provides both access and a low berm to define the pond boundary. Slopes of 4:1 on the inside develop the pond and 3:1 outside define the berm. The road will be built largely above existing grade with construction similar to that proposed under Alternate 1, approximately 3 feet above grade.

An 8-foot chain-link fence with barbed wire will be constructed along the perimeter of the road system to control access to the effluent pond.

3.2.1.4 Changes to Existing WWTP

After the new system is functional, the existing, approximately 3,200 LF effluent discharge pipeline can be abandoned in place by filling it with sand/cement slurry from the connection point to the discharge. The pipe will need to be excavated near its discharge point so that it can be capped.

Since the WWTP will flow to the pond by gravity, the existing effluent lift station will no longer be required, and can be decommissioned.

The WWTP will no longer need to de-chlorinate the effluent. A chlorine residual in the effluent will be desirable to control algae growth, and prevent bacterial growth that could cause the water to become oxygen deficient, septic, and generate odors. It may be necessary to increase chlorine dosage to provide algae control, or use an algae control chemical such as copper sulfate.

3.2.2 Environmental Impacts and Permitting

For Alternate 2, discharge permit parameters, discharge limits, and points of compliance must be considered. In general, WWTPs disposing of effluent to the groundwater have been required to meet nitrate limits at their property line. Given the groundwater gradient / flow to the north in this area, compliance at the north side of the property is expected, before the subdivision. This is about 640 feet north of the proposed wastewater pond.

When considering a discharge to groundwater, the WWTP primarily produces two contaminates of concern, ammonia and nitrate. Nitrate is a recognized health risk and assigned a 5 mg/L "trigger level" and a 10 mg/L maximum contaminate limit (MCL) in drinking water. Ammonia is not a regulated contaminate in drinking water, nor is it typically directly regulated (as ammonia) in effluent discharges to subsurface groundwater. However, via nitrifying bacteria, ammonia does have the potential to convert to nitrates after discharge. Ammonia in groundwater can also affect subsequent treatment or disinfection of the water by downstream users, wells, water systems, etc.

The WWTP surface water discharge does include ammonia limits, so the WWTP regularly tests for ammonia. Recent results are provided in Table 19. The ammonia level varies year round with the temperature of the lagoons. The average ammonia level throughout the year is about 25 mg/L. Due to the cold temperatures in North Pole, there is little ammonia removal by nitrification. As a result, the lagoons do no produce very much nitrate. Since the WWTP is not presently regulated for nitrate, relatively little data exists. A selection of performance testing data from 2008 to 2010 is available, plus additional testing performed by Stantec in 2015 is included in Appendix C. Nitrate levels were found to average about 1.3 mg/L, with the highest observation of 5.0 mg/L. This is atypically low for WWTP lagoon systems, with lagoons in warmer climates reaching 10-20 mg/L. However, for meaningful nitrification to occur, lagoon temperatures need to be at least 10 to 20 deg C before the bacteria will grow and consume ammonia. The average annual temperature of the North Pole Lagoons is 20 deg C for a month or two in summer, but closer to 2 deg C in the winter. Average temperature is less than 10 deg C, so very little nitrification is possible in the lagoons.

Table 19 - WWTP Effluent Ammonia

Season	Date	Result (mg/L)
Winter	2/6/14	41.3
Spring	5/18/14	35.8
Summer	8/7/14	17.4
Fall	11/13/14	23.0
Winter	2/10/15	37.1
Spring	5/14/15	25.0
Summer	8/18/15	3.5
Fall	10/6/15	4.6

Groundwater from the footprint of the proposed basin was sampled and tested for nitrates during the geotechnical investigation. Background levels of nitrate range from 0.03 to 0.05 mg/L, substantially under the MCL.

S&W performed a simplified evaluation of the nitrate and ammonia concentration potential for the proposed discharge. The results of the analysis are provided in Appendix B. An effluent nitrate level of 5 mg/L, and an effluent ammonia level of 25 mg/L were assumed as typical annual average for the WWTP. Table 20 summarizes the analysis:

Table 20 - WWTP Nitrate Concentrations at Property Line

		Effluent Flow Rate		
		0.2 MGD	0.5 MGD	1.0 MGD
Nitrate Concentration, From Applied Nitrate	mg/L	1.4	2.4	3.2
Nitrate Concentration, From Applied Ammonia (see text)	mg/L	6.6	11.8	16.0
Predicted Total Nitrate Concentration At Property Line	mg/L	8.0	14.2	19.2

The analysis assumes that all of the ammonia converts to nitrate. This is erroneous, and S&W has stated this analysis is not accurate. Due to the low groundwater temperatures, and the anaerobic environment, the potential for subsequent production of nitrate from the discharged ammonia is very low. If the ammonia conversion is taken out of the analysis, it is much more likely that nitrate levels at the property line will be in the range of 1.4 to 3.2 mg/L, below the trigger limit.

