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Susitna-Watana Hydroelectric Project
(FERC No. 14241)

2012 Susitna River Water Temperature and Meteorological Field Study

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

URS Corporation

Tetra Tech Inc.

February 2013

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LIST OF ACRONYMS AND SCIENTIFIC LABELS

Abbreviation	Definition
AEA	Alaska Energy Authority
APA	Alaska Power Authority
°C	degrees Celsius
EFDC	Environmental Fluid Dynamics Code
FERC	Federal Energy Regulatory Commission
ILP	Integrated Licensing Process
LB	Left bank of the river looking downstream
MET	Meteorological
NEPA	National Environmental Policy Act
Project	Susitna-Watana Hydroelectric Project
RB	Right bank of the river looking downstream
RM	River Mile(s) referencing those of the 1980s APA Project. These were the distance of a point on a river measured in miles from the river's mouth along the low-water channel.
SNTEMP	Stream Network Temperature

SUMMARY

The objective of this study was to provide a foundation for development of reservoir and riverine temperature models for the Project. This work include a review of the previous temperature model studies performed on the river, installation of temperature monitoring stations, and installation of meteorological (MET) monitoring stations.

The 1980s temperature model using Stream Network Temperature (SNTEMP) was reviewed and considered for use; however the newer Environmental Fluid Dynamics Code (EFDC) model appears to be better suited for evaluating this Project.

Water temperature monitoring and meteorology stations were established in select locations throughout the proposed Project area. Temperature sensors were deployed at 33 of 37 sites on the river (RM 15.1 through 233.4). Four sites could not be installed due to access issues. If possible, two types of temperature monitoring installations were deployed at each site: 1) buoy systems with thermistor probes attached at three locations (surface, mid, and bottom) along a cable, and 2) a bank-mounted system with a single thermistor at the bottom of a steel pipe that served as a stilling well and could be used for a longer time period with a lower maintenance cost. Only 15 suitable sites for the bank mounted system could be found in the river. The purpose for installing two systems was to evaluate similarity of data collected between the two strategies.

The bank installation system was found to be safer and more efficient to operate under different scenarios, especially during flooding, as occurred in September 2012. Loss of monitoring equipment was greater with buoy monitoring systems set in the main channel than were those permanently mounted on bedrock or other stable objects on the river bank. Approximately 10 percent of the 2012 temperature monitoring equipment was either moved or lost during the September 2012 flood event. These data will be replaced with continuing temperature monitoring efforts at all of the thirty-seven sites during 2013 field studies.

Temperature data collection began at the earliest installed sites in June 2012 with data collected at 15-minute intervals retrieved from sites through October 2012. In October 2012, bank-mounted system were winterized with data retrieval beginning after ice breakup. The buoy systems were removed from the river, and replaced with an overwinter buoy system at some suitable locations. Data retrieved from the overwintering monitoring will be used to document when the freeze began and when the thaw begins. The information used here will be incorporated into the EFDC temperature model and used in the Ice Processes model as boundary conditions at either end of the winter season.

The temperature data collected during 2012 studies was used to calibrate the thermal imaging project in the Middle River. This digital imagery was collected to determine if the resolution was high enough to identify thermal refugia important for life stages of the resident and migrating anadromous fisheries. The results of the thermal imaging pilot study are contained in a separate report.

Three new MET stations were installed at the following locations: Susitna River and Indian River (RM 138.5), at the Watana Dam site (RM 184.1), and Susitna River above Oshetna River (RM 233.4). The stations have been recording the following meteorological data at 15-minute intervals since August 2012 and transferred by telemetry system to a server in Talkeetna.

1. INTRODUCTION

This report provides the results of the 2012 Water Temperature and Meteorological Field Study, based on the work outlined in the 2012 Existing Water Temperature Model Results and Data Collection Study plan: http://www.susitna-watanahydro.org/wp-content/uploads/2012/05/2012_WaterTemp_Final_2012-05-02.pdf.

The Alaska Energy Authority (AEA) is preparing a License Application that will be submitted to the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project (Project) using the Integrated Licensing Process. The Project is located on the Susitna River, an approximately 300-mile-long river in Southcentral Alaska. The proposed Project dam site is located at river mile (RM) 184.

This study provided information to serve as the basis for the 2013–2014 formal study program, for preparing Exhibit E of the License Application, and for use in FERC's National Environmental Policy Act analysis for the Project license. The Project's operations will modify the flow and water temperature 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 water temperature in the Susitna River could modify river ice conditions, which in turn could impact channel morphology and riparian vegetation, as well as the suitability and productivity of aquatic habitats.

The 2012 data collection sites were selected in accordance with water temperature data collection in the 1980s, as well as the current water temperature modeling needs. The collected data will be used in the 2013-2014 Water Temperature Modeling Study (RSP Section 5.7).

2. STUDY OBJECTIVES

The collective goal of the water quality studies program (see RSP Section 5) is to assess the effects of the proposed Project and its operations on water quality in the Susitna River basin.

The objective of this study is to provide a foundation for the 2013-2014 water temperature modeling study of reservoir and stream temperatures. The specific objectives are as follows:

- Evaluate the 1980s water temperature model results and determine the applicability of the past results to the currently proposed Project.
- Initiate collection of stream temperature and meteorological data that will be needed for the 2013 and 2014 studies.

This report presents the results of 2012 Water Temperature and Meteorological Field Study. This portion of the overall study program begins collection of stream temperature and meteorological data that will be needed for the 2013 and 2014 studies (RSP Sections 5.5 and 5.6) and be used to calibrate riverine and reservoir models.

3. STUDY AREA

The study area includes the Susitna River from the Oshetna River confluence (RM 233.4), located above the proposed Watana Reservoir, downstream to RM 10.1, above the Alexander Creek confluence (Table 4.1 and Figure 4.1).

4. METHODS

The 1980s water temperature data and monitoring locations (Figure 5.1) were evaluated to determine which of the historic locations should be monitored in 2012. Replicating the 1980s monitoring locations helps to determine if conditions have changed and how this impacts thermal refugia. Locations were selected for monitoring based on (1) adequate representation of locations throughout the Susitna River and tributaries; (2) preliminary consultation with licensing participants; (3) safety, and (4) the needs of studies (e.g., fisheries, instream flow, ice processes).

Of the 1980s sites, 37 sites were selected for installation of water temperature data loggers (Figure 4.1, Table 4.1). Of these sites, 32 were replicates of sites monitored in the 1980s, and five of these sites represented new or relocated sites from the 1980s data set. Temperature data logger locations were either mainstem, tributary, or slough locations.

New MET stations were installed at three locations between RM 138.5 and RM 233.4 (Table 5.1, Figures 5.4 and 5.5). Three additional locations have been identified that are generating useable data for constructing the riverine model (Table 5.1, Figure 5.3).

Greater detail of continuous temperature monitoring sites and MET station locations is provided in Figures 5.2 to 5.5. Locations of other monitoring program sites are included in these figures to demonstrate the linkages between information collection and how these data may be used by more than one study.

4.1. Installation and Monitoring Protocol

4.1.1. Water Temperatures

Water temperatures were recorded in 15-minute intervals using Onset TidbiT® v2 water temperature data loggers during July to September of 2012. The TidbiT® v2 has a precision sensor for ±0.2°C (degrees Celsius) accuracy over an operational range of -20° to 70°C (-4° to 158°F). Data readouts were available in less than 30 seconds via an Optic USB interface. The loggers were situated in the river to record water temperatures which were representative of the mainstem or slough being monitored, avoiding areas of groundwater upwelling, unmixed tributary flow, direct sun exposure, and isolated pools that may have affect the quality of the data.

Summaries of all thermistor sites complete with photos, GPS coordinates, aerial images, and installation field notes are included in Appendix A. Once installed, data was downloaded monthly during the ice free period (July through October).

To reduce the possibility of data loss, redundant data logger systems were used at each site. In general, three different methods of installing sensors were used, depending on site characteristics, a bank mounted pipe system, a summer anchor and buoy system, and a winter anchor and buoy system. Table 5.2 summarizes which types of temperature monitoring installations were deployed at each site. Table 5.3 summarizes the download dates for the thermistors. The installation types are described below.

4.1.1.1. Bank-Mounted Pipe System

The bank-mounted temperature recorders were installed to withstand the rigors of ice forces at locations where large, stable structures (rocks or bedrock) could be used to anchor the assemblies.

The thermistor protection and steel pipe housing assembly contained:

- An approximately 8 foot long by 2-inch internal diameter, partially perforated steel pipe, threaded at both ends with threaded end caps. Half the length of the pipe was perforated, consisting of 0.25-inch holes, spaced approximately 7.5 inches apart;
- A bottom end cap with a 0.25-inch hole to allow for fine sediment drainage; and
- An upper end cap with an adequate-sized hole to accommodate the eyebolt to which the thermistor suspension cable was attached.

The perforated side of the pipe, when installed, was face-down. A schematic of the bank-mounted installations is depicted in Figure 5.6.

The steel pipe housing assembly was bolted to a rock surface by means of three 0.25-inch thick pipe brackets about 1.25 inches wide and long enough to accommodate mounting the steel pipe housing at a level surface and six 0.38-inch rock anchor bolts. Two mounting bracket holes were drilled 1.5-inches from each end, able to accommodate the concrete anchor bolts which had a slightly wider expansion head (approximately 0.44-inches).

The TidbiT sensor(s) was attached to the end of a 0.25-inch diameter metal cable which was inserted into the steel pipe housing. The cable was then withdrawn from the steel pipe housing to download data (Figure 5.6).

4.1.1.2. Anchor-and-Buoy System (summer)

The second type of temperature monitoring installation consisted of data loggers that were suspended on a cable between an anchor and buoy. The anchor was a 2-foot section of steel rail weighing approximately 60 pounds. The anchor was attached to either a tree or large boulder on the shore using a 0.25-inch diameter steel cable secured to the upstream end of the anchor (Figure 5.7).

Because a 2-foot to 5-foot daily fluctuation in water level was possible, buoy systems deployed for monitoring used a 1:2.5 or 1:3 ratio to determine cable length that was attached to each buoy. This ensured that the buoys could rise and fall with fluctuating water level and be completely submerged only periodically.

The temperature monitoring system was equipped with three to four temperature loggers positioned near the bottom, mid-water column, and water surface to record continuous temperature conditions throughout the water column.

While effective, these anchor and buoy systems could not survive the winter, and were removed prior to freeze up (October 15).

4.1.1.3. Anchor-and-Buoy System (winter)

The summer anchor and buoy system as replaced with a winter version that consisted of the same steel rail anchor and shore cable system, but with a single data logger encased in a protective PVC casing and suspended on a two-foot section of cable buoyed by two small commercial fishing net floats (Figure 5.8). This type of system was mainly used at monitoring locations where deployment of a bank-mounted pipe system was not possible or at locations at which the bank-mounted pipe system would be dry during reduction in winter flows.

The 15 sites selected for overwinter monitoring were based on locations where the sensors might survive winter conditions, where deep water and good anchor locations were present. They will not be recovered until the river is ice free again.

4.1.1.4. Pressure Transducers

To provide data for the Open Water HEC-RAS Flow Routing Model (R2 et al. 2013), pressure-transducers, or water-level loggers, with temperature recording capability were installed at 12 of the temperature monitoring sites (Table 4-1). A redundant string of TidbiT v2 temperature loggers (measuring bottom, mid, and surface conditions), were deployed at these sites to complement the full deployment of equipment installed at all other temperature monitoring sites.

4.1.2. Meteorological Station Data Collection

Newly installed MET stations consisted of, at a minimum, a 3-meter tripod with mounted monitoring 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 (Photo 5.1). The station loggers had sufficient ports and programming capacity to allow for the installation of instrumentation to collect additional meteorological parameters as required. Such installation and re-programming occurred at any time without disruption of the data collection program.

A MET station was established along the Susitna River near RM 138.5, immediately downstream of the mouth of the Indian River (Figure 5.4, Table 5.1). This MET station, referred to as the Indian River MET Station, was installed September, 2012. The site was located upland from the river above areas that had recently flooded. Because of vegetation at this location, the anemometer for measuring wind speed and wind gust direction was mounted on a nearby tree.

A second MET station was installed in the uplands at about the 2,300 foot elevation on the north side of the river near the Watana Dam site (RM 184). The location of this MET station was determined by the Project design engineers as well as the water quality modelers.

The third MET station was installed on the Susitna River immediately above the Oshetna River confluence. It is located on a low bench. This MET station was established within low-growing shrub vegetation to better represent conditions that will influence dynamics in the upper reservoir.

Campbell Scientific CR1000 data loggers were used to record data at each of the sites. The archiving interval for all meteorological parameters was 15 minutes, with a storage capacity to log up to two (2) years of data before filling the memory. The meteorological stations were 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 were protected by fencing as appropriate.

4.2. Deviations from Study Plan

Field reconnaissance of the 1980s sites was conducted by boat or viewed from the air during the 2012 field season. It was determined that four of the 1980s historical study sites were either no longer accessible due to changes in the river channel (2 sites), or unsafe to access due to high water (2 sites). Attempts were made to relocate these monitoring sites to accessible areas close by to the original location. However, weather-related conditions (flooding, storms, and early ice) prohibited the final installation of the remaining four temperature monitoring sites.

Due to the access issues, only 33 of the originally proposed 37 temperature monitoring stations were installed during the 2012 field season.

Other minor deviations occurred during the installation of bank-mounted systems. The original intent was to install more such systems on the river. However, there were some sites where only a buoy system could be installed due to the steepness of the bank, the lack of stable anchoring material, or shallowness of the river. The number of temperature loggers deployed on each buoy cable varied depending on the depth of the water at each location.

Downloading of temperature loggers was scheduled monthly during the ice-free period, however due to extreme flooding of the river in 2012, and the onset of ice, some sites could not be accessed monthly for downloads. The sensors are capable of recording temperatures throughout the winter without maintenance, and redundancy of the sensors should ensure that adequate data is available.

Three MET stations were installed. One location was moved from the proposed site above the dam, to above the Oshetna River confluence since this was a more stable and accessible location.

Snow gauges will be installed in 2013.

Some minor temperature gauge losses occurred during flooding in September, however the systems were immediately replaced after the river flows subsided. This also delayed deployment of some of the systems until late fall. These systems were designed for winter deployment and data will be collected from them in the spring.

Late in the season, some of the sensors became frozen in ice, and recorded 0ºC consistently. Occasionally changes to river stages would lead to sensors being above the water line. Both of these issues were anticipated. Redundant sensors were able to continue measuring temperature.

5. RESULTS

Results from the temperature monitoring sites are presented in Figures 6-1 to 6-23. Some of the temperature monitoring sites were set up late in the fall, and no data has been collected yet.

Overall the thermistors and the MET stations have been successful in recording data from the river. At this time, the available data set is too small to draw conclusions regarding the temperature profile of the river.

6. DISCUSSION

The field effort during the 2012 study season resulted in deployment of 33 of the 37 sites identified in the 2012 Study Plan. The locations not installed had substantial challenges for access, including flooding and accessibility. The study team is currently developing plans for different installation mechanisms at these locations or alternative locations in preparation for the 2013 field effort. The locations selection will be based on the needs of the project, access, and safety.

Data for other sites where installation of monitoring equipment was possible will undergo rigorous evaluation for data quality according to the procedures outlined in the Quality Assurance Project Plan (QAPP) prepared for this study.

Provisional results from the 2012 field monitoring effort (Figures 6-1 to 6-23) show distinct patterns in monthly average values and the same for variation based on minimum and maximum observations. These data will eventually be used by the water quality model developers (RSP Section 5.6) to calibrate the reservoir and riverine models constructed using EFDC.

In most cases the temperature data for the different installations (bank mounted and buoy and anchor) were identical, with very little variation in temperature (Figures 6-1 to 6-22). It also appeared that the depth at which the thermistor was placed in the river did not result in significant differences in temperature. This suggests that the river is well mixed at most locations. The only location where there appeared to be a discrepancy between deeper and shallower sensors was at RM 130.8. The cause of this variation is under investigation.

Looking at a plot of all the data together (Figure 6-23) it becomes apparent that there is little variation in surface water temperature along the mainstem Susitna River. The few anomalous locations were as follows:

- RM 83.9 was located in an eddy near a bridge abutment. It is not clear why this thermistor showed colder temperatures than the rest of the mainstem Susitna.
- RM 98.1 was located in the Chulitna River, which is typically colder than the mainstem Susitna.
- RM 142 was located in Slough 21. The stable temperatures over time, and lack of tracking with the mainstem Susitna temperatures, suggest groundwater may be a significant contributor to this water body.

- RM 126 was located in Slough 8A, which was consistently warmer than the mainstem Susitna.
- RM148.8 and RM 148 were located at Portage Creek, which appears to run slightly colder than the mainstem Susitna.

