WQ-S2: Baseline Water Quality Study

* 1. Requestor of Proposed Study

To be determined.

* 1. Responses to Study Request Criteria (18 CFR 5.9(b))
     1. Describe the goals and objectives of the study proposal and the information to be obtained.

The collective goal of the water quality studies is to assess the effects of the proposed project operations on water quality in the Susitna River basin and to identify and develop protection, mitigation, and enhancement measures that can be implemented to minimize these effects.

The objectives of the Baseline Water Quality Study are to:

* Build upon and use, as appropriate, the historical water quality data available for the study area.
* Continued collection of stream temperature and meteorological data.
* Characterize surface water physical, chemical, and bacterial water quality conditions in the Susitna River within and downstream of the proposed project area.
* Document baseline mercury levels in sediment and fish tissue and compare to state criteria.
* Assess the potential for mercury methylation (i.e., bioavailable form) in the newly formed reservoir and assess the potential for changes to mercury levels in fishes in the proposed reservoir.
* Conduct a pilot thermal imaging assessment of a portion of the Susitna River.
  + 1. If applicable, explain the relevant resource management goals of the agencies and Alaska Native groups with jurisdiction over the resource to be studied.

To be completed by the requesting organization.

* + 1. If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

To be completed by the requesting organization.

* + 1. Describe existing information concerning the subject of the study proposal, and the need for additional information.

Historical water quality data available for the study area includes water temperature data collected during the 1980s. Some of these data will be evaluated as part of the 2012 WQ-S1: Water Temperature Modeling Results and Data Collection study with regard to their applicability to the 2013–2014 water quality studies.

A data gap analysis was conducted for water quality and sediment transport in 2011 (URS 2011). The data gap analyses were used to identify future studies needed to develop the riverine and reservoir water quality models. These are as follows:

*Lower Susitna from Cook Inlet to the Susitna – Chulitna –Talkeetna confluence   
(River Mile 0-99)*

1. Large amounts of data were collected in this reach during the 1980s. Very little data are available that describe current water quality conditions.
2. Metals data are not available for the mouth of Chulitna River. The influence of major tributaries (Chulitna and Talkeetna Rivers) on water quality conditions is unknown. There are no monitoring stations in receiving water at these mainstem locations.
3. Metals data are not available for the Skwentna River or the Yentna River.
4. Continuous temperature data are not available for the mainstem and sloughs potentially used for spawning and rearing habitat.

*Middle Susitna River and tributaries from the Susitna – Chulitna–Talkeetna confluence to the mouth of Devil’s Canyon*

*(River Mile 99-150)*

1. The source(s) for metals detected at high concentrations in mainstem Susitna River are unknown.
2. Current data reflects large spatial data gaps between upper river and the mid- to lower portion of the river.
3. Continuous temperature data is not available for mainstem, tributary, and sloughs potentially used for spawning and rearing.

*Middle Susitna River from Devil’s Canyon to the proposed Susitna-Watana Dam site (River Mile 150-184)*

1. Temperature data is not available above and below most tributaries on the mainstem Susitna River.
2. Overall, very limited surface water data available for this reach.
3. Metals monitoring data does not exist or is limited.
4. Concentrations of metals in sediment immediately below the proposed project are not known. Metals in these sediments may become mobile once the project begins operation.
5. Monitoring of mainstem and sloughs (ambient conditions and metals) is needed for determining the potential for metal bioaccumulation in fishes.

*Upper Susitna River including headwaters and tributaries above the proposed Susitna-Watana Dam site*

*(River Mile 184-313)*

1. Surface water and sediment analysis for metals are not available for the mainstem, only for one tributary.
2. Information on concentrations of metals in media and current water quality conditions is needed to predict if toxics can be released in a reservoir environment.
3. Continuous temperature data is not available for mainstem, tributary, and sloughs potentially used for spawning and rearing.
   * 1. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

This study addresses some aspects of the following issues identified in the PAD (AEA 2011) for which existing information appears to be insufficient. The project's operations will modify the flow and water temperature regimes in the Susitna River downstream of the proposed reservoir. Reservoir operation and storage levels will affect water temperature in the reservoir and influence outflow water temperatures. Alteration of the baseline water temperature regime of the Susitna River is expected to modify baseline river ice conditions (which may affect channel morphology and riparian vegetation) and the suitability and productivity of aquatic habitats.

