Hydrological, Sedimentological, and Meteorological Observations and Analysis on the Sagavanirktok River

2017 Interim Report

H. Toniolo, E.K. Youcha, K.D. Tape, R. Paturi, J. Homan, A. Bondurant, I. Ladines, J. Laurio, D. Vas, J. Keech, T. Tschetter, and E. LaMesjerant

Prepared for
Alaska Department of Transportation and Public Facilities
and Alyeska Pipeline Service Company

Water and Environmental Research Center
University of Alaska Fairbanks
Fairbanks, AK 99775

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Front cover photo:

Dry pit at DSS3 Sagavanirktok River at Happy Valley on July 7, 2017

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ABSTRACT

The Dalton Highway near Deadhorse was closed twice during late March and early April 2015 because of extensive overflow from the Sagavanirktok River that flowed over the highway. That spring, researchers from the Water and Environmental Research Center at the University of Alaska Fairbanks (UAF) monitored the river conditions during breakup, which was characterized by unprecedented flooding that overtopped and consequently destroyed several sections of the Dalton Highway near Deadhorse. The UAF research team has monitored breakup conditions at the Sagavanirktok River since that time. Given the magnitude of the 2015 flooding, the Alyeska Pipeline Service Company started a long-term monitoring program within the river basin. In addition, the Alaska Department of Transportation and Public Facilities (ADOT&PF) funded a multiyear project related to sediment transport conditions along the Sagavanirktok River. The general objectives of these projects include determining ice elevations, identifying possible water sources, establishing surface hydro-meteorological conditions prior to breakup, measuring hydro-sedimentological conditions during breakup and summer, and reviewing historical imagery of the aufeis extent. In the present report, we focus on new data and analyze it in the context of previous data.

We calculated and compared ice thickness near Franklin Bluffs for 2015, 2016, and 2017, and found that, in general, ice thickness during both 2015 and 2016 was greater than in 2017 across most of the study area. Results from a stable isotope analysis indicate that winter overflow, which forms the aufeis in the river area near Franklin Bluffs, has similar isotopic characteristics to water flowing from mountain springs.

End-of-winter snow surveys (in 2016/2017) within the watershed indicate that the average snow water equivalent was similar to what we observed in winter 2015/2016. Air temperatures in May 2017 were low on the Alaska North Slope, which caused a long and gradual breakup, with peak flows occurring in early June, compared with mid-May in both 2015 and 2016. Maximum discharge measured at the East Bank station, near Franklin Bluffs was 750 m^3/s (26,485 ft^3/s) on May 30, 2017, while the maximum measured flow was 1560 m^3/s (55,090 ft^3/s) at the same station on May 20, 2015. Available cumulative rainfall data indicate that 2016 was wetter than 2017.

In September 2015, seven dry and wet pits were dug near the hydro-sedimentological monitoring stations along the Sagavanirktok River study reach. The average grain-size of the sediment of exposed gravel bars at sites located upstream of the Ivishak-Sagavanirktok confluence show relatively constant values. Grain size becomes finer downstream of the confluence.

We conducted monthly topo-bathymetric surveys during the summer months of 2016 and 2017 in each pit. Sediment deposition and erosion was observed in each of the pits. Calculated sedimentation volumes in each pit show the influence of the Ivishak River in the bed sediment-transport capacity of the Sagavanirktok River. In addition, comparison between dry and wet pit sedimentation volumes in some of the stations proves the complexity of a braided river, which is characterized by frequent channel shifting

A two-dimensional hydraulic model is being implemented for a material site. The model will be used to estimate the required sediment refill time based on different river conditions.

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ACKNOWLEDGMENTS AND DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the accuracy of the data presented herein. This research was funded by the Alaska Department of Transportation and Public Facilities (ADOT&PF) and the Alyeska Pipeline Service Company (APSC). The contents of the report do not necessarily reflect the views or policies of the ADOT&PF or the APSC. This work does not constitute a standard, specification, or regulation. We thank Joel Bailey, Ken Irving, Kathy Petersen, and Bill Schnabel who assisted in field data collection efforts; Troy Hicks, Joshua Innes, Hagen Billy, and Tim Braman at ADOT&PF, who collected and processed much of the GPS survey data. We thank BP, in particular Rick Rodriguez, for providing access to install the water level observation station on the bridge over the Sagavanirktok River west channel.

The use of trade and firm names in this document is for the purpose of identification only and does not imply endorsement by the University of Alaska Fairbanks, ADOT&PF, Alyeska Pipeline Service Company, or any other sponsor.

CONVERSION FACTORS, UNITS, WATER QUALITY UNITS, VERTICAL AND HORIZONTAL DATUM, ABBREVIATIONS, AND SYMBOLS

Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	43560.0	square feet (ft^2)
acre	0.405	hectare (ha)
square foot (ft^2)	3.587e-8	square mile (mi^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	3785.412	milliliter (mL)
cubic foot (ft^3)	28.317	liter (L)
acre-ft	1233.482	cubic meter (m^3)
acre-ft	325851.43	gallon(gal)
gallon(gal)	0.1337	cubic feet (ft^3)
	Velocity and Discharge	
foot per day (ft/d)	0.3048	meter per day (m/d)
square foot per day (ft^2/d)	0.0929	square meter per day (m^2/d)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/sec)
	Water Density	
kilograms per cubic meter (kg/m^3)	1/1000	grams per cubic centimeter (g/cm^3)
grams per cubic centimeter (g/cm^3)	1.94	slugs per cubic foot (slugs/ft^3

Units

In this report, both metric (SI) and English units were employed. The choice of "primary" units employed depended on common reporting standards for a particular property or parameter measured. The approximate value in the "secondary" units may also be provided in parentheses.

Thus, for instance, runoff is often reported in cubic meters per second (m^3/s) followed by the cubic feet per second (ft^3/s) value in parentheses.

Physical and Chemical Water-Quality Units:

Temperature

Water and air temperatures are given in degrees Celsius (°C) and in degrees Fahrenheit (°F). Degrees Celsius can be converted to degrees Fahrenheit by use of the following equation:

$$°F = 1.8(°C) + 32$$

Milligrams per liter (mg/L) or micrograms per liter (μg/L)

Milligrams per liter is a unit of measurement indicating the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7000 mg/L, the numerical value is the same as for concentrations in parts per million (ppm).

Horizontal datum

The horizontal datums for locations in this report is either North America Datum of 1983 (NAD83) or World Geodetic Survey 84 (WGS84).

Vertical datum

“Sea level” in the following report refers to the North American Vertical Datum of 1988 (NAVD88) (GEOID12A) datum for all water level elevations, unless otherwise noted. The ellipsoid (WGS-84) datum was initially used for ice elevations, imagery, and sediment trap bathymetry but was converted to NAVD88 (GEOID12A) as described in the methodology.

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

ADCP	acoustic Doppler current profiler
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation and Public Facilities
APSC	Alyeska Pipeline Service Company
C	Celsius (°C)
cfs	cubic feet per second
cm	centimeter
cms	cubic meters per second
d	day
DGS	digital grain size
F	Fahrenheit (°F)
ft	feet
GIS	Geographic Information System
GPS	Global Positioning System
hr	hour
in	inch
INE	Institute of Northern Engineering
km	kilometer
m	meter
mg/L	milligrams per liter, equivalent to ppm
mi	mile
min	minute
mm	millimeter
MP	milepost
NAVD	North American Vertical Datum
NMS	Non-metric Multidimensional Scaling
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
RTK	real-time kinematic
s	second
SAR	synthetic aperture radar
SBAS	satellite based augmentation system
SSC	suspended sediment concentration
SWE	snow water equivalent
TDR	time domain reflectometry
TSS	total suspended solids
UAF	University of Alaska Fairbanks
USF&WS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

WAAS	Wide Area Augmentation System
WERC	Water and Environmental Research Center

1 INTRODUCTION

Researchers from the Water and Environmental Research Center (WERC) at the Institute of Northern Engineering, University of Alaska Fairbanks (UAF), are performing hydro-sedimentological studies of the Sagavanirktok River, where it parallels the Dalton Highway. In this study, which began in 2015, in response to winter and spring flooding of the river that damaged sections of the Dalton Highway and threatened the trans-Alaska pipeline, we are monitoring the river conditions and meteorology throughout the watershed. The research is funded by both public and private sectors. Specifically, the State of Alaska provides public funds through the Alaska Department of Transportation and Public Facilities (ADOT&PF), and Alyeska Pipeline Service Company (APSC) provides private support.

Since 2015, we have produced yearly reports that describe conditions in the Sagavanirktok River during spring breakup (see Toniolo et al., 2015, and Toniolo et al., 2016a). In addition, last year we reported the initial results on bed-sediment transport conditions in the river (Toniolo et al., 2016b).

Data collection efforts along the study reach, which is approximately from Milepost (MP) 318 to MP405 of the Dalton Highway, involve discharge measurements, water level monitoring, water sampling, and basic meteorological variables recording (air temperature, wind direction and wind speed, barometric pressure, relative humidity, and solid and liquid precipitation). Meteorological variables have been recorded at several additional stations distributed throughout the entire watershed. These meteorological stations measure conditions in the mountains, foothills, and coastal plain areas.

We surveyed ice elevations at Franklin Bluffs, in the river and on the adjacent floodplain, at the end of winter to characterize ice thickness and aufeis extent prior to breakup, and we performed snow surveys throughout the watershed to estimate water availability. We collected water and precipitation samples to determine the source of winter overflow in the Sagavanirktok River. During the warm season, we performed monthly topo-bathymetric surveys in each of the seven sediment traps excavated in the river to better understand bed-sediment transport conditions in the river.

In this report, we focus on new data and analyze it in the context of previous data.

2 STUDY AREA

The Sagavanirktok River (Figure 1) originates in the mountains of the Brooks Range and flows north to the Beaufort Sea east of Deadhorse. In the headwaters, the Sagavanirktok River basin contains the Ivishak River and the Upper Sagavanirktok River. Table 1 summarizes the Sagavanirktok River basin characteristics (Toniolo et al., 2015). The basin has a low hydraulic gradient (Coastal Plain) near the Arctic Ocean and a high hydraulic gradient (Brooks Range) in the headwaters to the south. The hypsometric curve for the Sagavanirktok River basin is shown in Figure 2 (from Toniolo et al., 2015). The basin area (at the observation station near Franklin Bluffs) is approximately 13,500 km^2, most of which lies in the Brooks Range (>50%). Less than 20% of the basin area is located on the Coastal Plain. Nearly half of the Sagavanirktok River basin encompasses the Ivishak drainage. The basin length is approximately 250 km, and the stream length is at least 300 km. The river is fed by snowmelt, rain, and several small glaciers. The floodplain varies in width, from narrow at the river's source to several miles wide where the river discharges into the Arctic Ocean (Toniolo et al., 2016b). The river channels adjacent to the Dalton Highway and the trans-Alaska pipeline are characterized by extensive braiding, with some bars vegetated by shrubs (Toniolo et al., 2016a). River discharge has been continuously measured on the Sagavanirktok River since 1983 by the United States Geological Survey (USGS) at a station (15908000) located near Pump Station 3 (MP325). Additional measurements of discharge and river stage in the lower Sagavanirktok River near Deadhorse were made during environmental studies for the Endicott Development in the late 1970s to early 1990s. Table 2 lists each of the hydro-sedimentological and meteorological research sites. Sagavanirktok River at Happy Valley, site 005 (DSS3), and Sagavanirktok River near MP318, site 066 (DSS4), are located in the middle Sagavanirktok River basin, above the confluence with the Ivishak River (Figure 1). The Sagavanirktok River below the Ivishak River confluence (DSS2) site is located approximately 7 miles below the confluence. Sagavanirktok River at MP405 near Deadhorse, site 042 (DSS1), is in the west channel of the lower Sagavanirktok River approximately 8 miles south of Deadhorse (Figure 1). Specifically, we want to characterize sediment conditions. We installed the monitoring stations at these four locations for the purpose of understanding sediment transport conditions and how the extraction of gravel could affect river morphology.

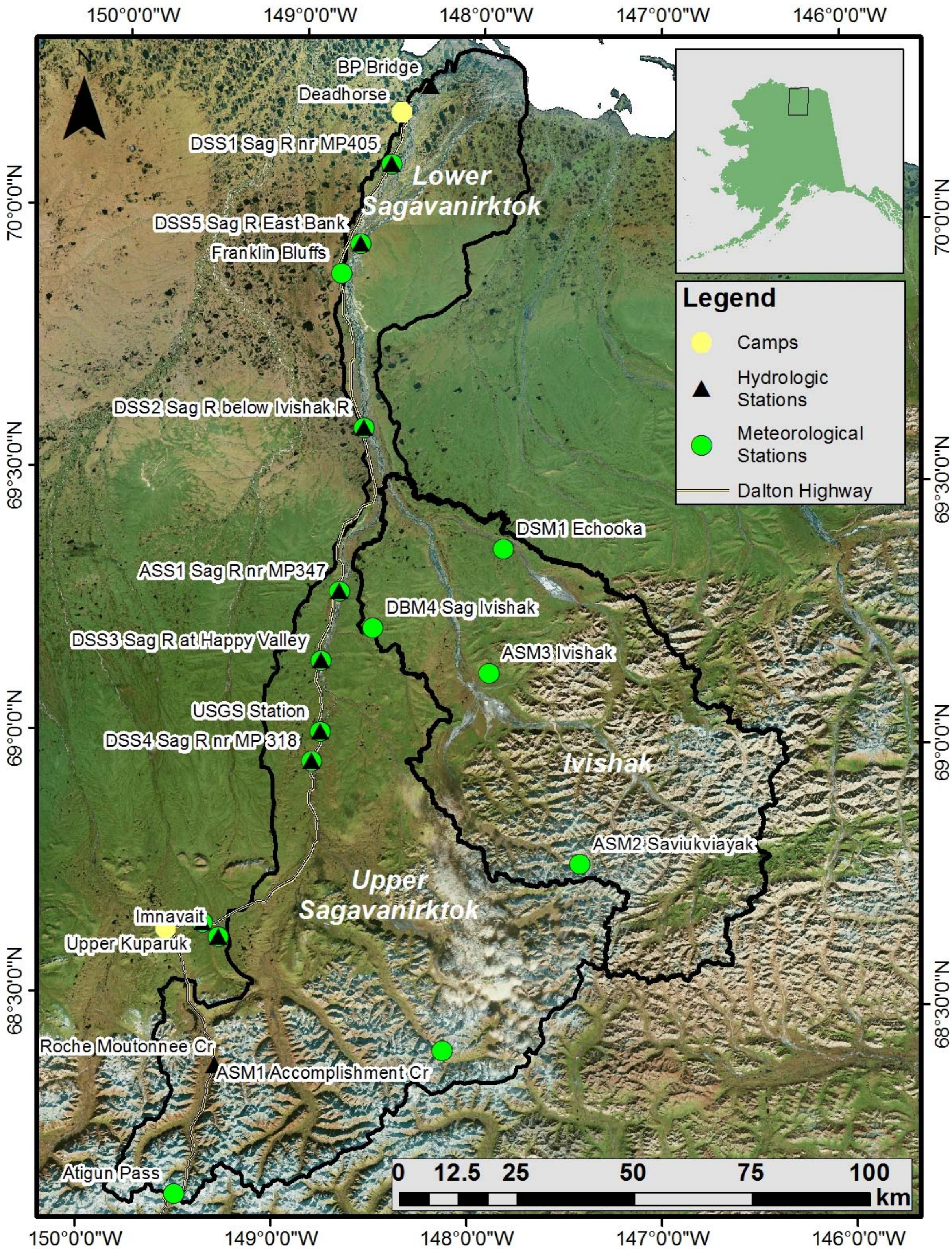


Figure 1. Sagavanirktok River basin and the hydro-sedimentological and meteorological observation network. The black line indicates the Sagavanirktok and Ivishak watershed boundaries.

