Tanana Valley Watershed Association

Water Quality Sampling in Three Water Bodies

State of Alaska Department of Environmental Conservation
Project ACWA 12-07

Final Report

July 2011-June 2012

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Introduction

Problem Definition

This project was for the Chena River Basin (United States Geological Survey (USGS) Hydrologic Unit Code (HUC) 19040506, which includes three streams that are on Alaska's Section 303(d) list: Noyes Slough (Alaska ID Number 40506-003), Chena Slough (Alaska ID Number 40506-002), and the Chena River (Alaska ID Number 40506-007). All three streams are currently classified as Category 5 streams as impaired due to sediment. Sediment load has not been sampled at many locations, or during the range of flow conditions typically encountered in the watershed. Turbidity and suspended solids have been frequently monitored in this watershed as surrogate measures of sediment, but these parameters may or may not be directly related to settleable solids, which is the relevant ADEC standard of concern. This data gap is addressed by this project. This project was designed to collect sufficient information with which to make final decisions in support of Impaired Water body needs for the three major water bodies in the Chena watershed (Chena River, Chena Slough and Noyes Slough); the data collected in the project will be used to determine the impairment due to sediment present in the three focal streams.

Project Background

Water bodies in the Chena River basin have been listed as impaired for pollutants including petroleum hydrocarbons, oils and grease as well as sediment. (i.e. petroleum hydrocarbons, and sediment). Previous studies collected data on petroleum hydrocarbons and resulted in delisting for the Chena River and Chena Slough. Noyes Slough was not delisted because of the presence of sheens, but a total maximum daily load (TMDL), or waterbody recovery plan, was completed in 2011.Noyes Slough is also listed as impaired due to residues (trash)and a TMDL for residues (debris) was approved by EPA in June 2008.

In addition to the impairments already included on the Section 303(d) list above, metals, fecal coliform, and nutrients have also been identified as potential threats in the Chena River Basin. These parameters, as well as the effects of excess nutrients (such as low dissolved oxygen and excess algae or Chlorophyll a) are also of future interest in this watershed.

The following Location and Hydrology were pulled from the Watershed Characterization Report by Tetra Tech, November 2011:

Location

The Chena River is a tributary of the Tanana River and is located in interior Alaska, entirely within the Fairbanks North Star Borough (Figure 1). The City of Fairbanks, which is Alaska's second largest city, is located in the lower portion of the Chena River Basin. The headwaters of the Chena River begin in the White Mountains about 145 km (90 mi) east of the city of Fairbanks. The river flows southwest to its confluence with the Tanana River in Fairbanks. The maximum length of the basin is 161 km (100 mi) and the maximum width is 64.5 km (40 miles). The Chena River drains an area of approximately 5,478 km^2 (2,115 mi^2).

Chena Slough (aka Badger Slough) begins at the City of North Pole and flows for approximately 27 km (17 mi) northwest through the City of North Pole, residential areas, and a park until it empties into the Chena River, 8 km (5 mi) east of Fairbanks (Figure 1). The Chena Slough watershed encompasses approximately 68 km^2 (26 mi^2).

Noyes Slough, located in the City of Fairbanks, is 5.5 miles long and is a tributary to the Chena River (Figure 1). Noyes Slough branches off to the north from the Chena River and returns to the north bank of the Chena River upstream of the confluence of the Chena River with the larger Tanana River. The slough is stagnant and is used mostly during the winter months for dog mushing, skiing, and dog walking. Noyes Slough and its adjacent wetlands provide habitat for beavers, muskrat, and waterfowl and spawning grounds for grayling and other fish (Kennedy et al. 2004). Noyes Slough is also a popular canoeing area and serves as a "living laboratory" where local elementary students observe local wildlife and learn about the value of clean waterways and the effects of urban pollution (Kennedy et al. 2004).

Hydrology

The Chena River begins in the mountains and flows to the lowlands of the watershed, which are a mosaic of wetlands and braided sloughs at the mouth of the river near Fairbanks. Water in the Chena River basin comes from precipitation, upstream flows, and groundwater (from unconfined aquifers). Chena River flow at Fairbanks ranges from 2.83 to 2,107 cubic meters per second (m^3/s) (100 to 74,400 cubic feet per second [cfs]), with an average flow of 38 m^3/s (1,344 cfs). High flows occur in the summer months (May through September) and low flows tend to occur in the winter months (November through April). Ice forms on the river in October and breaks up in April and May. The highest flows usually occur in May following spring rains and snow and ice-melt.

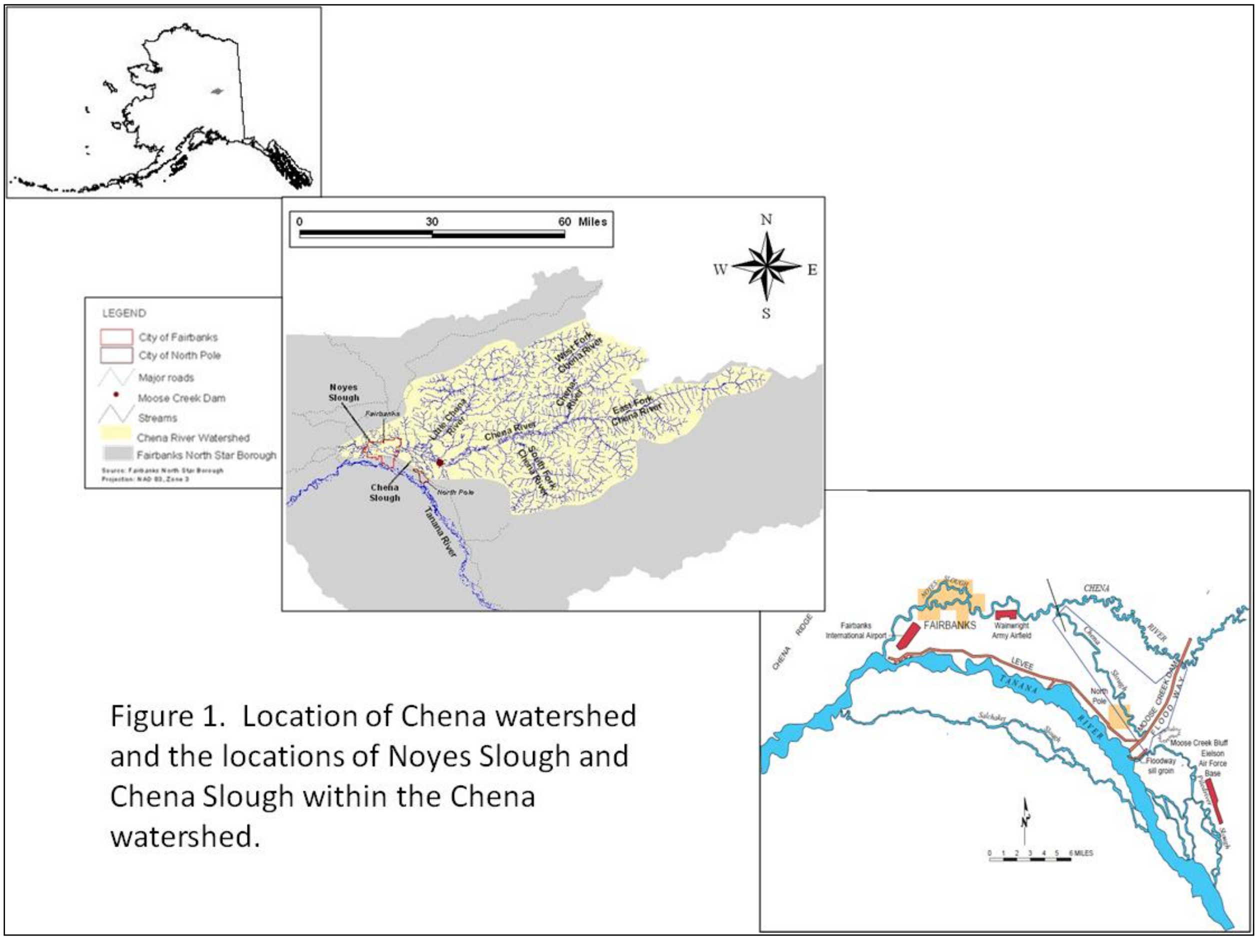


Figure 1. Location of Chena watershed and the locations of Noyes Slough and Chena Slough within the Chena watershed.

Image from: http://dec.alaska.gov/water/wnpspc/protection_restoration/ChenaRiverWQ/docs/ChenaRiver_Watershed_Characterization_11-11.pdf

Flow in the Chena River Basin has been altered over the past 50 years because of flood-control structures on the Chena and Tanana Rivers. Moose Creek Dike was built across Chena Slough in 1945, blocking flow from the Tanana River. The 1967 flood on the Chena River resulted in the construction of a diversion dam (Moose Creek Dam), a floodway leading to the Tanana River, and a levee along the north bank of the Tanana River to avoid potentially severe flooding in Fairbanks.