The results of the 2013–2014 water quality studies will be used as a basis to assess the effects of the proposed project operations on water quality in the Susitna River basin and to identify and develop protection, mitigation, and enhancement measures related to water quality (including temperature), ice formation, and aquatic habitat in the reservoir and in project-affected river reaches downstream of the dam.

* + 1. Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

The study components consist of:

* Water temperature data collection;
* Meteorological (MET) data collection;
* Baseline water quality measurements;
* Sediment and pore water samples for mercury/metals in reservoir area;
* Fish tissue samples; and
* Evaluation of a pilot thermal imaging effort for identification of thermal refugia.

Water temperature data and MET data will be collected in 2012. The 2013/2014 sampling for these parameters will be conducted at the same sites identified in the 2012 Study Plan.

* + - 1. Water Temperature Data Collection

*Overview*

Water temperature data loggers will be installed at 38 sites identified in Table 1 and Figure 1 as part of the 2012 Study Plan. These sites were selected based on

* Results of the 1980s studies;
* Adequate representation of locations throughout the Susitna River and tributaries above and below the proposed dam site;
* Preliminary consultation with AEA and licensing participants including co-location with other study sites (e.g., instream flow, ice processes); and
* Access and land ownership issues.
* Eight of the sites are mainstem monitoring sites that were previously used for SNTEMP modeling in the 1980s. Thirty of the sites are mainstem, tributary, or slough locations, most of which were also monitored in the 1980s.

*Monitoring Protocol*

Water temperatures will be recorded in 15-minute intervals using Onset TidbiT v2 water temperature data loggers (or equivalent instrumentation). The TidbiT v2 (or equivalent) has a precision sensor for ±0.2°C accuracy over an operational range of -20° to 70°C (-4° to 158°F).Data readout is available in less than 30 seconds via an Optic USB interface

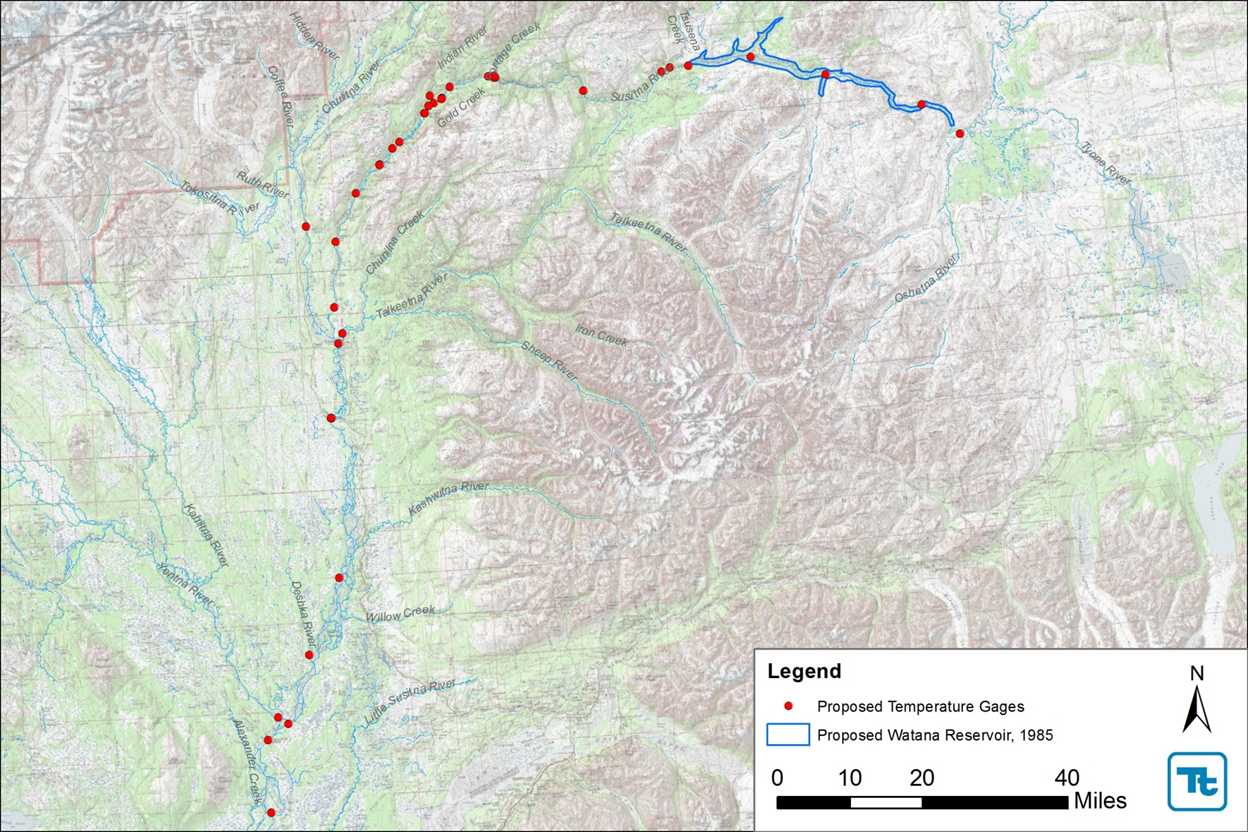
Table 1. Proposed Susitna River Basin Temperature Monitoring Sites