7. REFERENCES

AEA (Alaska Energy Authority). 2011. Pre-Application Document: Susitna-Watana Hydroelectric Project FERC Project No. 14241. December 2011. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, Alaska.

URS. 2011. AEA Susitna Water Quality and Sediment Transport Data Gap Analysis Report. Prepared by Tetra Tech, URS, and Arctic Hydrologic Consultants. Anchorage, Alaska. 62p.+Appendixes.

8. PHOTOS

Photo 5.1. Example of a completed MET Station at the Watana Dam site (RM 184.1)

9. FIGURES

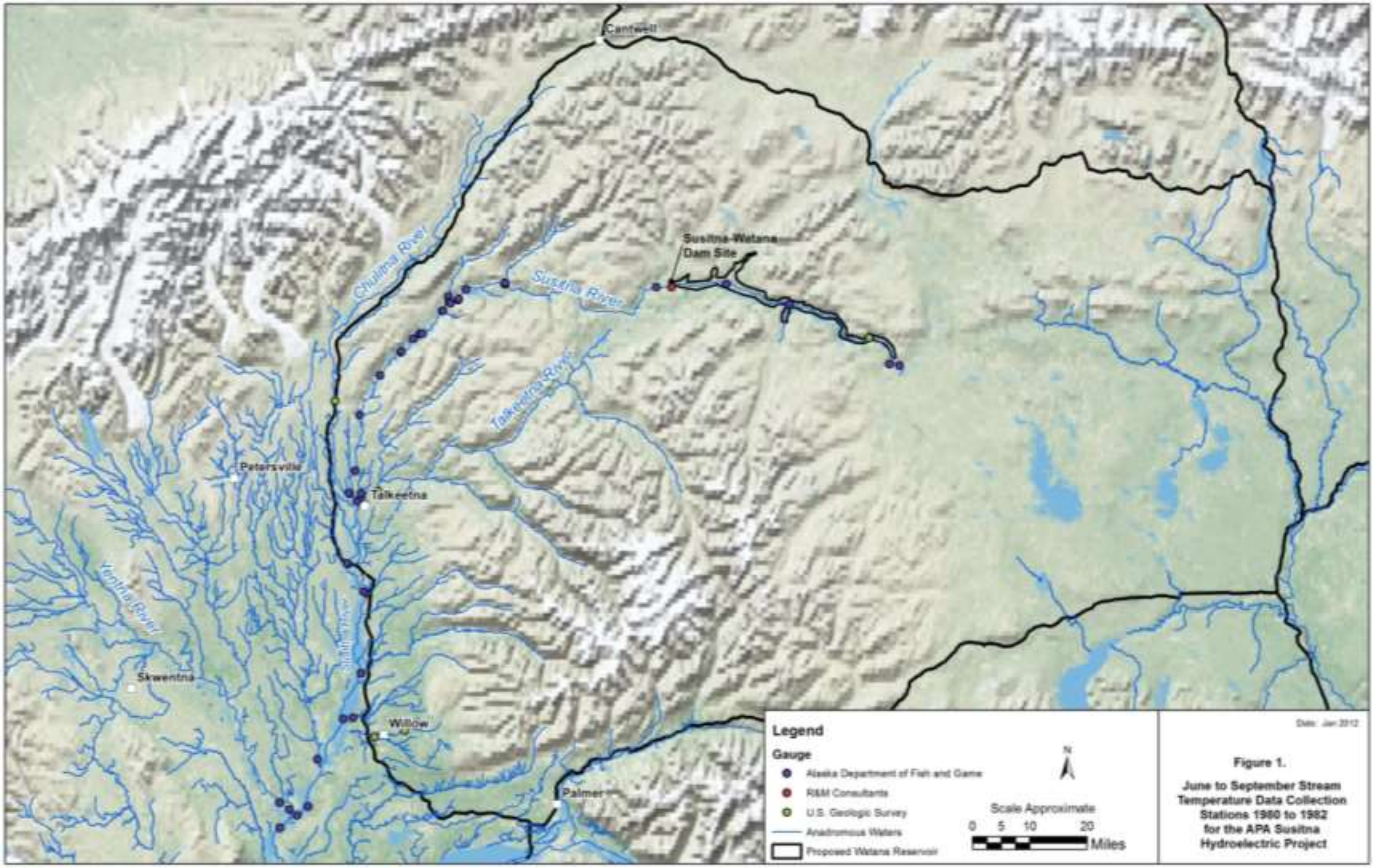

Figure 4.1. June to September stream temperature data collection stations 1980 to 1982 for the APA Susitna Hydroelectric Project

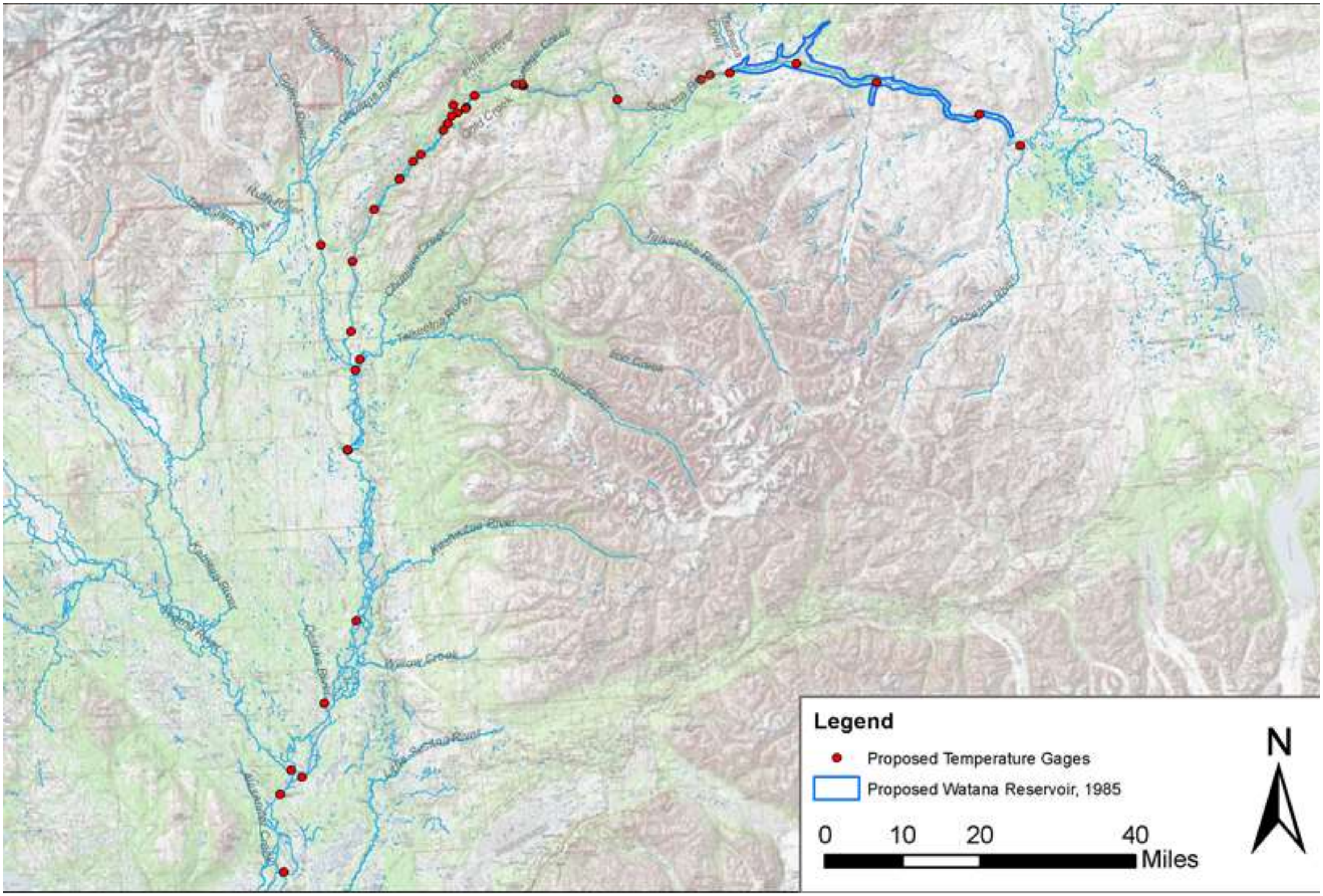

Figure 5.1. 2012 Stream temperature data collection sites for the Susitna-Watana Hydroelectric Project

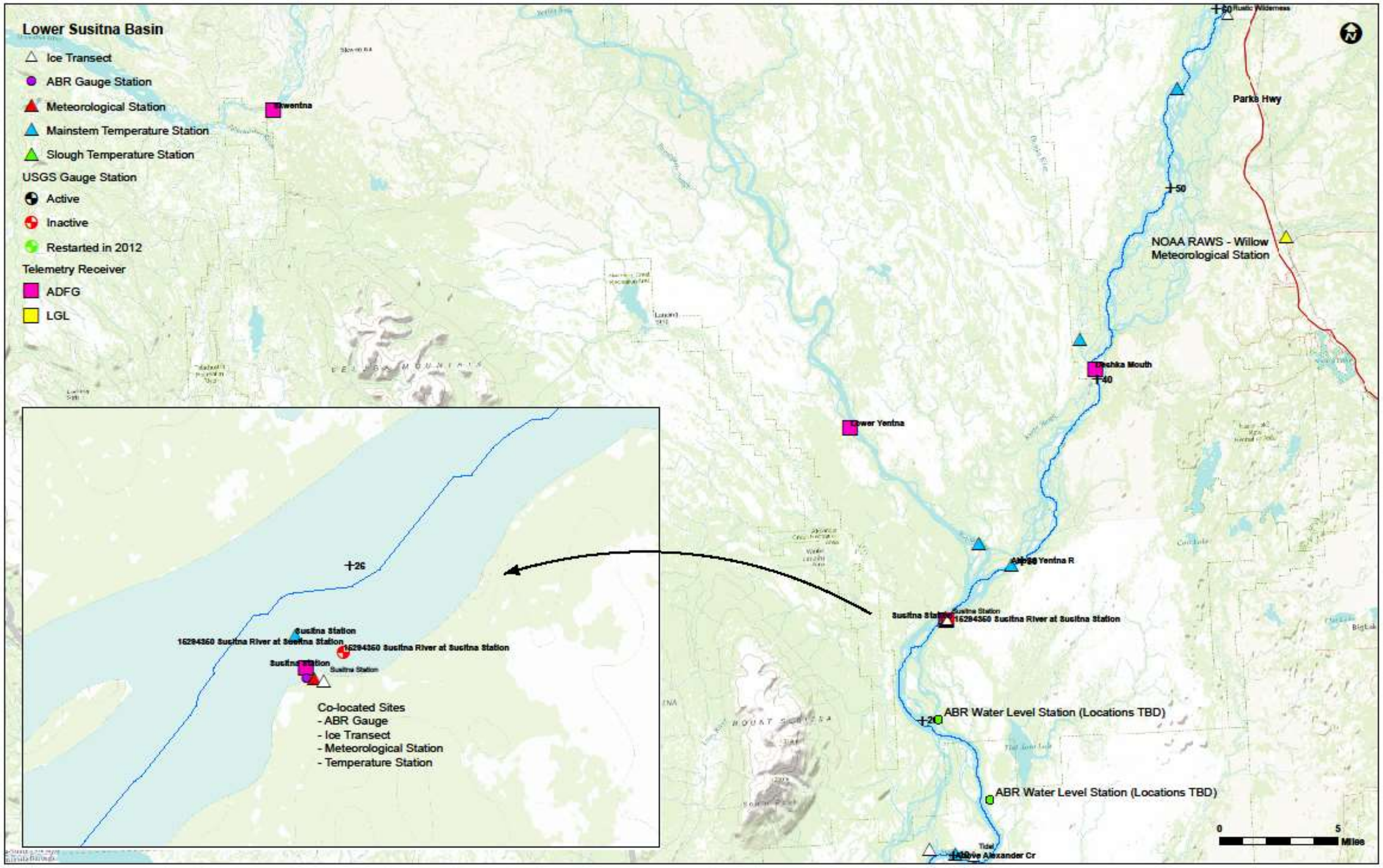

Figure 5.2. Lower Susitna River continuous temperature monitoring sites (blue and green triangles) and meteorological stations (red triangles).

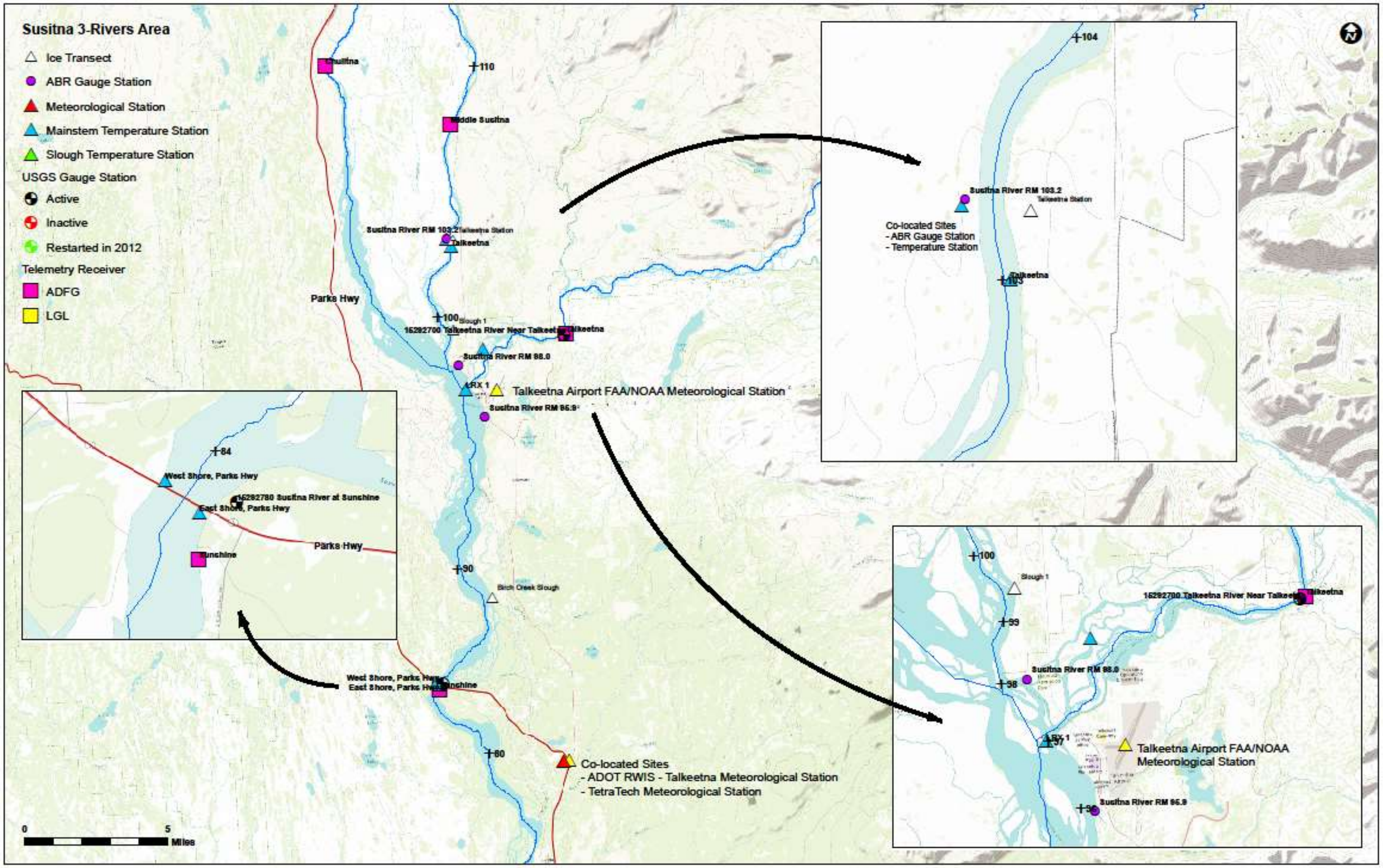

Figure 5.3. Lower and Middle Susitna River continuous temperature monitoring sites (blue and green triangles) and meteorological stations (red triangles).