Eielson AFB has a similar discharge to groundwater, operating under similar temperature and environmental conditions. It is permitted with a 5 mg/L nitrate trigger limit, and a 10 mg/L maximum limit. We are not aware of any compliance issues or exceedances at Eielson. Note also that all of the properties down gradient of the proposed pond are on public water systems, and it the event of nitrate exceedance at the property line, there are no wells expected to be impacted.

S&W has suggested a much more sophisticated, three dimensional particle transport and transformation model be completed to more precisely predict nitrate levels. However, this is a costly model outside the scope of the current study, and only worth completing if Alternate 2 is selected as the preferred alternate.

Other potential issues associated with the ammonia discharge are chloramines and nitrite. Chloramines are weak disinfectants formed when the WWTP chlorinates the effluent for disinfection, and chlorine complexes with the ammonia. Chloramines are associated with taste and odor issues. The effluent has not been tested for chloramines, but they will exist at some level. Chloramines are not typically regulated in subsurface discharges, but they do have a 4 mg/L MCL in drinking water. It is unclear if ADEC would regulate chloramines in the discharge as 1) they reduce the nitrate formation potential, and 2) they are not generally a health risk as there are no drinking water wells in proximity to the WWTP. The chloramines will also decay once in contact with the soil and organic matter.

Nitrite is another regulated ammonia byproduct. It is usually present only at very low levels, but can be present when ammonia nitrifies. Since Alternate 2 places ammonia into the groundwater, nitrite may be present as well. ADEC has not stipulated a nitrite standard for injection wells or subsurface discharge, but the drinking water MCL is 1.0 mg/L. In the future, if ADEC decides to treat nitrite similarly to nitrate, the off property limit could be as low as 0.5 mg/L for that contaminant.

Because the effluent is disinfected, it does not present a substantial health risk. Even so, access to the pond will be controlled with fences.

During the *Preliminary Study*, ADEC Contaminated Sites Program indicated that there were no major concerns regarding construction of a wastewater effluent infiltration pond in the proposed location. Sulfolane concentrations north of the refinery along the south western portion of the groundwater contaminant plume have been declining due to remediation efforts from the Refinery's groundwater treatment system. The aquifer in the project area is large with high transmissivity and no discernable impact is foreseen; however, the potential will need to be evaluated during final design as the pond dilute but also drive the plume.

Alternate 2 is not anticipated to have any long-term impacts to fish, wildlife, or the public as this alternate will be developed in compliance with ADEC's water quality standards and will not introduce wastewater directly to waterbodies where exposure is likely to occur.

No impacts to migratory birds are anticipated as the project will comply with the USFWS's recommendations requiring clearing be done outside the nesting window of May 1st to July 15th of any calendar year. It is anticipated that wildlife would avoid the area during construction.

As discussed in Section 1.2.2.3, the USACE is expected to require mitigation for wetland impacts. While the cost of compensatory mitigation, if required, is negotiated and not standard, it is assumed to be $30,000/acre for this report and included in the capital costs discussed below.

Table 21 – Alternate 2 Wetlands Impacts

Alternate 2	Wetland Type	Wetland Code	Approximate Impacted Acres
	Freshwater Scrub Shrub	PSS	14

In summary, this alternate will require the following permits and authorizations:

- ADEC plan review and a new discharge permit for the WWTP, including delineation of points of compliance and nitrate limits.
- A Certificate of Water Quality Assurance under Section 401 of the CWA from ADEC.
- A Department of Army permit under Section 404 of the CWA for impacts to wetlands and waters of the U.S. from USACE.
- FNSB authorization, zoning, and floodplain permit.

This alternate requires substantially fewer permits than Alternate 1. The permits that are required will also take less effort to obtain. Additionally, we do not expect this alternate to be impacted by changes in discharge permit requirements resulting in need to upgrade WWTP treatment processes.