Table 1. Characteristics of the Sagavanirktok River basin (from Toniolo et al., 2015).

Basin Area (km^2)	13,500
Aspect	north
Minimum Elevation (m)	0
Maximum Elevation (m)	2477
Mean Elevation (m)	784
Basin Area above 500 m (%)	70
Basin Area above 1000 m (%)	35
Basin Length (km)	250
Shrub (%)	43
Barren (%)	37
Sedge (%)	14
Other (%)	6

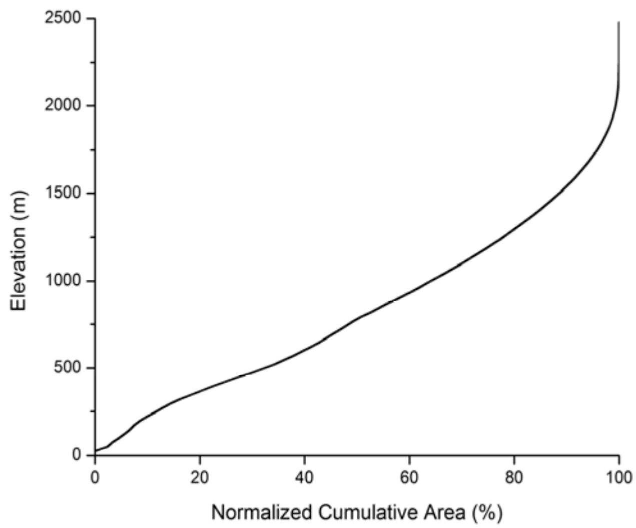


Figure 2. Hypsometric curve for the Sagavanirktok River basin (from Toniolo et al., 2015).

In September 2015, ADOT&PF excavated small pits in the river channel and in the adjacent floodplain at each station site to trap sediment to use for calculating average bed-sediment transport rates. Bathymetric surveys were performed to establish baseline conditions after the pits were dredged. Bed-sediment transport volumes are obtained by comparing successive bathymetric surveys of the pits over time. Bathymetric surveys were completed each summer month of 2016 and 2017. Observations at the four sediment study sites included basic weather variables (air temperature, relative humidity, wind speed, and wind direction), bathymetric surveys, discharge measurements, and specific measurements to quantify bed and suspended sediment loads (see Table 2). Additional new hydro-meteorological stations were installed throughout the Sagavanirktok River basin in 2015 and 2016 after the Sagavanirktok River flooded in 2015 near Franklin Bluffs. Observations of weather, water levels, and discharge are made at these additional stations to improve our understanding of the overall hydrology and water balance of the basin (Table 2, Figure 1). In September 2016, a water level observation station was installed on the BP bridge over the west channel of the Sagavanirktok River near Deadhorse. During spring breakup 2017, a temporary water level observation site was installed across from the East Bank (DSS5) station at Spur Dike 3 near MP396. The map in Figure 3 shows the location of the study area and observation station near Franklin Bluffs.

Table 2. Station locations established in the Sagavanirktok River basin in 2015 and 2016.

Site ID	Site Name	Latitude (WGS84)	Longitude (WGS84)	Elevation (m) (NAVD88)	Data Type
Hydro-Sedimentological Research Sites					
DSS1	Sagavanirktok River near Deadhorse MP 405 site 042	70.09912	-148.50892	26	Air temperature (AT), Relative Humidity (RH), Wind Speed (WS), Wind Direction (WD), Water Levels (WL), Discharge (Q), Suspended Sediment (SS), Turbidity (TU)
DSS2	Sagavanirktok River below Ivishak River	69.59580	-148.62600	137	AT, RH, WS, WD, WL, Q, SS,TU
DSS3	Sagavanirktok River at Happy Valley site 005	69.15065	-148.82323	291	AT, RH, WS, WD, WL, Q, SS,TU
DSS4	Sagavanirktok River near MP 318 site 066	68.95835	-148.85997	371	AT, RH, WS, WD, WL, Q, SS,TU, Rainfall (P)
General Hydrological or Meteorological Monitoring					
DSS5	Sagavanirktok River East Bank	69.9461	-148.6714	60	AT, RH, WS, WD, WL, Q
	Spur Dike 3	69.9607	-148.7192	56	WL
	BP Bridge	70.2495	-148.3036	5	WL, AT
ASS1	Sagavanirktok River Alyeska1 near MP347	69.2829	-148.7359	241	WL, Water Temperature (WT), AT, RH, P, WS, WD, Barometric Pressure (PB)
DSM1	Echooka Met	69.3709	-147.8546	335	AT, RH, WS, WD, ST, PB, P, Net Radiation (NR), Snow Depth (SD),
DBM4	Sag-Ivishak Met	69.2156	-148.5519	431	AT, RH, WS, WD, ST, PB, NR, SD, P
ASM1	Accomplishment Creek Met (formerly DBM1)	68.4116	-148.1365	1458	AT, RH, WS, WD, ST, NR, SD, P
ASM2	Saviukviayak Met	68.7705	-147.4323	945	AT, RH, WS, WD, PB, NR, SD, P
ASM3	Ivishak Met	69.13382	-147.92338	401	AT, RH, WS, WD, PB, NR, SD, P

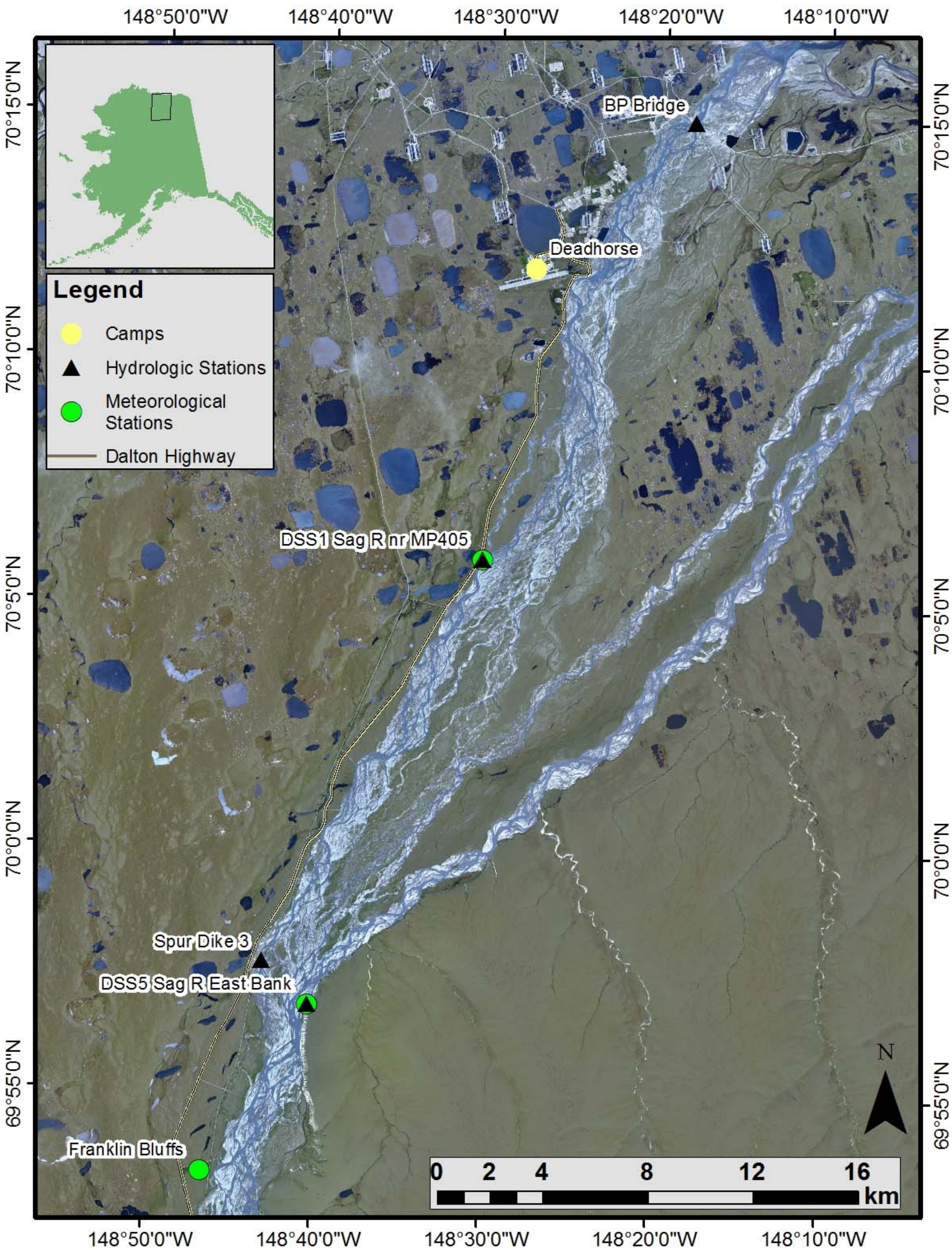


Figure 3. Sagavanirktok River study area near Franklin Bluffs and Deadhorse. Areas of aufeis develop in this area each winter. In 2015, winter and spring breakup flooding of the Dalton Highway occurred. Hydrological observation station DSS5 is on the east bank of the river, just before the river splits into an east and west channels. A temporary water level observation site was installed during breakup 2017 across from the East Bank site at Spur Dike 3. A water level observation station was established at the BP bridge near Deadhorse in 2016. Other nearby stations include Franklin Bluffs meteorological station and the hydro-sediment monitoring station near MP405 (DSS1).

2.1 Sagavanirktok River near MP318 Site 066 (DSS4)

Site 066 (DSS4) is located near Dalton Highway MP318, on the Sagavanirktok River above its confluence with the Ivishak River, in the foothills region of the watershed. The watershed area above this station is approximately 4,725 km^2. The river is slightly braided at this site, with at least two active channels (Figure 4). The floodplain is approximately 0.8 km wide. The test pits and the station are located on the left bank of the left-most channel. Gravel extraction has not yet occurred at this location, but future extraction is probable.

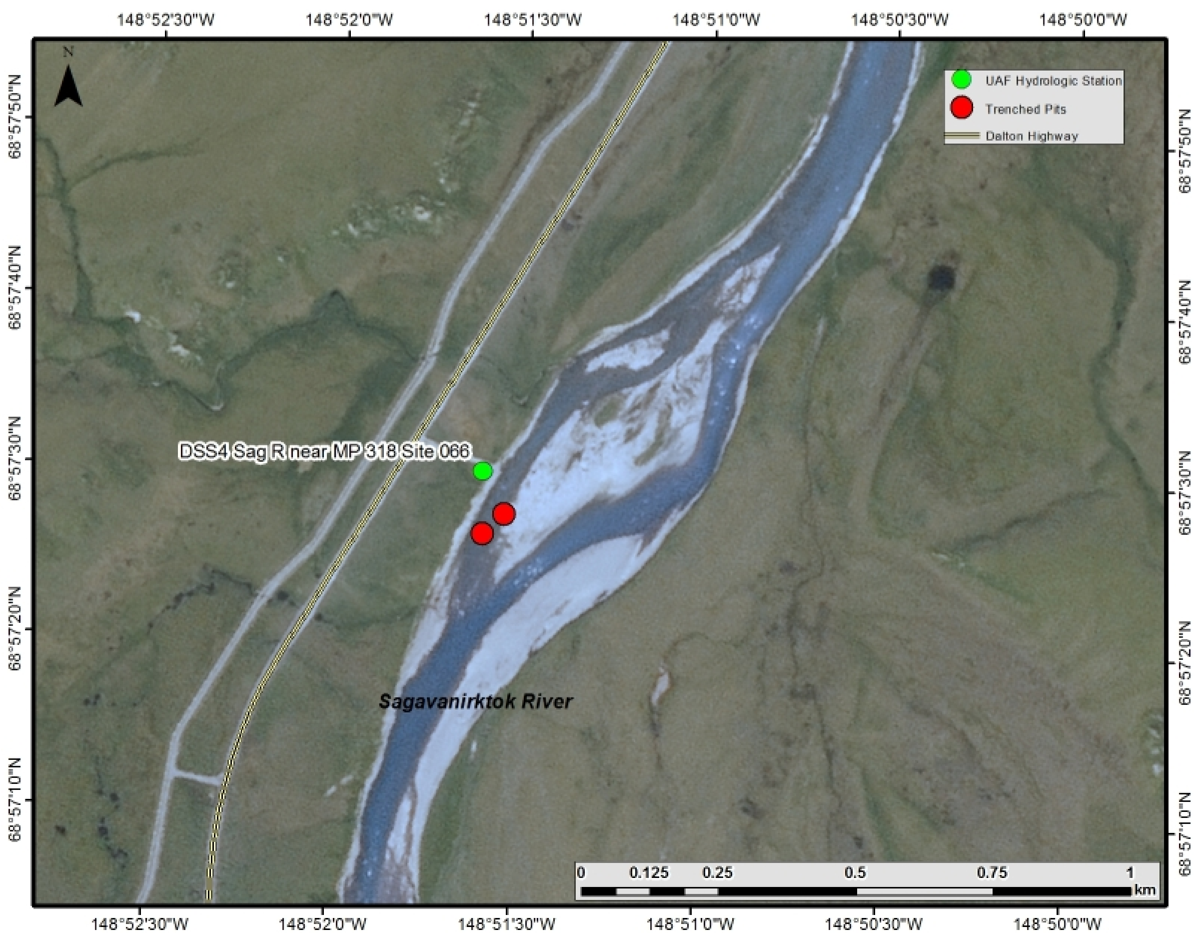


Figure 4. Sagavanirktok River near MP318 at site 066 (DSS4), near Dalton Highway MP318. Flow direction is from bottom to top.

2.2 Sagavanirktok River at Happy Valley Site 005 (DSS3)

Site 005 (DSS3) is located in the foothills regions of the watershed, on the Sagavanirktok River at Happy Valley (DSS3), near MP334 of the Dalton Highway (Figure 5), at an active camp and airstrip. The station is located above the confluence with the Ivishak River, and the watershed area is approximately 5,800 km^2 above the station. The river is braided at this site and the floodplain is approximately 1.6 km wide. The test pits are located at the north end of the runway, and the station is located at the south end.