Peak flows in the Chena River were reduced further in 1980 after the completion of the Chena River Lakes Flood Control Project, which was designed to limit Chena River flow through Fairbanks to 12,000 cubic feet per second (cfs) (Burrows et al. 2000 and Kennedy et al. 2004). The Moose Creek Dam is located approximately 17 miles east of Fairbanks and divides the Chena River into an upper and lower reach. The construction of the dam resulted in blocking many sloughs and side channels of the Tanana River. These water bodies were once fed by Tanana River flows, but are now fed mainly by groundwater.

The Chena River Lakes Flood Control Project is operated only for flood control and does not permanently hold water upstream of the Moose Creek Dam. The Tanana-Kuskokwim Lowland below the dam is composed of pervious gravels, sands, and silts that let groundwater flow relatively freely. Chena River volumes can vary widely depending on the amount of flow into or out of the groundwater supply. Groundwater is considered to be an important element of the local hydrologic condition and flood control operations in the basin take groundwater conditions into account. To avoid expanses of standing water within the area downstream of Moose Creek Dam, a network of seepage collector channels has been installed to collect the water moving through the foundation gravels and route it to the Chena River.

Flow in Chena Slough and Noyes Slough has declined over the past 50 years because of construction of the Moose Creek dike and dam. The streamflow in Chena Slough is less than 100 cfs and mainly comes from groundwater (Scharfenberg 2004) as well as local runoff from disturbed areas such as roads and drainage ditches.

The reduction in peak flows in the Chena River likely resulted in reduced flows in Noyes Slough (Burrows et al. 2000 and Kennedy et al. 2004). These flow-reduction measures have also caused down-cutting (lowering) of the Chena River channel bed at the entrance to Noyes Slough, reducing the magnitude and duration of surface water flow from Chena River to the slough. Consequently, Noyes Slough is slowly drying up and flows will likely continue to decline without intervention to reverse the process.

Typically, Noyes Slough is navigable except during low flows. During very dry periods there is still standing water in the slough, but there is little to no flow. Many reaches of the slough are stagnant. At times of no surface water flow from the Chena River into Noyes Slough, pools of water in the deeper parts of the slough correspond to local groundwater levels, indicating input from groundwater. In winter, no water flows in the slough, and the channel is filled with ice and snow (Burrows et al. 2000 and Kennedy et al. 2004).

Summary of Tasks

The study objective is to collect data on multiple water quality parameters in accordance with an updated QAPP in the Chena River, Chena Slough, and Noyes Slough at twelve (12) designated locations during at least three (3) flow regimes to characterize conditions. Four tasks are required to complete this objective; these tasks and progress on these tasks are summarized below:

- **Task 1: Review and update 2009 QAPP.**
  Start and end date: July 1, 2011 – July 15, 2011
  Description: Review the 2009 DEC approved QAPP. Submit an updated QAPP and sampling plan to the DEC Project Manager. The updated QAPP should describe the TVWA as following the previously prepared document.
  Product: Revised QAPP submitted to the DEC Project Manager for approval.

Progress: The updated QAPP and sampling plan was approved by the DEC Project Manager on August 4, 2011.

- **Task 2: Sampling training.**
  Start and end date: July 1, 2011 – July 31, 2011
  Description: Receive and provide training for the executive director and volunteers in sampling procedures in accordance with the QAPP.
  Product: Trained sampling personnel.
  Progress: The executive director received training in water sample collection using a depth-integrated sampler from Ben Kennedy, Project QA officer and BLM Hydrologist, Alaska Eastern Interior Field Office on August 13, 2011. The executive director then trained volunteers as needed for sampling events.

- **Task 3: Data collection.**
  Start and end date: July 15, 2011 – June 30, 2012
  Description: In accordance with the revised DEC approved QAPP, collect baseline water quality (i.e. DO, pH, temperature, conductivity), and settleable solid samples at locations in the Chena River, Chena Slough, and Noyes Slough under break up, base flow, and storm flow conditions (if available during sample period). Photographs will be taken to document conditions during sampling events.
  Product: Data from water quality sampling events. Data will be entered into AWQMS/STORET or provided to the DEC in the specified format. Data will be compared among sites and dates and related to stream discharge data. Data will be evaluated relative to state water quality standards. Data and site visit photos will be presented through quarterly reports (that will include findings and analysis) with recommendations for future research, monitoring, and restoration needs.
  Progress: Three sets of water quality and settleable solid samples were taken at the 12 study site locations during this reporting period. The location and dates of the sampling effort as well as a preliminary summary of the water quality data and results can be found in Appendix A.

- **TASK 4: Reports.**
  Start and end date: September 30, 2011 – July 31, 2012
- **Description**: Quarterly reports describing progress made in achieving the objectives and tasks of this project will be submitted to the DEC in accordance with the time tables established on page one of the work agreement. A draft final report and final report will be produced that evaluate and describe the project accomplishments and their environmental benefit. The draft and final reports will include background information, an evaluation of monitoring results (including, but not limited to, presentation of the results in tables and figures), a narrative discussion, and a summary which includes conclusions and recommendations as to the sediment impairment condition of the water bodies. A summary of each task will be required. See each task product/deliverable section for more information.

- **Product**: Four quarterly financial reports, a draft final, and a final progress report. The quarterly reports are due October 10, 2011, January 10, 2012, April 10, 2012, and July 15, 2012; the draft final report is due December 31, 2011; the final report is due July 31, 2012.
- **Progress**: All quarterly progress reports have been completed for the periods ending on September 30, 2011 and December 31, 2011, March 31, 2012, and June 30, 2012. A draft final report for the period ending December 31, 2012 has been submitted. This report fulfills the final progress report requirement.

Methods

SAMPLING METHOD REQUIREMENTS

Samplers wore disposable gloves and safety eyewear, when needed, and observed precautions while collecting samples, remaining aware of the potential chemical and biological hazards present. The project sampling staff collecting samples took care not to touch the insides of bottles or lids/caps during sampling.

Sample Types

Samples were listed as “composite” or “grab” on the Chain-of- Custody or Transmission Form and in field logbook or field data sheets.

Table 1. Water sample parameters, analytical methods, measurement quality objectives and Alaska Water Quality Standards; Project ACWA 12-07, Sampling Water Quality Sampling in Three Water Bodies, 2011-12

Group	Parameter	Method	MDL (µg/L)	PQL (µg/L	Alaska WQS		Precision (RPD or RSD)	Accuracy (% Rec)
					Aquatic Life	Recreation/Drinking Water		
Settleable Solids	Settleable Solid	EPA 160.5	0.2 ml/L/h	0.2 ml/L/h	No measureable increase abov natural condition	<5% increase in 0.1 mm to 0.4 mm fine sediment for waters wi anadromous fish; <30% by weight of fines in gravel beds	±30%	NA
Water Quality	DO	In situ (electronic probe) EPA 360.1	NA	0.01 mg/L	>7 mg/l for anadromous fish; >5 mg/l for non-anadromous fish; < 1 mg/L	>4.0 mg/L	±20%	NA
	pH	In situ (electronic probe) EPA 150.1	NA	0.01 pH units	6.5 - 8.5; not vary by 0.5 from natural condition	6.5 - 8.5	±0.1 pH unit	±0.1 pH unit
	Temperature	In situ (electronic probe) EPA 170.1	NA	0.1°C	<20°C Migration routes < 15°C Spawning areas < 13°C Rearin areas < 15°C Egg /fry incubation < 13°C	<30°C	±0.2°C	±0.2°C
	Conductivity	In situ (electronic probe) EPA 120.1	NA	0-1: 0.001 1-10: 0.01 10-100: 0.1 (mS/cm)	NA	NA	± 10%	± 10%

NA = None available.

Sample Containers and Equipment

Sample containers were supplied by the analytical laboratory. Commercially available pre-cleaned jars were used, and the laboratory maintained a record of certification from the suppliers. Sample containers were clearly labeled at the time of sampling. Labels included the project name, sample location and number, sampler’s initials, analysis to be performed, date, and time.

The sediment load sampling device were rinsed with site water between sampling stations. The equipment was kept wrapped in plastic bags until the time of use, when it was rinsed again with site water.