3.2.3 Design and Construction Challenges

Alternate 2 has a number of design and construction challenges that must be considered. These items may influence the viability and cost of the alternate. Items include:

- Excavation Below Groundwater/Dewatering. While the first 6 to 8 feet of the pond excavation will be conventional, at some point, it may not be possible to control inflow of groundwater, and the last 4 to 9 feet of pond depth will be below the water table, essentially a dredging operation. Dewatering needs to be avoided as much as possible due to the sulfolane contamination. While the basin is not within the mapped plume, pumping for conventional dewatering would draw the plume towards the WWTP changing its current migration pattern. Carefully designed dewatering operations could allow for infiltrating pumped water as a hydraulic barrier to plume migration. Alternatively, a capture and treat operation might be feasible. S&W also believes it will be possible to complete the excavation with a conventional hydraulic excavator. There are several quarries and contractors in the Fairbanks area with below water table operations, so this expertise should be available. Regardless of the methodology, the pond excavation will not be conventional work, which adds to the cost of excavation. For the cost estimate, we have assumed material excavated below the water table will be at least 80 percent more expensive that normal excavation.

- Disposal of Excavation. The pond excavation will generate a large volume of excavation, on order of 144,000 cubic yards. While some material may be placed on the WWTP, the majority of soil will need to be disposed of offsite. Suitable disposal area(s) will need to be located. Ideally, other projects in the area will need fill material, but this cannot be guaranteed. Excavated material will need to be stacked on site to drain before it can be loaded and hauled off site. The material should drain quickly, in a matter of days, but space will need to be available - requiring clearing of the remainder of the site and probably use of the area west of the lagoons where sludge has been stored.

- Contamination of Excavated Soil. The excavated soil may include a trace level of sulfolane contamination should groundwater contamination be present. Once the soil has drained, and given the weight of the soil and the relative moisture content (less than 15 percent), any remaining sulfolane on the soil will be very small and probably below any action level, but does need to be considered.

- Confirmation of Groundwater Depth. Groundwater depth varies seasonally, and is generally understood to be at its lowest in the fall. Freeze protection design is based upon a 9-foot depth into the water table, so fall / winter elevation of water table must be confirmed, and depth of pond adjusted accordingly. Groundwater monitoring wells were installed on site for this purpose.

- Algae Control. Excessive algae growth in the pond could lead to accumulation of decaying biomass, clogging of the infiltrative strata, and potentially odors from septic conditions. This can be controlled by maintaining a free-chlorine residual in the effluent discharge.

- Need for Aeration / Dissolved Oxygen. The WWTP effluent contains a small residual level of biological oxygen demand (BOD), typically around 10 to 20 mg/L. If biological activity occurs, dissolved oxygen in the pond will be consumed, the water will go septic, and odors can be generated. We do not believe that Eielson AFB has experienced this in their disposal pond. The presence of chlorine residual and the low temperatures in the pond are likely to suppress biological activity. The pond is covered with ice much of the year, so temperatures are very low. If dissolved oxygen levels were to become a problem, this would only happen in the summer, and the solution would be to add a floating aerator to the pond.

- Compliance Permitting / Groundwater Quality Impact Permitting. As previously stated, Alternate 2 will introduce nitrate contamination into the groundwater. Point(s) of compliance and compliance levels need to be negotiated with ADEC. This will require additional and more sophisticated groundwater modeling to determine nitrate concentrations than can be completed under this report. Fortunately, groundwater flow patterns and rates in this area are well understood from prior work on the Flint Hills sulfolane plume. If this alternate is pursued, modeling will also consider the impacts to the sulfolane plume and Flint Hills remediation efforts.

- Potential Capacity Limitations for Future Growth. As previously explained, the site may not be able to accommodate the target of 1.0 MGD for ultimate WWTP capacity.

3.2.4 Costs

3.2.4.1 Capital Costs

Based on the 4.4-acre pond described here, the estimated probable construction cost for Alternate 2 is approximately $4.15 million. The complete construction estimate is provided in Appendix F, and includes a 20 percent estimating contingency. The cost estimate is based upon the currently proposed maximum footprint of 11 acres. Table 22 summarizes other project costs:

Table 22 – Alternate 2 Project Cost Summary

Estimated Probable Construction Cost – 2015	**$4,328,484**
Design Survey	$25,000
Geotechnical Work	$25,000
Design Engineering	$250,000
Construction Administration	$260,000
Easements	$0
Permitting	$45,000
Permit Fees	$25,000
Wetlands Mitigation	$420,000
Subtotal	$5,378,484
Inflation / Escalation - Five Years at 3%	$806,800
Total Project Cost – 2017	**$6,185,284**

Cost for engineering, design, permitting, etc. are approximated based on experience with similar work. They have not been estimated in detail, so additional contingency may be appropriate. The table does not include CONP administrative costs.