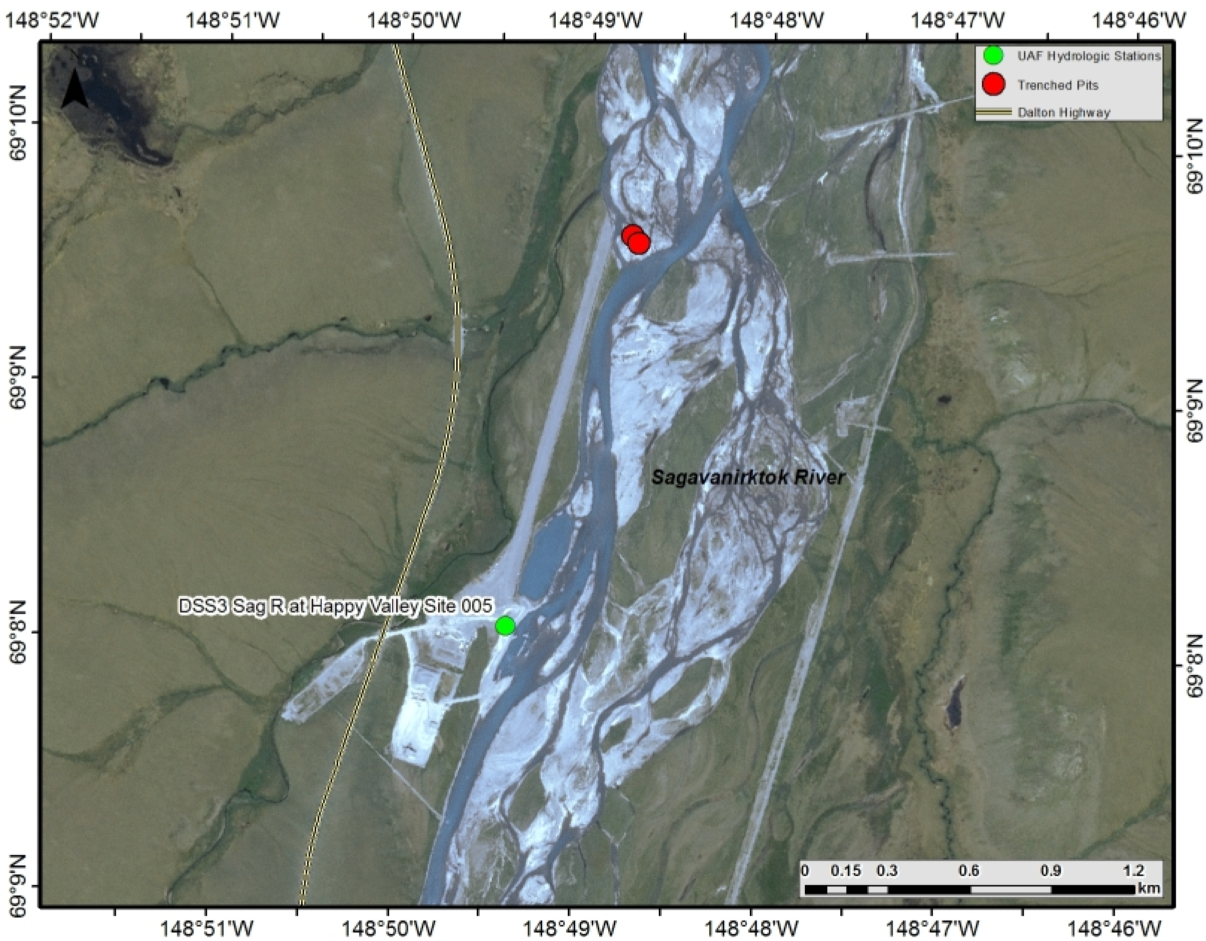
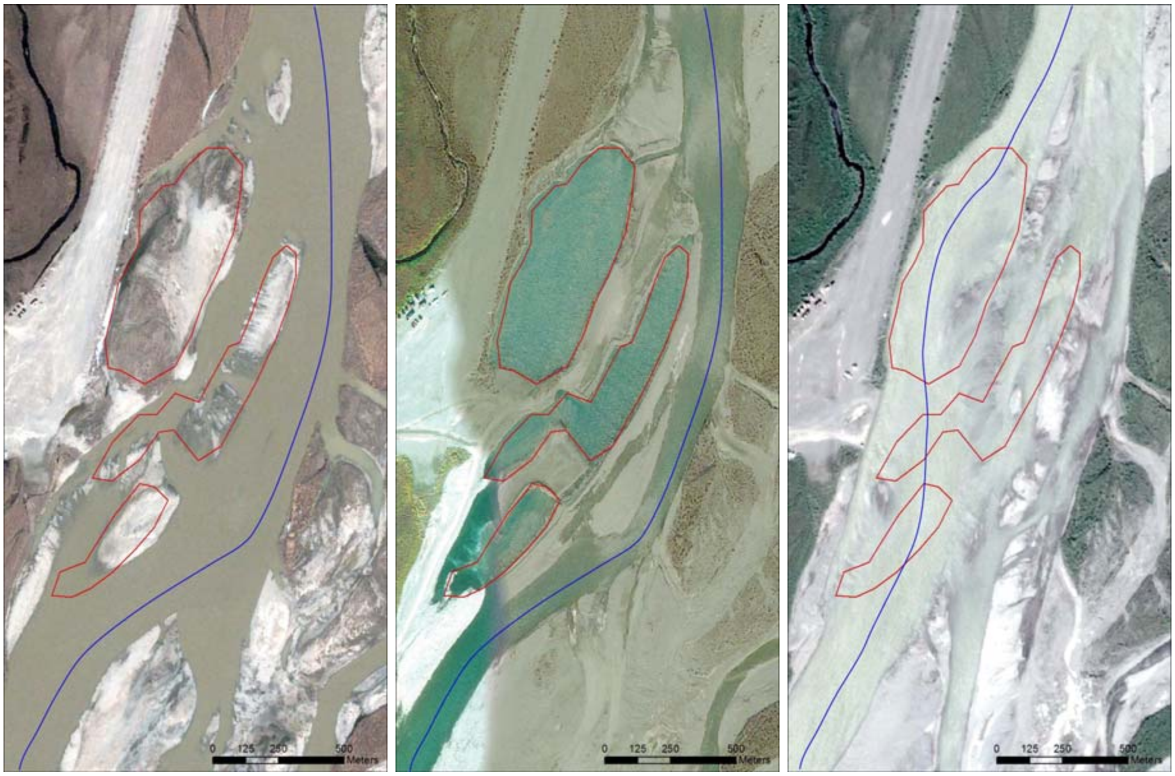


Figure 5. Sagavanirktok River at Happy Valley site 005 (DSS3). Flow direction is from bottom to top.

In 2008, approximately 300,000 m^3 of gravel were extracted from the floodplain adjacent to the Happy Valley airstrip at MP334. Figure 6 is an aerial photograph showing the river (Figure 6a) prior to gravel extraction, (Figure 6b) during extraction, and (Figure 6c) 6 years after extraction. The red outline represents the approximate location of the gravel pits, and the blue line is the approximate location of thalweg. The main channel has migrated from east to west, and currently flows through the area of the former main extraction pit.



(a) (b) (c)

Figure 6. Sagavanirktok River at Happy Valley (DSS3) in (a) June 2007, (b) late 2008, and (c) July 2014. Flow direction is from bottom to top of photographs (Tschetter et al., 2016).

2.3 Sagavanirktok River below the Confluence with the Ivishak River (DSS2)

The DSS2 site on the Sagavanirktok River is located approximately 11 km below the confluence with the Ivishak River, near MP368 of the Dalton Highway. The watershed area above this station is approximately 11,790 km^2. At this location, several spur dikes were built on the left margin of the river to protect the Alyeska trans-Alaska pipeline. The river becomes extremely braided in this lower part of the river, and the floodplain at the site is approximately 3.6 km wide. In 2017, gravel extraction began approximately 1.6 km upstream (see Section 4.9); additional gravel extraction is planned for the future. Figure 7 shows the hydro-sediment station location and the two pits on the left side of the river near the spur dikes.

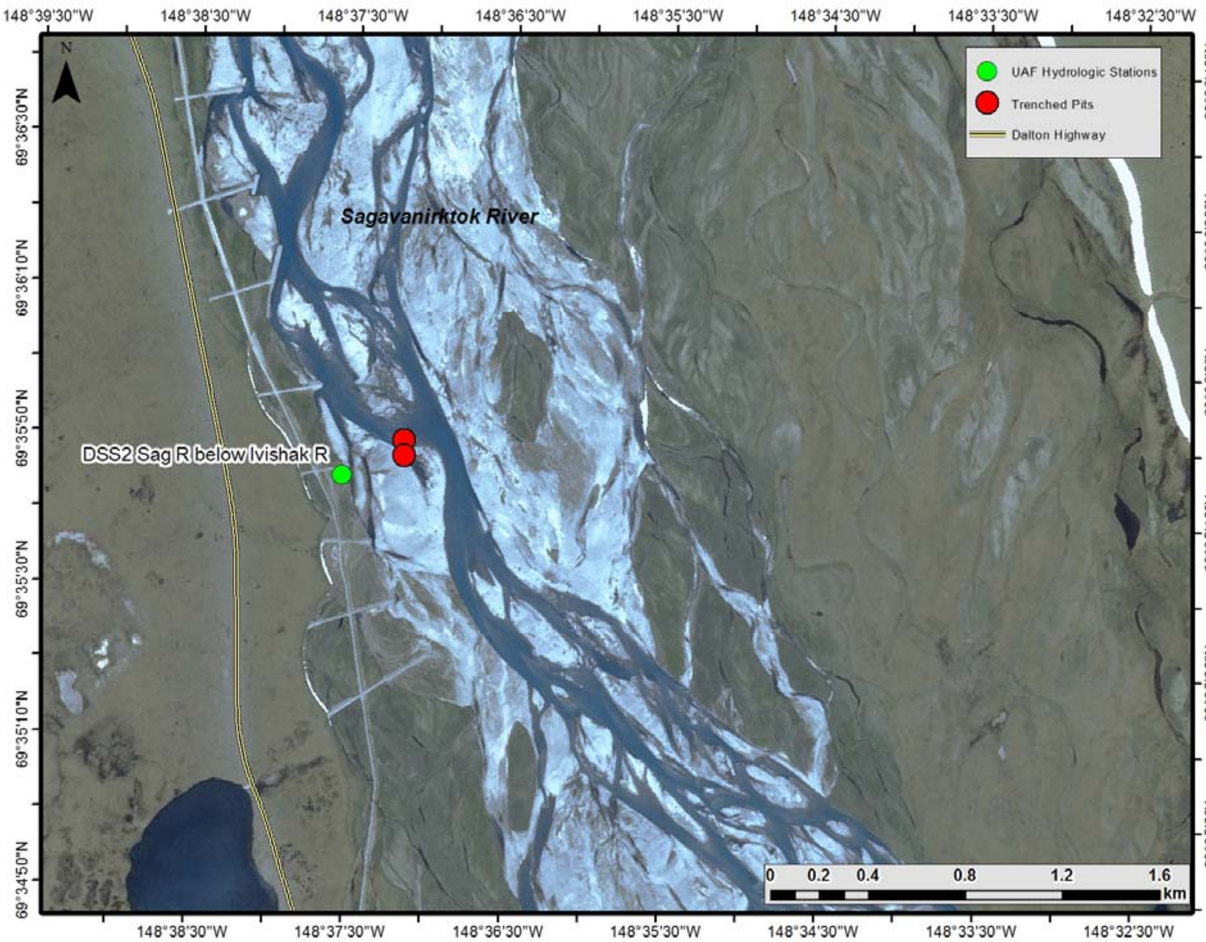


Figure 7. Sagavanirktok River below the Ivishak River confluence (DSS2). Flow direction is from bottom to top.

2.4 Sagavanirktok River near MP405 Site 042 (DSS1)

The Sagavanirktok River splits into two channels (east and west) at approximately MP395 of the Dalton Highway. At this location, the river is extremely braided, and the floodplain is wide. The station is located near MP405 (DSS1), on the left bank of the most western channel. Figure 8 shows the hydro-sediment station location and the test pit. Only one test pit exists at this location. Gravel extraction occurred at this site near MP404.5 from 2015 to 2017 (Figure 9).

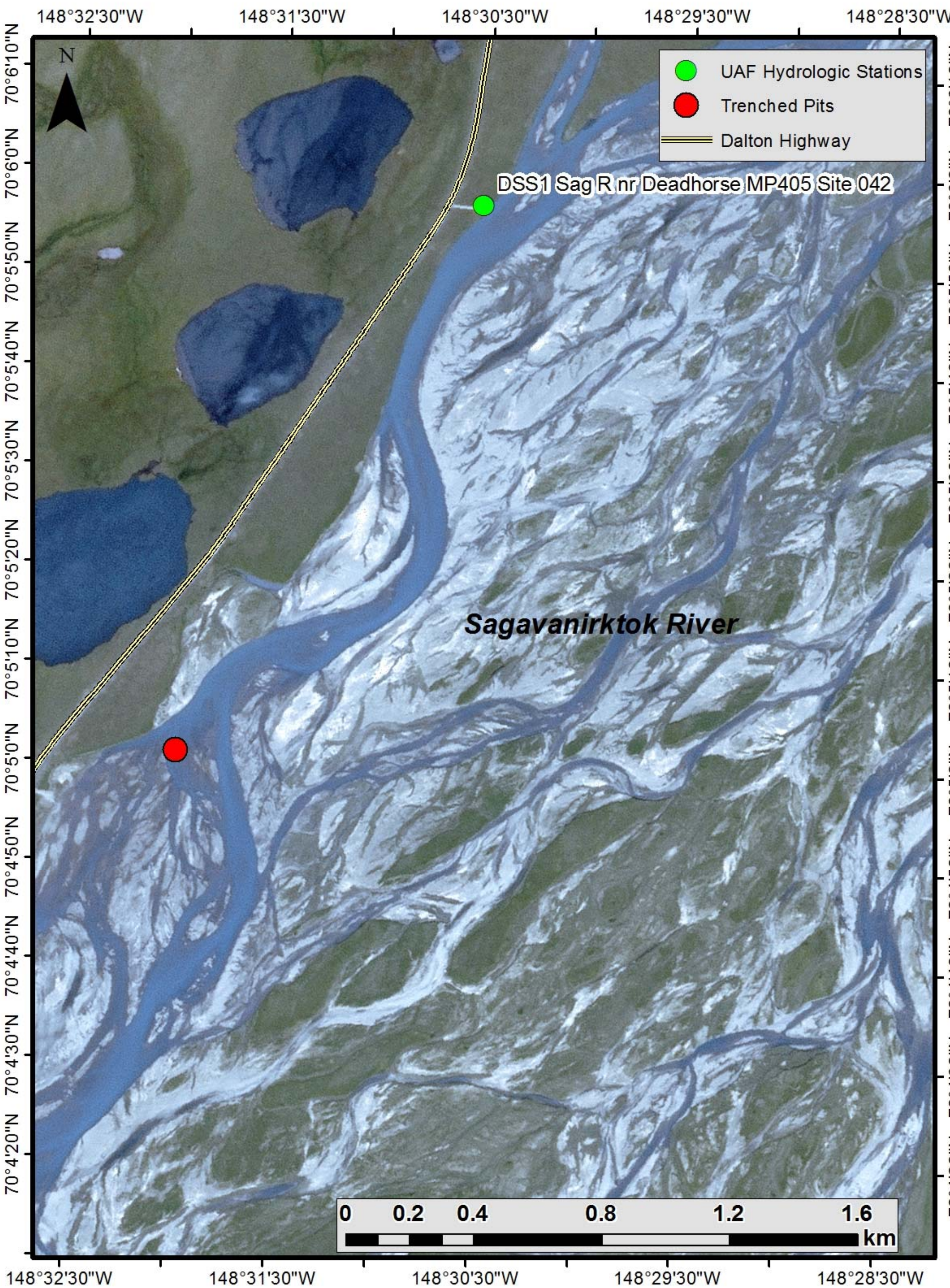


Figure 8. Sagavanirktok River near MP405 site 042 (DSS1), near Deadhorse and Dalton Highway MP405. Station is on the left bank of the west channel. Flow direction is from bottom to top.

Figure 9. Aerial photograph showing gravel mining on the west channel of the Sagavanirktok River near Dalton Highway MP405 (station DSS1 is approximately 1.5 km downstream).

