



# Climate Station Maintenance in the Central Alaska Inventory and Monitoring Network *2019 Summary*

Natural Resource Data Series NPS/CAKN/NRDS—2020/1274



**ON THE COVER**

Tana Knob weather station, Wrangell-St. Elias National Park and Preserve.  
NPS/Ken Hill

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# **Climate Station Maintenance in the Central Alaska Inventory and Monitoring Network**

## *2019 Summary*

Natural Resource Data Series NPS/CAKN/NRDS—2020/1274

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## Abstract

The mission of the Central Alaska Network Inventory and Monitoring Program (CAKN) is to collect, compile and synthesize scientific information about the central network of parks in order to manage park resources "unimpaired for the enjoyment of future generations". The Inventory and Monitoring (I&M) Program is a major component of the National Park Service's (NPS) strategy to improve park management through greater reliance on scientific information.

The objective of the climate monitoring program is to monitor and record weather conditions at representative locations in order to identify long and short-term trends, provide reliable climate data to other researchers, and to participate in larger scale climate monitoring and modeling efforts beyond park boundaries. Thirteen remote automated I&M weather stations (RAWS) have been installed in CAKN parks since 2003. There are additional weather and climate stations in the parks run by state and federal agencies with specific objectives and missions. It is in the best interest of the CAKN program to cooperate with these other entities on maintenance site visits. During the 2019 field season maintenance site visits were conducted at a total of twenty-two sites, including thirteen CAKN RAWS, four SNOTEL (snow telemetry) stations in coordination with Natural Resource Conservation Service (NRCS) staff, and five fire RAWS stations.

This report summarizes all work for the 2019 field season and includes current sensor metadata. These annual operations reports are compiled each year along with other discreet deliverables so that it is clear how the data were collected. For more information, including data access, weather summaries, and annual reports please visit the CAKN climate website at <https://www.nps.gov/im/cakn/climate.htm>.

## List of Acronyms

|            |                                                                            |
|------------|----------------------------------------------------------------------------|
| Ah:        | Amp hour                                                                   |
| AT:        | Air Temperature                                                            |
| AT-RH:     | Air Temperature-Relative Humidity                                          |
| CAKN:      | Central Alaska Network                                                     |
| DENA:      | Denali National Park and Preserve                                          |
| DLP:       | Data Logger Program                                                        |
| FTS:       | Forest Technology Systems                                                  |
| GOES:      | Geostationary Operational Environmental Satellite                          |
| GPS:       | Global Positioning System                                                  |
| I&M:       | Inventory and Monitoring                                                   |
| NESDIS ID: | National Environmental Satellite, Data, and Information Service Identifier |
| NPS:       | National Park Service                                                      |
| NRCS:      | Natural Resource Conservation Service                                      |
| RAWS:      | Remote Automated Weather Station                                           |
| RG-TB:     | Rain Gauge – Tipping Bucket                                                |
| SD:        | Snow Depth                                                                 |
| SNOTEL:    | Snow Telemetry                                                             |
| SR:        | Solar Radiation                                                            |
| ST:        | Soil Temperature                                                           |
| W:         | Watt                                                                       |
| WFMI:      | Wildland Fire Management Information                                       |
| WRST:      | Wrangell-St. Elias National Park and Preserve                              |
| WS-WD:     | Wind Speed – Wind Direction                                                |
| YUCH:      | Yukon-Charley Rivers National Preserve                                     |

# Introduction

For the 2019 field season, the Central Alaska Network (CAKN) continued its climate monitoring program by visiting stations in Denali National Park and Preserve (DENA), Yukon-Charley Rivers National Preserve (YUCH), and Wrangell – St. Elias National Park and Preserve (WRST) (Figure 1). Thirteen CAKN climate stations were maintained (Table 1) along with NPS support at four NRCS snow and soil sites, four fire RAWS stations, and one NOAA Climate Reference Network station. Annual maintenance includes downloading data, updating software and programming, replacing sensors, and troubleshooting problems. Maintenance is critical in order to provide continuous, high-quality meteorological data.

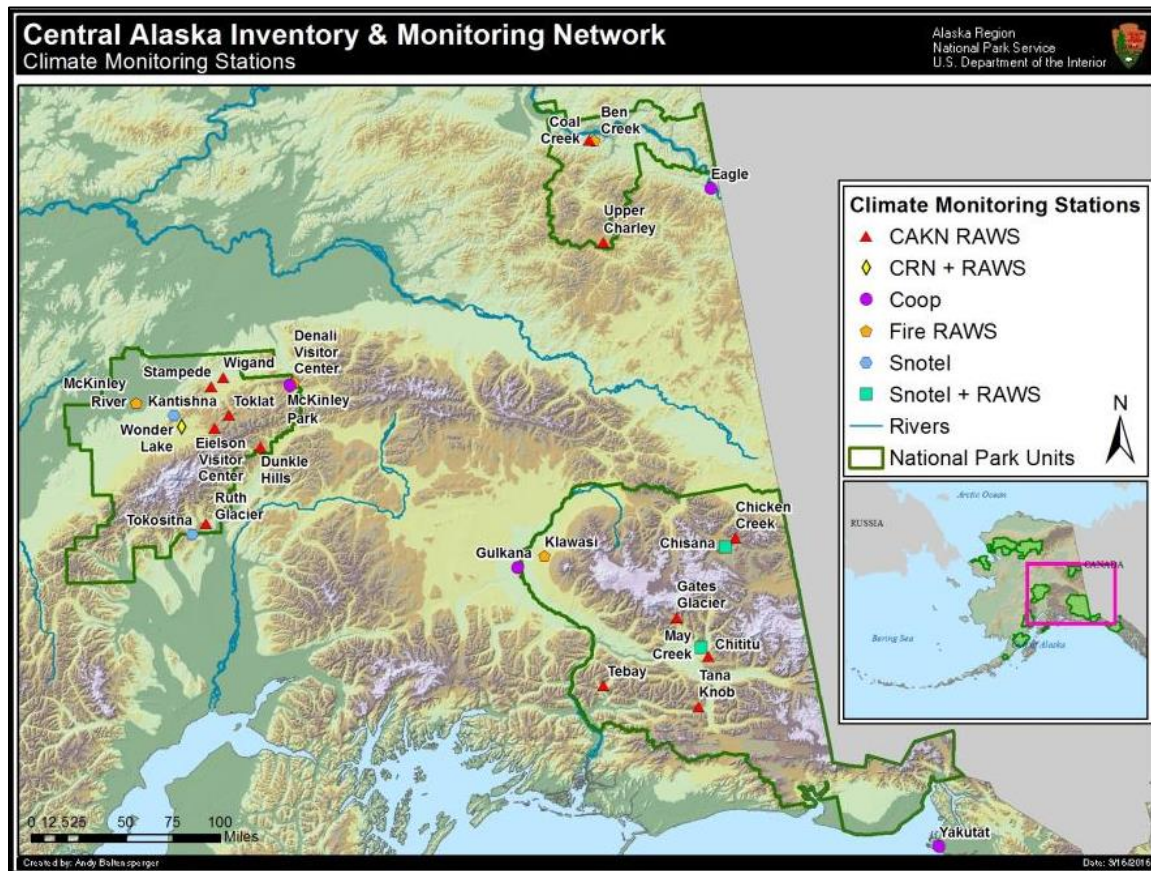


Figure 1. Locations of CAKN climate stations.