Table 2: Preservation and Holding Times for the Analysis of Samples					
Analyte	Matrix	Container	Necessary Volume	Preservation and Filtration	Maximum Holding Time
Residue (settleable solids)	Surface Water	P, FP, G	1 L	Cool <6^{o}C, do not freeze	48 hours

P = polyethylene, FP = flouropolymer, G = glass, PA = autoclavable plastic

Sampling Methods

Sampling methods followed those approved by ADEC in Alaska's water quality standards including the use of Imhoff cones and grab samplers (i.e., DH-48, Kemmer bottle, or other similar device). Sampling methods for the chemical characterization of surface water at both base flow and other flow conditions were based on methods previously used in Chena River watershed.

Surface Water – Sediment Load

Sampling in the Chena River watershed involved instrument measurements made directly in the field, as well as collecting samples for laboratory analysis. Flowing stream water was collected using an isokinetic, depth-integrated or nonisokinetic sampling methods. This plan assumes that the number of depth-integrated samples required could be reduced because the stream was well mixed. In order to validate this assumption, each time a station was sampled, four in-situ parameters (oxygen, pH, specific conductance and temperature) were measured at each selected sampling point. If the stream appeared well mixed (i.e, values are within 5% of each other which is within typical measurement error), the composite sample was collected from depth-integrated samples drawn at these selected sampling points (Table 8). If variability was excessive, additional depth-integrated sampling points (max 10) were required for that particular station (USGS, 2006).

Once stream variability was assessed, collection of a water sample, both horizontally and vertically integrated commenced. When the maximum stream velocity observed (i.e., at the USGS gauging station) was greater than or equal to 1.5 ft/sec and under 9.0 ft/sec an isokinetic equal width increment (EWI) composite sample would be generated using an approved USGS sampler (DH48 Depth-Integrating Suspended Sediment Sampler). If maximum stream velocity was under 1.5 ft/sec, a non-isokinetic equal-width increment composite sample would be generated. No sampling method for velocities over 9 ft/sec was been developed (USGS, 2006).

Table 3. Number of depth-integrated samples required by stream width (MDNR, 2006). Modified from USGS National Field Manual for the Collection of Water Quality Data (Chapter A4.) (http://water.usgs.gov/owq/FieldManual/chapter4/html/chap.4contents.html)

Width of waterway (ft.)	Minimum # of Depth-Integrated Samples

0 – 25	1
25 – 100	3
100 – 250	5
250 – 500	7
>500	9

The EWI composite sample was generated by collecting individual depth integrated samples at each specified sampling point (USGS, 2006). These samples were composited in a churn splitter, with a minimum volume of 2 liters after which appropriate samples bottles were filled. Water depth at each sampling point was recorded on the field data sheets. Protocols for surface water grab sampling generally followed the *USGS National Field Manual for the Collection of Water Quality Data* (USGS Variously Dated) and EPA SOP #2013 (EPA 1994). More detailed procedures on the sampling and collection procedures can be found at http://pubs.water.usgs.gov/twri9A.

In addition to collecting grab samples for pollutant analyses, general water quality parameters (temperature, pH, conductivity, and dissolved oxygen) was measured directly in the field at each location and at each sampling event using field meters.

SAMPLE HANDLING AND CUSTORY REQUIREMENTS

Individual samples for analysis was placed in the appropriate pre-cleaned sample containers. To ensure sample integrity specific sampling and documentation procedures were followed. These procedures included labeling containers prior to sampling, extensive sample and site information recording, appropriate sample handling and comprehensive chain-of-custody procedures. Sample and site information was recorded in the field notebooks. Holding times for each sample analysis type were met.

Sample documentation procedures included project field notebooks, chain-of-custody forms and sample labels. Specific information such as site identification, sample identification numbers, sampling observations and sample collection time and date was recorded in field notebooks. Additionally, photographic documentation was collected during the sampling event.

Samples were in custody when they were in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals. A chain-of-custody record was signed by each person who had custody of the samples and accompanied the samples at all times. Copies of the chain-of-custody were included in laboratory and QA/QC reports. At minimum, the form included the following information:

- Site name
- Field coordinator's name and team members responsible for collection of the listed samples
- Collection date and time of each sample
- Sampling type (e.g., composite or grab)
- Sampling station location

- Number of sample containers
- Requested analysis
- Sample preservation information
- Name of the carrier relinquishing the samples to the transporter, noting date and time of transfer and the designated sample custodian at the receiving facility.

The field coordinator, as the designated field sample custodian, was responsible for all sample tracking and chain-of-custody procedures for samples in the field. The sample custodian was responsible for final sample inventory and maintained sample custody documentation. The custodian completed chain-of-custody forms prior to removing samples from the sampling vessel. Upon transferring samples to the laboratory sample custodian, the field coordinator signed, dated, and noted the time of transfer on the chain-of-custody form.

The original chain-of-custody form was transported with the samples to the laboratory. The laboratory also designated a sample custodian who was responsible for receiving samples and documenting their progress through the laboratory analytical processes. Each custodian ensured that the chain-of-custody and sample tracking forms were properly completed, signed, and initialed upon transfer of the samples.

Upon receipt of the samples by the laboratory, the laboratory sample custodian inventoried the samples by comparing sample labels to those on the chain-of-custody document. The custodian entered the sample number into a laboratory tracking system by project code and sample designation. The custodian assigned a unique laboratory number to each sample and was responsible for distributing the samples to the appropriate analyst or for storing samples in an appropriate secure area.

Sample Handling and Transport

Sample coolers and packing materials were supplied by the analytical laboratories. Individual sample containers were placed into sealed plastic bags. Samples were then packed in a cooler lined with a large plastic bag. Ice in sealed plastic bags or "blue ice" were placed in the cooler to maintain a temperature of <4ºC. When the cooler was full, the chain-of-custody form was placed into a ziplocked bag and taped on the inside lid of the cooler.

The coolers were clearly labeled with sufficient information (i.e., name of project, time and date container was sealed, person sealing the cooler, and company name and address) to enable positive identification.

Waste Disposal

Any excess water remaining after processing was returned to the collection site. All disposable materials used in sample collection and processing, such as paper towels and gloves, were disposed of properly. Liquid wastes from decontamination of the sampling equipment was disposed into the sanitary sewer system.

ANALYTICAL METHODS AND REQUIREMENTS

Water quality analytical methods used throughout this project are outlined below. All analysis methods used for this program were EPA-approved. The contracted laboratory (Analytica) is an ADEC drinking water certified laboratory. The contracted laboratory's Quality Management Plan (QMP) is on file with ADEC detailing their quality assurance procedures. Laboratory turnaround time was 20 business days. Any issues regarding analytical data quality will be resolved by the Grantee's project manager and project QA Officer through discussions with the laboratory project manager.

Sampling Parameters

Dissolved Oxygen: measured in mg/L, and is representative of the amount of dissolved oxygen available in solution at the time of the measurement. Dissolved oxygen was measured using a YSI 650 MDS multi-probe meter, or an equivalent meter.

Conductivity: measure of the electrical conductance, or the amount of dissolved salts and ionized chemical species found in solution in a particular water sample. Conductivity was measured in µS/cm using a YSI 650 MDS multi-probe meter, or an equivalent meter.

pH measurements made in the Standard Unit (SU) logarithmic scale, and provide information on the levels of H^+ and OH^- ions in solution, or the acid and base properties of a water sample. pH was measured using a YSI 650 MDS multi-probe meter, or an equivalent meter.

Temperature: reported in °C, and was measured using a YSI 650 MDS multi-probe meter or an equivalent meter.

Sediment measured as settleable solids employed the ADEC standard settling method specified in Note 15 in 18 AAC 70 based on EPA Method 160.5, using a 1 liter Imhoff Cone with a 45 minute settling/stir/15 minute settling time. The volume of settleable matter was then recorded in ml/liter. The sub-contracted lab staff measured settleable solids using the Imhoff cone method after collecting the samples from the field staff.

Under direction of the Project Manager, project staff ensured that all equipment and sampling kits used in the field met EPA-approved methods.

B.5 QUALITY CONTROL REQUIREMENTS

Quality control activities in the field included adherence to documented procedures and the comprehensive documentation of sample collection information included in the field notebooks. A rigidly enforced chain-of-custody program ensured sample integrity and identification. The chain-of-custody procedure documented the handling of each sample from the time the sample was collected to the arrival of the sample at the laboratory.

B.5.1 Field Quality Control (QC) Measures

Quality Control measures in the field include but were not limited to:

- Proper cleaning of sample containers and sampling equipment.

- Maintenance, cleaning and calibration of field equipment/ kits per the manufacturer's and/or laboratory's specifications, and field Standard Operating Procedures (SOPs).
- Chemical reagents and standard reference materials are used prior to expiration dates.
- Proper field sample collection and analysis techniques.
- Correct sample labeling and data entry.
- Proper sample handling and shipping/transport techniques.
- Field replicate measurements (1 replicate measurement/10 field measurements).