3 METHODOLOGY AND EQUIPMENT

The goal of the monitoring program was to establish hydrologic/sedimentologic observation stations at each of the pit locations on the Sagavanirktok River. Sediment and hydrologic monitoring stations were installed in July 2015; excavations occurred in September 2015. Streambed bathymetry was mapped at the sites in September 2015, immediately after the pits were excavated by ADOT&PF. Bathymetry was surveyed each summer month in 2016 and 2017 to look for sediment deposition within the pits.

At each station along the river, we record 15-minute water levels and turbidity, and collect daily water samples to determine suspended sediment concentration, hourly air temperature, wind speed, and wind direction. We conduct snow surveys throughout the basin each April to measure the snowpack conditions just prior to breakup. In 2016, we installed several new meteorological stations within the foothills and mountains of the Brooks Range to observe air temperature and precipitation in the upper part of the basin. Station data are transmitted via telemetry, and data are downloaded to the project websites in "near real time":

http://ine.uaf.edu/werc/projects/sagdot/data.aspx and
http://ine.uaf.edu/werc/projects/alyeska/data.aspx

In July, August, and September 2015, 2016, and 2017, we made individual measurements of stream discharge at each station. In 2016 and 2017, we made frequent measurements during the spring runoff period. We are developing a stream stage–discharge relationship using individual measurements of stage and discharge. During summer 2015, we performed a floodplain vegetation and substrate survey at each of the four study reaches (Toniolo et al., 2016b).

3.1 Pits

3.1.1 Excavation

In September 2015, the ADOT&PF excavated seven pits at four locations in the river channel and active floodplain of the Sagavanirktok River (near MP405 site 042 [DSS1], below the Ivishak River confluence [DSS2], at Happy Valley site 005 [DSS3], and near MP318 site 066 [DSS4]). The pits were 2–3 m in depth and 10–20 m in diameter, excavated during the week of September 8, 2015, with a Komatsu PC270LC excavator. Two pits were excavated at DSS2, DSS3, and DSS4. Only one pit was excavated at the west channel near MP405 (DSS1). We refer to the pits as *wet* and *dry* because of the location where they were excavated. The wet pits were excavated in shallow water near the edge of the active channel; the dry pits were excavated from the gravel bar at a higher elevation and farther from the water than the wet pits. After the excavations, all of the dry pits filled with water, seeping from the permeable floodplain sediments. The two pits at each site were positioned to reduce the probability of both pits filling completely with sediment during one high-flow event. A dry pit was not excavated in the river at MP405 (DSS1) because the Komatsu PC270LC could not access the dry gravel bars from the highway.

3.1.2 Surveying

Following excavation of the pits, the sites were surveyed using a real-time kinematic (RTK) GPS, and the bathymetry was recorded using an acoustic Doppler current profiler (ADCP).The survey data were collected using a Leica Viva GS14 survey-grade differential GPS (Leica, 2015). This system achieves horizontal and vertical accuracies of ±0.008 m and ±0.015 m, respectively. At least 4 hours of static GPS data were collected at each station to obtain an OPUS (Online Positioning User Service) solution for the position of the local temporary benchmark (TBM). The RTK GPS data were referenced to the OPUS solution position in post-processing.

Initial pit bathymetry was surveyed using a RDI StreamPro ADCP and a RTK GPS system. The kayak- or jet boat-mounted StreamPro ADCP was integrated with a Novatel Smart V1-2US-L1 GPS receiver, which received RTK corrections via Bluetooth from a base station (another Novatel receiver). The Novatel SMART V1-2US-L1 (Novatel, 2011) is a single-frequency (L1) receiver with reported horizontal accuracy (RMS) of 0.7 m. The base station was programmed to transmit RTK corrections following a 6-minute fast static position lock, which established an arbitrary local datum for the survey. Muirhead and Annable (2014) noted that the accuracy of an ADCP bathymetry survey is dependent on the accuracy of the arbitrary local datum defined by the base station. To improve the accuracy of the survey, the position of the base station was surveyed with the survey-grade GPS. In post-processing, all points in the ADCP bathymetry dataset were adjusted to account for the true base station position.

Beginning in June 2016, we resurveyed the pits at approximately 1-month intervals throughout the summer (3 surveys per season) to monitor changes. The above-mentioned methods apply to the first two interval surveys of 2016. Beginning August 30, 2016, we changed from using RTK

GPS equipment to using Hemisphere S321 receivers and Hemisphere XF3 data controllers, running Carlson SurvCE software—this survey-grade equipment achieving similar resolution as previously outlined. Bathymetric method and general technique remained the same.

In 2017, we continued using the Hemisphere S321 receivers and Hemisphere XF3 data controllers with Carlson SurvCE software for the pit-monitoring surveys. Bathymetric methods have changed with the retirement of the StreamPro ADCP/Novatel GPS system and the inclusion of a Satlab Geosolutions SLD-200 Echo Sounder. The SLD-200 can achieve resolution of ±0.01 m and interfaces directly with the Hemisphere RTK GPS equipment. This direct interface allows the bathymetric and topographic survey data to be collected in a single contiguous file at each pit site, simplifying post-processing.

Table 3 is a summary of the date of each bathymetric survey of the pits. We were unable to obtain three of the pit surveys because we could not launch a powerboat or safely kayak with the survey equipment during high water events. The pits we could not survey were Sagavanirktok River at MP318 (DSS4) dry and wet pit in August 2017, and the wet pit at Sagavanirktok River below the Ivishak River (DSS2) in September 2017.

Table 3. Date of bathymetric surveys at pits.

Site Name	2015	2016	2017
Sagavanirktok River MP405 site 042 (DSS1)	Sep 14	Jun 27–28, Aug 1, Sep 1	Jul 8, Aug 5, Sep 6
Sagavanirktok River below Ivishak (DSS2)	Sep 10, Sep 13	Jun 30-Jul 1, Aug 2, Aug 31	Jul 9, Aug 6, Sep 7 (n/a for wet pit in Sep)
Sagavanirktok River at Happy Valley site 005 (DSS3)	Sep 18	Jul 2, Aug 3, Sep 3	Jul 7, Aug 4, Sep 5
Sagavanirktok River near MP318 site 066 (DSS4)	Sep 16	Jul 3, Aug 4, Aug 30	Jul 6, n/a, Sep 4

3.2 Surface Meteorology

Several UAF stations within or near the Sagavanirktok basin collect surface meteorology data including air temperature, relative humidity, wind speed and direction, rainfall, and snow depth. The UAF meteorological stations used in this study are located at the Sagavanirktok River near MP405 (DSS1), Sagavanirktok River East Bank (DSS5), Franklin Bluffs, Sagavanirktok River below Ivishak (DSS2), Sagavanirktok River at Happy Valley (DSS3), Sagavanirktok River at

MP318 (DSS4), Alyeska Stream Station 1 near MP347 (ASS1), Echooka (DSM1), Saviukviayak (ASM2), Sag-Ivishak (DBM4), Ivishak (ASM3), and Accomplishment Creek (ASM1) (see Figure 1). Sensor specifications at these stations are described in Toniolo et al. (2015), Kane et al. (2014), and Youcha et al. (2015), and summarized in Table 4. Precipitation and air temperature data from the Natural Resources Conservation Service (NRCS) Atigun Pass station and the USGS Sagavanirktok River gauging station were examined also.

Table 4. Details of equipment used on the Sagavanirktok River study.

Category	Item	Model	Accuracy	Remarks
Met	Wind Direction	RM Young 05103	± 3 degrees	
Met	Wind Speed	RM Young 05103	± 0.3 m/s	
Met	Air Temperature	HMP45C	± 0.5°C at −40°C	
Met	Air Temperature Backup	CR1000 Panel Temperature (Betatherm 10K3A1A)	± 0.3°C from −25 to −50°C	Inside logger box, not aspirated
Met	Air Relative Humidity	HMP45C	± 3% at 20°C	
Met	Barometric Pressure	CS106	± 1.5 mb @ −40 to +60°C	
Met/Hydro	Sonic Depth Sensor for Snow Depth and Water Level	SR50A	± 1 cm or 0.4% of distance to target (whichever is greatest)	Requires external temperature compensation
Hydro	Water Level	INW AquiStar PT12 SDI-12	± 0.5 cm (5 psi), ± 1.6 cm (15 psi)	Vented to atmosphere
Hydro	Water Level	HOBO U20	± 0.6 cm	Absolute pressure, barometric corrections required
Hydro	Water Levels	CS451	± 0.7 cm (7 psig)	Vented to atmosphere
Hydro	Water Levels, Ice Growth	Sonic Ranging Sensor (SR50A)	±1 cm or 0.4% of distance to target (whichever is greatest)	
Hydro	ADCP	RDI River Pro		
Hydro	ADCP	RDI Rio Pro		
Hydro	ADCP Software	WinRiver II		
Hydro	ADCP GPS Reference	Novatel Smart-V1, Geneq SX Blue, and Hemisphere S321		
Hydro	ADCP Manned Boat	15-foot aluminum Jon boat		35 HP jet motor, Kentucky-type ADCP mount
Hydro	Computer	Panasonic Toughbook CF19		
Station	Datalogger	CR1000		

Category	Item	Model	Accuracy	Remarks
Station	Camera	CC640 or PlantCam		
Station	Radio	FreeWave FGR or DGR		
Station	Solar Panel	Sharp 85 W, typical		
Station	Batteries	Concorde 104 AH		3 batteries
Station	Charge Controller	SunSaver 10 or 12		
Station	Tripod	CM110		

During winter 2016/2017, telemetry failed at a repeater that serves the hydro-sediment monitoring station below the Ivishak River (DSS2). The datalogger memory at the station was full, and data were lost from November 2016 through February 2017. In April and May 2017, power was lost at the East Bank (DSS5) station due to damage caused by animals, and data were lost.

Historical snow survey sites within the Sagavanirktok basin (Kane et al., 2006; Berezovskaya et al., 2007; Berezovskaya et al., 2008; Berezovskaya et al., 2010a; Berezovskaya et al., 2010b; Stuefer et al., 2011; Stuefer et al., 2012; Stuefer et al., 2014) were re-established in April 2016 to gain a better understanding of end-of-winter snowpack conditions. Snow water equivalent (SWE) is defined as

$$SWE = (\text{snow depth} * \text{snow density}) / (\text{water density}).$$

To measure SWE, we used the double sampling technique (Rovansek et al., 1993). In this sampling technique, 5 snow density and 50 snow depth measurements are collected. We collected snow cores for density measurements using an Adirondack tube, and measured snow depth along an L-shaped transect, with samples approximately 1 m apart (Derry et al., 2009). In 2017, we made only 3 snow density measurements (instead of the typical 5) at several of the snow survey sites.

3.3 Aufeis Extent

One of our objectives was to monitor and delineate the extent of the Sagavanirktok aufeis deposit in 2016 and 2017. In this section, we describe the methodology and equipment used for our observations.

3.3.1 Field Methods

We performed topographic surveys of the extensive aufeis formation on the Sagavanirktok River between Franklin Bluffs and the Dalton Highway in late winter 2016 (Toniolo et al., 2016a). In 2017, we performed only one survey of the aufeis formation, on April 17. The primary goal of these surveys was to measure the surface elevation and topography of the ice formation and determine changes over time. The surveyed area along the Dalton Highway extends from MP386 to MP400. Surveys were conducted using a real-time kinematic (RTK) GPS technique.

We used survey-grade Leica GS14 and GS15 receivers, and we collected data using a Leica CS15 controller that runs Leica Viva software. We attached a GPS rover receiver in a fixed position on a PistenBully tracked vehicle, and horizontal and vertical data were automatically collected at 1-second intervals as the vehicle traversed the ice. Control datum was pre-established ADOT&PF monuments on the Dalton Highway. The expected precision of the RTK GPS technique is +/- 0.01m horizontal and +/- 0.02 m vertical. Personnel with ADOT&PF operated the GPS survey equipment and post-processed the data using Leica Geomatics Office with control values from the NOAA OPUS average and static network. Elevations are reported as NAVD88 (GEOID12A), and the horizontal position is reported in Alaska State Plane Zone 4 (NAD83).

3.3.2 Imagery

In Toniolo et al. (2016a), Landsat satellite imagery was used to estimate the end-of-winter aufeis extent in the Sagavanirktok River floodplain for the recent historical record (2000 to 2016). Landsat 7 and 9 images were examined and the near-infrared (NIR) portion of the spectrum was used to delineate water and ice. The study area of the present investigation is near Franklin Bluffs, but it extends from the confluence of the Ivishak River to the Beaufort Sea. The methodology of this analysis is described in Toniolo et al. (2016a), but we updated the analysis to include an estimate of aufeis extent at winter's end 2017. As described in Toniolo et al. (2016a), the analysis method used may underestimate the extent of aufeis because the aufeis that underlies fresh or windblown snow is not recognized or because additional aufeis may have formed after the date of imagery. Additionally, this method may overestimate the extent of aufeis by including snow-free river ice as aufeis (Toniolo et al., 2016a).

On May 7, 2015, ADOT&PF contracted DOWL and Kodiak Mapping to produce a LiDAR DEM of the Dalton Highway and Sagavanirktok River between MP392 and MP405 near Deadhorse. The LiDAR ice elevation dataset has a vertical accuracy of approximately 0.04 m (DOWL, 2015).

On May 10, 2016, Fairbanks Fodar acquired Structure from Motion (SfM) ice surface elevation data (36 cm resolution) of the aufeis field affecting the Dalton Highway near the peak of its winter ice volume. The vertical accuracy of this dataset is up to 1 m, but typically is ~0.3 m (Nolan, 2017). More information on the acquisition can be found in Toniolo et al. (2016a) and http://fairbanksfodar.com/mapping-aufeis-on-the-dalton-highway.

Ice thickness in late winter 2017 was calculated at the GPS survey locations by comparing ice surface elevation with a July 20, 2014, IfSAR-derived digital elevation model (DEM). The IfSAR digital elevation model has a vertical accuracy of up to 3 m. The 2017 GPS surveyed ice surface elevations were also compared with a May 7, 2015, LiDAR-derived elevation model and May 10, 2016, SfM-derived elevation model in order to compare the 2017 ice thickness with the 2015 and 2016 ice thickness. The native vertical datum for the 2015 LiDAR and 2014 IfSAR is NAVD88 (GEOID9). The SfM data from May 10, 2016, use the WGS84 ellipsoid as datum. The 2015 LiDAR and 2014 IfSAR datasets were transformed to NAVD88 (GEOID12A) datum, and the 2016 SfM dataset was transformed to NAD83 UTM6 NAVD88 (GEOID12A) using NOAA's vertical datum transformation tool, VDatum. Ice thickness was determined by subtracting the ice surface elevations from the IfSAR ground surface elevations. Inter-year comparisons were made by subtracting the 2017 elevation from the 2016 (SfM) and from the 2015 (LiDAR) ice elevations.

3.4 Water Level Measurements

Water levels (or stage) are measured every 15 minutes with both vented and non-vented pressure transducers at each station. Accuracy information for each water level sensor is listed in Table 4. Errors associated with the pressure transducer itself are typically less than 1 cm. Additional errors may occur if the sensor does not have a secure installation and moves due to high flows or during ice-affected conditions. An acoustic sensor was installed on the bridge over the Sagavanirktok River west channel to measure the distance to the water surface; accuracies of this sensor are 1 cm, or 0.4% of the distance to target (whichever is greatest) (Campbell Scientific, Inc., 2016a). Point measurements of stage are also collected with traditional surveying equipment. Temporary benchmarks at each station (except the station ear MP347) are established by ADOT&PF surveyors using GPS techniques; the vertical datum is NAVD88 (GEOID12A). The Sagavanirktok River near MP347 (ASS1) has an arbitrary datum. Cameras take an hourly photograph of the river at each site; the images may be used to qualitatively evaluate the river stage, corroborate pressure transducer data, and observe ice conditions.