**Table 1.** Locations of CAKN climate stations maintained in 2019 field season.

| <b>Station Name</b>    | <b>Latitude</b> | <b>Longitude</b> | <b>Elevation (m)</b> | <b>Park</b> |
|------------------------|-----------------|------------------|----------------------|-------------|
| Chititu                | 61.274          | -142.621         | 1385                 | WRST        |
| Chicken Creek          | 62.124          | -141.847         | 1597                 | WRST        |
| Tana Knob              | 60.908          | -142.901         | 1140                 | WRST        |
| Gates Glacier          | 61.603          | -143.013         | 1237                 | WRST        |
| Tebay                  | 61.181          | -144.342         | 573                  | WRST        |
| Chisana SNOTEL/RAWS    | 62.072          | -142.065         | 1012                 | WRST        |
| May Creek SNOTEL/RAWS  | 61.348          | -142.694         | 503                  | WRST        |
| Klawasi RAWS           | 62.217          | -144.995         | 2513                 | WRST        |
| Strelina/Chitina RAWS  | 61.521          | -144.198         | 1232                 | WRST        |
| Upper Charley          | 64.517          | -143.202         | 1114                 | YUCH        |
| Coal Creek             | 65.314          | -143.132         | 292                  | YUCH        |
| Toklat                 | 63.524          | -150.043         | 890                  | DENA        |
| Eielson Visitor Center | 63.431          | -150.309         | 1202                 | DENA        |
| Wigand                 | 63.814          | -150.109         | 1716                 | DENA        |
| Ruth Glacier           | 62.710          | -150.540         | 1006                 | DENA        |
| Stampede               | 63.747          | -150.328         | 549                  | DENA        |
| Dunkle Hills           | 63.268          | -149.539         | 808                  | DENA        |
| Wonder Lake CRN        | 63.452          | -150.875         | 2163                 | DENA        |
| Kantishna SNOTEL       | 63.540          | -150.990         | 472                  | DENA        |
| Tokositna SNOTEL       | 62.629          | -150.775         | 259                  | DENA        |

## Climate Station Maintenance Summaries

This section describes the maintenance details of twenty-two climate stations in CAKN organized by park unit. This work is being implemented based on Central Alaska Network (CAKN) climate vital sign protocols (Sousanes 2018) and standard operating procedures (Sousanes et al. 2017).

See Appendix A for detailed logistics for each of the base locations. Appendices B and C provide sensor specifications and metadata.

### Denali National Park and Preserve

This section includes descriptions of all station maintenance in DENA in 2019. The sites include: Dunkle Hills, Eielson Visitor Center, Ruth Glacier, Stampede, Toklat, Wigand, Wonder Lake CRN, Tokositna SNOTEL, and Kantishna SNOTEL.

#### ***Dunkle Hills***

Date: August 8, 2019

Time of visit: 1145–1300

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco – N970TH– Mark Freiheit

Purpose of trip: Annual Maintenance

Weather: 61°F, 10–15 mph

Sensors replaced: AT-RH (EE181), SR (Li200X), TX312 (replaced with TX321), ST4 (installed)

The Dunkle Hills station (Figure 2) was accessed by helicopter from DENA park headquarters. A few cables had received minor damage caused by wildlife and were pulled out of the enclosure a bit. The solar radiation (SR) cable was severed near the sensor head (bird?). All data were downloaded from the datalogger. The air temperature-relative humidity (AT-RH) sensor (HMP45 model) was replaced with an EE181 model. The SR sensor was replaced for routine calibration. A fourth soil temperature (ST) sensor was installed at 90 cm depth. The TX312 transmitter was updated to a CS2 compliant TX321 model. Dave Swanson completed a soil and vegetation characterization survey at the site. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *Note: data quality control in fall 2019 indicated erroneous measurements from the ST2 sensor in fall 2018. The sensor should be inspected at the next field visit.*

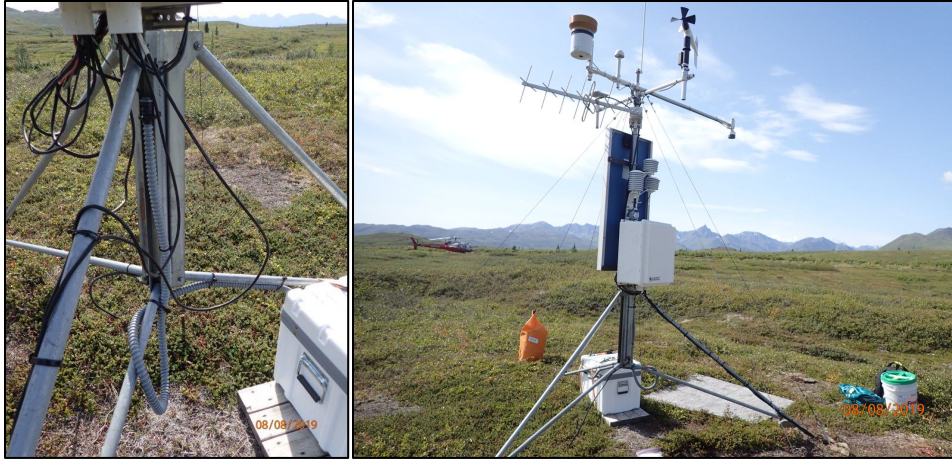


**Figure 2.** Dunkle Hills climate station, August 8, 2019, showing sensor cables pulled out of enclosure box (left).

### ***Eielson Visitor Center***

Date: June 5, 2019

Time of visit: 1200–1330

Personnel: Ken Hill

Mode of transport: DENA Park Road

Purpose of trip: Annual Maintenance

Weather: 49°F, 5–10 mph, partly cloudy

Sensors replaced: AT-RH (EE181), SR (Li200X), RG-TB (TE525)

The Eielson Visitor Center station (Figure 3) was accessed by the DENA park road. The rain gage – tipping bucket (RG-TB) had been damaged by wildlife. All data were downloaded from the datalogger. The HMP45 AT-RH sensor was replaced with an EE181 sensor. The SR sensor was replaced for routine calibration. The damaged RG-TB gage was replaced and a new 4" National Weather Service (NWS) cooperative rain gage was installed for redundant measurements by visitor center summer staff. The desiccant packets were replaced in the enclosure. *Consider replacing the enclosure box due to deteriorating fiberglass.* Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.

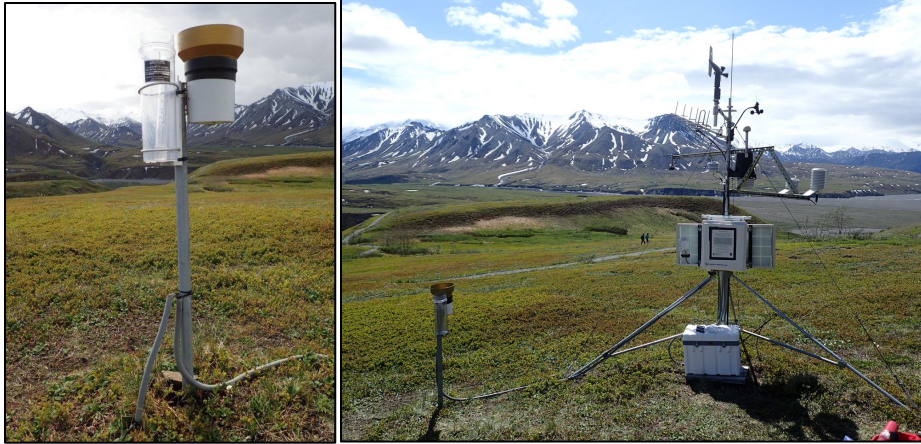


**Figure 3.** Eielson Visitor Center climate station, June 5, 2019. The rain gage (left) was replaced after being damaged in October 2019.

### ***Ruth Glacier***

Date: June 26, 2019

Time of visit: 1050–1250

Personnel: Ken Hill

Mode of transport: A-star helicopter – Temsco – N570AE – Andy Hermansky

Purpose of trip: Annual Maintenance

Weather: 60°F, 5–10 mph, mostly sunny

Sensors replaced: AT-RH (EE181), TX312 (replaced with TX321), ST4 (installed), Enclosure

The Ruth Glacier climate station (Figure 4) was accessed by helicopter from Talkeetna. All data were downloaded from the datalogger. The electric fence was in decent condition – only one connector needed to be replaced. The HMP45 AT-RH sensor was replaced with an EE181 sensor. A new soil temperature sensor was installed at 90 cm (ST4). There were no new watchdog errors or low 12V battery counts recorded since the last field visit. The TX312 transmitter was updated to a CS2 compliant TX321 model. A new program was sent to the datalogger and the cumulative rainfall was reset to its observed value of 14.20 inches. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *The enclosure was replaced, but a hole needs to be drilled to accommodate the battery cable conduit. This should be completed at the next field visit.*