Field replicate measurements of pH, conductivity, dissolved oxygen, and water temperature was performed at every sampling event. Field replicate samples were made on 10% of the collected settleable solids samples (approximately 7). These replicates were equally distributed among sites and sampling events. In addition, equipment calibration verification checks were conducted prior to and following each sampling event.

Table 4: Field Quality Control Samples

Field Quality Control Sample	Measurement Parameter	Frequency		QC Acceptance Criteria Limits
		# of Sampling Events	# of QC per measurement	
Field Replicate Measurement	pH, conductivity, dissolved oxygen, water temperature	72 (12 sites, 6 visits to each site)	3 values for each parameter were recorded at each location where depth integrated water samples were taken (varied by site; see Appendix A for all replicate data)	See the required precision levels for each paramete in Table 1.
Field Replicate Measurement	Settleable solids		6 replicate samples (see **Table 6** for location/date of replicate sampling)	
Calibration Verification Check Standard	pH, conductivity, dissolved oxygen		Prior to and following each sampling event	

Laboratory Quality Control (QC) Measures

Quality Control in laboratories included the following:

- Laboratory instrumentation calibrated with the analytical procedure,
- Laboratory instrumentation maintained in accordance with the instrument manufacturer's specifications, the laboratory's QAP and Standard Operating Procedures (SOPs),
- Laboratory data verification and validation prior to sending data results to ADEC and/or permitted facility.

The sub-contracted lab provided analytical results after verification and validation by the laboratory QA Officer. The laboratory provided all relevant QC information with its summary of data results so that the project manager and project QA officer performed field data verification and validation, and review the laboratory reports. The project manager reviewed the data to ensure that the required QC measurement criteria were met. If a QC concern is identified in the review process, the Project Manager and Project QA Officer will seek additional information from the sub-contracted laboratory to resolve the issue and take appropriate corrective action/s.

There were not specified laboratory QC requirements for the analysis of settleable solids. However, lab replicate analyses were conducted on 10% of the samples received by the lab. For those collections, water samples were collected in 2L volumes which were split in the lab and settleable solids analysis was performed on each 1L sample. The lab's QC precision criterion for this measurement is 30%. In addition, contract laboratories typically are required to participate in EPA's DMR QA study annually. The DMR QA subjects analytical laboratories to proficiency testing to determine their ability to accurately measure a known concentration of test material. Analytical laboratories typically analyzed QA samples for all parameters that they routinely analyze for clients. The results of the 2010 DMR QA study has been submitted by the contract laboratory, and the results of the 2011 DMR QA study was upon completion.

INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

Prior to a sampling event, all sampling instruments and equipment were tested and inspected in accordance with the manufacturers' specifications. All equipment standards (thermometers, multi-meters, etc) were calibrated appropriately and within stated certification periods prior to use.

Monitoring staff documented when required acceptance testing, inspection and maintenance were performed. Records of this documentation were kept with the instrument/equipment kit in bound logbooks or data sheets.

Contracted and sub-contracted laboratories followed the testing, inspection and maintenance procedures required by EPA Clean Water Act approved methods and as stated in the respective laboratory's QAP and SOPs.

INSTRUMENT CALIBRATION AND FREQUENCY

Field instruments were calibrated where appropriate prior to using the instruments. If equipment and/or kits required calibration immediately prior to the sampling event, the calibration date was recorded in the operator's field logbook or field data sheets. When field instruments required only periodic calibration, the record of this calibration was kept with the instrument. The project manager ensured that instruments were calibrated correctly and appropriate documents recorded and retained.

The surface water samplers (i.e., DH-48) used to collect surface water samples were routinely inspected to verify that it was working properly. Routine maintenance of the sampler was conducted prior to each sampling event. Maintenance included a visual inspection that all parts were present, attached correctly and devoid of any obvious contamination. The project manager coordinated ordering replacement parts and repairing samplers.

Sub-contracted laboratories followed the calibration procedures found in its QAP and the laboratory's Standard Operating Procedures (SOPs). Specific calibration procedures for regulated pollutants were in agreement with the respective "EPA Approved" Clean Water Act Pollutant methods of analysis. Field and/or Laboratory calibration records will be made available to ADEC upon request.

INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All sample collection devices and equipment were appropriately cleaned prior to use in the monitoring project.

All sample containers, tubing, filters, etc. provided by a laboratory or by commercial vendor, was certified clean for the analyses of interest. The sampling manager/person made note of the information on the certificate of analysis that accompanies sample containers to ensure that they met the specifications and guidance for contaminant-free sample containers for the analyses of interest.

No standard solutions, buffers, or other chemical additives were used if the expiration date had passed. It was the responsibility of the sampling manager or his/her designee to keep appropriate records, such as logbook entries or checklists, to verify the inspection/acceptance of supplies and consumables, and restock these supplies and consumables when necessary.

Contracted and sub-contracted laboratories followed procedures in their laboratory's QAP and SOPs for inspection/acceptance of supplies and consumables.

Project sample procedures were in accordance with the methods outlined in the Quality Assurance Project Plan for "Water Quality Sampling in Three Water bodies." For more details, see the Quality Assurance Project Plan in Appendix C.

Results

In accordance with the approved QAPP, TVWA recorded water quality parameters of temperature, pH, conductivity, and dissolved oxygen, and collected composite water samples for analysis of settleable solids at 4 locations in the Chena River, 4 locations in Chena Slough, and 4 locations in Noyes Slough (Table 5) under variable flow conditions. Six rounds of sampling were completed; August 15-18, September 6-8, September 26 – October 4, May 14-17, May 29-31, and June 25-28. Dissolved oxygen measurements from sample events four and five were removed from the analysis after it was determined that the meter was likely not calibrated prior to sampling. The data obtained at these events are, however, included in Appendix A for reference. Water quality, settleable solids, and associated streamflow data are summarized for each sample event in Table 6. Complete data files are included in Appendix A. Photographs obtained at each of the 12 sample sites are included in Appendix B.

Table 5. Water quality and settleable solids sampling sites and locations in Chena River, Chena Slough, and Noyes Slough, Fairbanks, Alaska, 2011-2012

[**Abbreviations:** D.d ; decimal degrees. North American Datum 1983 (NAD83)]

Water Quality Measurement Site Number	Settleable Solids Sampling Site Number	Waterbody	Site Name	Site Latitude (D.d)	Site Longitude (D.d)
CR-1	CR-1	Chena River	Rosehip Campground		
CR-2	CR-2	Chena River	Chena River at Nordale Road	64.846	-147.410
CR-3	CR-3	Chena River	Old Steese Highway	64.846	-147.709
CR-4	CR-4	Chena River	University Avenue	64.841	-147.812
CS-1	CS-1	Chena Slough	Laurence Road	64.733	-147.289
CS-2	CS-2	Chena Slough	Hurst Road	64.762	-147.344
CS-3	CS-3	Chena Slough	Nordale Road	64.814	-147.410
CS-4	CS-4	Chena Slough	Persinger Drive	64.835	-147.487
NS-1	NS-1	Noyes Slough	Minnie Street	64.849	-147.707
NS-2	NS-2	Noyes Slough	O'Connor Road	64.857	-147.725
NS-3	NS-3	Noyes Slough	Aurora Drive	64.861	-147.761
NS-4	NS-4	Noyes Slough	Goldizen Road.	64.844	-147.809

Water quality field parameter QA/QC procedures were accomplished using standard calibration procedures, standard calibration solutions, and collecting multiple measurements under comparable conditions at selected sites (Appendix A).

Settleable solids laboratory quality control replicate samples that were not less that the MRL were within specified accuracy and precision criteria of ± 30 percent. The variance between routine field samples and QA/QC replicates are shown in Table 6. However, all but four of the settleable solids replicate concentrations were less than the method reporting level (MRL).

Sampling events were referenced to mean daily flows at the USGS Chena River stream gage (Figure 2a and 2b) near the Steese Highway bridge crossing. The first round of samples, August 15-18, was collected during a storm event. Chena Slough was sampled August 15, with mean daily flow at approximately 2,400 ft^3/s and increasing stage. Noyes Slough was sampled August 16 when mean daily flow peaked at 3,130 ft^3/s and Chena River was sampled August 18 as flows receded to 2,850 ft^3/s. Normal flows of about 2,000 ft^3/s persisted for the second and third sample events, September 6-8, and September 26 – October 4.

Normal flow conditions were also present during the fourth and sixth sample events, May 14-17 and June 25-28. However, the fifth sample event was conducted during a period of very high water, where maximum flows exceeded 7,000 ft^3/s.

Figure 2a. Daily mean discharge for USGS Chena River stream gage 15514000 at Fairbanks, August 1 to October 31, 2011 with sample events and 10 year (2000-2010) average flows.