The two largest errors that result from manually measuring water levels are associated with (1) surveying and (2) the vertical datum related to the control point. Survey levels may be read incorrectly, but also rod levels may be difficult to read because of wave action, which can yield an error in water level of plus or minus several centimeters.

3.5 Runoff

Acoustic Doppler Current Profiler (ADCP) techniques are used to measure runoff at each site. The RDI Rio Grande, RDI River Pro, and the RDI StreamPro are used for this project. Both ADCP bottom tracking and GPS options were used as the reference to measure river velocity. Table 5 shows the GPS models used during ADCP measurements. Kane et al. (2012) discuss the methods and challenges associated with making discharge measurements using an ADCP.

Table 5. GPS models used during ADCP measurements of discharge.

GPS Make/Model	Horizontal Accuracy
Novatel Smart V1-2US-L1	0.2 m (RTK), 1.2 m (SBAS)
Geneq SXBlue II	0.6 m (SBAS)
Hemisphere S321	0.008 m (RTK), 0.3 m (SBAS)

To calculate river discharge and determine any directional bias, we made multiple transects from both the left-to-right-bank and the right-to-left-bank directions when possible. We gave each manual measurement a rating of good, fair, or poor, based on the variability of the transects, the accuracy and percentage of unmeasured areas, and the quality of the boat navigation reference (Mueller, 2012; Mueller et al., 2013; Wagner and Mueller, 2011).

3.6 Suspended Sediment

We deployed automated portable Isco 3700 autosamplers when it was possible at four Sagavanirktok River stations to monitor suspended sediment concentration (SSC) during breakup, and during the summers of 2015, 2016, and 2017. Each sampler has the capacity to hold 24 samples; therefore, we placed two samplers at each site to collect data for the entire month. We programmed the samplers to collect water samples every 48 hours, 24 hours apart.

In 2015 and 2016, we elevated the sampler intake tubes ~12 cm above the streambed and attached them to rebar stakes in the channel near the turbidimeters. In 2017, we modified this method of installation. Due to extensive shore ice and anchor ice, we could not drive rebar into the streambed; therefore, we attached the sampler intake tubes to weights to secure them to the streambed. The weights rested on the streambed, which could have consisted of anchor ice, gravel, sand, or silt, depending on when they were installed.

On site visits in 2017, we collected grab water samples and analyzed them for suspended sediment. The purpose of the grab samples was to compare the SSC at various locations in the river with the autosampler (located near the river's edge) results. The collection of the grab samples involved taking a 1 L bottle and manually filling it with water from the river at various locations. We took grab samples from the stream close to the bank, near the autosamplers, or in the main channel.

Similar to previous years' methodology (Toniolo et al., 2016b), we took the samples to the Water and Environmental Research Center at UAF to determine the SSC of the Sagavanirktok River at each study site. Following ASTM Standard 3977-97, the samples were vacuum filtered through Whatman GF/C glass microfiber filters with a particle retention size of 1.2 μm. The percentage of organic matter in each sample was then determined using ASTM Standard 2974-17 (Test Method C), in which samples were placed in a muffle furnace at 440°C for 12 hours. Additionally, several water samples taken during a high flow event were selected from the Sagavanirktok River at Happy Valley (DSS3) station for sediment grain size analysis. The samples were sent to Particle Tech Labs in Downers Grove, Illinois, for particle-size distribution testing with an AccuSizer 780 AD optical sensor that has a working range of 0.5 μm to 400 μm.

3.7 Turbidity

Turbidity is a measure of water clarity, which we use to qualitatively understand suspended sediment load in the river. Campbell Scientific OBS500/501 turbidity sensors operate at a wavelength of 850 nanometers, and contain a near-infrared laser and two photodiodes (Campbell Scientific, Inc., 2016b), which allow the sensors to detect light that is scattered from suspended solids in the water. The turbidimeters record backscatter and sidescatter. The backscatter sensor has a higher accuracy rate in areas with high turbidity, and is not disrupted by bubbles, organic matter, or ambient light. The sidescatter sensor is more accurate in areas that have low turbidity and fairly clean water. Combined, the two have the capability of measuring from 0 to 4000 NTUs (nephelometric turbidity units), with an accuracy of 2% of the reading or 0.5 NTU (whichever is greater). We have installed OBS500/501 turbidity sensors in the Sagavanirktok River from early July to mid-September each year at the four hydro-sediment observation stations (DSS1–DSS4). Each year the installation process has involved mounting the sensors to rebar that were driven into the streambed, with the optics facing the middle of the channel. We installed the sensor roughly 15 cm above the channel bed and in proximity to the suspended sediment autosamplers. Each turbidity sensor was connected to the surface-water observation station datalogger at each site, which measured turbidity every 15 minutes.

3.8 Stable Isotopes

We collected samples of Sagavanirktok River water and/or springs from the Sagavanirktok headwaters in late November 2016 (under ice, courtesy of USGS), early December 2016, mid-March 2017, and April 2017 for stable isotope analysis. We also collected snow samples from throughout the watershed in April 2017.

We obtained stable isotope data using continuous-flow isotope ratio mass spectrometry (CFIRMS), and used pyrolysis-EA-IRMS to measure $\delta^{2}H$ and $\delta^{18}O$. This method utilizes a ThermoScientific high temperature elemental analyzer (TC/EA) and Conflo IV interface with a DeltaV^{Plus} Mass Spectrometer. Stable isotope ratios were reported in ∂ notation as parts per thousand (‰) deviation from the international standards, V-SMOW (Standard Mean Ocean Water). Typically, instrument precision is <3.0 ‰ for hydrogen and <0.5 ‰ for oxygen. The Alaska Stable Isotope Facility at the University of Alaska Fairbanks Water and Environmental Research Center performed the analysis.

4 RESULTS

In this chapter, we present all hydrological, meteorological, and water chemistry data collected on this and related projects in 2016 and 2017. Selected data can be found in the appendices.

4.1 Meteorology

We collected meteorological data at various stations throughout the Sagavanirktok River basin. Variables such as air temperature and precipitation are important in understanding general hydrology and watershed processes. Air temperature is used for prediction of spring breakup, peak flows, and timing of a flow event. Air temperature may also play an important role in the formation of aufeis (Kane and Carlson, 1973). Precipitation measurements are used for the prediction of runoff events and the calculation of the water balance of a basin. In this section, we present the results of meteorological data collected at stations within or near the Sagavanirktok River basin, along with measurements of the snowpack throughout the basin.

4.1.1 Air Temperature

Air temperature is an important variable that controls many factors of spring breakup, such as the initiation of snowmelt, and the timing and magnitude of peak flows. For example, as reported in Toniolo et al. (2017) and Toniolo et al. (2015), widespread warming was observed throughout the Sagavanirktok River basin in May 2015, resulting in rapid snowmelt and high peak discharges during breakup.

Air temperature was measured at the following UAF stations within the Sagavanirktok River basin: Accomplishment Creek (ASM1), Saviukviayak (ASM2), Ivishak (ASM3), Sag-Ivishak (DBM4), Sagavanirktok River near MP318 (DSS4), Sagavanirktok River near MP347 (ASS1), Sagavanirktok River at Happy Valley (DSS3), Echooka (DSM1), Sagavanirktok River below the Ivishak (DSS2), Sagavanirktok River at East Bank (DSS5), and Sagavanirktok River at MP405 (DSS1). Existing data are shown in Appendix A. Air temperature is also measured by the NRCS (2017a) at Atigun Pass. Winter air temperature and air temperature prior to and during spring breakup are presented in Figure 10 through Figure 21.

In 2017, air temperatures in the upper Sagavanirktok River basin at the Atigun Pass (Figure 10) and Accomplishment Creek (ASM1) (Figure 11) stations warmed to above freezing by May 11, and remained above freezing during the day with a few exceptions. By June 1, day and night air temperatures remained mostly above freezing. Temperatures at the Saviukviayak station (ASM2), located in the upper Ivishak basin, started warming to above freezing on May 5, but cooled to below freezing between May 8 and 11 (Figure 12). After May 11, air temperatures were mostly above freezing both day and night. These three stations are the farthest south, are located at high elevations (approximately 950 to 1460 m above sea level), and represent the meteorological conditions in the mountains region, which is nearly 50% of the basin area. Warm temperatures in this region initiate the early breakup flows in the Sagavanirktok River.

Stations in the middle Sagavanirktok basin (Sagavanirktok River near MP318 [DSS4], Sagavanirktok River at Happy Valley [DSS3], Sagavanirktok River near MP347 [ASS1], Sag-Ivishak [DBM4], Ivishak [ASM3], and Echooka [DSM1]) are located in the foothills region, which represents at least 30% of the basin area. Daytime temperatures were above freezing in this region beginning May 15, but by May 19, had dropped to below freezing (Figure 13 through Figure 18). On May 24, both day and night temperatures increased to above freezing.

Further north on the coastal plain (Figure 19 through Figure 21), air temperatures remained cool through May and early June, with temperatures hovering around 0°C from May 24 to June 17. Due to low May air temperatures throughout the coastal plain, rivers with basin areas confined to the coastal plain saw a long and gradual breakup, with peak flows occurring in early June, compared with mid-May in 2015 and late May in 2016.

The general pattern observed in 2017 was similar to that observed in 2016: an initial warm-up initiated spring runoff, but air temperatures dropped, causing breakup to progress gradually with lower flows. In 2016, coastal plain temperatures increased to above freezing in late May, whereas in 2017, temperatures did not increase until well into June. As previously mentioned, high discharges were observed during breakup in 2015 due to rapid warming throughout the entire Sagavanirktok basin.

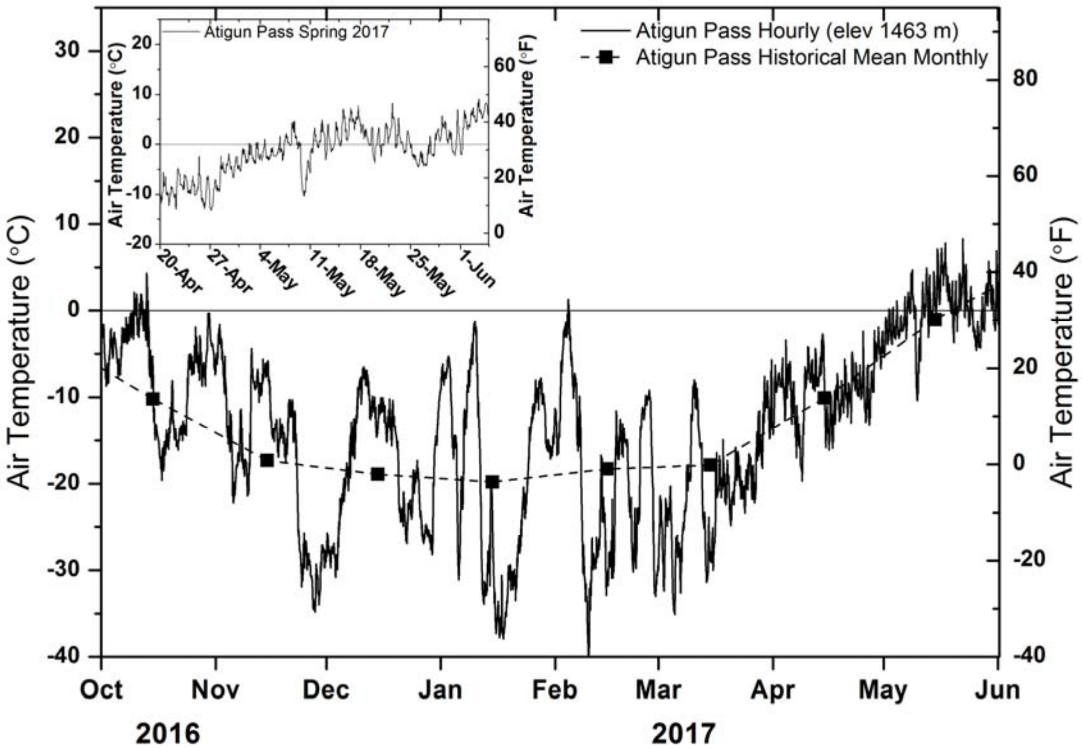


Figure 10. Atigun Pass (NRCS, 2017a) air temperatures for winter 2016/2017.

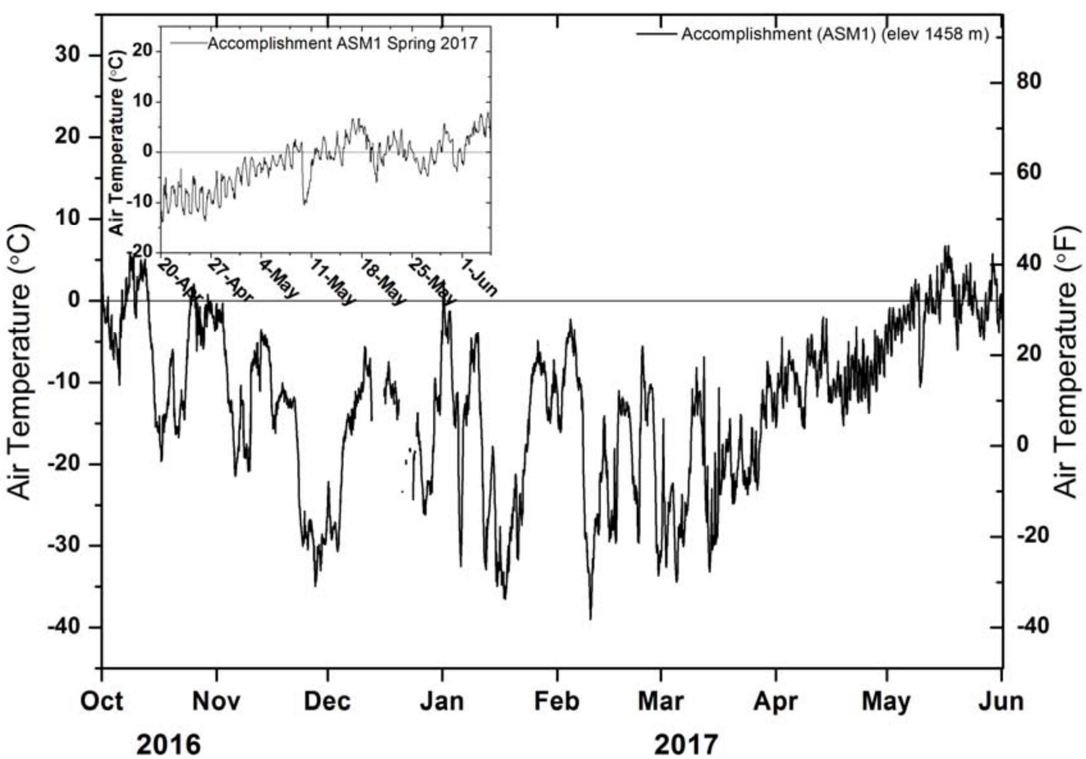


Figure 11. Accomplishment Creek (ASM1) air temperatures for winter 2016/2017.