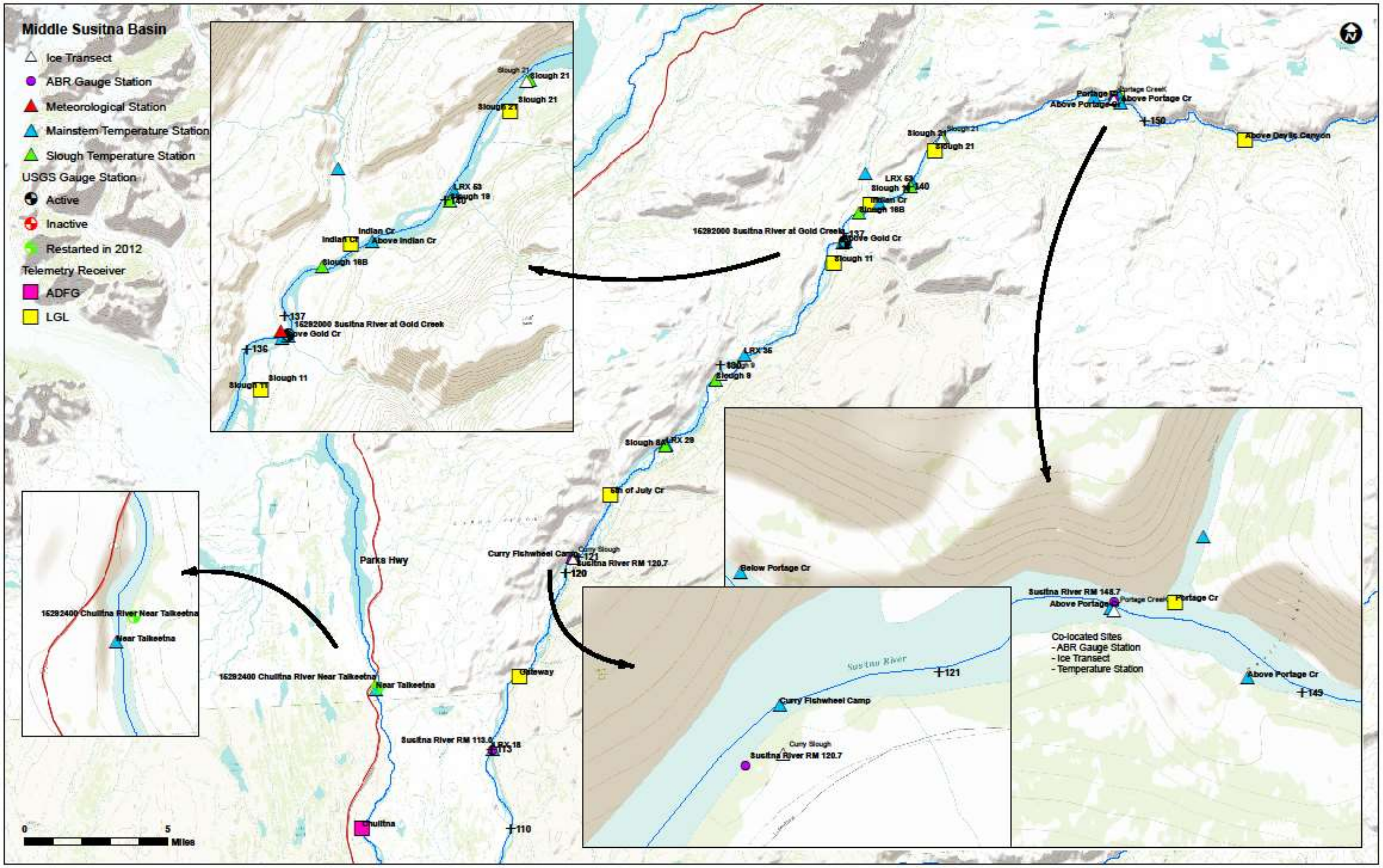

Figure 5.4. Middle and Upper Susitna River continuous temperature monitoring sites (blue and green triangles) and meteorological stations (red triangles).

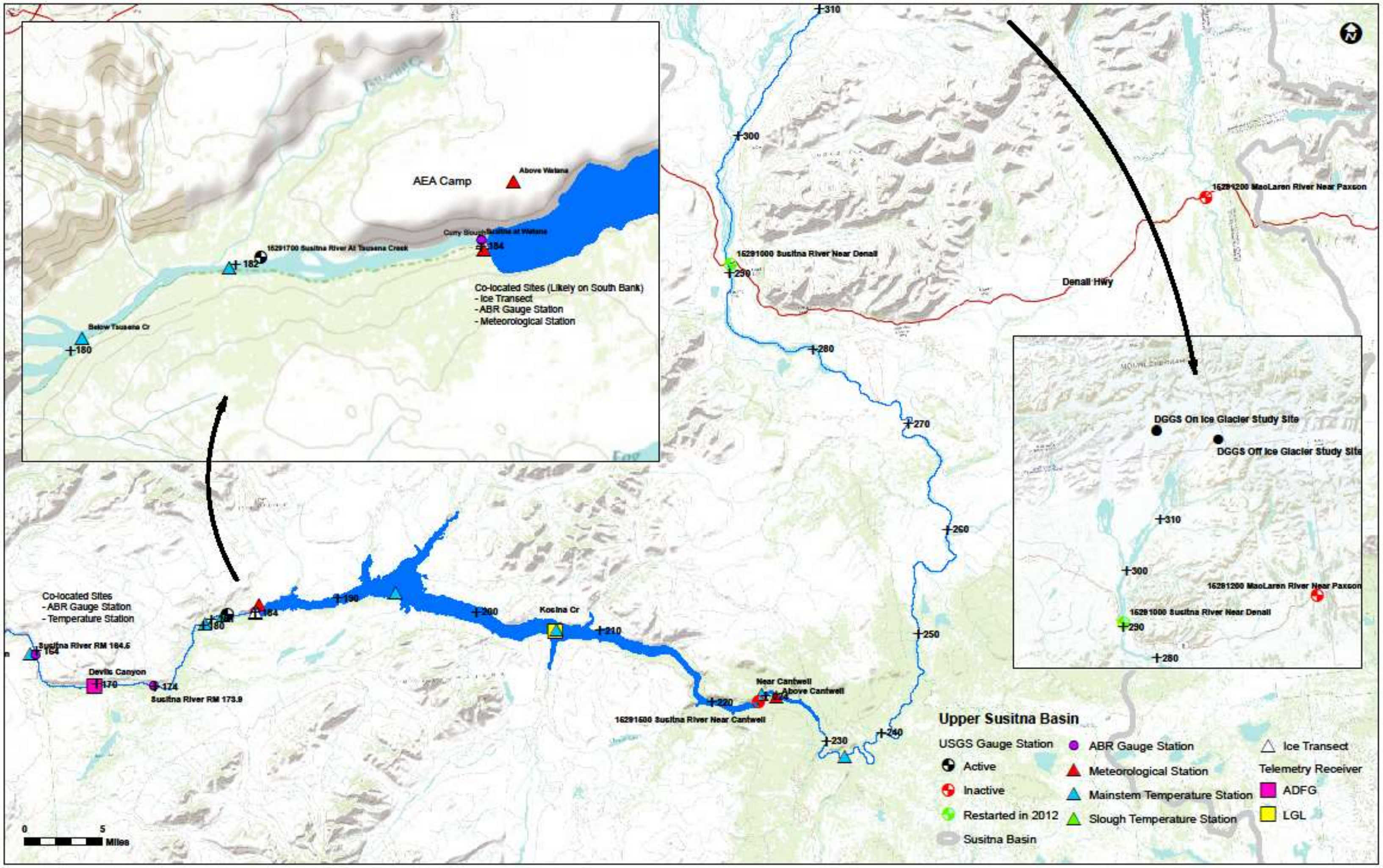

Figure 5.5. Upper Susitna River continuous temperature monitoring sites (blue and green triangles) and meteorological stations (red triangles).