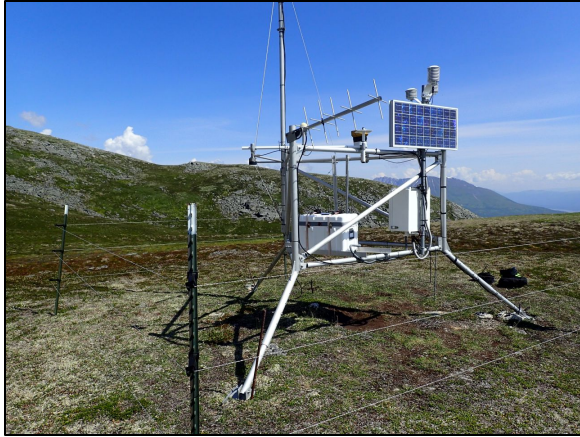


**Figure 4.** Ruth Glacier climate station, June 26, 2019.

### ***Stampede***

Date: August 8, 2019

Time of visit: 1450–1600

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco – N970TH – Mark Freiheit

Purpose of trip: Annual Maintenance

Weather: 70°F, calm

Sensors replaced: AT-RH (HMP45), SR, TX312 (replaced with TX321), ST1 (10 cm), ST2 (20 cm), ST3 (50 cm), ST4 (90 cm)

Stampede climate station (Figure 5) was accessed by helicopter from DENA park headquarters. The RG-TB and all ST sensors had been damaged, presumably by a bear, on 7/27/2019. All data were downloaded from the datalogger. The AT-RH and SR sensors were replaced for routine calibration. The RG-TB was reattached and leveled. The bucket and funnel were cleaned and re-taped. *The RG-TB sensor should be mounted on the tripod at the next visit with B-line clamps and a small pipe.* All ST sensors were replaced and a new ST4 sensor was installed at 90 cm. The TX312 transmitter was updated to a CS2 compliant TX321 model. Dave Swanson completed a soil and vegetation characterization survey at the site. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *The brush near the station was cleared, but vegetation is beginning to encroach on the area surrounding the station. Consider requesting a clearing by the fire crew in 2020.*

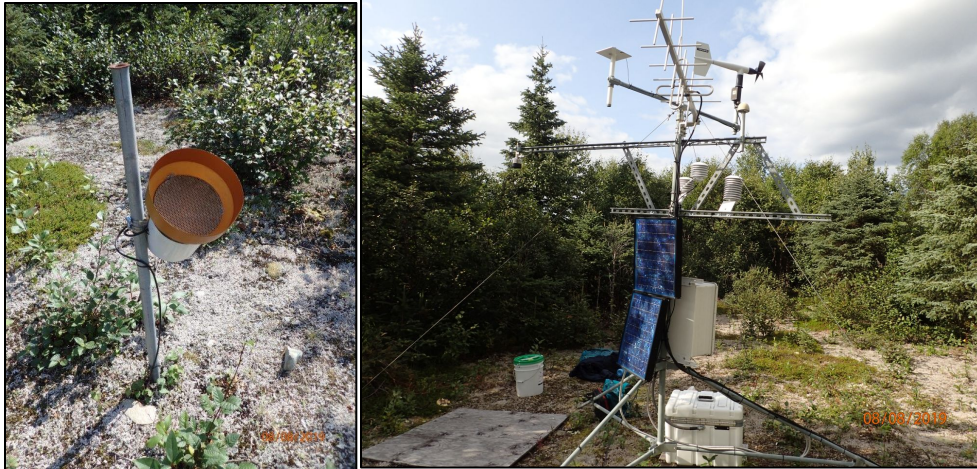


**Figure 5.** Stampede climate station, August 8, 2019 showing the unlevel rain gage (left) before maintenance.

### ***Toklat***

Date: June 5, 2019

Time of visit: 1500–1630

Personnel: Ken Hill

Mode of transport: DENA Park Road

Purpose of trip: Annual Maintenance

Weather: 56°F, 5–15 mph, showers building

Sensors replaced: AT-RH (EE181), 12 V / 100 aH batteries (x2)

The Toklat climate station site (Figure 6) was accessed by the DENA park road. All data were downloaded from the datalogger. The AT-RH sensor was replaced for routine calibration. The soil probes looked undisturbed and therefore were not excavated to verify depths. The 12-volt batteries were replaced. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. On August 23, 2019 the satellite transmitter stopped working. Staff at the Toklat road camp were contacted to help. The fail-safe on the TX321 had been tripped and was reset following the instructions in the manual. Transmissions resumed. The transmissions stopped again on September 6. *All power connections should be checked at the next field visit and the TX321 transmitter should undergo troubleshooting procedures (station currently not transmitting as of spring 2020).*

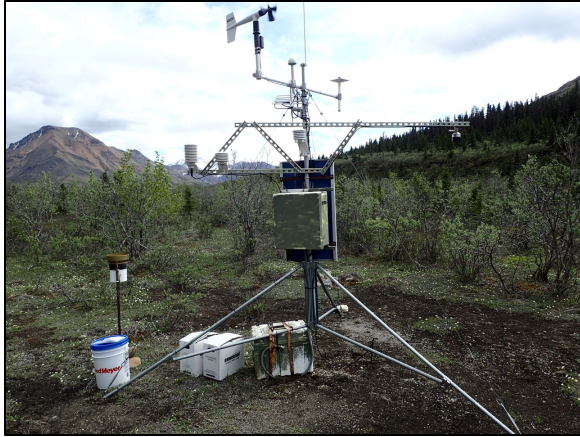


**Figure 6.** Toklat climate station, June 5, 2019.

### **Wigand**

Date: August 8, 2019

Time of visit: 1715–1815

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco – N970TH – Mark Freiheit

Purpose of trip: Annual maintenance

Weather: 64°F, 5–10 mph

Sensors replaced: AT-RH (HMP45), SR (Li200x), WS-WD (05103 30')

The Wigand climate station (Figure 7) was accessed from DENA park headquarters by helicopter. The station was in good condition, but it is slowly sinking making it difficult to undo guy wires. The metal clip used to lower the mast is bent and it took brute force to get it undone. *Consider replacing the tripod with a “lunar lander” model.* The AT-RH, SR, and WS-WD sensors were replaced for routine calibration. The TX312 transmitter was updated to a CS2 compliant TX321 model. The guy wires were tightened, and the electric fence was repaired as needed. All data were downloaded from the datalogger. Dave Swanson completed a soil and vegetation characterization survey at the site. The soil pit immediately filled with water upon excavation. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *A deeper soil temperature sensor (75 – 100 cm) should be installed at the next field visit.*



**Figure 7.** Wigand climate station, August 8, 2019.

### ***Denali Fire RAWS***

DENA staff completed annual maintenance at all fire RAWS in summer 2019. More information is available on the Wildfire Management Information system (WFMI).

Denali Visitor Center 5/22/2019: Keith Mitchell performed maintenance at the site. The AT-RH and RG-TB sensors were replaced. The battery was replaced. The rain bucket was zeroed. The transmitter was replaced on 4/25/2019.

McKinley River 5/23/2019: Annual maintenance by Shannon Koykendall. The AT-RH, WS-WD, and RG-TB sensors were replaced. A new datalogger was installed.

Wonder Lake 5/17/2019: Annual maintenance by Keith Mitchell. The AT-RH, RG-TB, WS-WD, datalogger, and battery were replaced.

### ***SNOTEL Sites***

Tokositna SNOTEL: Daniel Fisher and Dan Kenney from the Natural Resources Conservation Service completed the annual maintenance on June 26. The precipitation gage was flushed, and 10 gallons of fresh antifreeze were added for the winter. Sensors were replaced as needed according to the SNOTEL network protocols (National Engineering Handbook 2015). The work coincided with maintenance at the Ruth Glacier site on the same day.

Kantishna SNOTEL: Daniel Fisher (NRCS) drove the Denali park road on August 13–14 and completed maintenance at the site. The precipitation gage was flushed, and 10 gallons of fresh antifreeze were added for the winter. Sensors were replaced as needed according to the SNOTEL network protocols (National Engineering Handbook 2015). Daniel picked up a road permit at the Denali Visitor Center and spent the night at Friday Creek camp.

### ***Wonder Lake Climate Reference Network Station (AK Denali 27N)***

August 20–21, 2019. Mark Hall and Chuck Lindsay from the NOAA Climate Reference Network (CRN) maintained the station according to CRN standards. The site was accessed by the DENA park road and CRN staff were accompanied by Pam Sousanes. All staff stayed at Friday Creek camp.

## **Wrangell-St. Elias**

Stations maintained in WRST include Chicken Creek, Chititu, Gates Glacier, Tana Knob and Tebay. The May Creek and Chisana fire RAWS were also maintained. All CAKN staff used John Adam's airstrip for helicopter parking and fueled at the nearby Fireweed airstrip. All staff stayed at the McCarthy B&B.