| **Susitna River Mile** | **Description** | **Susitna River Slough ID** | **Latitude**  **(decimal degrees)** | **Longitude**  **(decimal degrees)** |
| --- | --- | --- | --- | --- |
| 10.1 | Susitna above Alexander Creek | NA | 61.4014 | 150.519 |
| 25.8 | Susitna Station | NA | 61.5454 | 150.516 |
| 28.0 | Yentna River | NA | 61.589 | 150.468 |
| 29.5 | Susitna above Yentna | NA | 61.5752 | 150.248 |
| 40.6 | Deshka River | NA | 61.7098 | 150.324 |
| 55.01 | Susitna | NA | 61.8589 | 150.18 |
| 83.8 | Susitna at Parks Highway East | NA | 62.175 | 150.174 |
| 83.9 | Susitna at Parks Highway West | NA | 62.1765 | 150.177 |
| 97.0 | LRX 1 | NA | 62.3223 | 150.127 |
| 97.2 | Talkeetna River | NA | 62.3418 | 150.106 |
| 98.5 | Chulitna River | NA | 62.5574 | 150.236 |
| 103.02 | Talkeetna | NA | 62.3943 | 150.134 |
| 113.02 | LRX 18 | NA | 62.5243 | 150.112 |
| 120.72 | Curry Fishwheel Camp | NA | 62.6178 | 150.012 |
| 126.0 | -- | 8A | 62.6707 | 149.903 |
| 126.12 | LRX 29 | NA | 62.6718 | 149.902 |
| 129.2 | - | 9 | 62.7022 | 149.843 |
| 130.82 | LRX 35 | NA | 62.714 | 149.81 |
| 136.5 | Susitna near Gold Creek | NA | 62.7672 | 149.694 |
| 136.8 | Gold Creek | NA | 62.7676 | 149.691 |
| 138.01 | -- | 16B | 62.7812 | 149.674 |
| 138.6 | Indian River | NA | 62.8009 | 149.664 |
| 138.72 | Susitna above Indian River | NA | 62.7857 | 149.651 |
| 140.0 | -- | 19 | 62.7929 | 149.615 |
| 140.12 | LRX 53 | NA | 62.7948 | 149.613 |
| 142.0 | -- | 21 | 62.8163 | 149.576 |
| 148.0 | Susitna below Portage Creek | NA | 62.8316 | 149.406 |
| 148.82 | Susitna above Portage Creek | NA | 62.8286 | 149.379 |
| 148.8 | Portage Creek | NA | 62.8317 | 149.379 |
| 148.8 | Susitna above Portage Creek | NA | 62.8279 | 149.377 |
| 165.01 | Susitna | NA | 62.7899 | 148.997 |
| 180.31 | Susitna below Tsusena Creek | NA | 62.8157 | 148.652 |
| 181.3 | Tsusena Creek | NA | 62.8224 | 148.613 |
| 184.51 | Susitna at Watana Dam site | NA | 62.8226 | 148.533 |
| 194.1 | Watana Creek | NA | 62.8296 | 148.259 |
| 206.8 | Kosina Creek | NA | 62.7822 | 147.94 |
| 223.7 | Susitna near Cantwell | NA | 62.7052 | 147.538 |
| 233.4 | Oshetna Creek | NA | 62.6402 | 147.383 |