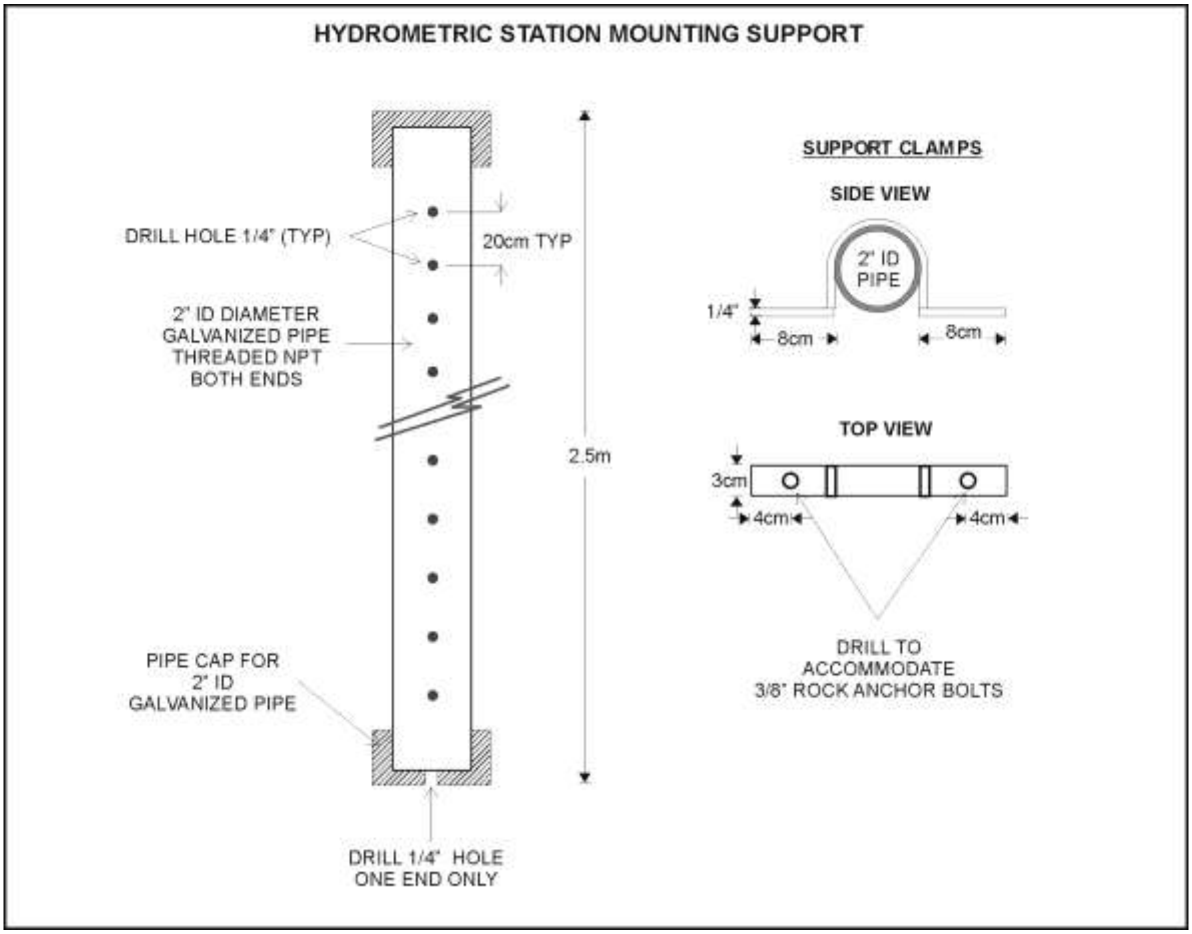

Figure 5.6. Bank-mounted temperature logger housing schematic

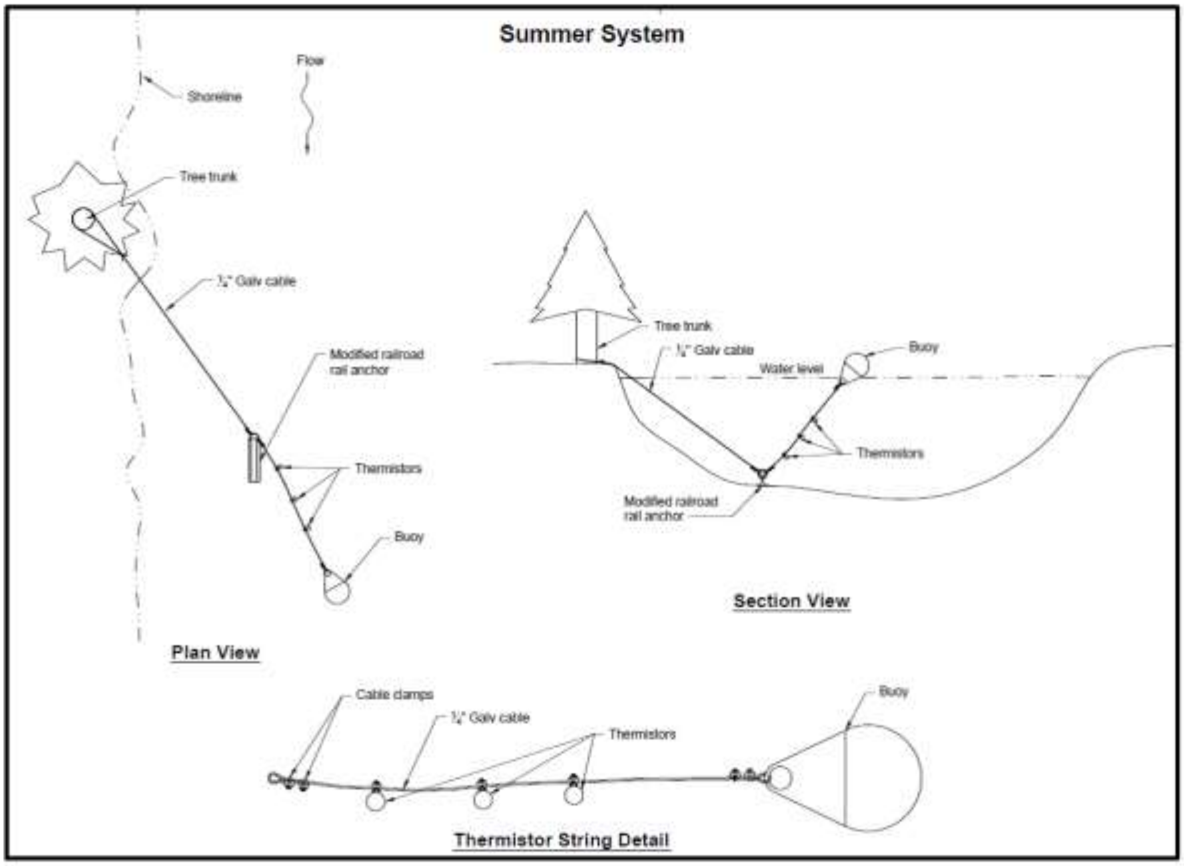

Figure 5.7. Anchor and buoy temperature monitoring buoy system

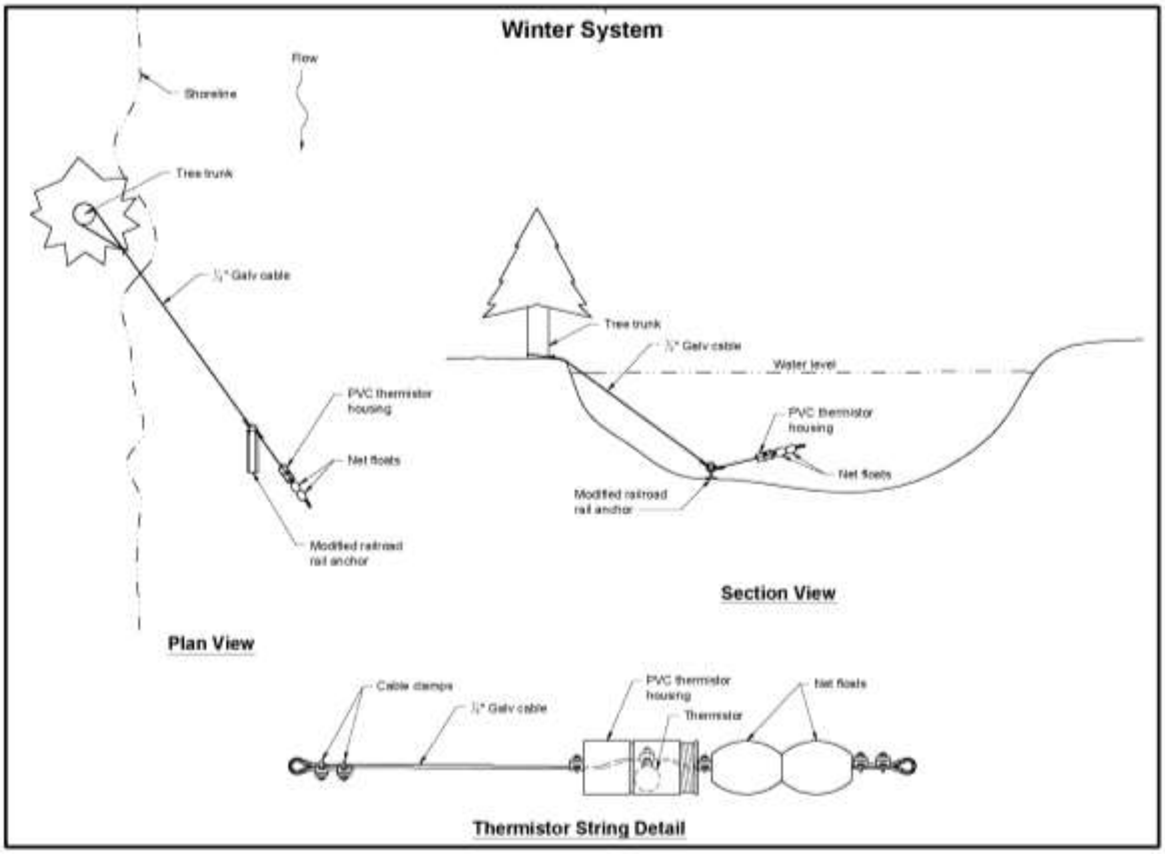

Figure 5.8. Anchor and buoy temperature monitoring buoy system

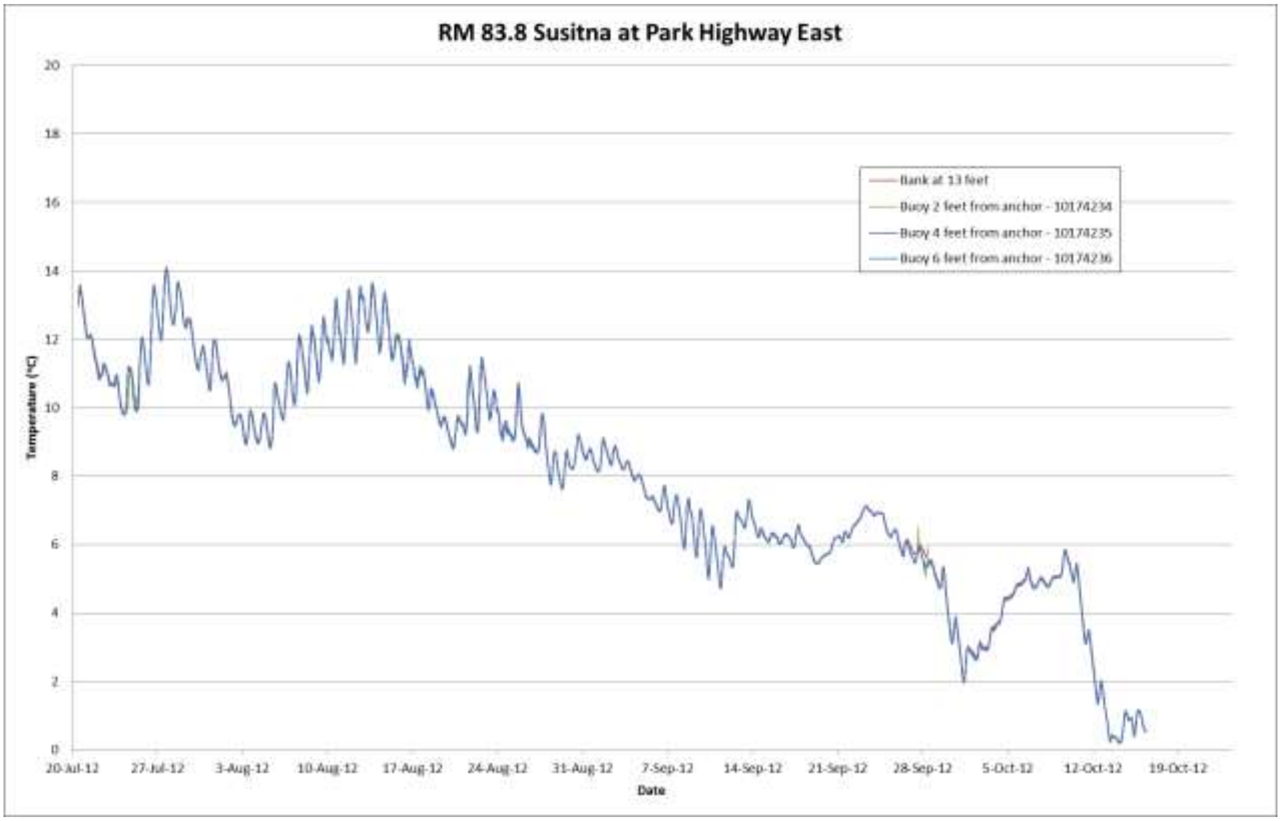

Figure 6.1. Temperature Data RM 83.8

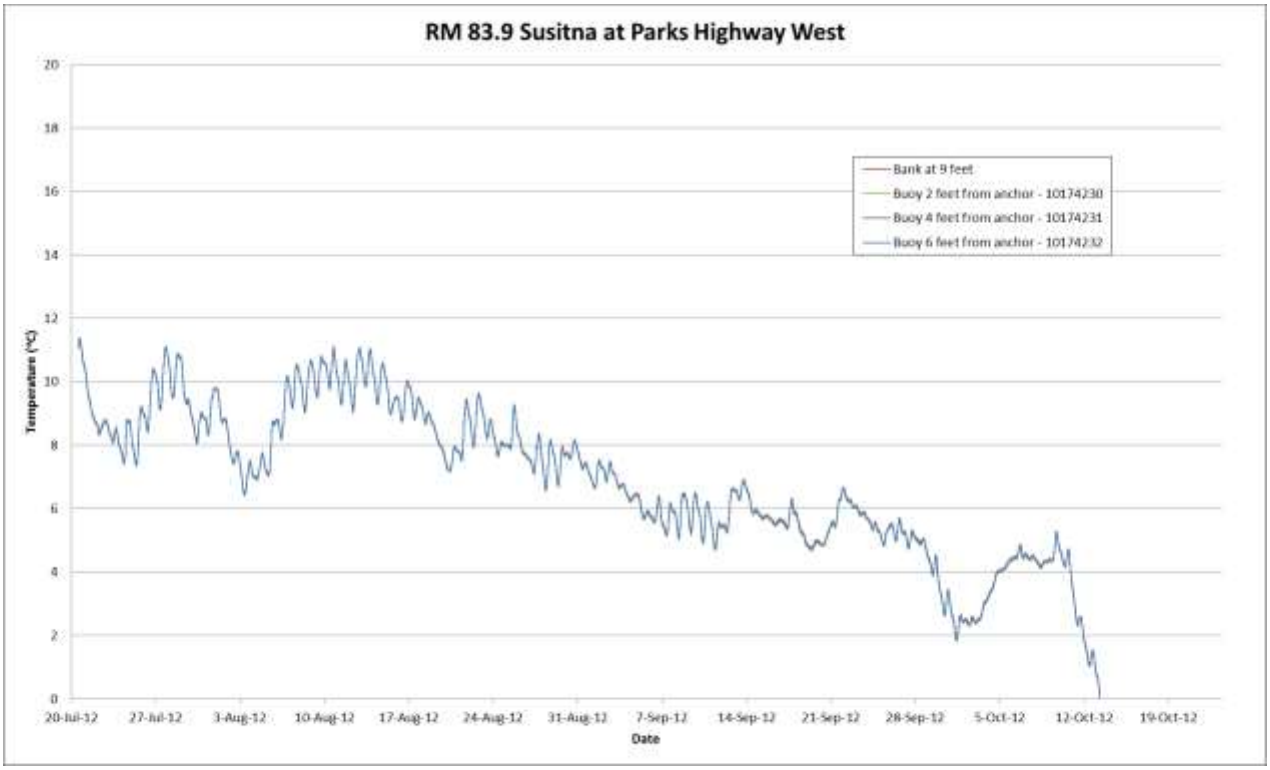