### ***Chicken Creek***

Date: June 26, 2019

Time of visit: 1320–1420

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco (NPS Eastern Area Fire) – N6094E – Nick Siegal

Purpose of trip: Annual maintenance

Weather: 55°F, 5–15 mph, rain

Sensors replaced: AT-RH (EE181), ST4 (80 cm),

The Chicken Creek station (Figure 8) was accessed by helicopter from McCarthy. The soil temperature sensors had been pulled out a bit. The three shallower sensors looked ok because they had pulled from the enclosure rather than through the soil profile. The deep sensor had been pulled out below the bottom of the tripod leg. The AT-RH sensor was replaced for routine calibration. A new ST4 sensor was installed at 80 cm. The battery connection was inspected and looked fine (did not replace). It was raining hard during the field visit. All data were downloaded from the datalogger. Dave Swanson completed a soil and vegetation characterization survey at the site. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



**Figure 8.** Chicken Creek climate station, June 26, 2019.

### **Chititu**

Date: June 27, 2019

Time of visit: 1445–1545

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco (NPS Eastern Area Fire) – N6094E – Nick Siegal

Purpose of trip: Annual maintenance

Weather: 64°F, 10–15 mph, sunny

Sensors Replaced: AT-RH (EE181)

The Chititu station (Figure 9) was accessed from McCarthy by helicopter. The station looked good upon arrival but had not transmitted since January 1. It was discovered that the 12-volt wire in the charging regulator was loose, which may have caused the issue. The AT-RH sensor was replaced for routine calibration. All data were downloaded from the datalogger. The charging regulator was moved inside the enclosure and rewired to allow more space. The status LED lit up before transmission, prompting a check to see if the fail-safe had been tripped. Following the instructions in the manual, the fault button was pushed for 2 seconds. Two flashes indicated a failsafe trip and the fault was cleared after 10 seconds. Transmissions resumed. Dave Swanson completed a soil and vegetation characterization survey at the site. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. *(Note: the station transmitted until October 19, 2019 before ceasing, again. All power connections should be checked at the battery, charging regulator, and transmitter.)*



**Figure 9.** Chititu climate station, June 27, 2019.

### **Gates Glacier**

Date: June 27, 2019

Time of visit: 1615–1715

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco (NPS Eastern Area Fire) – N6094E – Nick Siegal

Purpose of trip: Annual Maintenance

Weather: 65°F, 5–10 mph, sunny

Sensors Replaced: AT-RH (EE181 + shield); ST1, ST2, and ST3 replaced;

The Gates Glacier station (Figure 10) was accessed by helicopter from McCarthy. The station had some damage, presumably by a bear on 6/4/2019. The AT-RH sensor and radiation shield were damaged. All soil sensors had been pulled out and were damaged. The battery box for the camera had bite marks. The wood platform was chewed up and moved. The AT-RH radiation shield was bent 90 degrees to the north. The snow/camera crossbar had been shifted 15 degrees to the northwest. All data were downloaded from the datalogger. The AT-RH sensor was replaced for routine calibration and the radiation shield was replaced. The three soil temperature sensors were replaced and reinstalled (10, 20, 50 cm). The SD memory card in the camera was swapped. The camera angle was readjusted, but there was not enough time to compare with old images. Dave Swanson completed a soil and vegetation characterization survey at the site. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station. The helicopter immediately departed for fire duties following the climate station work in WRST. *A ST4 sensor should be installed at the next field visit at 75–100 cm if possible. Also, the south leg of the tripod was beginning to bend as of summer 2018.*

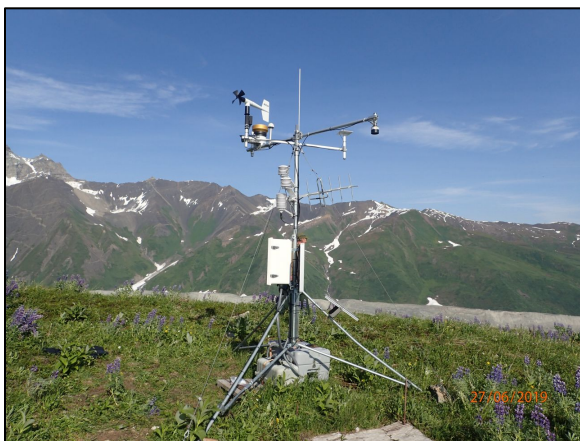


**Figure 10.** Gates Glacier climate station, June 27, 2019.

### **Tana Knob**

Date: June 27, 2019

Time of visit: 1230–1400

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco (NPS Eastern Area Fire) – N6094E – Nick Siegal

Purpose of trip: Annual maintenance

Weather: 67°F, 5–10 mph

Sensors replaced: AT-RH (EE181), WS-WD

The Tana Knob climate station (Figure 11) was accessed via helicopter from McCarthy. The AT-RH sensor (EE181) and WS-WD sensors were replaced for routine calibration. All data were downloaded from the datalogger. The datalogger status table indicated zero watchdog errors and 992 low 12V battery counts. The low 12V counts were reset. The radiation shield for the primary air temperature sensor (109) was replaced because it was bent to 90 degrees. The ground wire from the station to the enclosure was rewired. The electric fence was repaired as needed. Dave Swanson completed a soil and vegetation characterization survey at the site. The desiccant packets were replaced in the enclosure. The guy wires were tightened. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.

After multiple years of troubleshooting during field visits, it seems that replacing the faulty battery cable in 2018 may indeed have solved the issues. However, the high number of low 12V counts are still a mystery and potential problem. Further monitoring of the station status is warranted. *At the next field visit an ST4 sensor should be installed at 75–100 cm depth. Also, data quality control indicates an offset correction of –5.0 inches for the snow depth sensor, so the sensor height should be validated and/or adjusted at the next field visit.*



**Figure 11.** Tana Knob climate station, June 27, 2019.

### ***Tebay***

Date: June 27, 2019

Time of visit: 950–1150

Personnel: Pam Sousanes, Dave Swanson

Mode of transport: A-star helicopter – Temsco (NPS Eastern Area Fire) – N6094E – Nick Siegal

Purpose of trip: Annual maintenance

Weather: 50°F, 5 mph

Sensors replaced: AT-RH (EE181), SR, SD

The Tebay climate station (Figure 12) was accessed via helicopter from McCarthy. The AT-RH and SR sensors were replaced for routine calibration. The snow depth (SD) sensor was replaced and checked with the test program. The RG-TB sensor was checked and revealed minor debris in the funnel which was removed. All data were downloaded from the datalogger. Dave Swanson completed a soil and vegetation characterization survey at the site. The electric fence was repaired. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



**Figure 12.** Tebay climate station, June 27, 2019.

### ***May Creek and Chisana SNOTEL***

Date: July 24, 2019

Personnel: Daniel Fisher & Dan Kenney (NRCS)

Mode of transport: Fixed Wing Aircraft – WRST fleet plane – Lynn Ellis

Purpose of trip: Annual maintenance

Sensors replaced: as needed by NRCS

Daniel Fisher and Dan Kenney from the Natural Resources Conservation Service completed the annual maintenance at May Creek and Chisana SNOTEL sites. Sensors were replaced as needed according to the SNOTEL network protocols (National Engineering Handbook 2015). The

precipitation gages were flushed, and 10 gallons of fresh antifreeze liquid added for the winter. The electric fences were repaired.

### **Wrangell-St. Elias Fire RAWS**

Alaska Fire Service staff completed RAWS maintenance at Klawasi (8/3/2019 by Rob Redington). Sousanes completed the maintenance at Chisana and May Creek on June 26, 2019. The Chitina (Strelna) maintenance was done on 6/27/2019. Additional details are available in the Wildfire Management Information System (WFMI).

### **Yukon-Charley Rivers National Preserve**

CAKN stations maintained in YUCH include the Upper Charley and Coal Creek stations. Sousanes flew via fleet aircraft (N709M) to Coal Creek. Hill flew to Coal Creek from Fairbanks with NPS fire staff in helicopter N6094E. The eastern area fire helicopter (N6094E; pilot Nick Siegal) was used to access the Upper Charley station. Sousanes and Hill returned to Fairbanks via fixed wing fleet N709M.

#### **Coal Creek**

Date: May 16, 2019

Time of visit: 0900–1030

Personnel: Pam Sousanes, Ken Hill

Mode of transport: Fixed wing – Bushhawk – Fleet N709M – Brett Nigus)

Purpose of trip: Annual Maintenance

Weather: 55°F, calm winds

Sensors replaced: AT-RH (EE181), SR

The Coal Creek climate station (Figure 13) was accessed from Coal Creek camp. The AT-RH and SR sensors were replaced for routine calibration. All data were downloaded from the datalogger. The SD sensor height was changed from 72 to 72.5 inches. The desiccant packets were replaced in the enclosure. The guy wires were tightened. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.