The permitting costs shown are intended to cover ADEC reviews and minor permits. No easements or land use permits are expected for this alternate, as it is entirely on City land.

Alternate 2 is scalable and can be phased. For currently flows, it is feasible to construct only 5 to 7 acres of basin; the basin can then be expanded in the future as flows increase. The costs do not scale linearly, as the change is only in the overall excavation. A 6-acre basin would be approximately $1,200,000 less to construct than the full 11-acre basin the cost estimate is developed around.

3.2.4.2 O&M Costs

This alternate does not require substantial changes in operations from the "No Action" Alternate. In fact, under this alternate, it should be possible to decommission the WWTP effluent pump station. O&M tasks attributed to this alternate are summarized in Table 23. Changes in O&M when compared to the "No Action" Alternate include:

- Removal of the effluent lift station pumps with their associated, electrical, replacement and exercising cost. The wetwell will remain with its associated maintenance, as this is where flows exit the WWTP and are sampled.
- Outfall inspections will still occur but will be inspections of a fenced facility with less travel time and less likelihood of public trespass and vandalism.
- Monitoring samples associated with the outfall will become groundwater monitoring for nitrates and other parameters, which have been assumed to occur semiannually at four wells.
- Since the discharge will no longer be to surface waters, the WWTP will not need to de-chlorinate the effluent. Instead, chlorine concentrations will be increased as a means to control algae growth (50 percent increase assumed).
- While the effluent line to the pond will be equipped with heat trace, this is just for emergency thaw provisions and no power costs are included in the estimate shown in Table 23. Heat should not be needed on a regular basis. The operators will require some minimal amount of time annually to test the system's operation.
- The pond perimeter will need to be mowed and inspected regularly to prevent encroachment of vegetation, particularly trees that would interfere with access, reduce sunlight, and increase organics in the pond. Twice yearly mowing and sapling removal are included in Table 23.
- There is some likelihood that the effluent infiltration pond may need to be periodically dredged to remove any organic sludge accumulation on the pond bottom that may

reduce infiltration rates. This is expected to be infrequent, but can only be determined operationally. Dredging by a contractor every 20 years to maintain pond depth and infiltration rates has been assumed.

Additional detail on the development of Table 23 is provided in Appendix G.

Table 23 –Alternate 2 Estimated O&M Costs

Work Description	Annual Labor	Annualized Equipment Replacement	Equipment Power	Misc. Annual Costs	Total Annual Costs
Monthly cleaning of the wetwell to remove accumulations and facilitate inspection	24 hours	$0	$0	$0	$1,286
Weekly pond inspection	52 hours	$0	$0	$0	$2,786
Monitoring well sampling twice a year	16 hours	$0	$0	$2,500	$3,357
Weekly batch mixing of chlorine solution, with replacement of chemical metering pump and batch and dosing mixers every 7 years	208 hours	$1,204	$0	$18,000	$30,349
Heating system for emergency use	2 hours	$0	$0	$0	$107
Dredge pond bottom every 20 years	0 hours	$56,538	$0	$0	$56,538
Pond vegetation removal	16 hours	$1,050	$0	$0	$1,907
				Annual Total	**$96,331**

Overall, O&M activities listed here for the Alternate 2 account for approximately 318 hours per year in labor, approximately 17 percent of a FTE position. The differences in activities represent a 79.9 percent ($42,793) increase over the No-Action Alternate.