Figure 6.2. Temperature Data RM 83.9

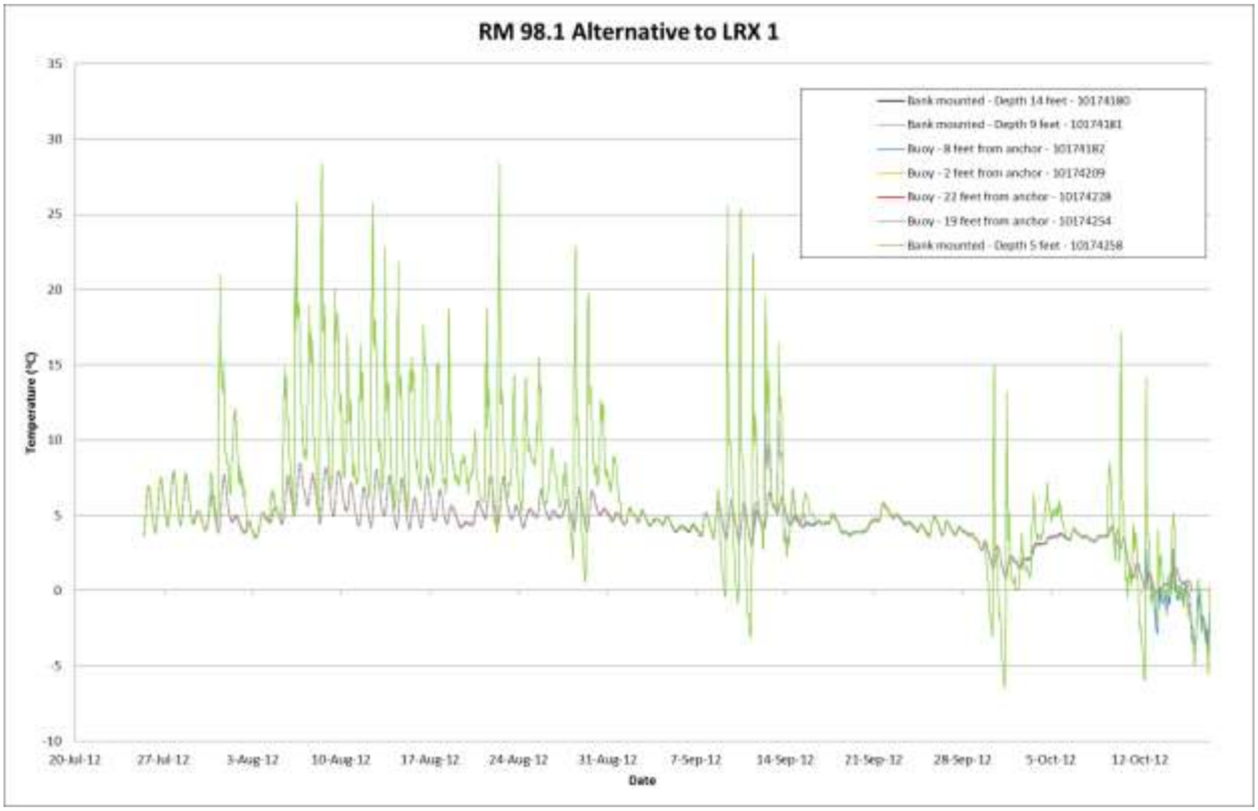

Figure 6.3. Temperature Data RM 98.1

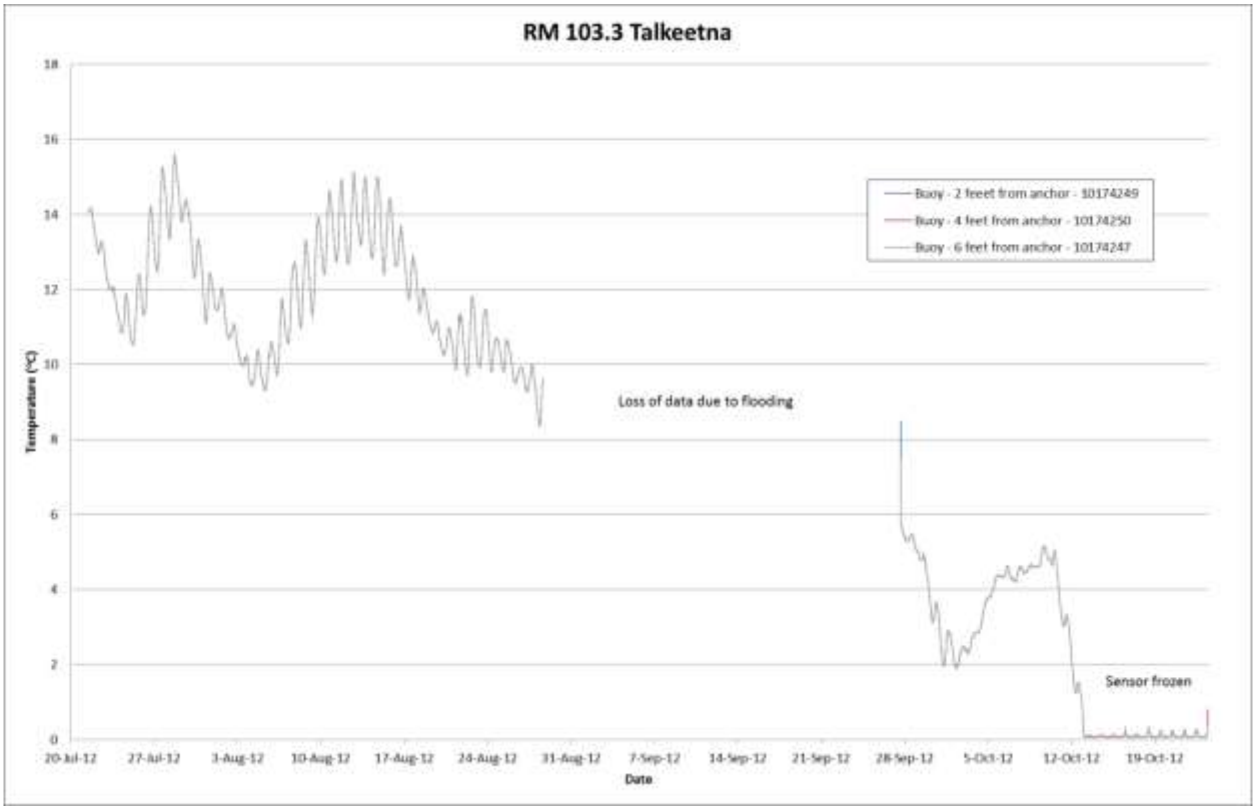

Figure 6.4. Temperature Data RM 103.3

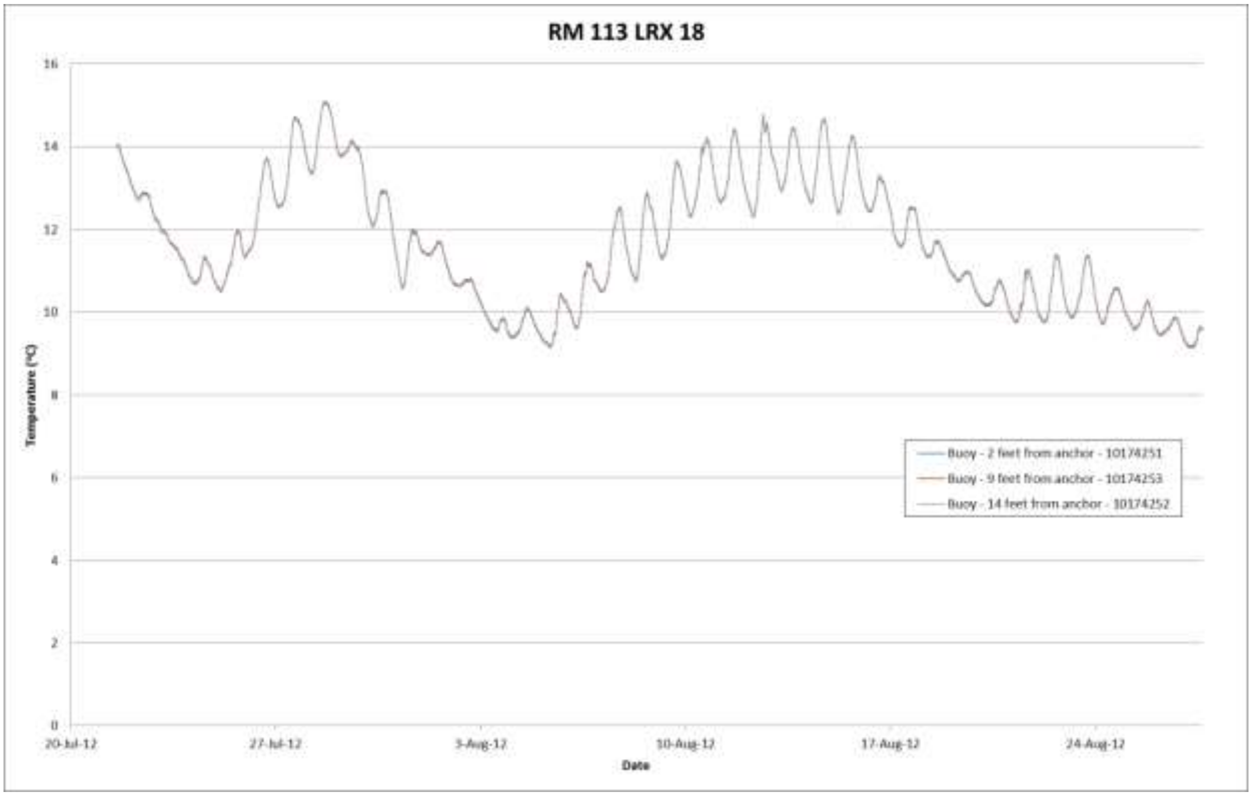

Figure 6.5. Temperature Data RM 113

Figure 6.6. Temperature Data RM 120.7

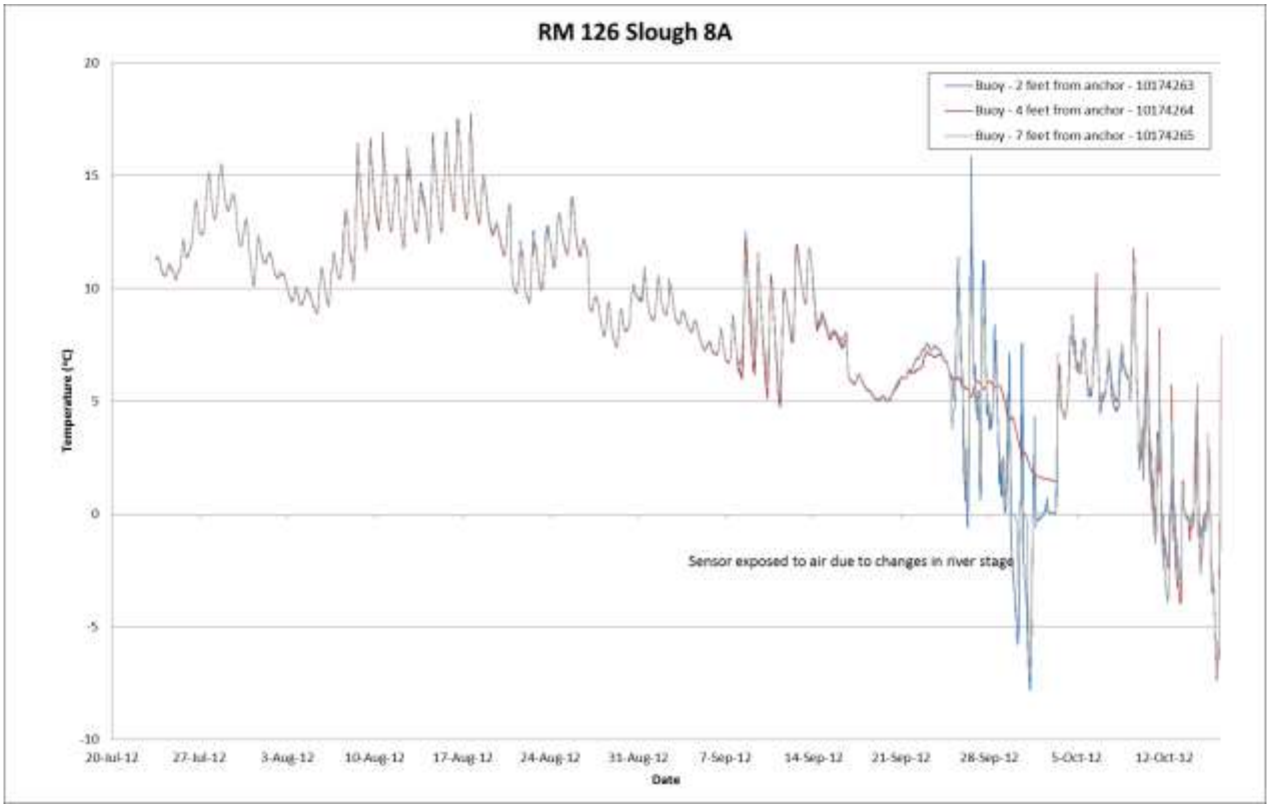

Figure 6.7. Temperature Data RM 120.7

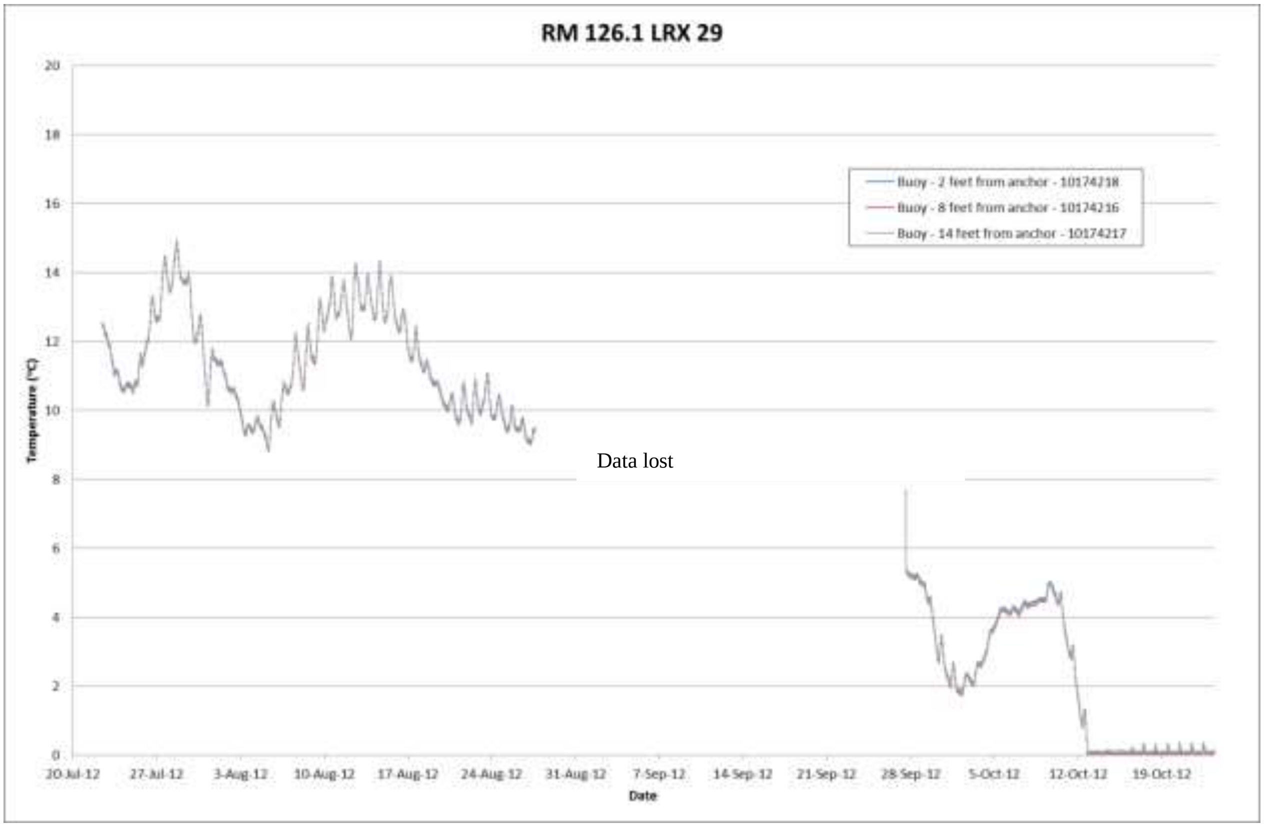

Figure 6.8. Temperature Data RM 126.1