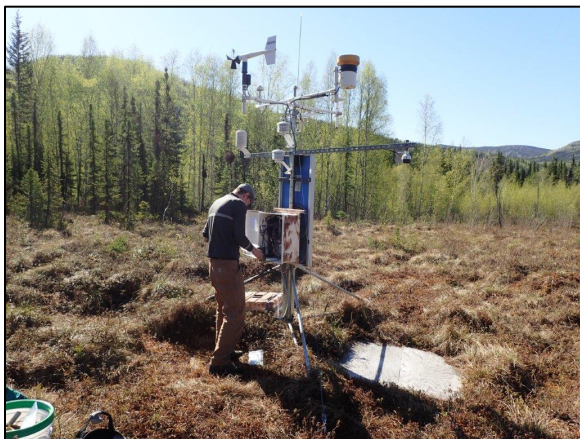


**Figure 13.** Coal Creek climate station, May 16, 2019.

### **Upper Charley**

Date: May 14, 2019

Time of visit: 1515–1700

Personnel: Pam Sousanes, Ken Hill, Matt Kampf (fire)

Mode of transport: A-star helicopter – Temsco (NPS Eastern Area Fire) – N6094E – Nick Siegal

Purpose of trip: Annual Maintenance

Weather: 54°F, 5–10 mph

Sensors replaced: AT-RH (EE181), ST4 (installed)

The Upper Charley climate station (Figure 14) was accessed by helicopter from Coal Creek camp. The RG-TB sensor was out of level by 90 degrees (loose nurail mount) and the funnel was on the ground. It was righted and tightened. The TX321 firmware is version 11.05. The electric fence was repaired by Kampf. A new soil temperature sensor (ST4) was installed at 75 cm depth. The HMP45 AT-RH sensor was replaced with an EE181 sensor. All data were downloaded from the datalogger. The SD memory card on the phenology camera was replaced. The desiccant packets were replaced in the enclosure. Photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



**Figure 14.** Upper Charley station before (left) and after (right) repairs on May 14, 2019.

### **Andrew Creek Fire**

Date: May 15, 2019

Time of visit: 1000–1600

Personnel: Pam Sousanes, Ken Hill

Mode of transport: A-star helicopter – Temsco (NPS Eastern Area Fire) – N6094E – Nick Siegal

Purpose of trip: Annual Maintenance

Weather: Sunny, calm

A new station was installed in the burned area of the 2018 Andrew Creek fire (N 65.32906°, W 142.94688°). The site was accessed by helicopter and a good landing zone was established by fire

staff. The station measures air temperature, rainfall, snow depth, and soil temperature (10, 20, 50, 75, and 90 cm). Two phenology cameras are also installed at the site. Data and photos are not transmitted. Field photos were taken from the four cardinal and four intercardinal directions both towards and away from the station.



**Figure 15.** Andrew Creek Fire station on May 15, 2019.

## Literature Cited

- National Engineering Handbook. 2015. United States Department of Agriculture Natural Resources Conservation Service. Part 622, Snow Survey and Water Supply Forecasting. Chapter 5, Maintenance and Calibration.
- Sousanes, P.J. 2018. Climate monitoring protocol for the Central Alaska Network: Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve, Version 1.01. Natural Resource Report. NPS/CAKN/NRR—2018/1599. National Park Service. Fort Collins, Colorado
- Sousanes, P., K. Hill, M. Bower, W. Johnson, and S. Miller. 2017. Standard operating procedure updates 2017: Central Alaska Network (CAKN) climate monitoring protocol. Natural Resource Report NPS/CAKN/NRR—2017/1504. National Park Service, Fort Collins, Colorado.

## **Appendix A. Logistics Summary 2019**

### **DENA Logistics**

June 5, 2019: DENA park road. Maintenance at Eielson and Toklat stations were completed by Ken Hill.

June 26, 2019: Tokositna SNOTEL and Ruth Glacier. Ken Hill and NRCS staff accessed sites with the DENA rescue A-star helicopter N570AE with pilot Andy Hermansky.

August 8, 2019: Dunkle Hills, Wigand, and Stampede. Pam Sousanes and Dave Swanson accessed these stations by helicopter from Denali Park headquarters with the Temsco A-star western area fire helicopter N970TH with pilot Mark Freiheit.

August 20–21, 2019: DENA park road. Pam Sousanes, Mark Hall (NOAA), and Chuck Lindsay (NOAA) traveled from Fairbanks to Friday Creek camp in a government vehicle on August 20. Maintenance at Wonder Lake CRN was completed August 20–21.

### **WRST Logistics**

June 25–28, 2019: Pam Sousanes and Dave Swanson drove from Fairbanks to McCarthy on June 25. The A-star helicopter N-6094E with pilot Nick Siegal was already staged for work in McCarthy. Fuel was purchased at the Fireweed airstrip on the west side of the Kennicott River (contact: Lori Rowland). The helicopter was staged at John Adams airstrip. Chicken Creek, Chisana RAWS, and May Creek RAWS station maintenance was completed on June 26. Tebay, Tana Knob, Chititu, and Gates Glacier station maintenance was completed on June 27. The helicopter immediately departed McCarthy for fire duties following climate station maintenance field work. All staff stayed at the McCarthy B&B (contact: John Adams).

July 24, 2019: The SNOTEL sites at May Creek and Chisana were accessed from Gulkana with NPS fleet pilot Lynn Ellis. Daniel Fisher and Dan Kenny (NRCS) completed the maintenance.

### **YUCH Logistics**

May 14–16, 2019: Pam Sousanes flew from Fairbanks to Coal Creek via fleet aircraft N709M with pilot Brett Nigus. They discovered that the fuel pump at the Coal Creek tank had been damaged by a black bear. Ken Hill flew from Fort Wainwright (Fairbanks) to Coal Creek via NPS eastern area fire helicopter on contract (Temsco A-star N6094E; pilot Nick Siegal). Fire staff Chris Havener and Matt Kampf also flew via N6094E. The helicopter was used to access the Upper Charley weather station on May 14. On May 15, the Andrew Creek fire station was installed. On May 16, maintenance at the Coal Creek station was completed and Sousanes/Hill returned to Fairbanks via fleet fixed wing N709M. A black bear was seen at the Coal Creek airstrip apron during departure.

## Appendix B. CAKN I&M Station Specifications

Tables B1 through B6 provide details on the climate station specifications.

**Table B1.** Sensor specifications.

| Measurements                        | Model/Manufacturer/Item#                                             | Purchased from:     |
|-------------------------------------|----------------------------------------------------------------------|---------------------|
| Air Temperature 1/Relative Humidity | HMP-45C/HMP155a/EE181 Temperature and Relative Humidity Probe        | Campbell Scientific |
| Air Temperature 2                   | Resistance Temperature Detector (RTD) Thermistor. Custom build.      | Therm-X             |
| Air Temperature 3                   | 109 Temperature Probe (primary beginning summer 2016)                | Campbell Scientific |
| Wind Speed and direction            | RM Young 05103/05103-45 (alpine version); or 05108 HD Alpine version | Campbell Scientific |
| Precipitation (summer rainfall)     | Texas Electronics TE525WS Rain Gage                                  | Campbell Scientific |
| Solar Radiation (incoming)          | LI-COR LI200X, LI200RX, CS320                                        | Campbell Scientific |
| Snow Depth                          | SR50A sonic ranging sensor                                           | Campbell Scientific |
| Soil Temperature                    | 107 Temperature Probe (3)                                            | Campbell Scientific |

**Table B2.** Datalogger specifications.

| Datalogger                               | Purchased from:     |
|------------------------------------------|---------------------|
| CR1000-XT Measurement and Control System | Campbell Scientific |

**Table B3.** Satellite communication specifications.

| Satellite Communication    | Model/Item #                                      | Purchased From:     |
|----------------------------|---------------------------------------------------|---------------------|
| GOES Satellite transmitter | TX312/TX320/TX321 High Data rate GOES Transmitter | Campbell Scientific |
| GPS Antenna                | GPS Antenna 3.3 V 17992                           | Campbell Scientific |
| GPS Cable                  | Antenna Cable 18017                               | Campbell Scientific |
| GOES Antenna               | GOES 11 dBi YAGI RHCP Antenna 25316               | Campbell Scientific |
| Coaxial Cable              | Antenna Cable RG8 COAXNTN                         | Campbell Scientific |