As noted earlier, the need for dredging will have to be determined operationally. If dredging is found to not be necessary, the overall O&M requirements are reduced to $39,793 annually, which would be an overall reduction in O&M of $13,745.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 COMPARISON OF ALTERNATES

While Alternate 1 and Alternate 2 nominally accomplish the same goal of providing CONP with a permitted WWTP discharge, the alternates are substantially different, making comparison difficult. Table 24 below lists and compares salient features as directly as possible:

Table 24 – Comparison of Alternates

	Alternate 1C **Effluent Discharge Pipe**	**Alternate 2** **Effluent Infiltration Pond**
COSTS AND OPERATIONS IMPACTS:		
Construction Cost	$4,339,740	$4,328,484
Total Project Cost	$5,942,940	$6,185,284
Effluent Capacity	1.0 MDG	580,000+ gpd Maximum Capacity Indeterminate
Constructible in Phases	Yes	Yes
Total Annual O&M Cost Projected	$68,409	$96,331 ($39,793 without dredging)
Estimated O&M Cost Increase / Decrease	$14,872 / yr. increase	$42,793 / yr. increase ($13,745 decrease without dredging)
Change in WWTP Operations	No	Yes
Freeze Protection Required	Yes	No
Periodic Sludge Removal Required	No	Possibly, Infrequent
Wetlands Impacts / Mitigation Required	2.48 Acres	14 Acres
Allows Future Expansion / Modification of WWTP	Yes	No - Occupies all Available Land

	Alternate 1C Effluent Discharge Pipe	Alternate 2 Effluent Infiltration Pond
REGULATORY REQUIREMENTS:		
ADEC Plan Review	Yes	Yes
APDES Discharge Permit	Yes	No
DNR and FNSB Easements	Yes	No
Groundwater Discharge Permit	No	Yes
USACE Wetlands Permits	Yes	Yes
FNSB Floodplain Permits	Yes	Yes
USACE Floodplain Modeling / LOMAR-F / No Rise Certification	Yes	No
Alaska Fish and Game Fish Habitat Permit	Yes	No
Relative Degree Of Permitting Effort	More	Less
Need for Additional Future Treatment (Nutrient Control, Toxics Control)	Probably Yes, But No Timeline Established	Probably Not
Potential Nitrate Exceedance or Other Groundwater Contamination	No	Possible. Fate of ammonia unclear. Requires additional modeling
CONSTRUCTION AND DESIGN CHALLENGES		
Stream, Unstable Ground Crossings	Yes	No
Potential Flood Damage	Yes	No
Construction through regulated levee	Yes	No
Public access / trespass issues	Yes	No
Excavation Below Groundwater	No	Yes
Disposal of Excavation	No	Yes
Process Questions – Algae Control, Dissolved Oxygen	No	Yes
Relative Degree of Construction and Design Challenges	Less	More

4.2 RECOMMENDATIONS

Table 24 compares the two alternates, and it can be seen that Alternate 1C and Alternate 2 have practically identical construction costs. In terms of total project cost, Alternate 1C is about $240,000 less than Alternate 2, about a 3% difference. This difference is not really significant within the preliminary nature of the estimates.

Alternate 2 does affect almost 6 times more wetland area than Alternate 1C (14 acres versus 2.5 acres). The wetlands mitigation for Alternate 2 is nearly $0.5 million; it is only $75,000 for Alternate 1C. While the true cost of mitigation cannot be determined until negotiated, wetlands have a real value and the 14-acre loss of wetlands with Alternate 2 is notable.

In addition to the construction and project costs, Alternate 2 has significantly higher operational costs when the annualized cost of dredging the infiltration pond is factored in, nearly $30,000 more per year. We believe it is likely the pond will need to be dredged eventually, so including that cost in the O&M budget is appropriate.

Alternate 2 will occupy nearly all CONP land available at the WWTP. In the event that the discharge to groundwater exceeds permitted contaminant levels, there is probably not enough space to enlarge or modify the WWTP to mitigate the problem. Consequently, in the event of future violation, the WWTP could end up having to return to a discharge to the river, with additional future cost and environmental impacts. In contrast, Alternate 1C preserves land at the WWTP, leaving room onsite to accommodate future expansion needs.

Alternate 1C readily meets future capacity target of 1.0 MGD, while it is not clear if Alternate 2 can achieve more than 0.58 MGD. The need for expensive dredging to maintain infiltration capacity becomes more likely as flows increase.

Alternate 1C results in less impact to wetlands; has a lower overall project cost; and can more readily achieve ultimate capacity targets. It also has lower O&M costs, while maintaining the ability / room for expansion and future process improvements at the WWTP. Disadvantages of Alternate 1C include greater regulatory and permitting effort, and new easements on FNSB and state lands. The DNR and USACE permitting process are expected to be time consuming, but all permits should be attainable. Under Alternate 1C, the WWTP may need to be eventually upgraded to remove nutrients or other contaminants as surface water permit regulations grow more stringent. However, this is likely to be years in the future. It also requires freeze protection, at least for the foreseeable future until winter flows increase significantly. The freeze protection is simple to implement, but does factor in to operations costs.