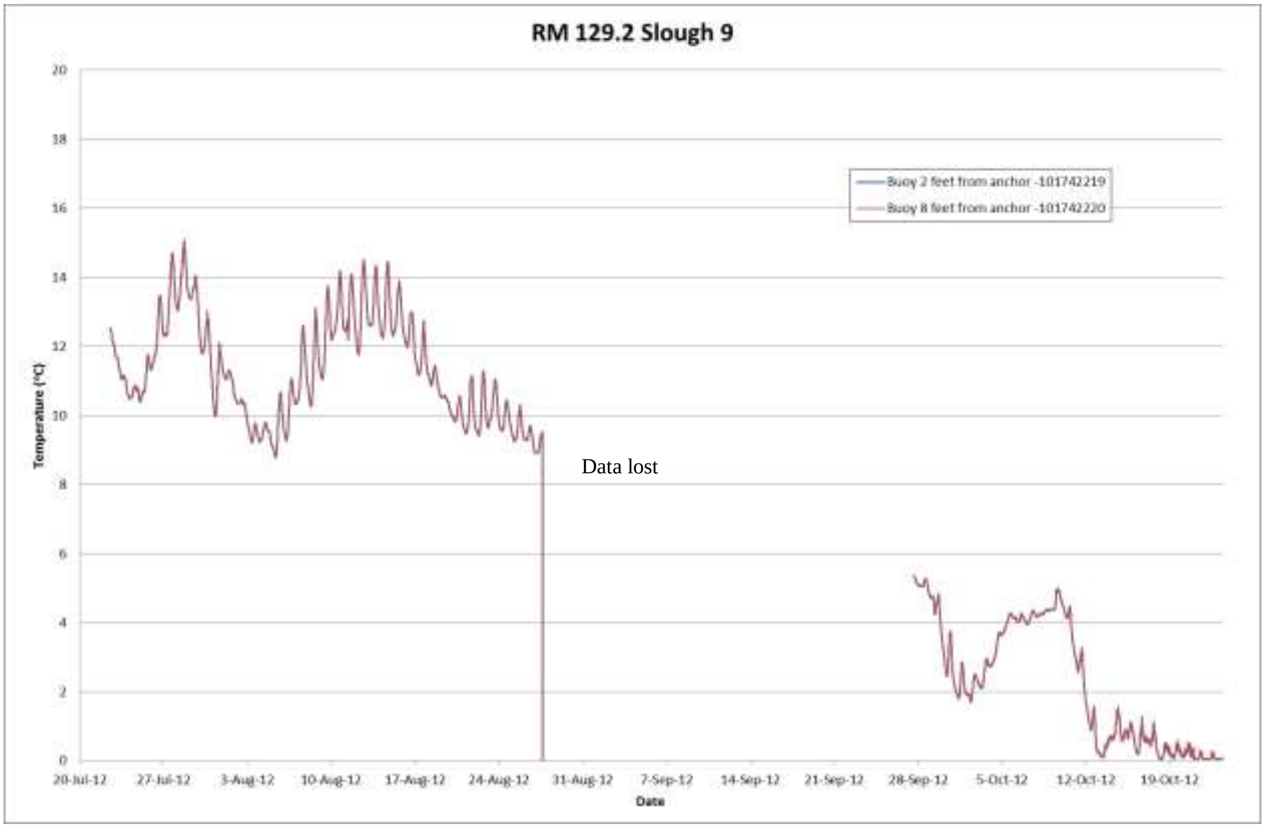

Figure 6.9. Temperature Data RM 129.2

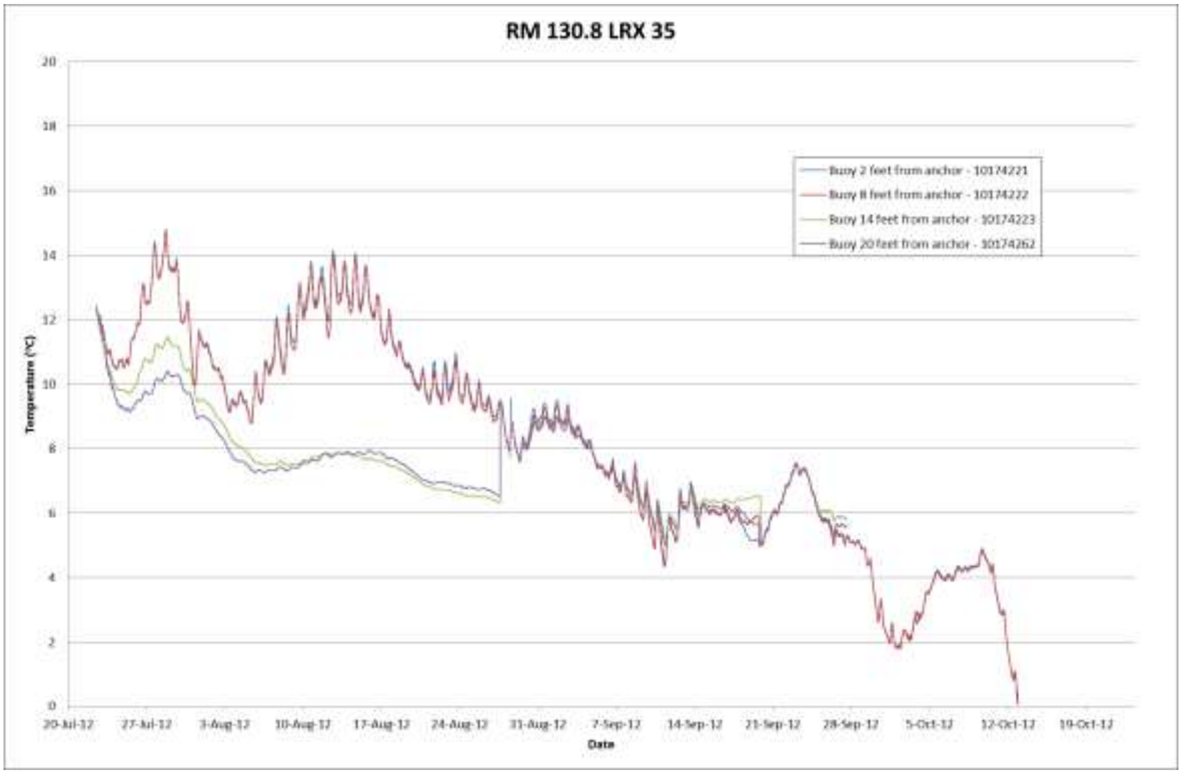

Figure 6.10. Temperature Data RM 130.8

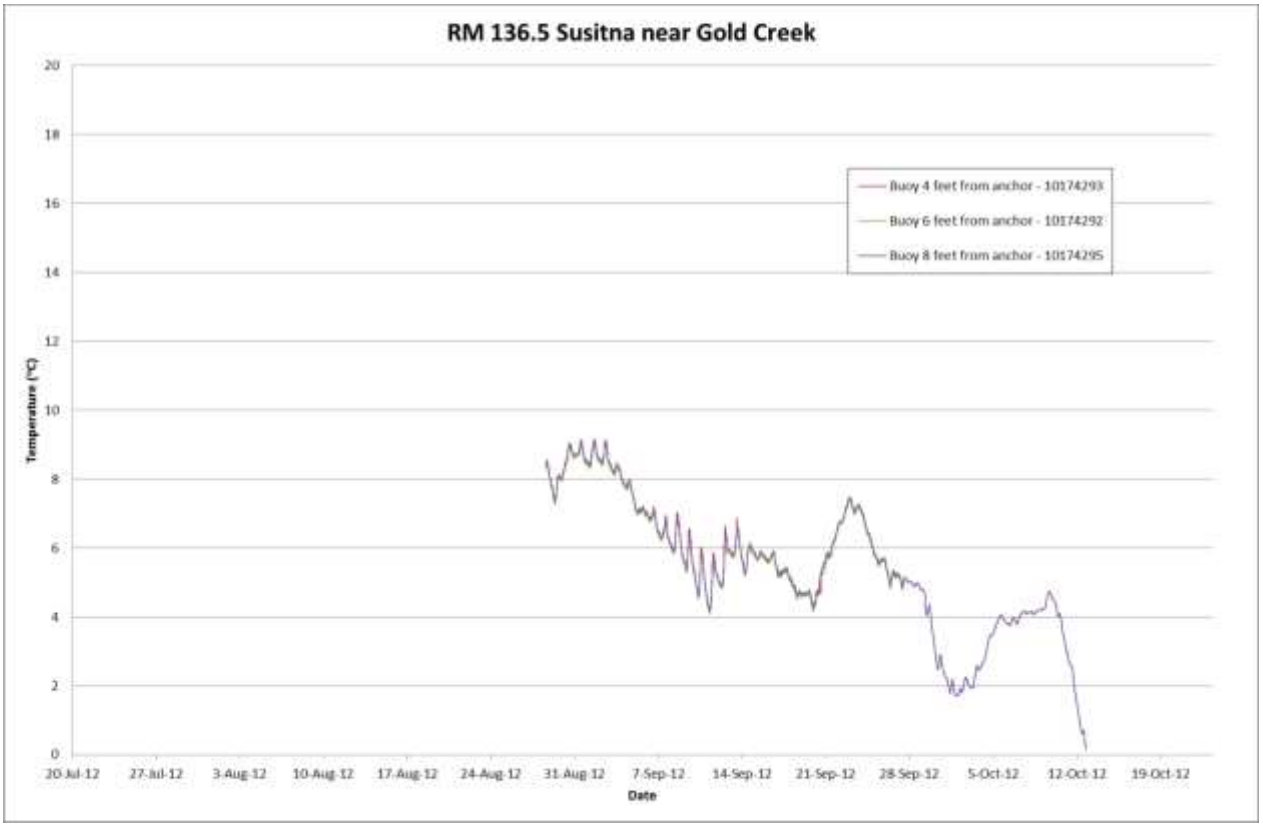

Figure 6.11. Temperature Data RM 136.5

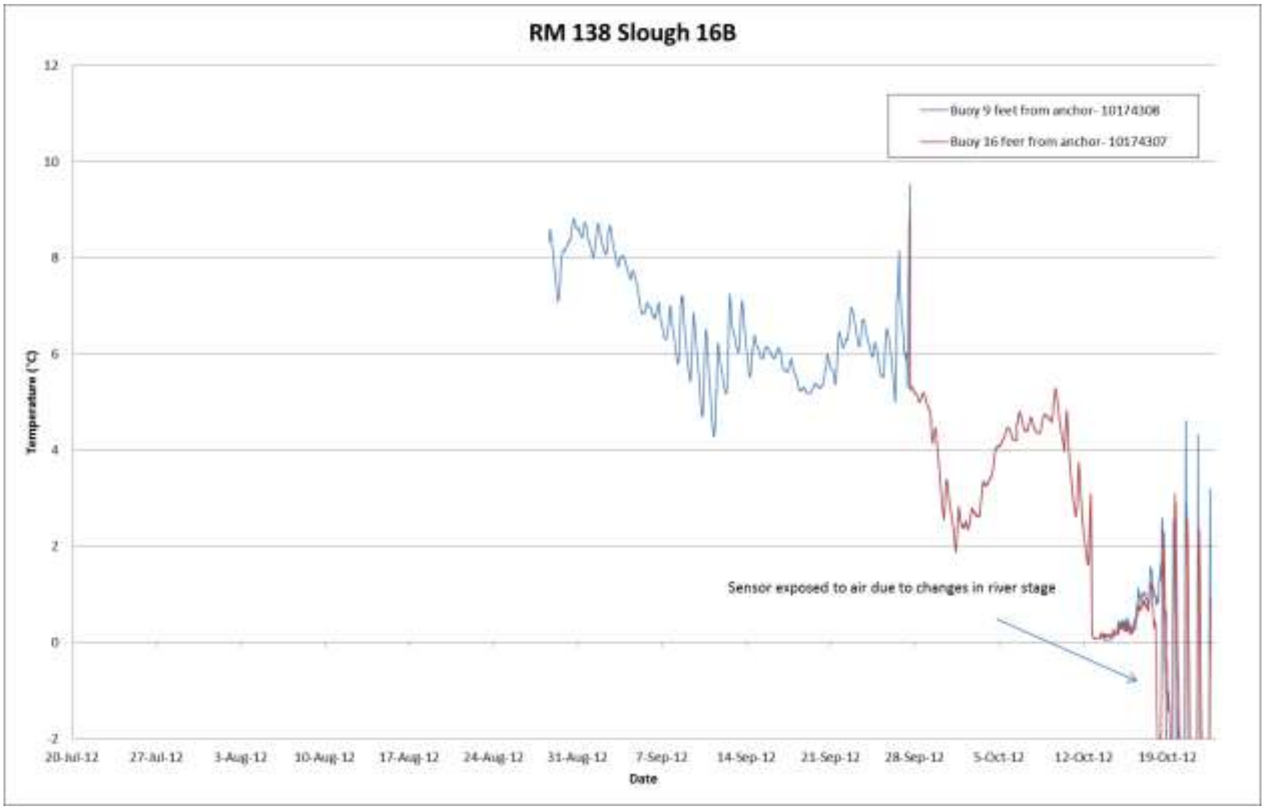

Figure 6.12. Temperature Data RM 138

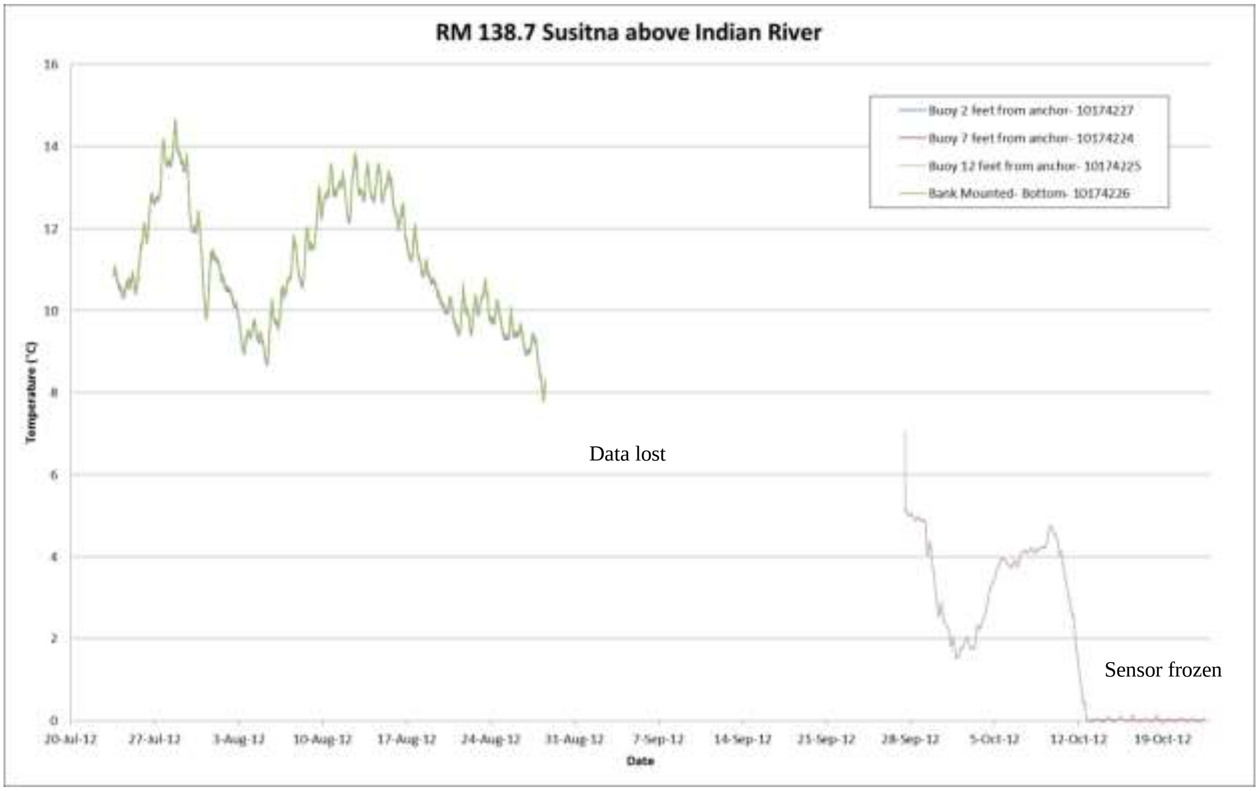

Figure 6.13. Temperature Data RM 138.7

Figure 6.14. Temperature Data RM 140