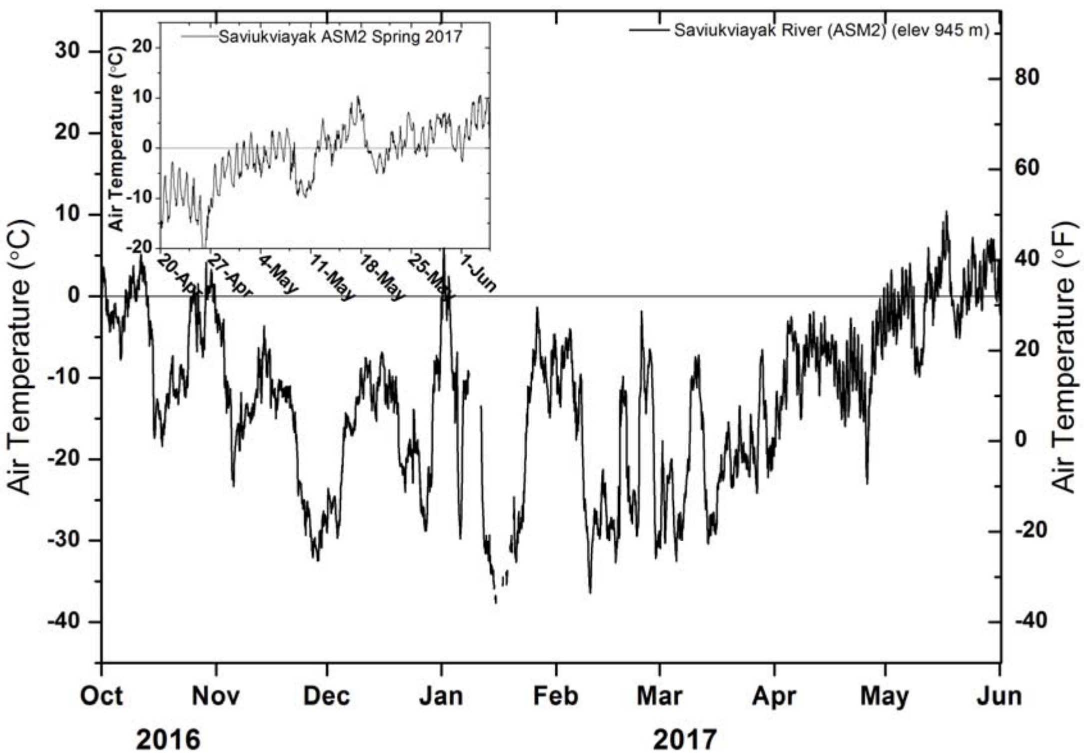


Figure 12. Saviukviayak (ASM2) air temperatures for winter 2016/2017.

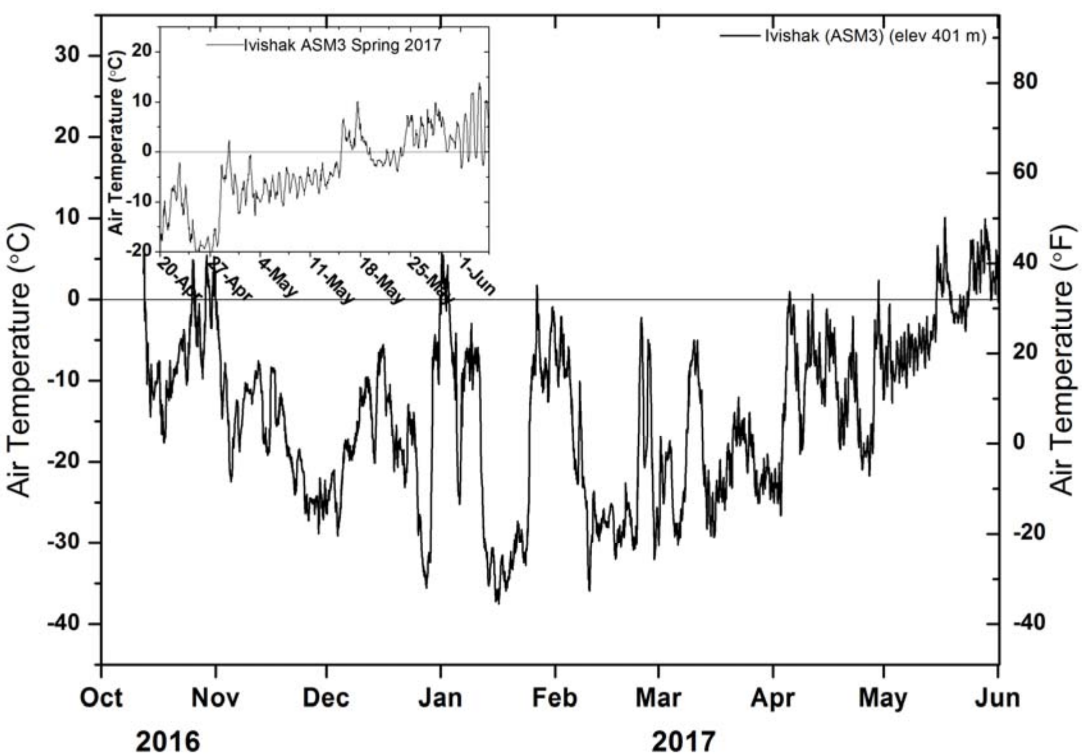


Figure 13. Ivishak (ASM3) air temperatures for winter 2016/2017.

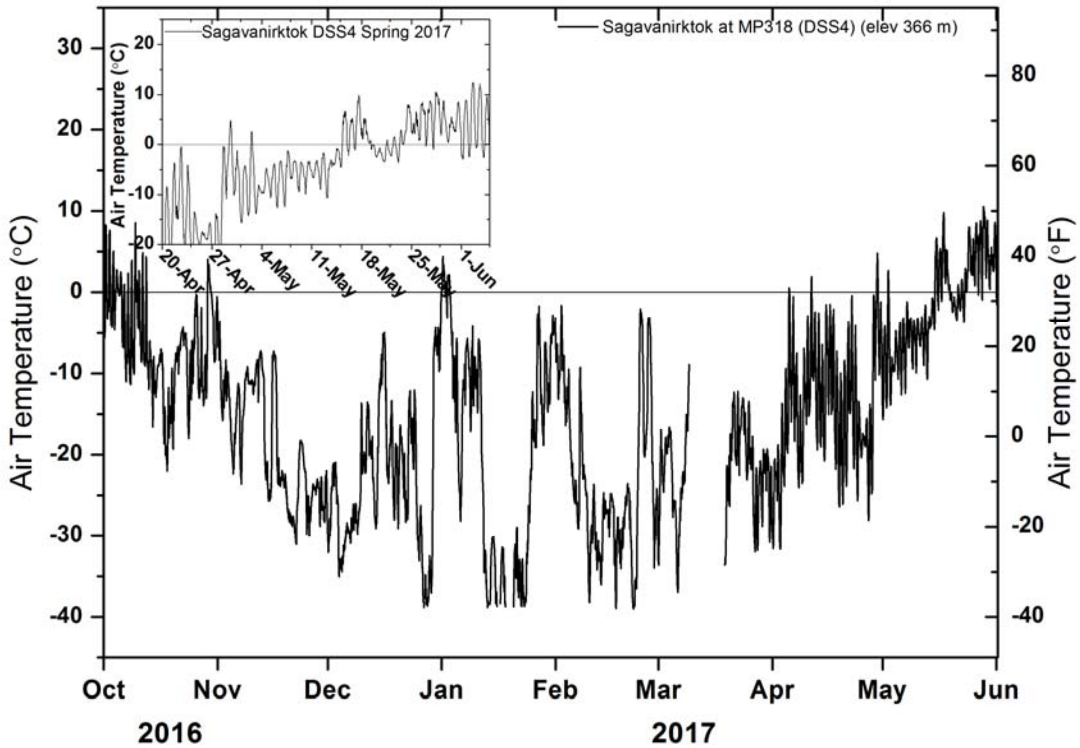


Figure 14. Sagavanirktok River at MP318 (DSS4) air temperatures for winter 2016/2017.

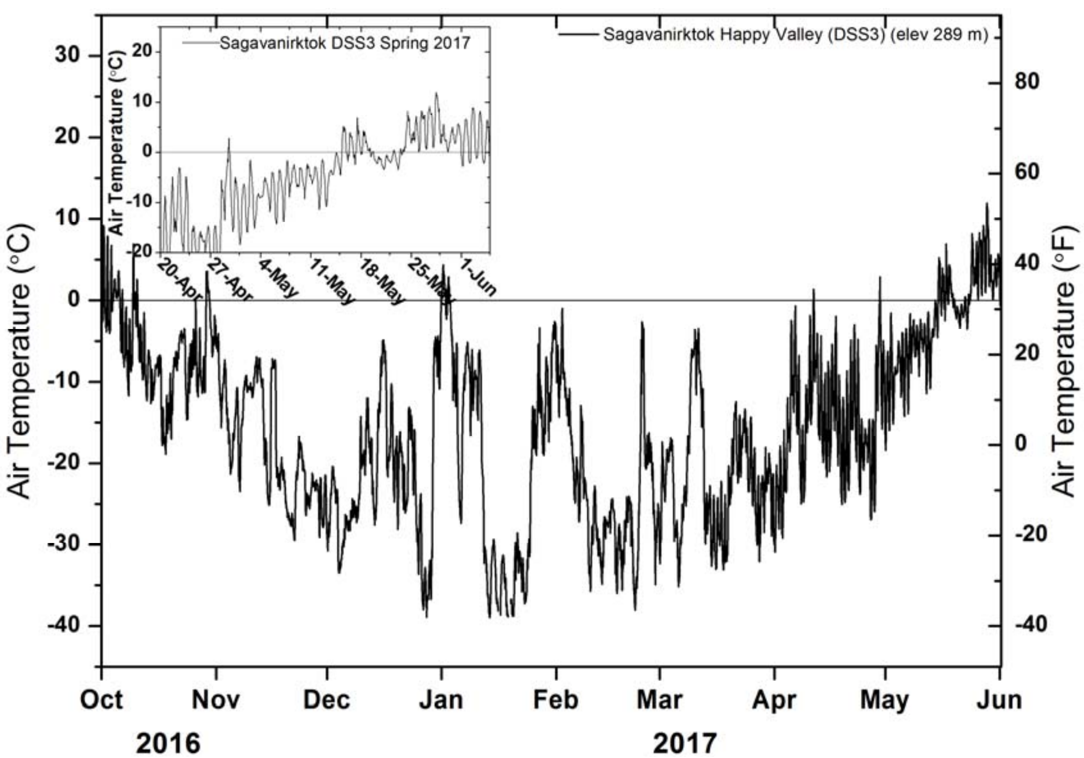


Figure 15. Sagavanirktok River at Happy Valley (DSS3) air temperatures for winter 2016/2017.

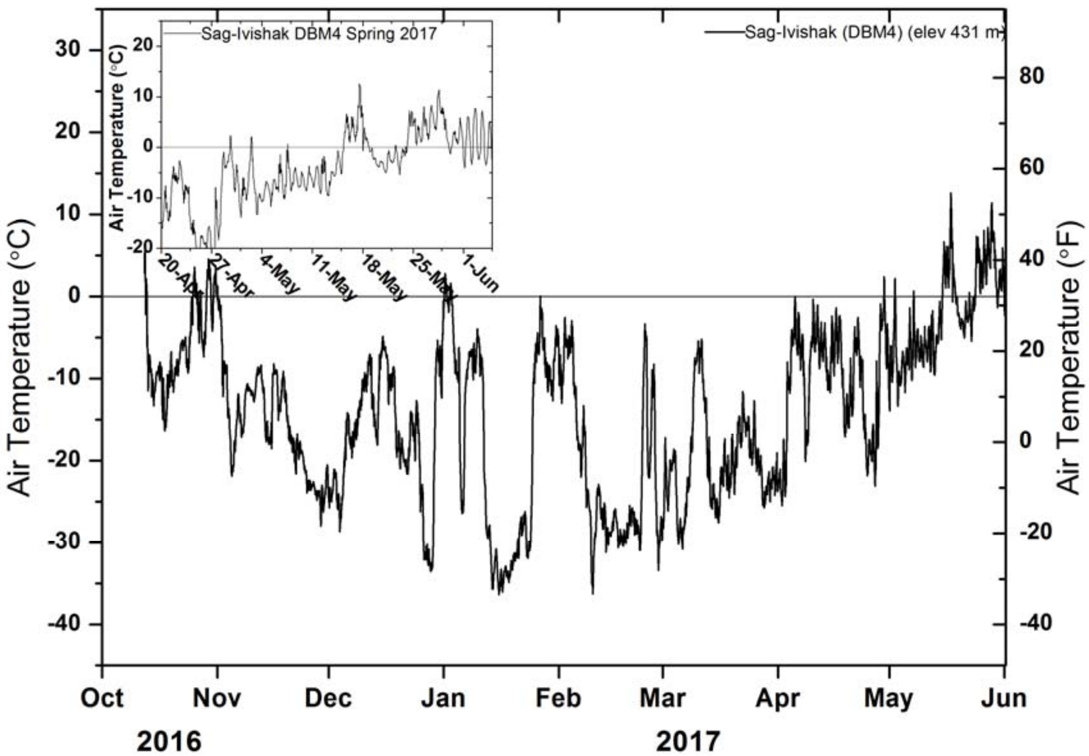


Figure 16. Sag-Ivishak (DBM4) air temperatures for winter 2016/2017.

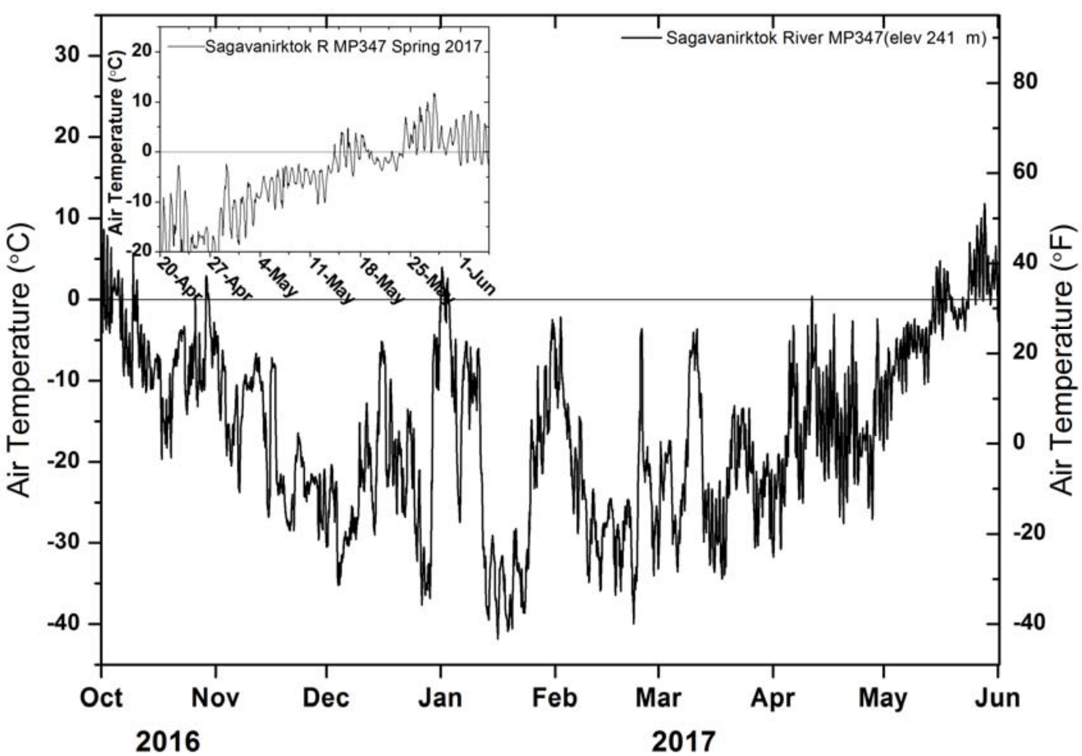


Figure 17. Sagavanirktok River near MP347 (ASS1) air temperatures for winter 2016/2017.