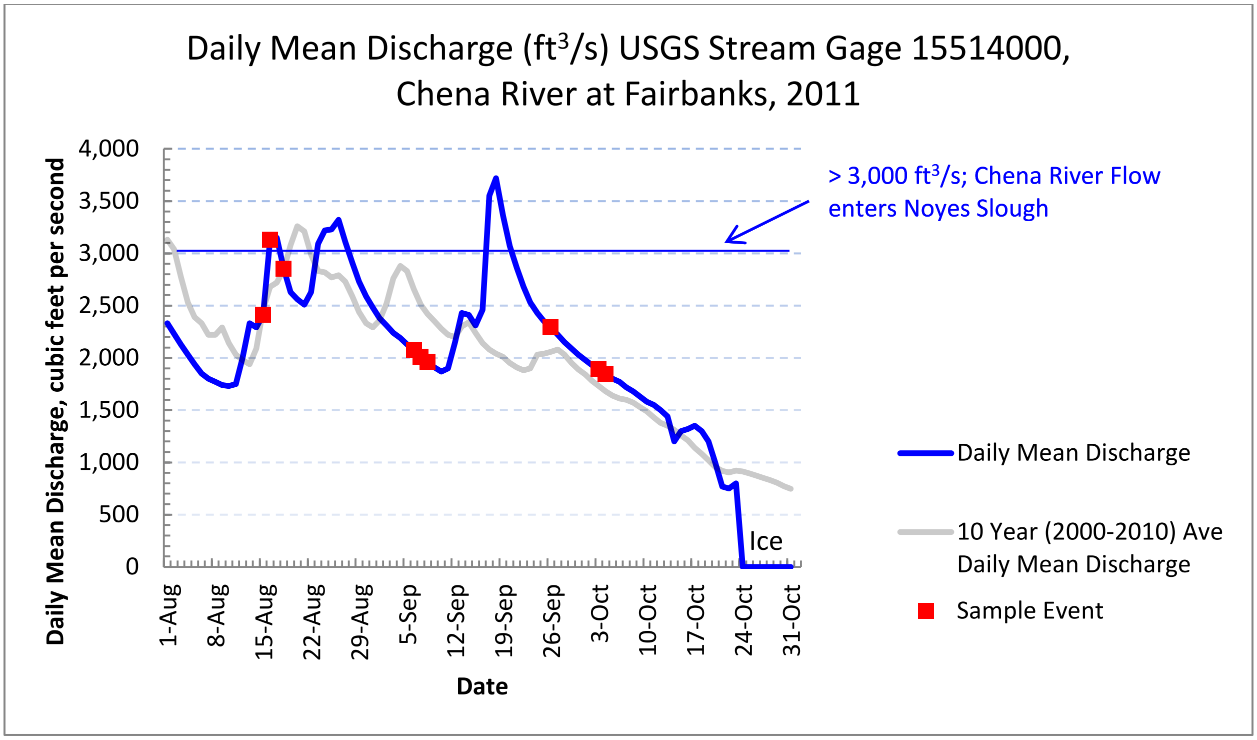
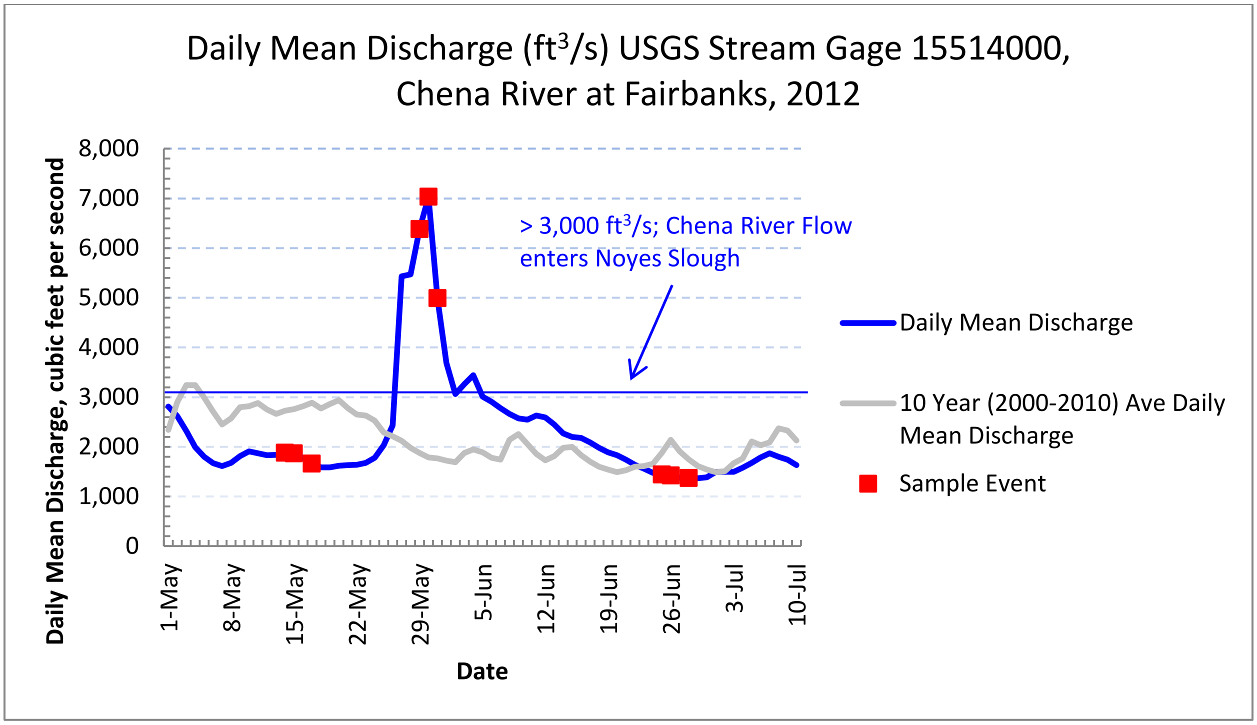


Figure 2b. Daily mean discharge for USGS Chena River stream gage 15514000 at Fairbanks, May 1 to July 10, 2012 with sample events and 10 year (2000-2010) average flows.



Chena River water quality parameters of temperature, pH, and dissolved oxygen recorded during the six sampling events were within State of Alaska Water Quality Standards for Aquatic Life and Recreation/Drinking Water. Temperature varied from 2.9 to 13.2 °C. Conductivity values ranged from 93 to 231 µS/cm, pH values were between 7.0 and 7.7 standard units, and dissolved oxygen varied from 9.9 to 13.2 mg/L (Figures 3-6).

Chena Slough water temperature varied from 1.6 to 21.4 °C. The maximum temperature of 21.4 °C was recorded June 25 at site CS1, Laurance Road, and exceeds the State of Alaska Water Quality Standard for Aquatic Life of 15°C for fish migration routes. This site consistently had the highest temperatures recorded in Chena Slough across all sample events and values greater than 15°C were recorded at three sample events. In addition, temperatures at all four sample sites on Chena Slough exceeded the temperature standard on June 25. Values of pH ranged from 7.5 to 8.6 standard units. The maximum pH of 8.6 was recorded August 15 at site CS4, Persinger Drive, and slightly exceeds the State of Alaska Water Quality pH Standard of 8.5 for Aquatic Life and Recreation/Drinking Water. Conductivity values ranged from 188 to 382 µS/cm and dissolved oxygen varied from 7.2 to 13.3 mg/L (Figures 3-6).

Noyes Slough water temperature varied from 3.7 to 19.4 °C. The maximum temperature of 19.4 °C was recorded June 26 at site NS3, Aurora Drive, and exceeds the State of Alaska Water Quality Standard for Aquatic Life of 15°C for fish migration routes. Similar to Chena Slough, all Noyes Slough sample sites on June 26 exceeded the temperature standard. Values of pH ranged from 6.6 to 7.7 standard units. Conductivity values ranged from 80 to 545 µS/cm and dissolved oxygen (DO) varied from 1.5 to 10.2 mg/L. The minimum DO of 1.5 was recorded September 26 at site NS3, Aurora Drive, and is less than the State of Alaska Water Quality Standard of > 5 mg/L for Aquatic Life and less than the > 4 mg/L standard for Recreation/Drinking Water(Figures 3-6).