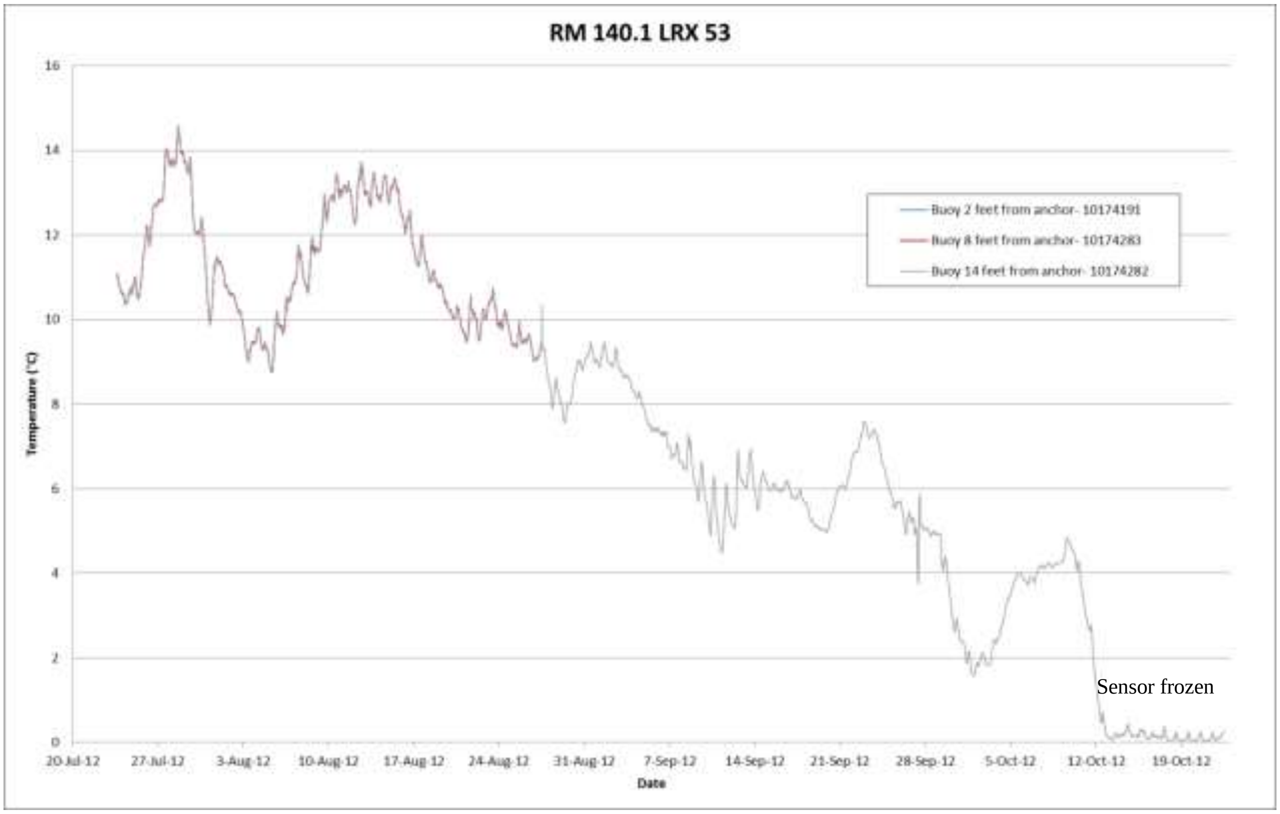

Figure 6.15. Temperature Data RM 140.1

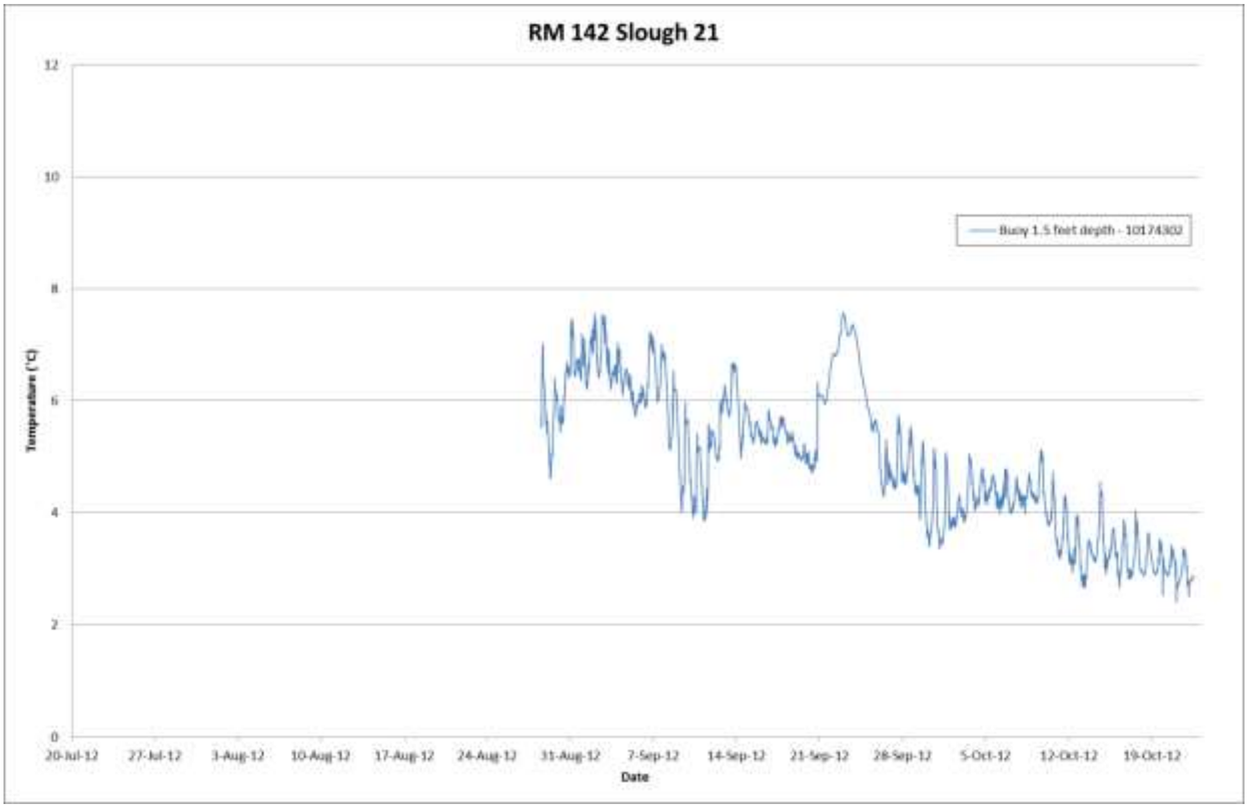

Figure 6.16. Temperature Data RM 142

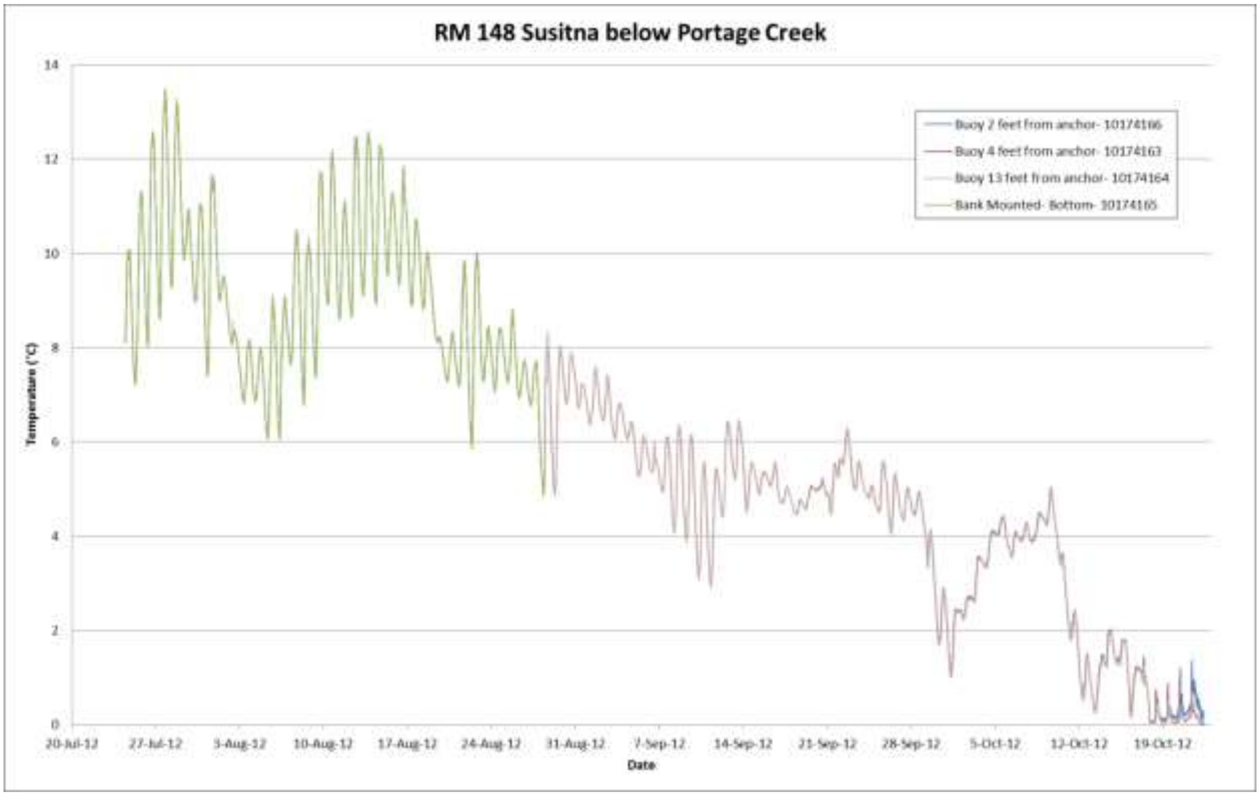

Figure 6.17. Temperature Data RM 148

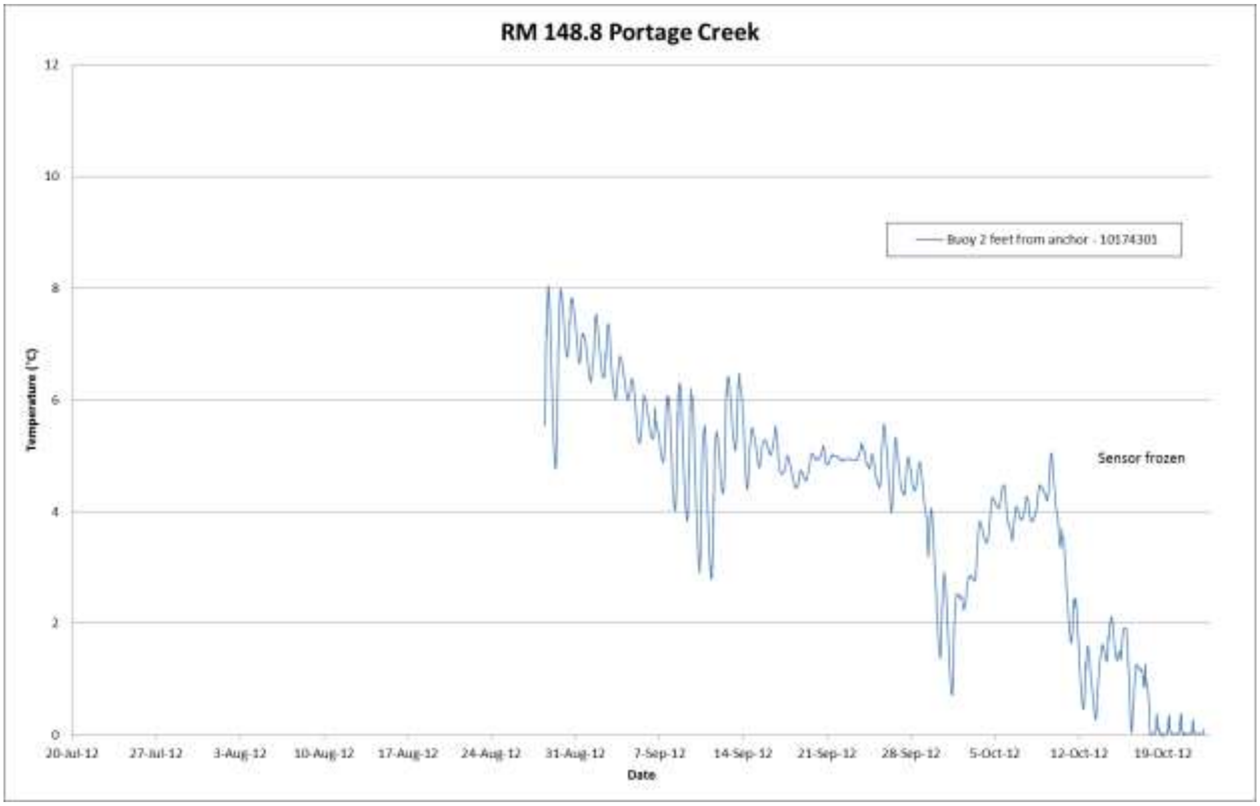

Figure 6.18. Temperature Data RM 148.8 (Susitna at Portage)

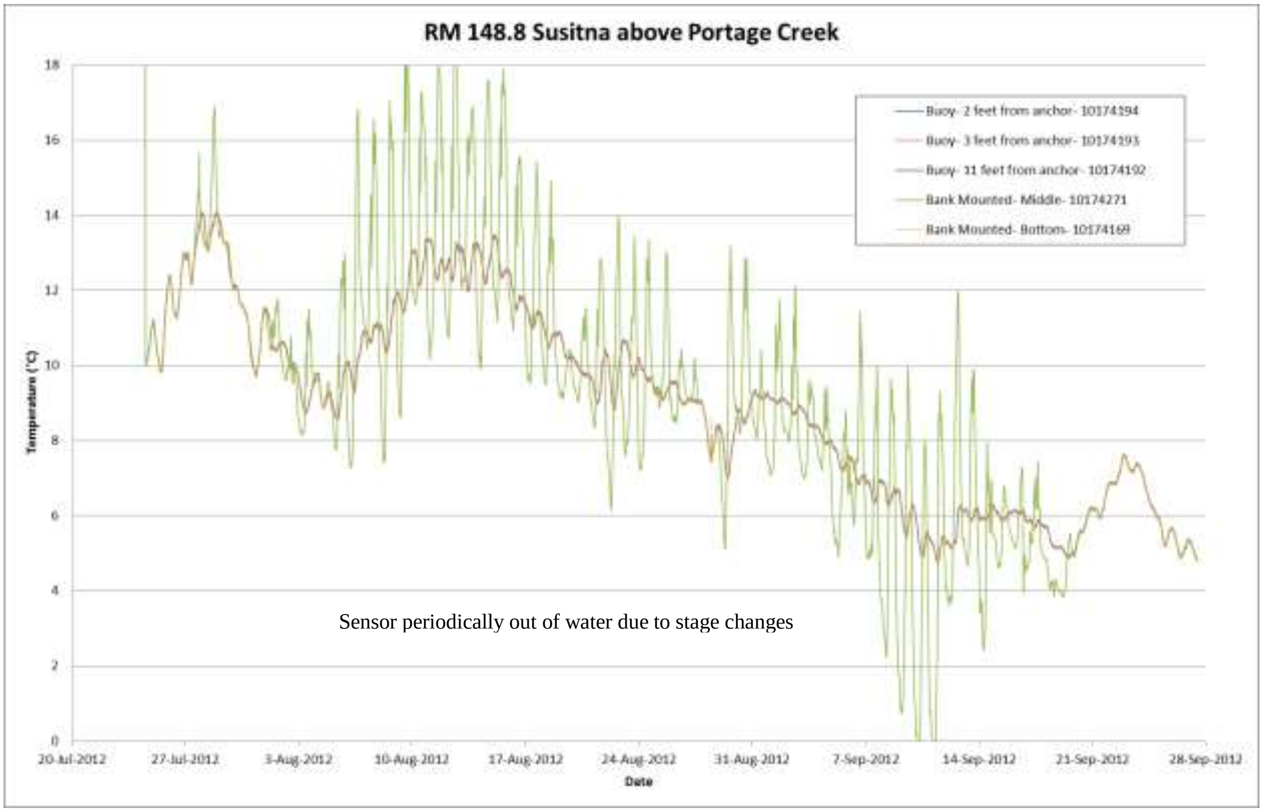

Figure 6.19. Temperature Data RM 148.8 (Susitna above Portage)