**Table B4.** Power specifications.

| <b>Power</b>       | <b>Model</b>                                                | <b>Purchased From:</b> |
|--------------------|-------------------------------------------------------------|------------------------|
| Batteries          | Concorde Sun Extender PV 1040 T<br>12 Volt 100 Amp hour (2) | ABS Alaskan            |
| Solar Panel        | 60–75 watt                                                  | Varies                 |
| Battery Box        | Pelican Hardigg Single Lid Case                             | AllCases               |
| Charging Regulator | CH100 12V Charging Regulator                                | Campbell Scientific    |

**Table B5.** Hardware specifications.

| <b>Station Hardware – Item</b>                                                | <b>Type/Model</b>                                           | <b>Purchased from:</b> |
|-------------------------------------------------------------------------------|-------------------------------------------------------------|------------------------|
| Tripod                                                                        | CM110 10 ft. stainless-steel tripod<br>w/grounding kit      | Campbell Scientific    |
| Guyline Kit                                                                   | Guy Kit for Tripod 19239                                    | Campbell Scientific    |
| Crossarm – 4 ft.                                                              | CM204 Sensor crossarm with<br>mounting hardware – 4ft       | Campbell Scientific    |
| Crossarm – 6 ft.                                                              | CM206 Sensor crossarm with<br>mounting hardware – 6ft       | Campbell Scientific    |
| Enclosure with (2) 1.5" diameter<br>holes and mounting hardware for<br>tripod | Weather Resistant 16" x 18"<br>enclosure ENC 16/18 – DC -MM | Campbell Scientific    |

**Table B6.** Electric fence specifications.

| <b>Electric Fence Parts</b> | <b>Type/Model</b>                                       | <b>Purchased from:</b> |
|-----------------------------|---------------------------------------------------------|------------------------|
| Metal fence posts           | 6 ft. T-Posts                                           | Various local vendors  |
| T-Post Insulators           | 5-inch extender insulators                              | Various local vendors  |
| Poly wire                   | 200 ft. Poly-wire                                       | Various local vendors  |
| Solar fence charger         | 10 mile low impedance fence<br>charger – various models | Various local vendors  |

## Appendix C. CAKN RAWS Components by Climate Station

Tables C1 through C 13 provide metadata on each climate station.

**Table C1.** Metadata for Chicken Creek climate station.

| Station Name  | Item        | Model              | Start Date |
|---------------|-------------|--------------------|------------|
| Chicken Creek | Antenna     | 25316 YAGI         | 8/21/2004  |
| Chicken Creek | AT          | 109                | 7/6/2016   |
| Chicken Creek | AT-RH       | EE181              | 6/26/2019  |
| Chicken Creek | Battery     | 100 AH (x2)        | 8/21/2004  |
| Chicken Creek | Cross arm   | CM204              | 8/21/2004  |
| Chicken Creek | Datalogger  | CR1000             | 6/19/2013  |
| Chicken Creek | DLP         | Chicken2018        | 7/12/2018  |
| Chicken Creek | GPS         | 17992 GPS          | 7/3/2014   |
| Chicken Creek | RG-TB       | TE525              | 7/12/2017  |
| Chicken Creek | SD          | SR50a              | 6/19/2013  |
| Chicken Creek | Solar Panel | 75 W               | 8/21/2004  |
| Chicken Creek | SR          | Li200x             | 7/12/2018  |
| Chicken Creek | ST -10 cm   | 107                | 7/2/2010   |
| Chicken Creek | ST -20 cm   | 107                | 7/2/2010   |
| Chicken Creek | ST -50 cm   | 107                | 7/2/2010   |
| Chicken Creek | ST -80 cm   | 107                | 6/26/2019  |
| Chicken Creek | Tripod      | CM106              | 8/21/2004  |
| Chicken Creek | TX321       | NESDIS ID 39603396 | 7/12/2018  |
| Chicken Creek | WS/WD       | 5103               | 7/6/2016   |

**Table C2.** Metadata for Chititu climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>       | <b>Start Date</b> |
|---------------------|-------------|--------------------|-------------------|
| Chititu             | Antenna     | 25316 YAGI         | 8/20/2004         |
| Chititu             | AT          | 109                | 6/30/2016         |
| Chititu             | AT-RH       | EE181              | 6/27/2019         |
| Chititu             | Battery     | 100 AH (x2)        | 8/20/2004         |
| Chititu             | Cross arm   | CM204              | 8/20/2004         |
| Chititu             | Cross arm   | CM206              | 8/20/2004         |
| Chititu             | Datalogger  | CR1000             | 6/26/2012         |
| Chititu             | DLP         | Chititu2018        | 7/11/2018         |
| Chititu             | Enclosure   | ENC 16/18          | 8/20/2004         |
| Chititu             | GPS         | 17992 GPS          | 6/21/2013         |
| Chititu             | RG-TB       | TE525              | 8/20/2004         |
| Chititu             | SD          | SR50a              | 6/21/2013         |
| Chititu             | Solar Panel | 75 W               | 8/20/2004         |
| Chititu             | SR          | Li200x             | 7/11/2018         |
| Chititu             | ST -10 cm   | 107                | 8/20/2004         |
| Chititu             | ST -20 cm   | 107                | 8/20/2004         |
| Chititu             | ST -50 cm   | 107                | 6/25/2011         |
| Chititu             | Tripod      | CM106              | 8/20/2004         |
| Chititu             | TX321       | NESDIS ID 396020E0 | 7/11/2018         |
| Chititu             | WS/WD       | 5103               | 7/11/2018         |

**Table C3.** Metadata for Coal Creek climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>       | <b>Start Date</b> |
|---------------------|-------------|--------------------|-------------------|
| Coal Creek          | Antenna     | 25316 YAGI         | 9/16/2004         |
| Coal Creek          | AT          | 109                | 7/6/2016          |
| Coal Creek          | AT-RH       | EE181              | 5/16/2019         |
| Coal Creek          | Battery     | 100 AH (x2)        | 9/16/2004         |
| Coal Creek          | Crossarm    | 3/4"               | 9/16/2004         |
| Coal Creek          | Crossarm    | 3/4"               | 9/16/2004         |
| Coal Creek          | Datalogger  | CR1000             | 7/24/2013         |
| Coal Creek          | DLP         | CoalCreek2019      | 5/16/2019         |
| Coal Creek          | Enclosure   | ENC 16/18          | 9/16/2004         |
| Coal Creek          | GPS         | 17992 GPS          | 9/8/2012          |
| Coal Creek          | RG-TB       | TE525              | 9/16/2004         |
| Coal Creek          | SD          | SR50a              | 7/24/2013         |
| Coal Creek          | Solar Panel | 75 W               | 9/16/2004         |
| Coal Creek          | SR          | Li200x             | 5/16/2019         |
| Coal Creek          | ST1         | 107                | 9/16/2004         |
| Coal Creek          | ST2         | 107                | 9/16/2004         |
| Coal Creek          | ST3         | 107                | 9/16/2004         |
| Coal Creek          | Tripod      | CM106              | 9/16/2004         |
| Coal Creek          | TX321       | NESDIS ID 39605670 | 6/14/2018         |
| Coal Creek          | WS/WD       | 5103               | 6/14/2017         |

**Table C4.** Metadata for Dunkle Hills climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>       | <b>Start Date</b> |
|---------------------|-------------|--------------------|-------------------|
| Dunkle Hills        | Antenna     | 25316 YAGI         | 8/1/2002          |
| Dunkle Hills        | AT          | 109                | 8/11/2016         |
| Dunkle Hills        | AT-RH       | EE181              | 8/8/2019          |
| Dunkle Hills        | Battery     | 100 AH (x2)        | 8/1/2002          |
| Dunkle Hills        | 3/4"        | CM204              | 8/1/2002          |
| Dunkle Hills        | 3/4"        | CM206              | 8/1/2002          |
| Dunkle Hills        | Datalogger  | CR1000             | 5/26/2015         |
| Dunkle Hills        | DLP         | Dunkle2019         | 8/8/2019          |
| Dunkle Hills        | Enclosure   | ENC 16/18          | 9/19/2011         |
| Dunkle Hills        | GPS         | 17992 GPS          | 8/1/2002          |
| Dunkle Hills        | RG-TB       | TE525              | 8/1/2002          |
| Dunkle Hills        | SD          | SR50a              | 8/22/2014         |
| Dunkle Hills        | Solar Panel | 75 W               | 8/1/2002          |
| Dunkle Hills        | SR          | Li200x             | 8/8/2019          |
| Dunkle Hills        | ST1         | 107                | 8/8/2017          |
| Dunkle Hills        | ST2         | 107                | 8/14/2013         |
| Dunkle Hills        | ST3         | 107                | 8/14/2013         |
| Dunkle Hills        | ST4 – 90 cm | 107                | 8/8/2019          |
| Dunkle Hills        | Tripod      | CM106              | 8/1/2002          |
| Dunkle Hills        | TX321       | NESDIS ID 3960B582 | 8/8/2019          |
| Dunkle Hills        | WS/WD       | 5103               | 8/8/2017          |