1  Site not sampled for temperature in the 1980s or location moved slightly from original location.

2 Proposed mainstem Susitna River temperature monitoring sites for purposes of 1980s SNTEMP model evaluation.

**Figure 1 Proposed 2012 Stream Temperature Data Collection Sites for the Susitna-Watana Hydroelectric Project.**



To reduce the possibility of data loss, a redundant data logger will be used at each site. In general, the two sets of sensors will be installed in different fashions (depending on site characteristics). One logger will be inserted into the bottom of a 2.5-meter (8.2-foot) length of perforated steel pipe housing which is fastened to a large bank structure via clamps and rock bolts. The TidbiT® (or equivalent instrument) will be attached to a rope which allows it to be easily retrieved for downloads. The top pipe cap will contain a locking mechanism which can only be opened using the appropriate Allen key to prevent theft or vandalism. The second set of temperature loggers will be anchored to a concrete block and buoyed so that a bottom, mid, and surface logger record continuous temperature conditions throughout the water column (fewer temperature loggers may be deployed depending on site characteristics). The block will be placed in a location of the channel that is accessible and retrievable during routine site visits and the apparatus will be attached with a steel cable to a post which is driven into the bank or to some other structure. The proposed installation procedures may require some alteration based on site specific conditions.

The sensors will be situated in the river to record water temperatures which are representative of the mainstem or slough being monitored, avoiding areas of groundwater upwelling, unmixed tributary flow, direct sun exposure, and isolated pools that may affect the quality of the data.

The 2012 instream flow study will install water-level loggers with temperature recording capability at several study sites that are yet to be determined. Where these study sites overlap the water temperature monitoring study sites (Figure 1), the water-level logger temperature sensors may be used. A redundant TidbiT v2, however, would be deployed at these sites for backup temperature recording.

* + - 1. Meteorological Data Collection

*Overview*

Meteorological (MET) data collection will be initiated and MET stations will be installed at up to eight (8) locations during 2012 between RM 224 and RM 80. The number of proposed installations will be based on availability of data from National Climatic Data Center (NCDC) meteorological stations, which has not yet been determined (see below). Table 2 lists the MET station locations. The exact spatial location will depend on access and suitability of an appropriate site for installing a MET station.

**Table 2. Proposed Susitna-Watana Meteorological Stations**

|  |  |
| --- | --- |
| **Susitna River Mile** | **Description** |
| 80.0 | Susitna River near Sunshine Gage |
| 103.0 | Susitna River at Talkeetna Camp |
| 120.6 | Susitna River at Curry Camp |
| 149.0 | Susitna River above Portage Creek |
| 183.5 | 2 stations below the Watana Dam site at river level (1 each side) |
| 184.5 | Susitna River above Watana Dam site (top of valley, north side) |
| 224.0 | Susitna River above Cantwell |

MET stations above the dam site need to be established at specific locations as requested by project design engineers. The upland MET station (RM 184.5) will record snowfall data and precipitation. The upland MET station will be established at about the 2,300 foot elevation on the north side of the river, either in the area of the proposed field camp or Borrow Site D area. The dam site MET stations may be located either on the north abutment, low on the abutment, in the vicinity of 100 feet to 1,850 feet elevation, or just above river level (e.g., 1,500+ feet elevation) depending on suitability of locations for establishing the structures. The MET station locations at the dam site will depend on ability to construct a road for maintenance access of the equipment.