Figure 3. Water temperature measurements; Chena River, Chena Slough, and Noyes Slough, 6 sampling events, 2011-2012

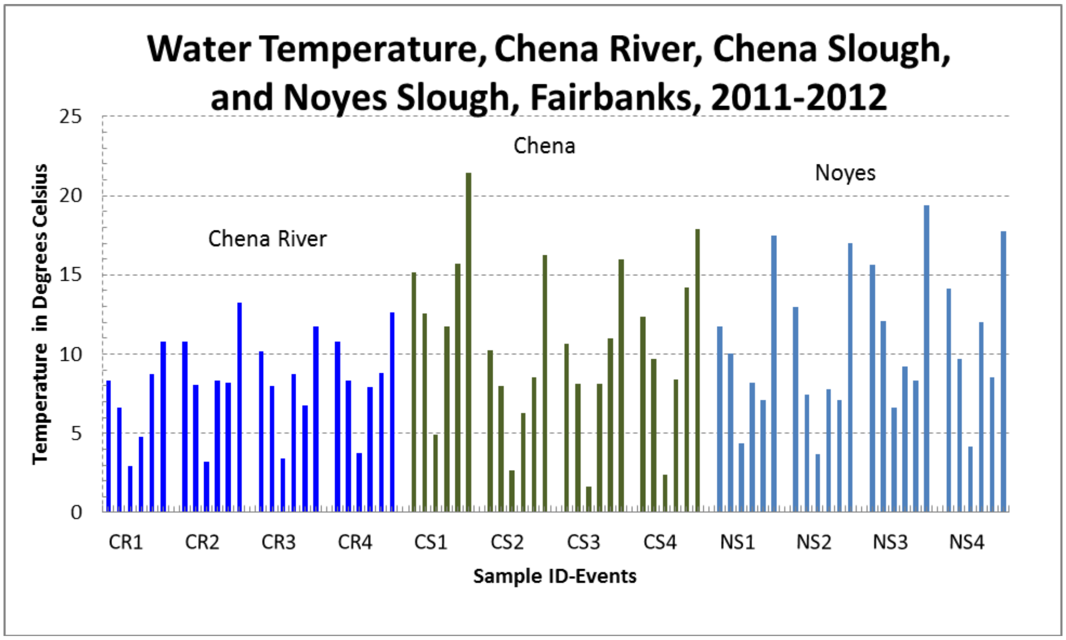


Figure 4. Water conductivity measurements; Chena River, Chena Slough, and Noyes Slough, 6 sampling events, 2011-2012

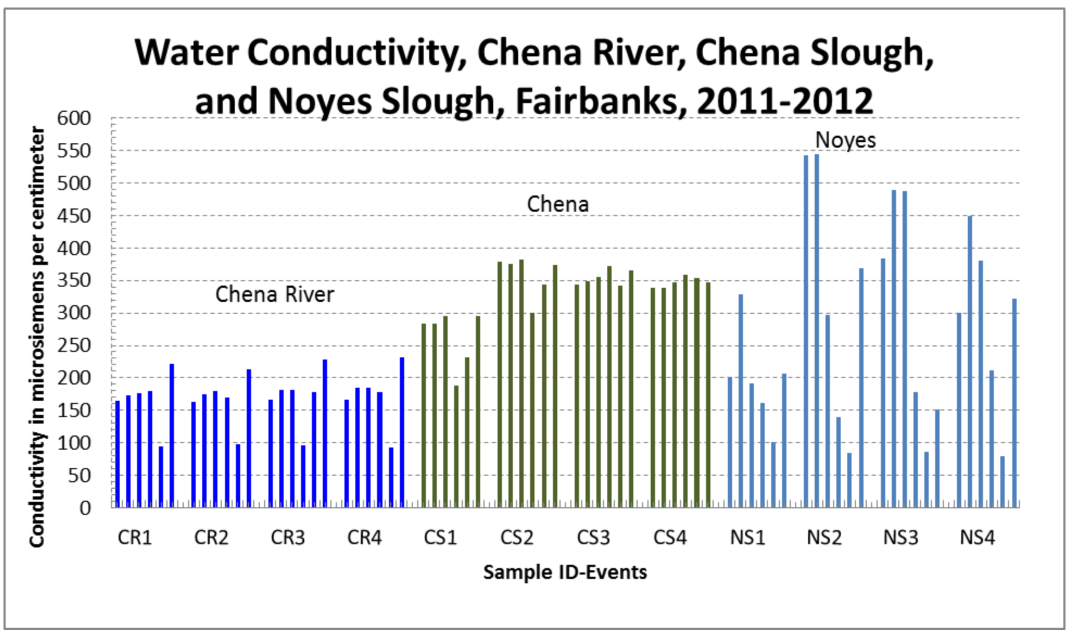


Figure 5. Water pH measurements; Chena River, Chena Slough, and Noyes Slough, 6 sampling events, 2011-2012

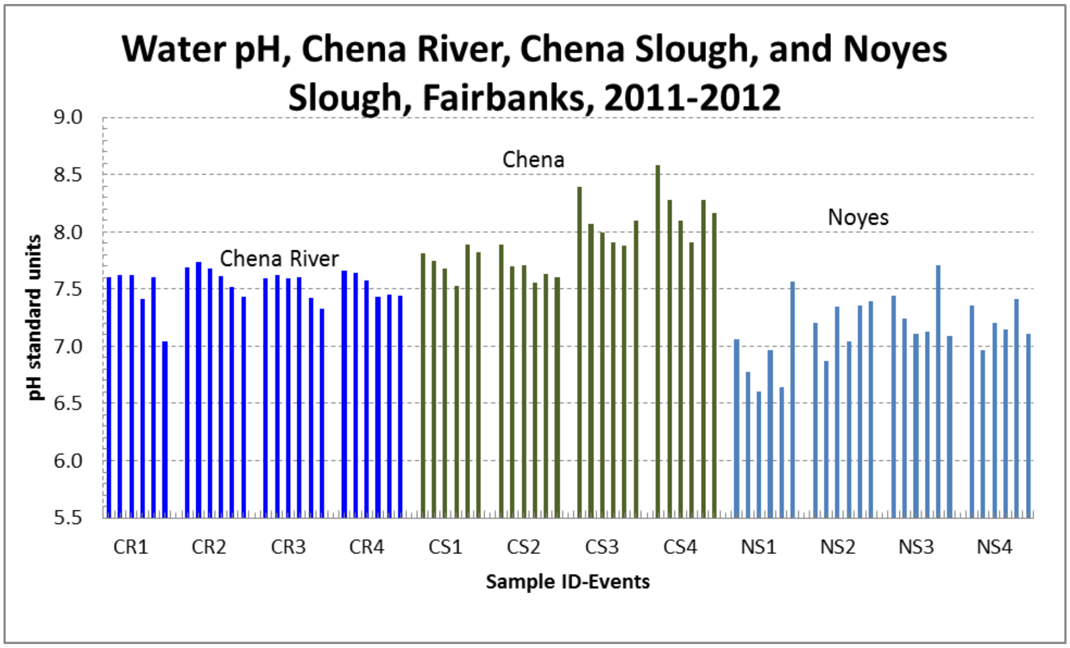
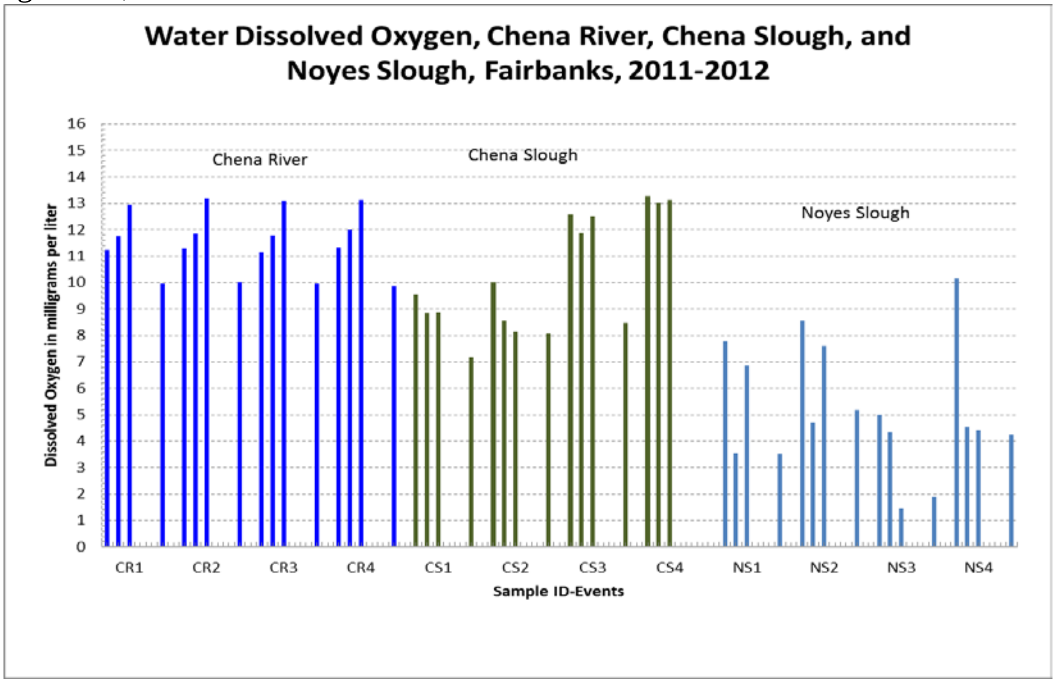


Figure 6. Water dissolved oxygen measurements; Chena River, Chena Slough, and Noyes Slough, 6 sampling events, 2011-2012



Results from Analytica Laboratory analyses of composite water samples for settleable solids were less than the method reporting limit (MRL) for all but 4 sample events: 2 (mL/L/hr) collected August 15 at site CS1, Laurance Road, 1 (mL/L/hr) collected at both CR1, Rosehip, and CR4, University, during the high water event on May 31, and 6 (mL/L/hr) collected on June 25 at site CS1, Laurance Road. The Alaska Water Quality Standard for Aquatic Life is no measurable increase above natural condition. The standard for Recreation/Drinking Water is <5% increase in 0.1 mm to 0.4 mm fine sediment for waters with anadromous fish; <30% by weight of fines in gravel beds.