Alternate 2 is located entirely on CONP land, and requires no easements; this is a major advantage for Alternate 2. Alternate 2 permitting is expected to be somewhat easier than Alternate 1C. This alternate can be partially constructed / scaled if required to meet funding limitations. The primary disadvantages to Alternate 2 are: 1) the construction requires extensive excavation below the water table, increasing the unit price for excavation; 2) it is extremely difficult to predict off-property nitrate levels resulting from the discharge; and 3) the proposed infiltration pond may not meet the full 1 MDG target capacity for this WWTP.

Given the lower overall project costs, lower environmental impacts, and greater level of certainty, Alternate 1C is recommended as the preferred alternate for development.

4.3 PROJECT SEQUENCE AND TIMELINE

Once this Feasibility Study has been approved by the CONP and ADEC, the following tasks are required for a complete and constructed project.

1. **Final Determination of Outfall Location.** This will require a site visit with ADF&G to confirm exact outfall location within proximity to the location shown on figures, and to confirm the selected spot is not likely fish spawning habitat.

2. **Route Verification.** Once the outfall is confirmed, a field crew will confirm and / or adjust the conceptual routing to avoid existing drainages and wetlands to the extent possible. Global positioning system (GPS) coordinates collected during this activity will allow drafting of preliminary easement documents for the next task.

3. **Easement Negotiation.** Once a route has been selected, preliminary easement documents will be prepared for FNSB and ADNR easement applications. The application will cover both geotechnical and survey work, and the proposed utility construction.

4. **Design Survey and Geotechnical.** Design survey of the proposed pipe corridor will be completed and geotechnical investigations conducted, as required, to support final design efforts. Survey and geotechnical work will take place in the January – February 2016 timeframe.

5. **Design Engineering.** Plans and construction documents will be prepared after survey is completed. Documents will be completed to the 95 percent level for permit applications. This allows any permitting conditions to be incorporated into the 100 percent plans prior to bidding for a construction contract. The documents in Appendix D represent about a 20 to 35 percent complete construction documents. With award of an engineering contract, 65 and 95 percent construction documents can be produced in 3 to 4 months (inclusive of both submittals) after receipt of survey and geotechnical data. Plans will be completed by July 2016 for inclusion with an ADEC Municipal Matching Grant (MMG) Program application in August 2016.

   Since the alignment for Alternate 1C coincides with the existing effluent main, Alternate 1C can be constructed in functional phases. Phase 1 will consist of the 4,320 feet of pipe "south" of the Tanana River Levee to extend the existing discharge to the new river outfall. This is sufficient to address immediate NOV concerns and current discharge flows. A future phase will be needed to replace the rest of the existing 8-inch effluent main with 12-inch pipe once effluent flows exceed 500,000 gpd. At this time, design will assume this phased construction program and include only Phase 1 work because of funding limitations. The cost for just Phase 1 of Alternate 1 is estimated in Table 25.

Table 25 – Alternate 1C Phase 1 Project Cost Summary

Estimated Probable Construction Cost – 2015	$2,992,000
Design Survey	$28,000
Geotechnical Work	$45,000
Design Engineering	$230,000
Construction Administration	$250,000
Easements	$26,000
Permitting	$75,000
Permit Fees	$25,000
Wetlands Mitigation	$75,000
Subtotal	$3,746,000
Inflation / Escalation – Five Years at 3%	$561,900
Total Project Cost – 2020	**$4,307,900**

6. **Permitting, Easement Acquisition, and Other Approvals.** Ideally, preparation of permit applications will be concurrent with the development of construction documents, and permit applications will be provided to the CONP for review and submission with the 95 percent documents. However, at this time, CONP only has enough funds in hand to begin design engineering. To complete permitting, flood plain models, mixing zone models, and permit applications must be prepared with total costs as approximated in Table 25. CONP must obtain additional funding for these items; timeline for funding is discussed in Section 4.4. Consequently, permitting will likely lag completion of engineering by 2 to 5 months. Permits are expected to be approved between March and July 2017.

7. **Funding Procurement.** Any funding package that includes incurring debt will require additional time as debt requires a municipal vote in North Pole. Funding timelines are discussed further in Section 4.4.