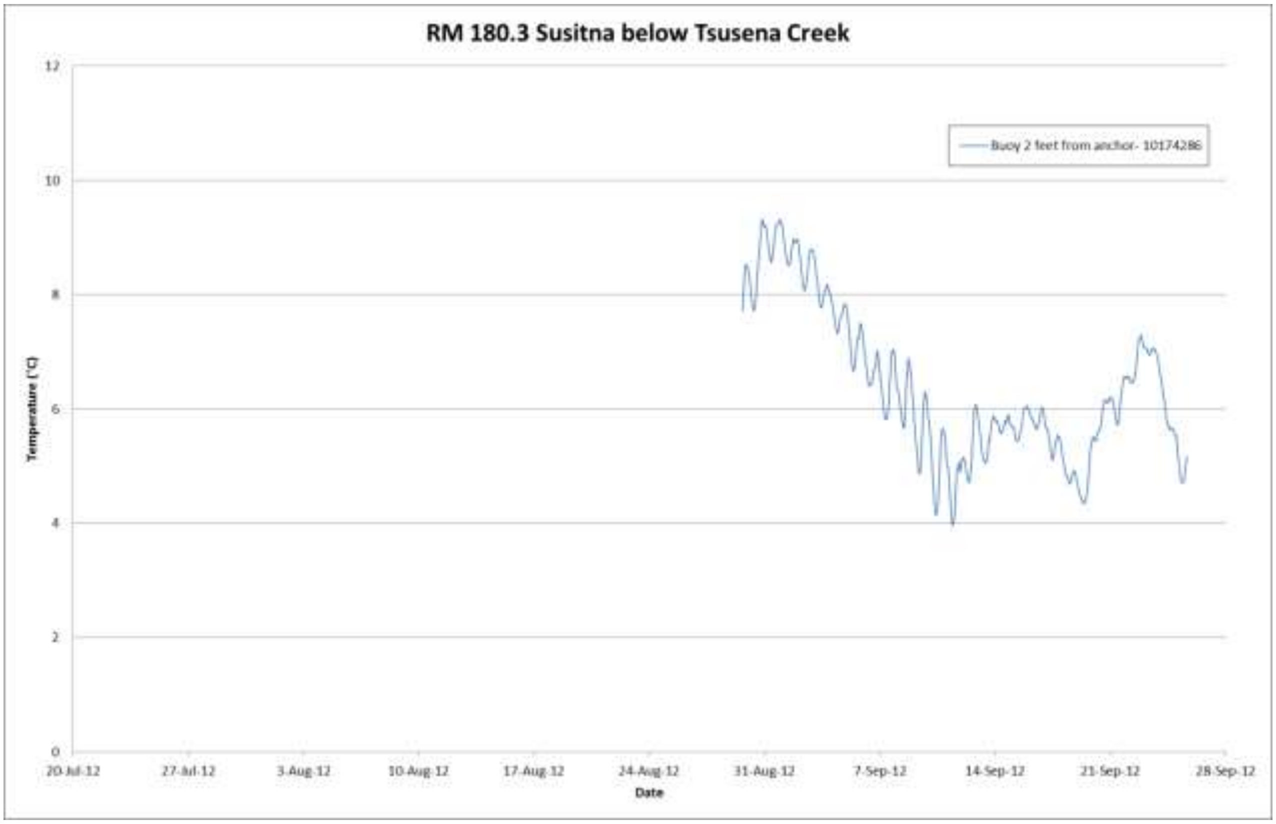

Figure 6.20. Temperature Data RM 180.3

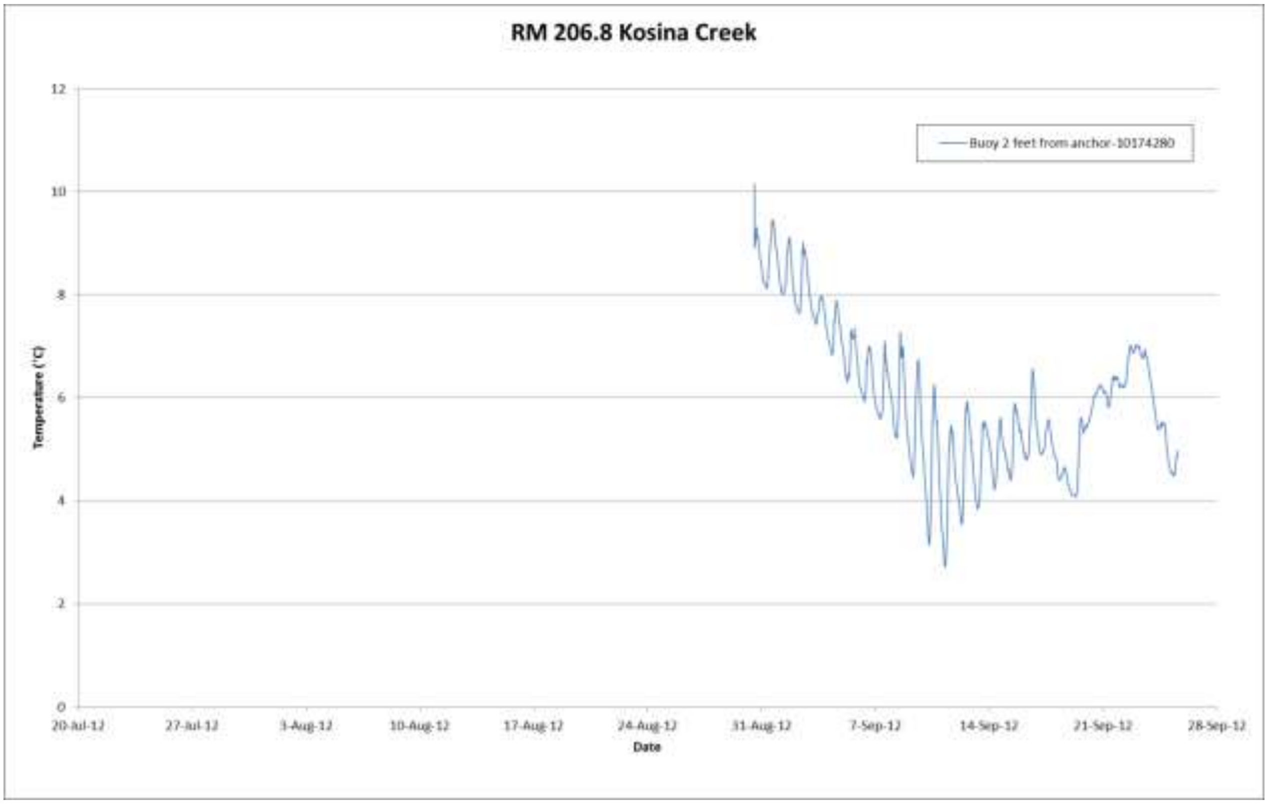

Figure 6.21. Temperature Data RM 206.8

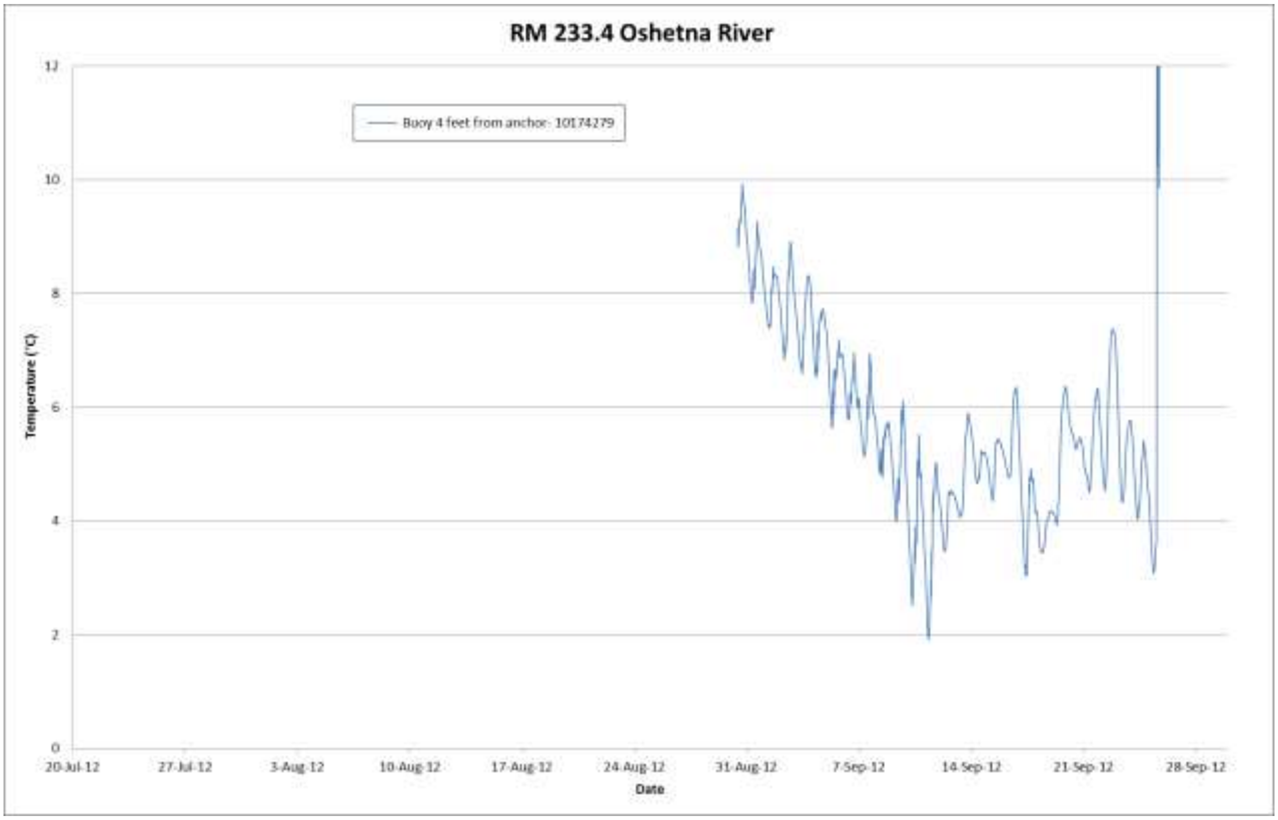

Figure 6.22. Temperature Data RM 233.4

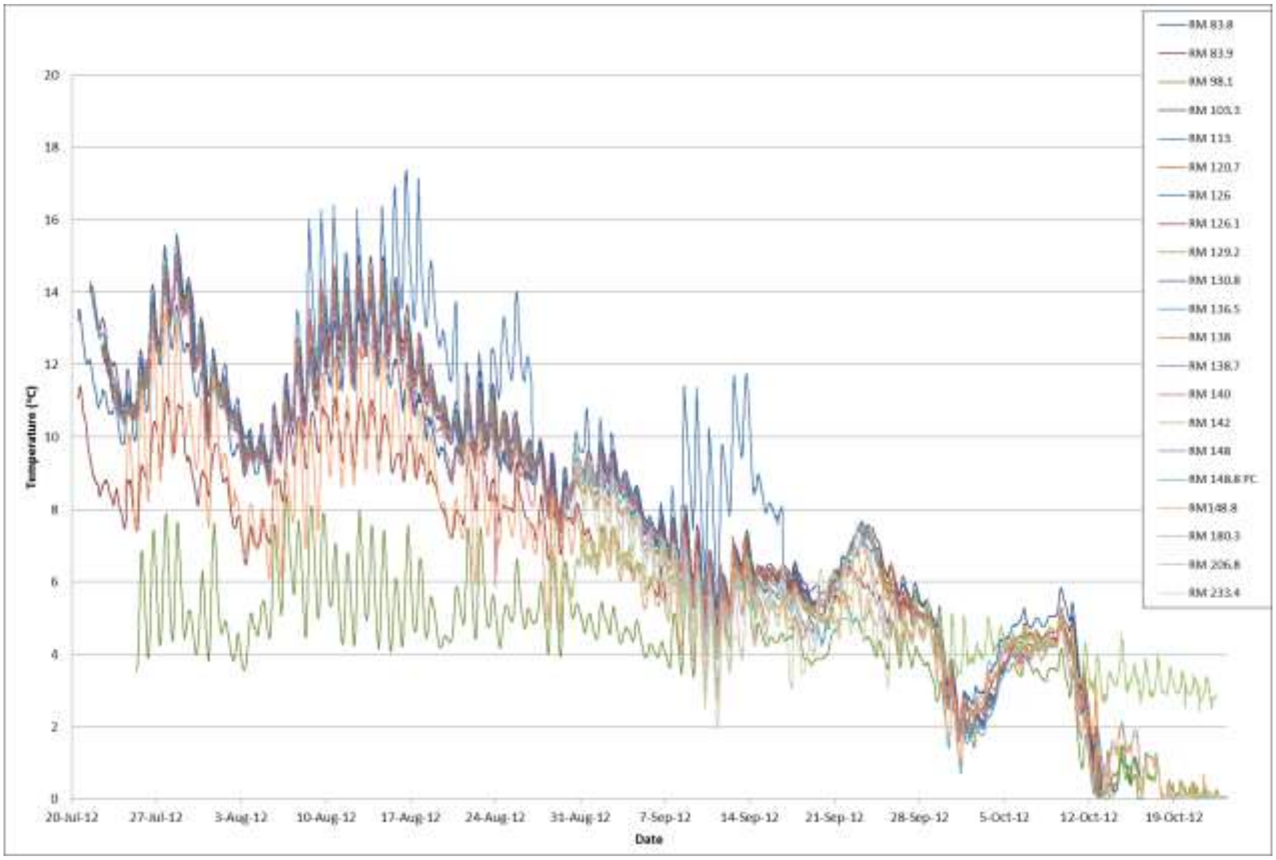

Figure 6.23. Temperature Data all sites

10. TABLES

Table 4.1. 2012 Susitna River Basin Temperature Monitoring Sites

Susitna River Mile	Description	Latitude (decimal degrees)	Longitude (decimal degrees)
15.1	Susitna above Alexander Creek	61.4391	-150.4851
25.8[3]	**Susitna Station**	**61.5454**	**-150.516**
28.0	Yentna River	61.5876	-150.4831
29.5	Susitna above Yentna	61.5759	-150.4270
40.6[3]	Deshka River	61.7095	-150.3248
55.0[1]	Susitna	61.8622	-150.1844
83.8[3]	Susitna at Parks Highway East	62.1748	-150.1732
83.9[3]	Susitna at Parks Highway West	62.1811	-150.1679
95.8	LRX 1	62.3063	-150.1087
97.2	Talkeetna River	62.3424	-150.1122
98.1	Chulitna River	62.5676	-150.2379
103.3	Talkeetna	62.3972	-150.1373
113.0[2]	LRX 18	62.5252	-150.1144
120.7[2,3]	Curry Fishwheel Camp	62.6178	-150.0136
126.0	Slough 8A	62.6704	-149.9029
126.1[2]	LRX 29	62.6739	-149.8991
129.2[3]	Slough9	62.7025	-149.8412
130.8[2]	LRX 35	62.7136	-149.8089
136.5	Susitna near Gold Creek	62.7673	-149.6935
136.8[3]	Gold Creek	62.7675	-149.6919
138.0[1]	Slough 16B	62.7802	-149.6853
138.6[3]	**Indian River**	**62.8009**	**-149.664**
138.7[2]	Susitna above Indian River	62.7854	-149.6484
140.0	Slough 19	62.7939	-149.6143
140.1[2]	LRX 53	62.7945	-149.6129
142.0	Slough21	62.8163	-149.576
148.0	Susitna below Portage Creek	62.8303	-149.3827
148.8[2]	Susitna above Portage Creek	62.8304	-149.3803
148.8	Portage Creek	62.8267	-149.3693
165.0[1]	Susitna	62.7916	-148.997
180.3[1]	Susitna below Tsusena Creek	62.8134	-148.6568
181.3[3]	Tsusena Creek	62.8217	-148.6068
184.5[1]	Susitna at Watana Dam site	62.8226	-148.533
194.1	**Watana Creek**	**62.8296**	**-148.259**
206.8	Kosina Creek	62.7822	-147.94
223.7[3]	**Susitna near Cantwell**	**62.7052**	**-147.538**
233.4	Oshetna River	62.6402	-147.383

1 Site not sampled for water quality or 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.

3 Locations with overlap of water quality temperature monitoring sites with other studies, including pressure transducers.

Locations in bold represent sites which were not installed during the 2012 sampling year.

Table 5.1. Susitna-Watana 2012 Meteorological Stations

Susitna River Mile	Description	Station Status (New / Existing)	Latitude (Decimal degrees)	Longitude (Decimal degrees)	Date Installed or Modified	Period of record	Parameters measured
44.3	Willow Creek	Existing (Willow Airport: NOAA RWIS)	61.7650	-150.0503	N/a	6/05 to present	Wind speed, visibility, temperature, relative humidity, barometric pressure, precipitation
80.0	Susitna River near Sunshine Gage	Existing (Talkeetna RWIS: Parks Highway @ Talkeetna Rd. MP 98.7)	62.1381	-150.1155	N/a	Unknown start date to present	Wind speed and direction, temperature, relative humidity, precipitation, dew point, pavement temperature, subsurface temperature
97.0	Susitna River at Talkeetna	Existing (Talkeetna Airport: FAA/NOAA Station)	62.3200	-150.0950	N/a	1/05 to present	Wind speed, visibility, temperature, relative humidity, barometric pressure, precipitation, wind chill, heat index
138.5	Susitna River at Indian River	New	62.7842	-149.6633	09/27/12	09/27/12 to present	Wind speed and direction, temperature, relative humidity, barometric pressure, precipitation, wind gust and direction, solar degree days
184.1	Susitna River at Watana Dam (upland on bench)	New	62.8295	-148.5518	08/29/12	08/29/12 to present	
233.4	Susitna River above Oshetna	New	62.6388	-147.3781	09/28/12	09/28/12 to present	

Table 5.2. 2012 Susitna River Basin Temperature Monitoring Sites and Installation Types

Susitna River Mile	Description	Bank-Mounted Installation	Anchor-and-Buoy System: Thermistor String	Anchor-and-Buoy System: Winter Single Thermistor
15.1	Susitna above Alexander Creek	N	Y	N
25.8[3]	Susitna Station	N	N	N
28.0	Yentna River	N	Y	N
29.5	Susitna above Yentna	N	Y	N
40.6[3]	Deshka River	N	Y	N
55.0[1]	Susitna	Y	Y	N
83.8[3]	Susitna at Parks Highway East	Y	Y	Y
83.9[3]	Susitna at Parks Highway West	Y	Y	Y
95.8	LRX 1	Y	Y	N
97.2	Talkeetna River	Y (Lost)	Y (Lost)	Y
98.1	Chulitna River	Y	Y	Y
103.3	Talkeetna	Y	Y	Y
113.0[2]	LRX 18	N	Y (removed)	N
120.7[2,3]	Curry Fishwheel Camp	Y	Y	N
126.0	Slough 8A	N	Y	N
126.1[2]	LRX 29	N	Y	Y
129.2[3]	Slough 9	N	Y (removed)	N
130.8[2]	LRX 35	N	Y	Y
136.5	Susitna near Gold Creek	N	Y	Y
136.8[3]	Gold Creek	N	Y (Lost)	Y
138.0[1]	Slough 16B	N	Y (removed)	N
138.6[3]	Indian River	N	N	N
138.7[2]	Susitna above Indian River	Y	Y	Y
140.0	Slough 19	N	Y (removed)	N
140.1[2]	LRX 53	N	Y	Y
142.0	Slough 21	N	Y (single thermistor)	
148.0	Susitna below Portage Creek	Y	Y	N
148.8[2]	Susitna above Portage Creek	Y	Y	N
148.8	Portage Creek	N	Y (single thermistor)	
165.0[1]	Susitna	N	N	Y
180.3[1]	Susitna below Tsusena Creek	N	Y	Y
181.3[3]	Tsusena Creek	N	N	Y
184.5[1]	Susitna at Watana Dam site	N	N	Y
194.1	Watana Creek	N	N	N
206.8	Kosina Creek	N	Y	Y
223.7[3]	Susitna near Cantwell	N	N	N
233.4	Oshetna River	N	Y	Y

1 Site not sampled for water quality or 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.
3 Locations with overlap of water quality temperature monitoring sites with other studies.
N = not installed, Y = installed
Locations in bold represent sites which were not installed during the 2012 sampling year.

Table 5.3. Thermistor Installation and Downloads

Thermistor #	Site Name	Date Installed	River Mile	Month Downloaded		
10174233	Susitna at Parks Highway East	20-Jul-12	83.8	Aug-12	Oct-12	
10174234	Susitna at Parks Highway East	20-Jul-12	83.8	Oct-12		
10174235	Susitna at Parks Highway East	20-Jul-12	83.8	Oct-12		
10174236	Susitna at Parks Highway East	20-Jul-12	83.8	Oct-12		
10174229	Susitna at Parks Highway West	20-Jul-12	83.9	Aug-12	Sep-12	Oct-12
10174230	Susitna at Parks Highway West	20-Jul-12	83.9	Aug-12	Sep-12	Oct-12
10174231	Susitna at Parks Highway West	20-Jul-12	83.9	Aug-12	Sep-12	Oct-12
10174232	Susitna at Parks Highway West	20-Jul-12	83.9	Aug-12	Sep-12	
10174243	Alternative to LRX 1	28-Sep-12	95.8	Sep-12		
10174244	Alternative to LRX 1	28-Sep-12	95.8	Sep-12		
10174245	Alternative to LRX 1	28-Sep-12	95.8	Sep-12		
10174246	Alternative to LRX 1	28-Sep-12	95.8	Sep-12		
10174180	Chulitna River	23-Jul-12	98.1	Oct-12		
10174181	Chulitna River	23-Jul-12	98.1	Oct-12		
10174182	Chulitna River	23-Jul-12	98.1	Oct-12		
10174209	Chulitna River	23-Jul-12	98.1	Oct-12		
10174228	Chulitna River	23-Jul-12	98.1	Oct-12		
10174254	Chulitna River	23-Jul-12	98.1	Oct-12		
10174258	Chulitna River	23-Jul-12	98.1	Oct-12		
10174247	Talkeetna	20-Jul-12	103.3	Aug-12	Oct-12	
10174249	Talkeetna	20-Jul-12	103.3	Aug-12	Oct-12	
10174250	*Talkeetna*	*20-Jul-12*	*103.3*	*Aug-12*	*Oct-12*	
10174251	LRX 18	20-Jul-12	113	Aug-12		
10174252	LRX 18	20-Jul-12	113	Aug-12		
10174253	LRX 18	20-Jul-12	113	Aug-12		
10174266	Curry Fishwheel Camp	21-Jul-12	120.7	Aug-12	Oct-12	
10174267	Curry Fishwheel Camp	21-Jul-12	120.7	Aug-12	Oct-12	
10174268	Curry Fishwheel Camp	21-Jul-12	120.7	Aug-12		
10174269	Curry Fishwheel Camp	21-Jul-12	120.7	Aug-12		
10174263	Slough 8A	20-Jul-12	126	Aug-12	Oct-12	
10174264	Slough 8A	20-Jul-12	126	Aug-12	Oct-12	

Table 5.3. Thermistor Installation and Downloads

Thermistor #	Site Name	Date Installed	River Mile	Month Downloaded		
10174265	Slough 8A	20-Jul-12	126	Aug-12	Oct-12	
10174216	LRX 29	21-Jul-12	126.1	Aug-12	Oct-12	
10174217	LRX 29	21-Jul-12	126.1	Aug-12	Oct-12	
10174218	LRX 29	21-Jul-12	126.1	Aug-12	Oct-12	
10174219	Slough 9	21-Jul-12	129.2	Aug-12	Oct-12	
10174220	Slough 9	21-Jul-12	129.2	Aug-12	Oct-12	
10174307	Slough 16B	26-Aug-12	130	Oct-12		
10174308	Slough 16B	26-Aug-12	130	Sep-12	Oct-12	
10174221	LRX 35	21-Jul-12	130.8	Aug-12		
10174222	LRX 35	21-Jul-12	130.8	Aug-12	Sep-12	Oct-12
10174223	LRX 35	21-Jul-12	130.8	Aug-12	Sep-12	
10174262	LRX 35	21-Jul-12	130.8	Aug-12	Sep-12	Oct-12
10174293	Susitna near Gold Creek	26-Aug-12	136.5	Sep-12		
10174295	Susitna near Gold Creek	26-Aug-12	136.5	Sep-12	Oct-12	
10174224	Susitna Above Indian River	22-Jul-12	138.7	Aug-12	Oct-12	
10174225	Susitna Above Indian River	22-Jul-12	138.7	Aug-12	Oct-12	
10174226	Susitna Above Indian River	22-Jul-12	138.7	Aug-12		
10174227	Susitna Above Indian River	22-Jul-12	138.7	Aug-12		
10174189	Slough 19	22-Jul-12	140	Aug-12	Sep-12	Oct-12
10174190	Slough 19	22-Jul-12	140	Aug-12	Oct-12	
10174191	LRX 53	22-Jul-12	140.1	Aug-12	Oct-12	
10174282	LRX 53	22-Jul-12	140.1	Aug-12	Sep-12	Oct-12
10174283	LRX 53	22-Jul-12	140.1	Aug-12	Oct-12	
10174302	Slough 21	26-Aug-12	142	Sep-12	Oct-12	
10174163	Susitna Below Portage Creek	22-Jul-12	148	Sep-12	Oct-12	
10174164	Susitna Below Portage Creek	22-Jul-12	148	Sep-12	Oct-12	
10174165	Susitna Below Portage Creek	22-Jul-12	148	Sep-12	Oct-12	
10174166	Susitna Below Portage Creek	22-Jul-12	148	Sep-12	Oct-12	
10174169	Susitna Above Portage Creek	24-Jul-12	148.8	Sep-12		
10174192	Susitna Above Portage Creek	24-Jul-12	148.8	Aug-12	Sep-12	
10174193	Susitna Above Portage Creek	24-Jul-12	148.8	Aug-12	Sep-12	
10174194	Susitna Above Portage Creek	24-Jul-12	148.8	Aug-12	Sep-12	
10174271	Susitna Above Portage Creek	24-Jul-12	148.8	Aug-12	Sep-12	
10174301	Portage Creek	26-Aug-12	148.8	Sep-12	Oct-12	
10174286	Susitna below Tsusena Creek	26-Aug-12	180.3	Oct-12		
10174280	Kosina Creek	26-Aug-12	206.8	Sep-12		
10174279	Oshetna River	26-Aug-12	233.4	Sep-12		