**Table C5.** Metadata for Eielson Visitor Center climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>       | <b>Start Date</b> |
|---------------------|-------------|--------------------|-------------------|
| Eielson             | Antenna     | 25316 YAGI         | 6/4/2005          |
| Eielson             | AT          | 109                | 9/8/2016          |
| Eielson             | AT-RH       | EE181              | 6/5/2019          |
| Eielson             | Battery     | 100 AH (x2)        | 6/4/2005          |
| Eielson             | Crossarm    | 3/4"               | 6/4/2005          |
| Eielson             | Datalogger  | CR1000             | 5/28/2014         |
| Eielson             | DLP         | Eielson2019        | 6/5/2019          |
| Eielson             | Enclosure   | ENC 16/18          | 6/4/2005          |
| Eielson             | GPS         | 17992 GPS          | 6/4/2005          |
| Eielson             | RG-TB       | TE525              | 6/5/2019          |
| Eielson             | SD          | SR50a              | 5/28/2014         |
| Eielson             | Solar Panel | 75 W               | 6/4/2005          |
| Eielson             | SR          | Li200x             | 6/5/2019          |
| Eielson             | Tripod      | CM106              | 6/4/2005          |
| Eielson             | TX321       | NESDIS ID 39604506 | 8/21/2018         |
| Eielson             | WS/WD       | 5103               | 8/16/2017         |

**Table C6.** Metadata for Gates Glacier climate station.

| <b>Station Name</b> | <b>Item</b>                | <b>Model</b>                  | <b>Start Date</b> |
|---------------------|----------------------------|-------------------------------|-------------------|
| Gates Glacier       | Antenna                    | 25316 YAGI                    | 7/6/2005          |
| Gates Glacier       | AT                         | 109                           | 6/29/2016         |
| Gates Glacier       | AT-RH                      | EE181                         | 6/27/2019         |
| Gates Glacier       | Battery                    | 100 AH (x2)                   | 7/6/2005          |
| Gates Glacier       | Camera                     | CC5MPX                        | 6/21/2013         |
| Gates Glacier       | Camera Battery/Solar Panel | 12 Volt – 100 AH / 10 W panel | 7/9/2015          |
| Gates Glacier       | Crossarm                   | 3/4"                          | 7/6/2005          |
| Gates Glacier       | Crossarm                   | CM206                         | 7/6/2005          |
| Gates Glacier       | Datalogger                 | CR1000                        | 6/21/2013         |
| Gates Glacier       | DLP                        | GatesGI2018                   | 7/11/2018         |
| Gates Glacier       | Enclosure                  | ENC 16/18                     | 7/6/2005          |
| Gates Glacier       | GPS                        | 17992 GPS                     | 7/6/2005          |
| Gates Glacier       | RG-TB                      | TE525                         | 7/6/2005          |
| Gates Glacier       | SD                         | SR50                          | 6/21/2013         |
| Gates Glacier       | Solar Panel                | 75 W                          | 7/6/2005          |
| Gates Glacier       | SR                         | Li200x                        | 7/11/2018         |
| Gates Glacier       | ST1                        | 107                           | 6/27/2019         |
| Gates Glacier       | ST2                        | 107                           | 6/27/2019         |
| Gates Glacier       | ST3                        | 107                           | 6/27/2019         |
| Gates Glacier       | Tripod                     | CM106                         | 6/21/2013         |
| Gates Glacier       | TX321                      | NESDIS ID 39608018            | 7/11/2018         |
| Gates Glacier       | WS/WD                      | 5103                          | 7/11/2018         |

**Table C7.** Metadata for Ruth Glacier climate station.

| <b>Station Name</b> | <b>Item</b>        | <b>Model</b>          | <b>Start Date</b> |
|---------------------|--------------------|-----------------------|-------------------|
| Ruth Glacier        | Antenna            | 25316 YAGI            | 9/6/2008          |
| Ruth Glacier        | AT                 | 109                   | 6/21/2017         |
| Ruth Glacier        | AT-RH              | EE181                 | 6/26/2019         |
| Ruth Glacier        | Battery            | 100 AH (x2)           | 9/6/2008          |
| Ruth Glacier        | Battery Cable      | Power Cable           | 6/13/2012         |
| Ruth Glacier        | Charging Regulator | CH-100                | 6/13/2012         |
| Ruth Glacier        | Datalogger         | CR1000                | 6/24/2014         |
| Ruth Glacier        | DLP                | Ruth2019              | 6/26/2019         |
| Ruth Glacier        | Enclosure          | ENC 16/18             | 6/26/2019         |
| Ruth Glacier        | GPS                | 17992 GPS             | 9/6/2008          |
| Ruth Glacier        | RG-TB              | TE525                 | 9/6/2008          |
| Ruth Glacier        | SD                 | SR50a                 | 6/21/2017         |
| Ruth Glacier        | Solar Panel        | 75 W                  | 9/6/2008          |
| Ruth Glacier        | SR                 | Li200x                | 6/20/2018         |
| Ruth Glacier        | ST1                | 107                   | 9/6/2008          |
| Ruth Glacier        | ST2                | 107                   | 9/6/2008          |
| Ruth Glacier        | ST3                | 107                   | 6/24/2014         |
| Ruth Glacier        | ST4 – 90 cm        | 107                   | 6/26/2019         |
| Ruth Glacier        | Tripod             | FTS RAWS Lunar Lander | 9/6/2008          |
| Ruth Glacier        | TX321              | NESDIS ID 396063EA    | 6/26/2019         |
| Ruth Glacier        | TX312 Cable        | Coaxial Cable         | 6/13/2012         |
| Ruth Glacier        | WS/WD              | 5103                  | 6/21/2017         |

**Table C8.** Metadata for Stampede climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>       | <b>Start Date</b> |
|---------------------|-------------|--------------------|-------------------|
| Stampede            | Antenna     | 25316 YAGI         | 8/1/2002          |
| Stampede            | AT          | 109                | 8/11/2016         |
| Stampede            | AT-RH       | HMP-45             | 8/8/2019          |
| Stampede            | Battery     | 100 AH (x2)        | 2003              |
| Stampede            | Crossarm    | 3/4"               | 8/1/2002          |
| Stampede            | Datalogger  | CR1000             | 9/16/2014         |
| Stampede            | DLP         | Stampede2019       | 8/8/2019          |
| Stampede            | Enclosure   | ENC 16/18          | 5/18/2011         |
| Stampede            | GPS         | 17992 GPS          | 8/1/2002          |
| Stampede            | RG-TB       | TE525              | 8/1/2002          |
| Stampede            | SD          | SR50a              | 9/16/2014         |
| Stampede            | Solar Panel | 75 W               | 8/1/2002          |
| Stampede            | SR          | Li200x             | 8/8/2019          |
| Stampede            | ST1         | 107                | 8/8/2019          |
| Stampede            | ST2         | 107                | 8/8/2019          |
| Stampede            | ST3         | 107                | 8/8/2019          |
| Stampede            | ST4 – 90 cm | 107                | 8/8/2019          |
| Stampede            | Tripod      | CM106              | 9/1/2002          |
| Stampede            | TX321       | NESDIS ID 3960A6F4 | 8/8/2019          |
| Stampede            | WS/WD       | 5103               | 8/8/2018          |