8. **Procurement.** Procurement of construction contract will take place in either January 2017 or January 2018, depending upon funding scenarios. The process of advertising, receiving, and evaluating bids is expected to take 6 weeks. This allows for award of construction contract by March.

9. **Construction.** Project construction can be completed in a single season as long as procurement is complete in the spring and permits are received. The 4,320 LF of pipe and road construction in Phase 1 of Alternate 1C will take approximately 3 to 4 months after purchase and delivery of materials. Construction timelines will also need to consider the following:

- Clearing must need to occur outside of the bird nesting window (May 1 to July 15). Because of this, the procurement and construction contract award are coordinated to allow for clearing in April.

- Outfall construction into the Tanana River must be completed during a low flow period to avoid affecting migrating fish and spawning activities. Schedule allows for this work to occur in fall (i.e., September or October), when the river is typically low.

Completion of construction is anticipated for October 2017 or 2018, again depending on funding scenario.

4.4 PROJECT FUNDING PLAN

The CONP has funds remaining under the existing legislative grant for this feasibility study that will be applied to project design engineering following acceptance of this document. The funds are sufficient to complete construction documents for the project, but not enough to complete all permitting activities. Project completion (permitting, mitigation, and construction) will be dependent on outside entities, specifically those associated with funding. Two funding scenarios have been identified – the first based on receipt of an Alaska Legislative Award and the second assuming MMG funding is pursued. Both scenarios include receipt of an Alaska Clean Water Fund (ACWF) Loan, and a subsequent vote and approval by the citizens of North Pole to incur that debt.

Funding milestones are well defined and concrete. Permitting timelines are not as solid, as these are highly dependent on agency workload. Permitting can be time consuming. The scenarios presented here allow 6 months for permit approval. Some permits may take longer, namely the ADNR land use permits. Scenarios presented here are focused on completion of construction as soon as possible, but delay in approval of permits potentially may extend the overall project schedule.

4.4.1 Scenario 1 - Critical Path with Legislative Award

The CONP preferred pathway to project completion is outlined in Table 26. This funding scenario is predicated upon the CONP receiving an award from the Alaska Legislature, as well as an ACWF Loan. This is the most expedient means of constructing the preferred alternative and addressing the ADEC NOV, but success is dependent on the State budget and will of the legislature. Legislative money may simply not be available in 2016 due to State budget projections.

Table 26 – Critical Path Schedule with Legislative Award

Approximate Start Date or Milestone	Activity
11/25/2015	Request engineering proposal from Stantec for development of Alternate 1C (under development at production of this report)
12/11/2015	Submit this Feasibility Report to ADEC
12/13/2015	Meet with Legislative representatives on need for a 2016 legislative award
1/4/2016	Submit engineering professional services agreement to City Council for approval
1/5/2016	Commence engineering and design of effluent discharge with available funds
2/12/2016	Submit ACWF Loan application
4/1/2016	Include funding needs in Utility Annual Report as start to education effort supporting loan
6/1/2016	ADEC releases ACWF Loan awards for 2016
6/1 /2016	Information released to voters on ACWF Loan vote (assumes award offer received)
6/30/2016	State capital budget signed with CONP receiving a legislative award
6/30/2016	Submit required ACWF Loan paperwork
7/1/2016	Engineering and design of effluent discharge completed (critical for a MMG application and second funding pathway, see Table 27)
7/15/2016	Submit to FNSB a ballot initiative for ACWF Loan
7/15/2016	Award offer for legislative award received. **Note if not received, see Table 27.**
8/15/2016	City Council accepts legislative award
9/1/2016	Commence permitting and plan review process with Legislative funds (estimated minimum 6 month process)
9/1 /2016	Release educational information to voters about effluent discharge and ACWF Loan vote
10/4/2016	CONP votes on ACWF Loan ballot initiative to accept ACWF Loan debt
10/21/2016	FNSB validates vote on ballot initiative (assumes voters approve initiative)
11/7/2016	City Council approves accepting ACWF Loan
12/1/2016	ADEC releases 2016 ACWF Loan funds
12/5/2016	City Council approves construction management contract with project engineering firm
1/15/2016	Invitation to bid for spring 2017 construction of Phase 1 effluent discharge project
3/1/2017	Permits approved (assumes 6-month minimum timeline achieved)
3/1/2017	Award construction contract
4/1/2017	Construction of Phase 1 effluent discharge begins
10/31/2017	Construction of Phase 1 effluent discharge completed, resolving NOV

State budget procedures drive the timeline under this scenario. Legislative awards are not finalized until the State capital budget is passed, typically June 30 of each year. ADEC typically also authorizes ACWF Loans in June each year. Additionally, under the City of North Pole Charter, the CONP cannot accept the ACWF debt without a public vote. Annual elections occur on the first Tuesday of October each year. As a result, October 2016 is the soonest full project funding can be available.