Table 6. Water quality parameters and settleable solids concentration, Chena River, Chena Slough, and Noyes Slough, Fairbanks, Alaska, 2011-2012

[**Abbreviations:** ft^3/s, cubic feet per second; ° C, degrees Celcius; µs/cm, microseimens per cubic centimeter,; mg/L, milligrams per liter; <MRL, concentration is below method reporting limit, Water Quality Parameters from 2nd field replicate 3rd record for each site unless data not available then use 3rd record of 1st field measurement to ensure most stable measurements for data analysis, *DO meter was not properly calibrated prior to these sampling events.

				Daily Mean	Water Quality Parameters *						
Site ID- Sample Event	Date mm-dd-yyyy	Time hhmm	Site Name	Discharge Chena River (ft3/s)	Temperature ° C	Conductivity µs/cm	pH std units	Dissolved Oxygen mg/L	Settleable Solids (mL/L)	Site ID- QC Sample	QC Settleable Solids (mL/L)
CR1-1	08-18-2011	930	Rosehip	2850	8.3	164	7.6	11.2	<MRL		
CR1-2	09-07-2011	900	Rosehip	2010	6.6	173	7.6	11.8	<MRL		
CR1-3	10-03-2011	923	Rosehip	1890	2.9	176	7.6	13.0	<MRL	CR1-3 Lab Rep	<MRL
CR1-4	05-17-2012	835	Rosehip	1660	4.8	179	7.4	*	<MRL		
CR1-5	05-31-2012	752	Rosehip	4990	8.7	95	7.6	*	1		
CR1-6	06-28-2012	830	Rosehip	1370	10.8	221	7.0	10.0	<MRL		
CR2-1	08-18-2011	1132	Nordale	2850	10.8	163	7.7	11.3	<MRL		
CR2-2	09-07-2011	1045	Nordale	2010	8.1	174	7.7	11.8	<MRL		
CR2-3	10-03-2011	1114	Nordale	1890	3.2	180	7.7	13.2	<MRL		
CR2-4	05-17-2012	1015	Nordale	1660	8.3	170	7.6	*	<MRL	CR2-4 Field Rep	<MRL
CR2-5	05-31-2012	911	Nordale	4990	8.2	97	7.5	*	<MRL		
CR2-6	06-28-2012	1015	Nordale	1370	13.2	214	7.4	10.0	<MRL		
CR3-1	08-18-2011	1254	Graehl	2850	10.2	166	7.6	11.1	<MRL	CR3-1 Lab Rep	<MRL
CR3-2	09-07-2011	1138	Graehl	2010	8.0	181	7.6	11.8	<MRL		
CR3-3	10-03-2011	1236	Graehl	1890	3.4	182	7.6	13.1	<MRL		
CR3-4	05-01-2012	1010	Graehl	4990	8.7	96	7.6	*	<MRL	CR3-4 Lab Rep	<MRL
CR3-5	05-17-2012	1130	Graehl	1660	6.8	178	7.4	*	<MRL		
CR3-6	06-28-2012	1100	Graehl	1370	11.7	228	7.3	10.0	<MRL		
CR4-1	08-18-2011	1450	University	2850	10.8	166	7.7	11.3	<MRL		
CR4-2	09-07-2011	1333	University	2010	8.3	184	7.6	12.0	<MRL		
CR4-3	10-03-2011	1410	University	1890	3.8	184	7.6	13.1	<MRL		
CR4-4	05-17-2012	1245	University	1660	7.9	178	7.4	*	<MRL		
CR4-5	05-31-2012	1152	University	4990	8.8	93	7.5	*	1		
CR4-6	06-28-2012	1200	University	1370	12.6	231	7.4	9.9	<MRL		
CS1-1	08-15-2011	935	Laurance	2410	15.2	283	7.8	9.5	2	CS1-1 Lab Rep	2
CS1-2	09-06-2011	915	Laurance	2070	12.6	284	7.8	8.9	<MRL		
CS1-3	10-04-2011	835	Laurance	1840	4.9	296	7.7	8.9	<MRL		
CS1-4	05-15-2012	931	Laurance	1870	11.7	188	7.5	*	<MRL		
CS1-5	05-29-2012	700	Laurance	6380	15.7	232	7.9	*	<MRL		
CS1-6	06-25-2012	1158	Laurance	1440	21.4	296	7.8	7.2	6		
CS2-1	08-15-2011	1140	Hurst	2410	10.2	379	7.9	10.0	<MRL	CS2-1 Field Rep	<MRL
CS2-2	09-06-2011	1045	Hurst	2070	8.0	376	7.7	8.6	<MRL		
CS2-3	10-04-2011	928	Hurst	1840	2.7	382	7.7	8.2	<MRL		
CS2-4	05-15-2012	1045	Hurst	1870	6.3	301	7.6	*	<MRL		
CS2-5	05-29-2012	638	Hurst	6380	8.5	344	7.6	*	<MRL		
CS2-6	06-25-2012	1235	Hurst	1440	16.3	374	7.6	8.1	<MRL		
CS3-1	08-15-2011	1300	Nordale	2410	10.7	344	8.4	12.6	<MRL		
CS3-2	09-06-2011	1200	Nordale	2070	8.1	348	8.1	11.9	<MRL		
CS3-3	10-04-2011	1015	Nordale	1840	1.6	356	8.0	12.5	<MRL	CS3-2 Field Rep	<MRL
CS3-4	05-15-2012	1120	Nordale	1870	8.1	372	7.9	*	<MRL		
CS3-5	05-29-2012	603	Nordale	6380	11.0	342	7.9	*	<MRL		
CS3-6	06-25-2012	1313	Nordale	1440	16.0	365	8.1	8.5	<MRL	CS3-6 Field Rep	<MRL
CS4-1	08-15-2011	1420	Persinger	2410	12.4	338	8.6	13.3	<MRL		
CS4-2	09-06-2011	1326	Persinger	2070	9.7	339	8.3	13.0	<MRL		
CS4-3	10-04-2011	1134	Persinger	1840	2.4	347	8.1	13.1	<MRL		
CS4-4	05-15-2012	1207	Persinger	1870	8.4	358	7.9	*	<MRL		
CS4-5	05-29-2012	523	Persinger	6380	14.2	354	8.3	*	<MRL		
CS4-6	06-25-2012	1423	Persinger	1440	17.9	347	8.2	NA	<MRL	CS4-6 Lab Rep	<MRL