A preliminary assessment has determined that an NNDC station already exists and is functional at Talkeetna (ID26528), however, the hours that the station is operational have not been verified. An NNDC meteorological station at Cantwell (ID46406) has a data record available to the public dated through August 2011. The station is likely currently operational and data since October 2011 is undergoing quality assurance review.

*MET Station Parameters*

MET stations are required to collect several types of parameters that will be used by the engineering design team for the proposed dam and will be used to provide inputs to the water quality temperature model. The following is a comprehensive list of parameters required for use in this project and will be measured continuously by each of the MET stations:

• Temperature – max, min, mean

• Relative humidity

• Wind speed – maximum, minimum, mean

• Wind gust – maximum

• Wind gust direction

• Solar degree days

*Installation and Monitoring Protocol*

Each MET station will consist of a tower with instrumentation to measure and record wind speed and direction, air temperature, relative humidity, barometric pressure, incident solar radiation, and water-equivalent precipitation in 15-minute intervals. The station loggers will have sufficient ports and programming capacity to allow for the installation of instrumentation to collect additional meteorological parameters as required. Such installation and re-programming can occur at any time without disruption of the data collection program.

MET station installation is intended to provide instrumentation that is sturdy enough to work continuously with little maintenance and produce high quality data through a telemetry system.

A Campbell Scientific CR1000 data logger will be used to record data. The archiving interval for all meteorological parameters will be 15 minutes, with a storage capacity to log up to two (2) years of data before filling the memory. The meteorological station is powered by a 12 Vdc 8 amp-hour battery and a 20-watt solar panel complete with charge regulator.

To protect the stations from wildlife intrusion and to discourage any potential vandalism the stations will be protected by fencing as appropriate.

*Satellite or Radio Telemetry Communications System*

Real-time data will be downloaded from the data logger using satellite transmission or radio telemetry hardware. This will enable study staff to download, inspect, and archive the data as well as monitoring station operational parameters for signs of problems without visiting the site. The communication will ensure that problems, if occur, are resolved promptly so that minimal data will be lost between the service periods.

* + - 1. Baseline Water Quality Monitoring

*Overview*

The purpose of the baseline water quality studies is to assess the effects of the proposed project operations on water quality in the Susitna River basin and to identify and develop protection, mitigation, and enhancement measures that can be implemented to minimize these effects.

Baseline water quality collection can be broken into two components, In-Situ Water Quality Sampling and General Water Quality Sampling. In-Situ Water Quality Sampling consists on-site measurements of physical parameters at fixed locations using field equipment. General Water Quality Sampling will consist of periodic grab samples that will be sent to an off-site laboratory for analyses. In general these samples represent water quality components that cannot be easily measured in-situ, such as metals concentrations, nitrates, etc.

Data collection will be at the same site locations proposed in the 2012 Water Quality Study Plan (Figure 2) with a potential reduction for number of sites based on needs of the selected water quality model and hydraulic routing data available. The number of locations where surface water samples will be collected represents an average of 5 river miles between successive sites. This proposed spacing follows accepted practice when segmenting large river systems for development of Total Maximum Daily Load (TMDL) water quality models.

*Monitoring Parameters*

Water quality samples will be analyzed for the following parameters:

Table 3 Parameters for water quality monitoring and laboratory analysis.