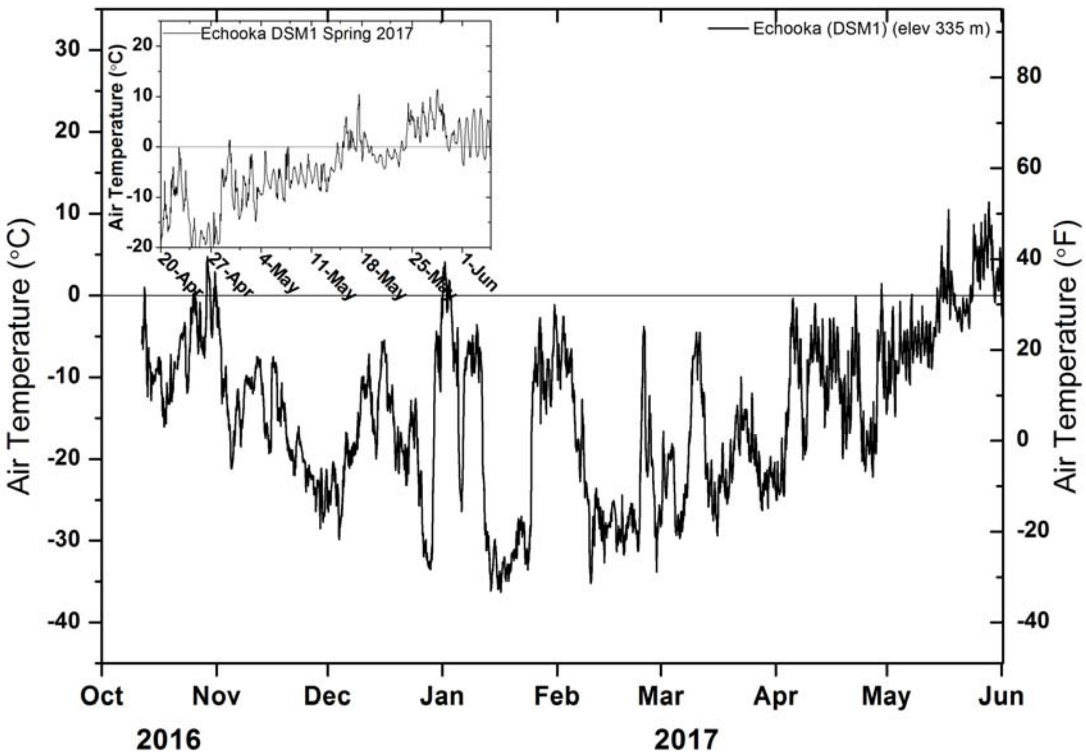


Figure 18. Echooka (DSM1) air temperatures for winter 2016/2017.

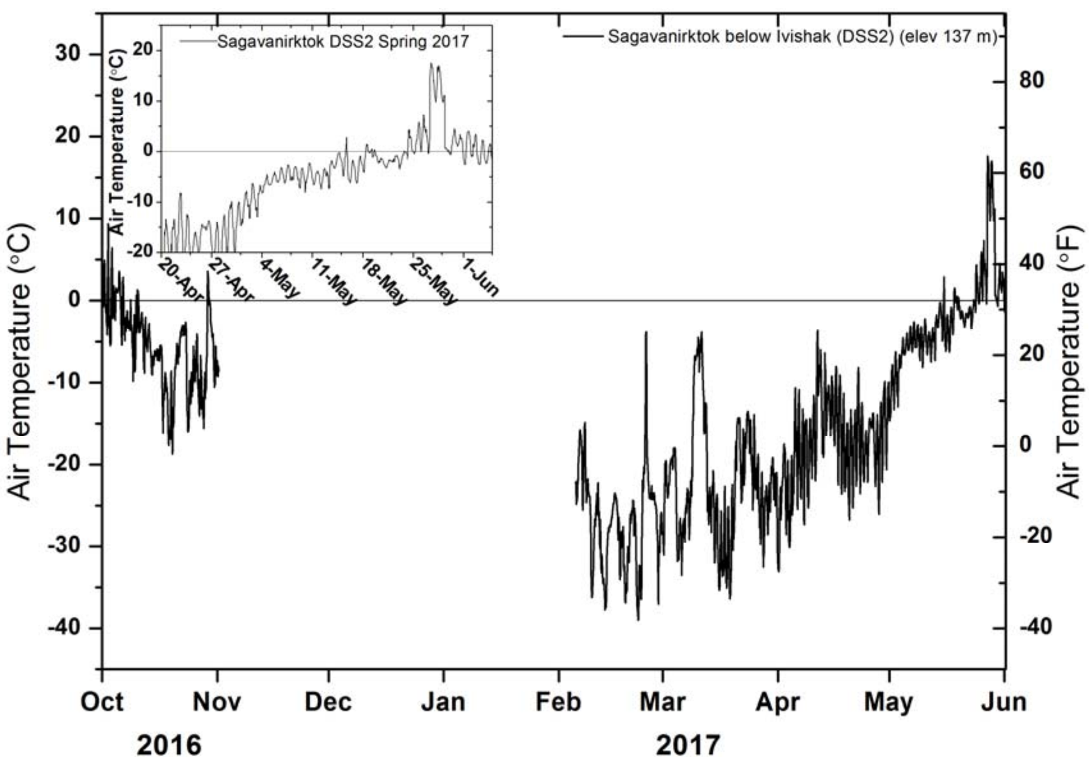


Figure 19. Sagavanirktok River below Ivishak River (DSS2) air temperatures for winter 2016/2017. Loss of data from November 2016 to February 2017 was due to a radio telemetry outage and full datalogger.

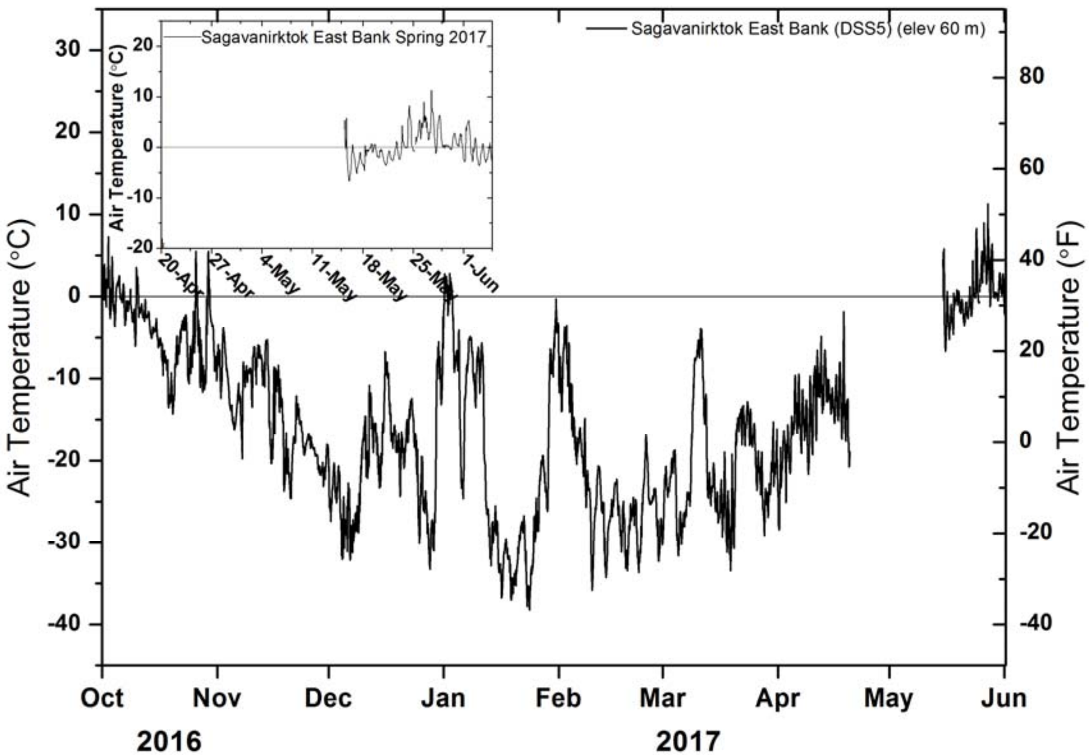


Figure 20. Sagavanirktok River at East Bank (DSS5) air temperatures for winter 2016/2017. Missing data in May 2017 due to loss of power at station.

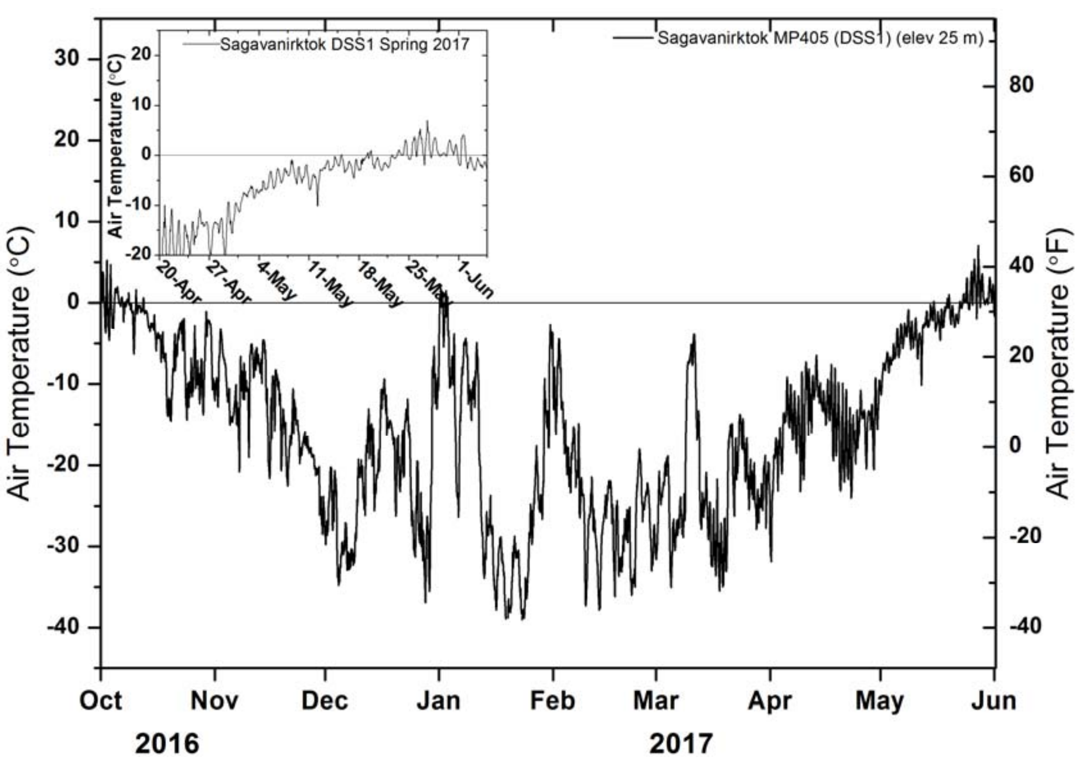


Figure 21. Sagavanirktok River near MP405 (DSS1) air temperatures for winter 2016/2017.

4.1.2 Precipitation

Attempts were made to measure both cold and warm season precipitation throughout the Sagavanirktok River basin. We measured cold season precipitation with snow depth sensors at the meteorological stations. We conducted snow surveys at the end of winter, measuring snow depth and SWE. In the summer months, tipping bucket rain gauges (which are shielded to reduce undercatch) monitor rainfall at most meteorological stations. In this section of the report, we present the results of our efforts to measure precipitation in 2016 and 2017.

4.1.2.1 Cold Season Precipitation

Kane et al. (2014) and Stuefer et al. (2014) attempted to quantify cold season precipitation by measuring end-of-winter snow density, depth, and SWE at selected locations within the Kuparuk, Sagavanirktok, and adjacent basins. The research teams found that the amount of SWE at winter's end in these basins varied little from that at the coastal plain to the continental divide in the Brooks Range (Homan and Kane, 2015; Kane et al., 2014). They also found spatial variation of snow depth and SWE at the scale of a few kilometers or less due to redistribution of snow (Kane et al., 2014).

In April 2016 and 2017, UAF researchers visited snow survey sites previously established in the Sagavanirktok River watershed (Kane et al., 2014; Stuefer et al., 2014). Snow depth and SWE measurements were made at 32 locations (Table 6, Figure 22, and Figure 23) in mid-April, and represent end-of-winter snowpack conditions. Section 3.2 describes the methodology used to measure SWE.

Nearly half of the sites are located in the mountains region of the basin. In this region, snow depth and SWE are highly variable due to blowing snow and variable topography. Vegetation influences snow depth and SWE. Tall shrubs, common at the stream channel, trap windblown snow and cause higher snow depth and SWE than that measured in the surrounding area. For winter 2016/2017, SWE in the mountains region (n=16) ranged from 2 to 16 cm, with a median of 8 cm. Measurements of SWE at coastal plain sites (n=8) tended to be more similar, ranging from 5 to 13 cm, with a median of 10 cm. In winter 2015/2016, SWE in the mountains region (n=16) ranged from 0 to 20 cm, with a median of 10 cm. On the coastal plain (n=8), SWE ranged from 4 to 10 cm, with a median of 6 cm.

Table 6. End-of-winter snow survey results for spring 2017.