NS1-1	08-16-2011	1016	Minnie	3130	11.7	201	7.1	7.8	<MRL		
NS1-2	09-08-2011	922	Minnie	1960	10.1	328	6.8	3.5	<MRL		
NS1-3	09-26-2011	930	Minnie	2290	4.4	192	6.6	6.9	<MRL		
NS1-4	05-14-2012	930	Minnie	1880	8.2	161	7.0	*	<MRL		
NS1-5	05-30-2012	900	Minnie	7030	7.1	101	6.6	*	<MRL	NS1-5 Lab Rep	<MRL
NS1-6	06-26-2012	1120	Minnie	1420	17.5	206	7.6	3.5	<MRL		
NS2-1	08-16-2011	1125	O'Connor	3130	12.9	543	7.2	8.6	<MRL		
NS2-2	09-08-2011	1011	O'Connor	1960	7.4	545	6.9	4.7	<MRL		
NS2-3	09-26-2011	1425	O'Connor	2290	3.7	297	7.4	7.6	<MRL		
NS2-4	05-14-2012	1121	O'Connor	1880	7.8	140	7.0	*	<MRL		
NS2-5	05-30-2012	955	O'Connor	7030	7.1	85	7.4	*	<MRL		
NS2-6	06-26-2012	1007	O'Connor	1420	17.0	369	7.4	5.2	<MRL		
NS3-1	08-16-2011	1210	Aurora	3130	15.6	384	7.4	5.0	<MRL		
NS3-2	09-08-2011	1119	Aurora	1960	12.1	490	7.2	4.3	<MRL		
NS3-3	09-26-2011	1035	Aurora	2290	6.6	488	7.1	1.5	<MRL	NS3-3 Field Rep	<MRL
NS3-4	05-14-2012	1217	Aurora	1880	9.2	178	7.1	*	<MRL		
NS3-5	05-30-2012	1052	Aurora	7030	8.3	86	7.7	*	<MRL		
NS3-6	06-26-2012	940	Aurora	1420	19.4	152	7.1	1.9	<MRL		
NS4-1	08-16-2011	1245	Goldizen	3130	14.1	300	7.4	10.2	<MRL		
NS4-2	09-08-2011	1213	Goldizen	1960	9.7	449	7.0	4.5	<MRL		
NS4-3	09-26-2011	1155	Goldizen	2290	4.2	380	7.2	4.4	<MRL	NS4-3 Lab Rep	<MRL
NS4-4	05-14-2012	1317	Goldizen	1880	12.0	212	7.2	*	<MRL		
NS4-5	05-30-2012	1145	Goldizen	7030	8.6	80	7.4	*	<MRL	NS4-5 Field Rep	<MRL
NS4-6	06-26-2012	815	Goldizen	1420	17.7	322	7.1	4.3	<MRL		
	Summary Statistics			CR-Maximum	13.2	231	7.7	13.2			
	Chena River			CR-Minimum	2.9	93	7.0	9.9			
				CR-Mean	8.1	170	7.5	11.5			
				CS-Maximum	21.4	382	8.6	13.3			
	Chena Slough			CS-Minimum	1.6	188	7.5	7.2			
				CS-Mean	10.6	331	7.9	10.3			
				NS-Maximum	19.4	545	7.7	10.2			
	Noyes Slough			NS-Minimum	3.7	80	6.6	1.5			
				NS-Mean	10.5	279	7.2	5.2			

Discussion of Results

Project goals included sampling water quality and settleable solids during 3 flow regimes; break-up, storm flow, and base flow. Storm flows were sampled during the August 15-18 sample event for Chena River, Chena Slough, and Noyes Slough when a daily mean flow of 3,130 ft^3/s was recorded at the USGS Chena River stream gage and again during the May 29-May 31 sample event when daily mean flows at the USGS Chena River stream gage exceeded 7,000 ft^3/s. According to recent USGS studies, Chena River flows in excess of 3,000 ft^3/s provide surface water input to Noyes Slough--an overflow channel of Chena River. However, beaver dams found in the upper sections of Noyes Slough may impede the influx of surface water, hence free-flowing condition of the slough depends on Chena River surface water elevations adequate to overtop the beaver dams.

Mean daily Chena River flows were about 2,000 ft^3/s for the both the September 6-8, and September 26-October 4 sample events. Flows of 2,000 ft^3/s at the USGS gage likely represent near average flow conditions for the Chena River, and may be a proxy for near normal flow conditions of Chena Slough and Noyes Slough. Chena River mean daily flows during the 2011 sampling program were similar to the 10-year (2000-2010) average daily mean discharge (Figure 2a).

Mean daily Chena River flows were less than 2,000 ft^3/s during the May 14-17 and June 25-28 sample events. The flows during these two periods were generally below the 10 year (2000-2010) average daily mean discharge (Figure 2b), but the period during the fifth sampling event, May 29-May 31, represented a significant high water event. The first sample event of 2012, May 14-17, occurred 19 days after spring breakup.

Water quality parameters measured during this project were generally within State of Alaska Water Quality Standards with the exception of water temperature. All sites in Chena and Noyes Slough exceeded the standard at the last sample event, June 25 and June 26, respectively. Water temperatures also exceeded 15 °C at CS1, Laurance Road, on two additional occasions, August 15, and May 29, and at NS3, Aurora Drive, on August 16. Elevated temperatures at both sites are likely the result of elevated atmospheric temperature, solar radiation, and lentic water environments. Summer surface water temperatures greater than15 °C are common for lentic water environments in interior Alaska.

One pH measurement for Chena Slough CS4 (pH 8.6) at Persinger Drive on August 15 exceeded the State of Alaska Water Quality pH Standard range of 6.5-8.5. The elevated pH is associated with a high dissolved oxygen concentration of 13.3 mg/L, recorded at the same time and site. In August much of the Chena Slough streambed and channel at Persinger Drive was covered by excessive growth of floating and rooted aquatic plants. High pH and dissolved oxygen levels can occur when algae and aquatic vegetation use CO2 for photosynthesis. When the rate of atmospheric CO2 diffusing into the water is less than the rate of photosynthesis, aquatic plants use dissolved carbonates (H2CO3, HCO3-, CO32-) as their source of carbon resulting in increased pH. Oxygen produced by aquatic vegetation during photosynthesis elevates the dissolved oxygen concentration. Where there are increased levels of algae and aquatic vegetation the dissolved oxygen concentration can be >100% during photosynthesis in lentic environments.

Noyes Slough dissolved oxygen concentration were relatively low during both the September 6-8, and September 26-October 4 sampling events, likely due to a decline in photosynthesis and continued respiration of plants and animals. Carbon dioxide (CO2) concentrations can become high as a result of respiration. The free CO2 released during respiration reacts with water, producing carbonic acid (H2CO3), and pH is lowered. This is consistent with the relatively low 6.6 to 7.2 pH values recorded in later Noyes Slough sample events. The lowest dissolved oxygen concentration of 1.5 mg/L was recorded September 26 at Noyes Slough site NS3, Aurora Drive and is less than the State of Alaska Water Quality Standard of > 5 mg/L for Aquatic Life as well as less than the > 4 mg/L standard for Recreation/Drinking Water.

Preliminary analytical results for settleable solids show nearly all sample concentrations were less than the method reporting limit (MRL) indicating Chena River, Chena Slough, and Noyes Slough were not sediment impaired during the sample events conducted for this project.

Appendix A

See Attached Water Quality Spreadsheet DATA.xlsx

Appendix B

Sample Site Photographs

Chena Slough at Laurence Drive; Site ID: CS1; September 6, 2011.

Chena Slough at Hurst Road; Site ID: CS2; September 6, 2011.

Chena Slough at Nordale Road; Site ID: CS3; September 6, 2011.

Chena Slough at Persinger Drive; Site ID: CS4; September 6, 2011.

Chena River at Rosehip Campground; Site ID: CR1; September 7, 2011.

Chena River at Nordale Road; Site ID: CR2; September 7, 2011.

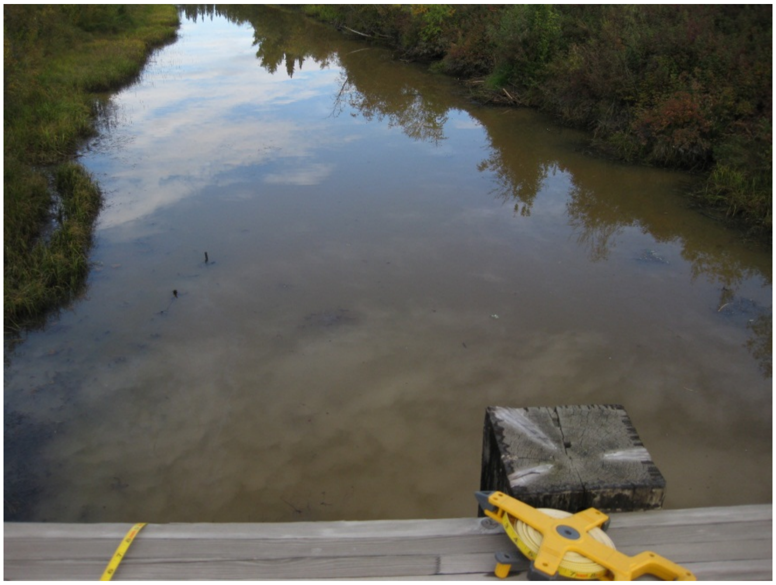
Chena River at Graehl Park; Site ID: CR3; September 7, 2011.

Chena River at University Avenue; Site ID: CR4; September 7, 2011.

Noyes Slough at Minnie Street; Site ID: NS1; September 8, 2011.

Noyes Slough at O'Conner Street; Site ID: NS2; September 8, 2011.

Noyes Slough at Aurora Drive; Site ID: NS3; September 8, 2011.



Noyes Slough at Goldizen Avenue; Site ID: NS4; September 8, 2011.

Appendix C

Quality Assurance Project Plan—see attached.