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Analysis Method** | **Sample Holding Times** | **Sample Locations  to be Analyzed** |
| **Water Quality Monitoring Parameter** | | | |
| In-Situ Measurements | | | |
| Dissolved Oxygen (DO) | Water Quality Meter | Not Applicable | All |
| pH | Water Quality Meter | Not Applicable | All |
| Water Temperature | Water Quality Meter | Not Applicable | All |
| Specific Conductance | Water Quality Meter | Not Applicable | All |
| Turbidity | Water Quality Meter | Not Applicable | All |
| Redox Potential | Water Quality Meter | Not Applicable | All |
| **Laboratory Analysis Parameter** | | | |
| General Parameters | | | |
| Hardness | EPA - 130.2 | 180 days | All |
| Nitrate/Nitrite | EPA - 353.2 | 48 hours | All |
| Ammonia as N | EPA - 350.1 | 28 days | All |
| Total Kjeldahl Nitrogen | EPA - 351.2 | 28 days | All |
| Total Phosphorus | EPA - 365.3 | 28 days | All |
| Ortho-phosphate | EPA - 365.3 | 48 hours | All |
| Total Dissolved Solids | EPA - 160.1 | 7 days | All |
| Total Suspended Solids | EPA - 160.2 | 7 days | All |
| Turbidity | EPA - 180.1 | 48 hours | All |
| TOC | EPA - 415.1 | 28 days | All |
| DOC | EPA – 415.1 | 28 days | All |
| Fecal Coliform | EPA 1604 | 30 hours | All |
| Metals – (Water) Dissolved and Total | | | |
| Aluminum | EPA – 6010B/6020A | 48 hours |  |
| Arsenic | EPA – 6010B/6020A | 48 hours | All |
| Cadmium | EPA – 6010B/6020A | 48 hours | All |
| Copper | EPA – 6010B/6020A | 48 hours | All |
| Iron | EPA – 6010B/6020A | 48 hours | All |
| Lead | EPA – 6010B/6020A | 48 hours | All |
| Mercury | EPA – 7470A | 48 hours | All |
| Zinc | EPA – 6010B/6020A | 48 hours | All |
| Metals –Sediment (Total) | | | |  |  |  |
| Aluminum | EPA - 200.7 | 180 days | All |
| Arsenic | EPA - 200.7 | 180 days | All |
| Cadmium | EPA - 200.7 | 180 days | All |
| Copper | EPA - 200.7 | 180 days | All |
| Iron | EPA - 200.7 | 180 days | All |
| Lead | EPA - 200.7 | 180 days | All |
| Mercury | EPA – 245.5 / 7470A | 28 days | All |
| Zinc | EPA - 200.7 | 180 days | All |
| Metals – Fish Tissue (Use EPA Sampling Method 1669) | | | |
| Total Mercury | EPA – 1631 | 7 days | Composite x spp. |
| Methylmercury | EPA – 1631 | 7 days | Composite x spp. |

Water quality samples will be labeled with the date and time that the sample is collected and preserved/filtered (as appropriate), then stored and delivered to a State-certified water quality laboratory for analyses in accordance with maximum holding periods. A chain-of-custody record will be maintained with the samples at all times.

The State-certified laboratory will report (electronically and in hard copy) each chemical parameter analyzed with the laboratory method detection limit, reporting limit, and practical quantification limit. The laboratory will attempt to attain reporting detection limits that are at or below the applicable regulatory criteria and will provide all laboratory QA/QC documentation

Water quality data will be summarized in a report with appropriate graphics and tables with respect to Alaska State Water Quality Standards and any applicable federal standards.

*Sampling Protocol*

Water quality grab samples will be collected during each site visit in a representative portion of the stream channel/water body, using methods consistent with Alaska State and EPA protocols for sampling ambient water and trace metal water quality criteria.

Mainstem areas of the river not immediately influenced by a tributary will be characterized with a single grab sample. Areas of the mainstem with a nearby tributary will be characterized using a 3-point sampling strategy (the sampling strategy will include an upstream/downstream and tributary sample). All samples will be collected from a well-mixed portion of the river/tributary.

These samples will be collected on a monthly basis and used for calibrating the same model framework used for predicting temperature. The period for collecting surface water samples will begin at ice break-up and extend to beginning of ice formation on the river. Identification of sampling locations, frequency of sample collection, and collection methods follow accepted practice using standard operating procedures for characterization of ambient conditions.

Water samples will be collected using appropriate sample container upstream of any agitated water that has been mixed either by a boat or walking.