Based on this scenario, project engineering will begin in January 2016; legislative funding received in August 2016 allows permitting to proceed. ACWF Loan funds, if approved by the North Pole voters, are then available in December 2016. The earlier legislative funding combined with the ACWF loan then allows a construction contract to be bid for construction in the 2017 season. Failure to achieve any of the critical activities could delay the process and escalate costs due to inflation.

4.4.2 Scenario 2 - Critical Path with MMG

In the event a legislative award is not approved, the second funding pathway involves seeking a MMG. The earliest a MMG can be applied for is August 2016, and the earliest the MMG will be approved and funded is July 2017. This will drive permitting into 2017 and construction into 2018.

Design engineering still begins in January 2016, and will support the MMG application. But funds for permitting are not available until the CONP 2017 budget is available (or the 2016 ACWF loan is funded from Scenario 1). Consequently, permitting under this scenario begins January 2017.

Schedule for construction contracting is dependent on receipt of ACWF Loan and MMG funding, with bidding expected in January 2018, and completion in October 2018.

Under this scenario, CONP will make a second attempt at a legislative award, but that application and process will not drive the timeline or alter the approach and milestones.

While Scenario 1 is definitely the optimal funding approach and achieves project completion sooner, it is dependent on approval of funds by the legislature. Given the current revenue projections for the State of Alaska, this is far from certain, so we believe that Scenario 2 is the more likely outcome and timeline for project completion. Based on this, we are projecting construction and project completion in 2018.

Table 27 – Critical Path Schedule with MMG Funding and without Legislative Award

Approximate Start Date or Milestone	Activity
11/25/2015 to 7/15/2015	See Table 26 – Critical Path Schedule with Legislative Award
8/5/2016	Submit MMG application to ADEC for 2017 funding
11/15/2016	Request funds for project permitting in CONP 2017 Utility budget, if 2016 ACWF not received or approved by voters
12/1/2016	Meet with Legislative representatives on need for a 2017 legislative award as a 2nd attempt at Legislative Award and increased chance of funding
12/1/2016	ADEC releases 2016 ACWF Loan funds, if approved (see Table 26)
1/1/2017	Commence permitting and plan review process with internal CONP resources or 2016 ACWF Loan funds (estimated minimum 6 month process)
2/3/2017	Submit 2017 ACWF Loan application if 2016 funding not received or sufficient
4/1/2017	Include funding needs in Utility Annual Report as part of education effort supporting loan (update to information in 2016)
6/1/2017	ADEC announces 2017 ACWF Loan awards for 2017
6/1/2017	Information released to voters on 2017 ACWF Loan vote (assumes award offer received)
6/30/2017	State capital budget signed with CONP receiving MMG and/or legislative award
6/30/2017	Submit required 2017 ACWF Loan paperwork
7/1/2017	Permits approved (assumes 6 month minimum timeline achieved)
7/13/2017	City Council accepts MMG and/or legislative award
7/15/2017	Submit to FNSB a ballot initiative for 2017 ACWF Loan
8/5/2017	Submit MMG application for 2018 funding if not funded for 2017
8/31/2017	ADEC approves 2017 MMG and releases funds
9/15/2017	City Council approves construction management contract with project engineering firm
10/1/2017	Invitation to bid for spring 2018 construction of Phase 1 effluent discharge noting award is contingent on receipt of future funding.
10/3/2017	CONP votes on 2017 ACWF Loan ballot initiative to accept ACWF Loan debt
10/20/2017	FNSB validates vote on ballot initiative to accept ACWF Loan debt
11/6/2017	City Council approves accepting 2017 ACWF Loan
11/16/2017	Award construction contract (assumes funding in place)
4/1/2017	Construction of Phase 1 effluent discharge begins
10/31/2017	Construction of Phase 1 effluent discharge completed, resolving NOV

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