**Table C9.** Metadata for Tana Knob climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>       | <b>Start Date</b> |
|---------------------|-------------|--------------------|-------------------|
| Tana Knob           | Antenna     | 25316 YAGI         | 7/5/2005          |
| Tana Knob           | AT          | 109                | 6/28/2016         |
| Tana Knob           | AT-RH       | EE181              | 6/27/2019         |
| Tana Knob           | Battery     | 100 AH (x2)        | 7/5/2005          |
| Tana Knob           | Crossarm    | CM204              | 7/5/2005          |
| Tana Knob           | Crossarm    | CM206              | 7/5/2005          |
| Tana Knob           | Datalogger  | CR1000             | 7/2/2014          |
| Tana Knob           | DLP         | Tana2018           | 7/10/2018         |
| Tana Knob           | Enclosure   | ENC 16/18          | 7/5/2005          |
| Tana Knob           | GPS         | 17992 GPS          | 7/5/2005          |
| Tana Knob           | RG-TB       | TE525              | 6/28/2016         |
| Tana Knob           | SD          | SR50               | 6/20/2013         |
| Tana Knob           | Solar Panel | 75 W               | 7/5/2005          |
| Tana Knob           | SR          | Li200x             | 7/10/2018         |
| Tana Knob           | ST1         | 107                | 7/5/2005          |
| Tana Knob           | ST2         | 107                | 7/10/2018         |
| Tana Knob           | ST3         | 107                | 7/5/2005          |
| Tana Knob           | Tripod      | CM106              | 6/27/2012         |
| Tana Knob           | TX321       | NESDIS ID 3960709C | 7/10/2018         |
| Tana Knob           | WS/WD       | 5103               | 6/27/2019         |

**Table C10.** Metadata for Tebay climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>       | <b>Start Date</b> |
|---------------------|-------------|--------------------|-------------------|
| Tebay               | Antenna     | 25316 YAGI         | 7/8/2005          |
| Tebay               | AT          | 109                | 6/28/2016         |
| Tebay               | AT-RH       | EE181              | 6/27/2019         |
| Tebay               | Battery     | 100 AH (x2)        | 7/8/2005          |
| Tebay               | Crossarm    | CM204              | 7/8/2005          |
| Tebay               | Crossarm    | CM206              | 7/8/2005          |
| Tebay               | Datalogger  | CR1000             | 6/20/2013         |
| Tebay               | DLP         | Tebay2018          | 7/10/2018         |
| Tebay               | Enclosure   | ENC 16/18          | 7/8/2005          |
| Tebay               | GPS         | 17992 GPS          | 7/8/2005          |
| Tebay               | RG-TB       | TE525              | 7/8/2005          |
| Tebay               | SD          | SR50a              | 6/27/2019         |
| Tebay               | Solar Panel | 75 W               | 7/8/2005          |
| Tebay               | SR          | Li200x             | 6/27/2019         |
| Tebay               | ST1         | 107                | 6/30/2010         |
| Tebay               | ST2         | 107                | 6/30/2010         |
| Tebay               | ST3         | 107                | 6/30/2010         |
| Tebay               | Tripod      | CM106              | 7/3/2014          |
| Tebay               | TX321       | NESDIS ID 3960936E | 7/10/2018         |
| Tebay               | WS/WD       | 5103               | 7/10/2018         |

**Table C11.** Metadata for Toklat climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>       | <b>Start Date</b> |
|---------------------|-------------|--------------------|-------------------|
| Toklat              | Antenna     | 25316 YAGI         | 6/16/2005         |
| Toklat              | AT          | 109                | 9/9/2016          |
| Toklat              | AT-RH       | EE181              | 6/5/2019          |
| Toklat              | Battery     | 100 AH (x2)        | 6/5/2019          |
| Toklat              | Crossarm    | 3/4"               | 6/16/2005         |
| Toklat              | Datalogger  | CR1000             | 9/9/2016          |
| Toklat              | DLP         | Toklat2019         | 6/5/2019          |
| Toklat              | Enclosure   | ENC 16/18          | 6/16/2005         |
| Toklat              | GPS         | 17992 GPS          | 5/28/2014         |
| Toklat              | RG-TB       | TE525              | 9/9/2016          |
| Toklat              | SD          | SR50a              | 5/28/2014         |
| Toklat              | Solar Panel | 75 W               | 6/16/2005         |
| Toklat              | SR          | Li200x             | 8/21/2018         |
| Toklat              | ST1         | 107                | 6/16/2005         |
| Toklat              | ST2         | 107                | 6/16/2005         |
| Toklat              | ST3         | 107                | 6/16/2005         |
| Toklat              | Tripod      | CM106              | 6/16/2005         |
| Toklat              | TX321       | NESDIS ID 396063EA | 8/21/2018         |
| Toklat              | WS/WD       | 5103               | 8/14/2017         |

**Table C12.** Metadata for Upper Charley climate station.

| <b>Station Name</b> | <b>Item</b>                | <b>Model</b>                  | <b>Start Date</b> |
|---------------------|----------------------------|-------------------------------|-------------------|
| Upper Charley       | Antenna                    | 25316 YAGI                    | 8/3/2005          |
| Upper Charley       | AT                         | 109                           | 6/13/2018         |
| Upper Charley       | AT-RH                      | EE181                         | 5/14/2019         |
| Upper Charley       | Battery                    | 100 AH (x2)                   | 8/3/2005          |
| Upper Charley       | Camera                     | CC5MPX                        | 7/23/2013         |
| Upper Charley       | Camera Battery/Solar Panel | 12 Volt – 100 AH / 10 W panel | 8/6/2015          |
| Upper Charley       | Crossarm                   | 3/4"                          | 8/3/2005          |
| Upper Charley       | Crossarm                   | CM206                         | 8/3/2005          |
| Upper Charley       | Datalogger                 | CR1000                        | 9/7/2012          |
| Upper Charley       | DLP                        | UCharley2019                  | 5/14/2019         |
| Upper Charley       | Enclosure                  | ENC 16/18                     | 8/3/2005          |
| Upper Charley       | GPS                        | 17992 GPS                     | 9/8/2012          |
| Upper Charley       | RG-TB                      | TE525                         | 8/3/2005          |
| Upper Charley       | SD                         | SR50a                         | 6/13/2017         |
| Upper Charley       | Solar Panel                | 75 W                          | 8/3/2005          |
| Upper Charley       | SR                         | Li200x                        | 6/13/2018         |
| Upper Charley       | ST1                        | 107                           | 7/23/2013         |
| Upper Charley       | ST2                        | 107                           | 7/23/2013         |
| Upper Charley       | ST3                        | 107                           | 7/23/2013         |
| Upper Charley       | ST4 – 75 cm                | 107                           | 5/14/2019         |
| Upper Charley       | Tripod                     | CM206                         | 8/3/2005          |
| Upper Charley       | TX321                      | NESDIS ID 3960D064            | 6/13/2018         |
| Upper Charley       | WS/WD                      | 5103                          | 6/13/2017         |

**Table C13.** Metadata for Wigand climate station.

| <b>Station Name</b> | <b>Item</b> | <b>Model</b>        | <b>Start Date</b> |
|---------------------|-------------|---------------------|-------------------|
| Wigand              | Antenna     | 25316 YAGI          | 8/3/2005          |
| Wigand              | AT          | 109                 | 8/11/2016         |
| Wigand              | AT-RH       | HMP45               | 8/8/2019          |
| Wigand              | Battery     | 100 AH (x2)         | 8/13/2013         |
| Wigand              | Crossarm    | 3/4"                | 8/13/2013         |
| Wigand              | Crossarm    | CM206               | 8/13/2013         |
| Wigand              | Datalogger  | CR1000              | 8/13/2013         |
| Wigand              | DLP         | Wigand2017          | 8/8/2017          |
| Wigand              | Enclosure   | ENC 16/18           | 8/13/2013         |
| Wigand              | GPS         | 17992 GPS           | 8/13/2013         |
| Wigand              | RG-TB       | TE525               | 8/13/2013         |
| Wigand              | SD          | SR50a               | 8/13/2013         |
| Wigand              | Solar Panel | 75 W                | 8/13/2013         |
| Wigand              | SR          | Li200x              | 8/8/2019          |
| Wigand              | ST          | 107                 | 8/13/2013         |
| Wigand              | ST          | 107                 | 8/13/2013         |
| Wigand              | ST          | 107                 | 8/13/2013         |
| Wigand              | Tripod      | CM206               | 8/13/2013         |
| Wigand              | TX321       | NESDIS ID 39600060C | 8/8/2019          |
| Wigand              | WS/WD       | 5103 (30" cable)    | 8/8/2019          |



The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service  
U.S. Department of the Interior



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