Variation of water quality in a river cross-section is often significant and is most likely to occur because of incomplete mixing of upstream tributary inflows, point-source discharges, or variations in velocity and channel geometry. It is possible that a flow-integrated sampling technique employed by USGS known as the *equal width increment/equal transit rate* (EWI) method (Edwards and Glysson, 1988; Ward and Harr, 1990) will be used. In this method, an isokinetic sampling device (a sampler that allows water to enter without changing its velocity relative to the stream) is lowered and raised at a uniform transit rate through equally-spaced verticals in the river cross-section. This can be done either by wading with hand-held samplers or from a boat using a winch mounted sampler, depending on river stage and flow conditions. The number of verticals employed will differ between sites depending on the site specific conditions.

Additional details of the sampling methods will be provided in the Sampling and Analyses Plan (SAP) and the Quality Assurance Project Plan (QAPP) for this study.

**In-Situ Water Quality Sampling.** During each site visit, *in-situ* measurements of dissolved oxygen, pH, specific conductance, redox potential, turbidity, and water temperature will be made. A Hanna Instruments HI 98703 Portable Turbidity Meter will be used to measure turbidity, while a Hydrolab® datasonde (MS5) will be used to measure the remaining field parameters during each site visit. Standard techniques for pre- and post-sampling calibration of *in-situ* instrumentation will be used to ensure quality of data generation and follows accepted practice. If calibration failure is observed during a site visit field data will be corrected according to equipment manufacturer’s instructions.

**General Water Quality Sampling.** Sampling will avoideddies, pools, and deadwater. Sampling will avoid unnecessary collection of sediments in water samples, and touching the inside or lip of the sample container. Samples will be delivered to EPA approved laboratories within the holding time frame. Each batch of samples will have a separate completed chain of custody sheet. A field duplicate will be collected for 10% (i.e., 1 for every 10 water grab samples) collected for laboratory analysis. Laboratory quality control samples including duplicate, spiked, and blank samples will be prepared and processed by the analytical laboratory

Quality Assurance/Quality Control (QA/QC) samples included field duplicates, matrix spikes, duplicate matrix spikes, and rinsate blanks for non-dedicated field sampling equipment. The results of the analyses will be used in data validation to determine the quality, bias and usability of the data generated.

Sample numbers will be recorded on field data sheets immediately after collection. Samples intended for the laboratory will be stored in coolers and kept under the custody of the field team at all times. Samples will be shipped to the laboratory in coolers with ice and cooled to approximately 4° C. Chain of custody records and other sampling documentation were kept in sealed plastic bags (Ziploc) and taped inside the lid of the coolers prior to shipment. A temperature blank accompanied each cooler shipped. Packaging, marking, labeling, and shipping of samples will be in compliance with all regulations promulgated by the U. S. Department of Transportation in the Code of Federal Regulations, 49 CFR 171-177.

The procedures used for collection of water quality samples will follow protocols from Alaska Department of Environmental Conservation (ADEC) and the U.S. Environmental Protection Agency Region 10 (Pacific Northwest). Water samples will be analyzed by a laboratory accredited by the ADEC or recognized under the national accreditation program (NELAP; National Environmental Laboratory Accreditation Program).

Additional details of the sampling procedures and laboratory protocols will be included in the SAP and QAPP.

* + - 1. Sediment samples for mercury/metals in the reservoir area

This study was designed to gather specific information on the distribution of Susitna

sediment contaminants of concern in potential source areas. In general, all sediment samples will be taken from sheltered backwater areas, downstream of islands, and in similar riverine locations in which water currents are slowed, favoring accumulation of finer sediment along the channel bottom. Samples will be analyzed for Total Metals, including aluminum, arsenic, cadmium, copper, iron, lead, mercury, and zinc. In addition, sediment size and total organic carbon (TOC) will be included to evaluate whether these parameters are predictors for elevated metal concentrations. Samples will be collected just below and above the proposed dam site. Additional samples will be collected near the mouth of tributaries near the proposed dam site, including Fog, Deadman, Watana, Tsusena, Kosina, Jay, Goose Creeks, and the Oshetna River. The purpose of this sampling will be to determine where metals, if found in the water or sediment, originate in the drainage.

Most of the contaminants of interest are typically associated with fine sediments, rather than

with coarse-grained sandy sediment or rocky substrates. Therefore, the goal of the sampling will be to obtain sediments with at least 5% fines (i.e., particle size <63 μm, or passing through a #230 sieve). At some locations, however, larger-sized sediment may be all that are available.

The sediment samples will be collected using an Ekman dredge or a modified Van Veen grab sampler. Sampling devices will be deployed from a boat. Samples may also be collected by wading into shallow near shore areas. To the extent possible, samples will consist of the top 15-cm of sediment.

* + - 1. Document baseline mercury levels in fish tissue and compare to state criteria

A screening level study of methyl mercury concentrations in sport fish muscle tissue (fillets) will be conducted. Target fish species in the vicinity of Susitna-Watana Reservoir will be Dolly Varden, Arctic grayling, whitefish species, and potentially longnose sucker and sculpin. Filets will be sampled from seven (7) adults of each species. Minimum fish sizes for adults will be identified (e.g., literature, field samples). Filet samples will be analyzed for methyl and total mercury.

Field procedures will be consistent with those outlined in applicable Alaska State and/or EPA sampling protocols (USEPA 2000). Larger fish with greater potential for bioaccumulation will be targeted. Clean nylon nets and polyethylene-gloves will be used during fish tissue collection. The species, fork length, and weight of each fish will be recorded. Fish will be placed in Teflon sheets and into zipper-closure bags and placed immediately on ice for delivery to the analytical laboratory. Fish samples will be submitted to a State-certified analytical laboratory for individual fish muscle tissue analysis. Results will be reported with respect to applicable Alaska State and federal standards.

* + - 1. Conduct a pilot thermal imaging assessment of a portion of the Susitna River

Thermal imagery of a portion of the Susitna River (e.g., 10 miles of the Middle River) will be collected. Data from the thermal imagery will be ground-truthed and the applicability and resolution of the data will be determined in terms of identifying water temperatures and thermal refugia/upwelling. In coordination with the In-stream Flow and fish studies, a determination will be made as to whether additional thermal imaging data will be applicable and whether or not additional thermal imaging will be collected during the 2013 field season to characterize river temperature conditions.

If the pilot study is successful, then a description of thermal refugia throughout the project area can be mapped using aerial imagery calibrated with on-the-ground verification. The verification data will be collected at the same time as the aerial imagery (or nearly the same time) using the established continuous temperature monitoring network and additional grab sample temperature readings where there may be gaps, such as in select sloughs. The following elements are important considerations for data collection, specifications for data quality, and strategy for relating digital imagery and actual river surface water temperatures.

*Radiant Temperature*

* Remotely sensed thermal images allow for spatially distributed measurements of radiant temperatures in the river.
* Radiant temperature measurements are made only on the surface layer of the water (top 10cm).
* Temperature readings can vary depending on the amount of suspended sediment in the water and the turbidity of the water.

*Spatial Resolution*

* The key to good data quality is determining the pixel size of the TIR sensor and how that relates to the near-bank environment.
* Best practice is 3 pure-water pixels (ensures that the digital image represented by any 3 contiguous pixels identifies water versus land).
* Very fine resolution (0.2 – 1m) imagery is best used to determine ground water springs and cold-water seeps.
* Larger pixels can be useful for determining characteristic patterns of lat and long thermal variation in riverine landscapes.

*Calibrating Temperature*

* Water temps change during the day, therefore collection should be measured near the same time daily and when water temp is most stable (early afternoon).
* Validation sampling site selections are determined where there is channel accessibility and where there are not known influences of tributaries, or seeps in the area.
* Hand-held ground imaging radiometers can provide validation as long as the precision is at least as good as that expected from airborne TIR measurements.

Availability of historical satellite imagery for thermal analysis will be investigated. Historical thermal imagery may enables exploration of potential trends in water temperature both spatially and temporally.

* 1. Level of Effort and Cost

To be determined.

* 1. Literature Cited

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