#	Station ID	Survey Date	Elevation (m)	Lat WGS84	Long WGS84	Snow Depth (cm)	(in.)	Snow Density (kg/m³)	(Slug/ft³)	SWE (cm)	(in.)
1	Atigun Pass	04/20/17	1469	68.13	-149.48	60	24	254	0.49	15.3	6.0
2	DBM1	04/16/17	1474	68.41	-148.14	117	46	140	0.27	16.3	6.4
3	DBM2	04/15/17	1478	68.64	-147.35	126	50	130	0.25	16.4	6.5
4	DBM4	04/15/17	431	69.22	-148.55	46	18	96	0.19	4.4	1.7
5	ECH1	04/15/17	868	69.10	-146.83	57	22	179	0.35	10.2	4.0
6	Franklin Bluffs	04/17/17	71	69.89	-148.77	34	13	233	0.45	7.9	3.1
7	FH1	04/15/17	548	68.87	-148.52	82	32	145	0.28	11.8	4.6
8	FH2	04/15/17	400	69.13	-147.92	80	31	111	0.22	8.9	3.5
9	FH3	04/15/17	524	69.23	-147.62	51	20	141	0.27	7.1	2.8
10	Galbraith	04/18/17	831	68.48	-148.50	51	20	277	0.54	14.2	5.6
11	Happy Valley	04/18/17	314	69.15	-148.84	84	33	249	0.48	20.9	8.2
12	IVI1	04/15/17	521	68.98	-147.23	62	24	105	0.20	6.5	2.6
13	IVI2	04/15/17	810	68.75	-146.82	58	23	79	0.15	4.6	1.8
14	LUP1	04/16/17	747	68.68	-148.04	90	35	104	0.20	9.4	3.7
15	MI1	04/18/17	48	70.00	-148.68	37	15	217	0.42	8.1	3.2
16	MI2	04/17/17	60	69.93	-148.77	35	14	284	0.55	10.0	3.9
17	MI3	04/17/17	90	69.80	-148.74	21	8	256	0.50	5.4	2.1
18	MI4	04/17/17	90	69.71	-148.72	42	16	234	0.45	9.7	3.8
19	MI5	04/17/17	140	69.61	-148.65	46	18	217	0.42	10.0	3.9
20	MI6	04/17/17	159	69.53	-148.60	32	12	213	0.41	6.7	2.7
21	MI7	04/18/17	175	69.49	-148.57	45	18	285	0.55	13.0	5.1
22	Oil Spill Hill	04/18/17	440	68.94	-148.87	49	19	268	0.52	13.0	5.1
23	RIB1	04/16/17	609	68.62	-148.15	52	21	89	0.17	4.7	1.8
24	RIB2	04/15/17	800	68.48	-147.84	20	8	104	0.20	2.0	0.8
25	RIB3	04/15/17	918	68.69	-147.48	93	37	98	0.19	9.1	3.6
26	SAG1	04/16/17	730	68.42	-148.96	25	0	126	0.24	3.2	1.3
27	SAG2	04/16/17	868	68.26	-148.83	74	29	90	0.17	6.7	2.6
28	SAG3	04/16/17	830	68.45	-148.70	46	18	149	0.29	6.8	2.7
29	Sagwon	04/18/17	275	69.43	-148.69	34	13	182	0.35	6.1	2.4
30	SAV1	04/15/17	955	68.77	-147.43	98	39	101	0.20	9.9	3.9
31	UP1	04/15/17	194	69.23	-148.45	25	10	94	0.18	2.4	0.9
32	UP2	04/15/17	318	69.34	-147.85	89	35	195	0.38	17.4	6.9
Basin Average						58	23	170	0.33	9.3	3.7

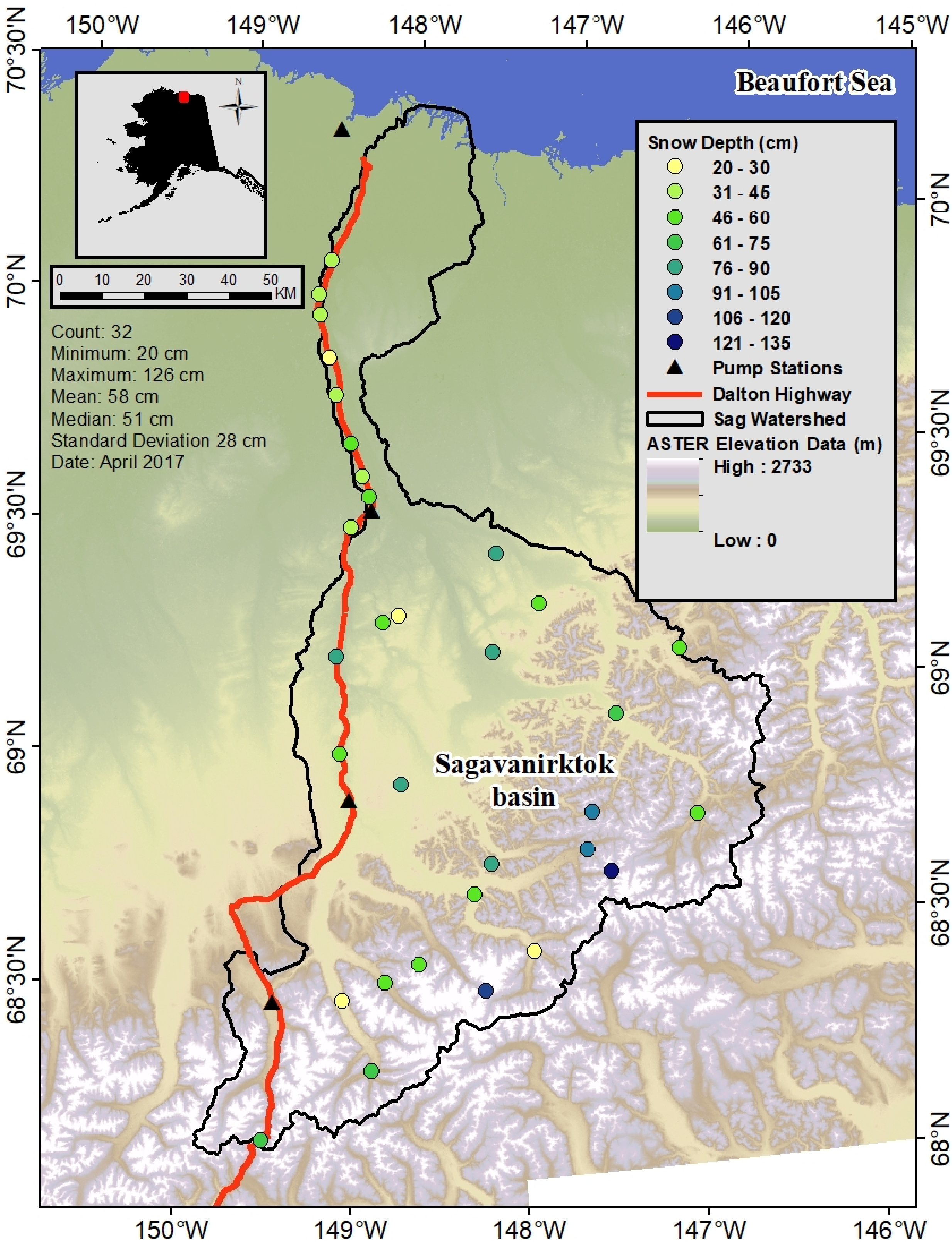


Figure 22. Snow depth at sites in the Sagavanirktok basin in April 2017.

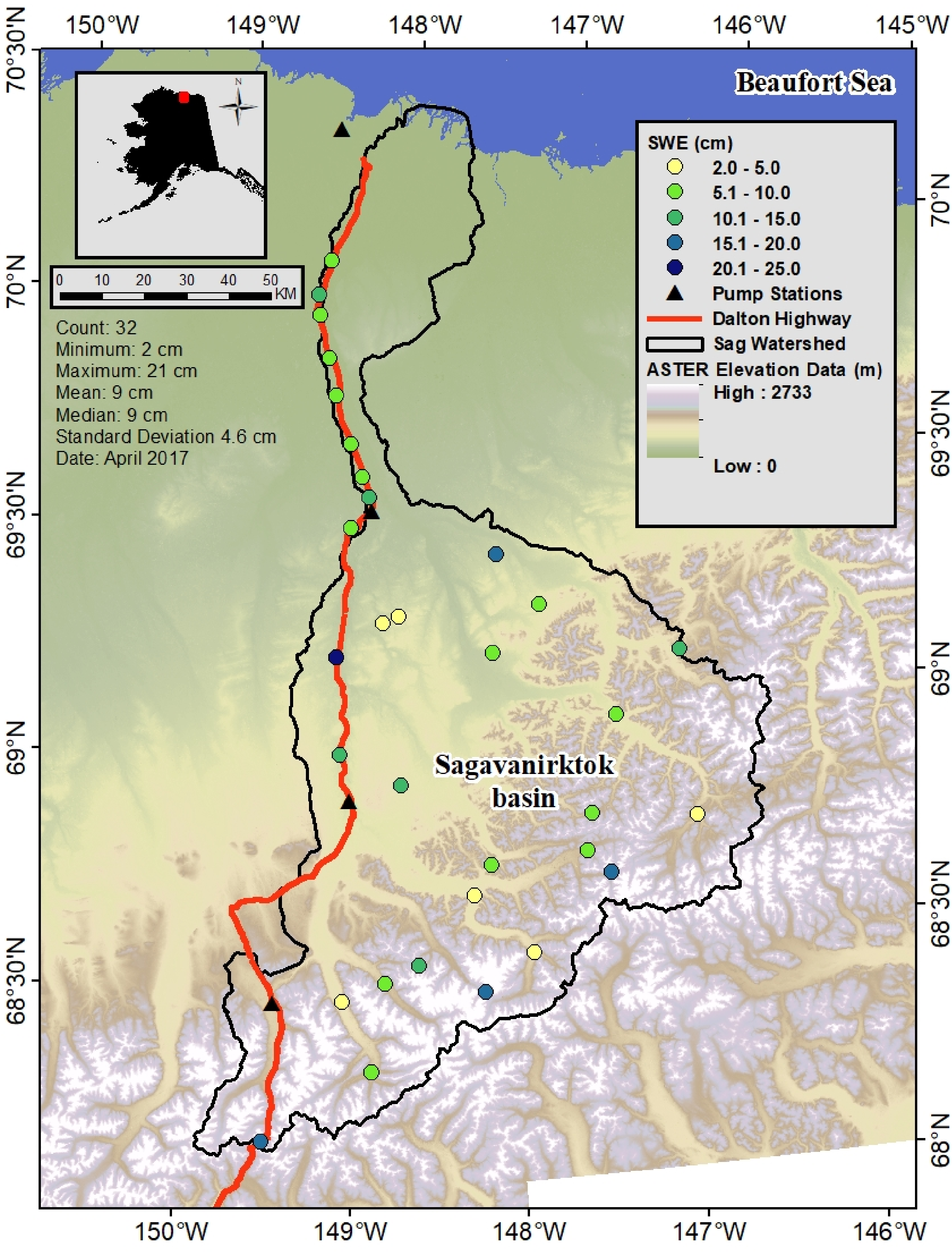


Figure 23. Snow water equivalent (SWE) at sites in the Sagavanirktok basin in April 2017.

End-of-winter SWE measured in 2017 was compared with historical measurements for each snow survey site (Table 7). The comparison shows that average SWE for the Sagavanirktok basin was near normal or slightly below normal for winter 2016/2017, similar to what was observed in winter 2015/2016. The NRCS also conducts snow surveys each month at Imnavait Creek in the foothills and at Atigun Pass in the mountains. The NRCS reported near-normal snowpack conditions for the end of winter (April 2017) in the Arctic region (NRCS, 2017b).

Table 7. Comparison of 2017 snowpack with the historical record (Stuefer et al., 2011; Stuefer et al., 2012; Stuefer et al., 2014; Kane et al., 2006; Kane et al., 2012; Berezovskaya et al., 2007; Berezovskaya et al., 2008; Berezovskaya et al., 2009) in the Sagavanirktok basin. Locations are presented in Table 6.

#	Station ID	Period of Record	Number of Years	Elevation (m)	2017 SWE		Historical SWE		Difference	
					(cm)	(in.)	(cm)	(in.)	(cm)	(in.)
1	Atigun Pass	2010, 16	2	1469	15	6	16	6	-1	0
2	DBM1	2007-10, 16	5	1474	16	6	13	5	3	1
3	DBM2	2007-10, 16	5	1478	16	6	12	5	4	2
4	DBM4	2007-10, 16	5	431	4	2	10	4	-6	-2
5	ECH1	2006-10, 16	6	868	10	4	13	5	-2	-1
6	Franklin Bluffs	2000-13, 16	15	71	8	3	11	4	-3	-1
10	Galbraith	2010-13, 16	5	831	14	6	11	4	3	1
11	Happy Valley	2000-13, 16	15	314	21	8	21	8	0	0
12	IVI1	2006-10, 16	6	521	6	3	6	2	0	0
13	IVI2	2006-10, 16	6	810	5	2	9	4	-5	-2
14	LUP1	2006-10, 16	6	747	9	4	9	3	1	0
15	MI1	2001-13, 16	14	48	8	3	9	3	0	0
16	MI2	2001-13, 16	14	60	10	4	9	4	1	0
17	MI3	2001-13, 16	13*	90	5	2	7	3	-2	-1
18	MI4	2001-13, 16	13*	90	10	4	10	4	0	0
19	MI5	2001-13, 16	13*	140	10	4	9	3	1	1
20	MI6	2001-13, 16	13*	159	7	3	13	5	-7	-3
21	MI7	2001-13, 16	13*	175	13	5	11	4	2	1
22	Oil Spill Hill	2010-13, 16	5	440	13	5	12	5	1	1
23	RIB1	2007-10, 16	5	609	5	2	7	3	-2	-1
24	RIB2	2007-10, 16	5	800	2	1	5	2	-3	-1
25	RIB3	2007-10, 16	5	918	9	4	9	4	0	0
26	SAG1	2006-13, 16	7*	730	3		2	1	1	-1
27	SAG2	2006-13, 16	9	868	7	3	12	5	-5	-2
28	SAG3	2006-13, 16	9	830	7	3	7	3	0	0
29	Sagwon	2000-13, 16	15	275	6	2	7	3	-1	0
30	SAV1	2006-10, 16	6	955	10	4	11	4	-1	0
31	UP1	2006-10, 16	5*	194	2	1	7	3	-5	-2
32	UP2	2006-10, 16	6	318	17	7	10	4	7	3
Basin Average					9	4	10	4	-1	0

Notes: * Missing 1 or more years during surveyed record

In addition to conducting end-of-winter snow surveys, UAF researchers installed sonic snow depth sensors at several stations within the Sagavanirktok River basin. The sensors measure snow depth below the sensor throughout the winter on an hourly timestep. Sensors were installed at Accomplishment Creek (ASM1), Ivishak (ASM3), Sag-Ivishak (DBM4), and Echooka (DSM1) and operated during the winter of 2016/2017. Results are shown in Appendix B. Maximum snow depth according to the snow depth sensors ranged from ~135 cm at Accomplishment Creek in the mountains, to ~50 cm (Sag-Ivishak) in the foothills, which compares well with measured average snow depth during the end-of-winter (April) snow survey. The average snow depth at Accomplishment Creek during the April 2017 snow survey was 117 cm (sensor measured 135 cm). The average snow depth at Sag-Ivishak was 46 cm (sensor measured 50 cm).

4.1.2.2 Warm Season Precipitation

As mentioned previously, precipitation varies with location, most noticeably in summer. Rainfall greatly increases with elevation (southward). Since most of the Sagavanirktok River basin lies in the mountains and foothills regions (over 75% of the basin area), we have examined rainfall data from these higher elevations to better understand runoff and the water balance. Unfortunately, rainfall data for the mountains and foothills regions are limited, particularly data for the Brooks Range. Long-term rainfall data are available from stations at Atigun Pass in the mountains, Imnavait Creek in the foothills, and Franklin Bluffs on the coastal plain (NRCS, 2016a; Kane, 2014; Arp and Stuefer, 2017).

Cumulative rainfall data are now available at several recently installed stations within the Sagavanirktok River basin: Saviukviayak (ASM2), Sag-Ivishak (DBM4), Ivishak (ASM3), Sagavanirktok River near MP318 (DSS4), Echooka (DSM1), and Sagavanirktok River near MP347 (ASS1). Data for rainfall measured at the Accomplishment Creek (ASM1) station are not presented due to a suspected malfunction of the tipping bucket rain gauge. Figure 24 shows cumulative rainfall during the warm season at the study area stations for 2016 and 2017. The warm season of 2016 was relatively wet, compared with the warm season in 2017. Summer across the North Slope in 2017 was very dry in June and early July. However, late summer and early fall were wet, beginning with a widespread rain event from July 20 through 25 that caused an increase in discharge in the Sagavanirktok River. Approximately 64 mm of rain fell at the mountain station Saviukviayak (ASM2) during this event.

We examined cumulative rainfall at station DBM4 Sag-Ivishak for the period of record (Figure 25). This station, located in the foothills region, was installed in 2007 (Kane et al., 2012) and removed in late summer 2010. We re-installed the station in late fall 2016 for this project. Rainfall at this site is variable, ranging from 50 to 225 mm per year, based on a 5-year period of record. A drought occurred in 2007 throughout the North Slope region, as reflected by low summer precipitation observed at the Sag-Ivishak station (50 mm of rain). In late June 2008, a record rain event occurred at the Sag-Ivishak station, where 47 mm of precipitation fell over a 7-hour period.

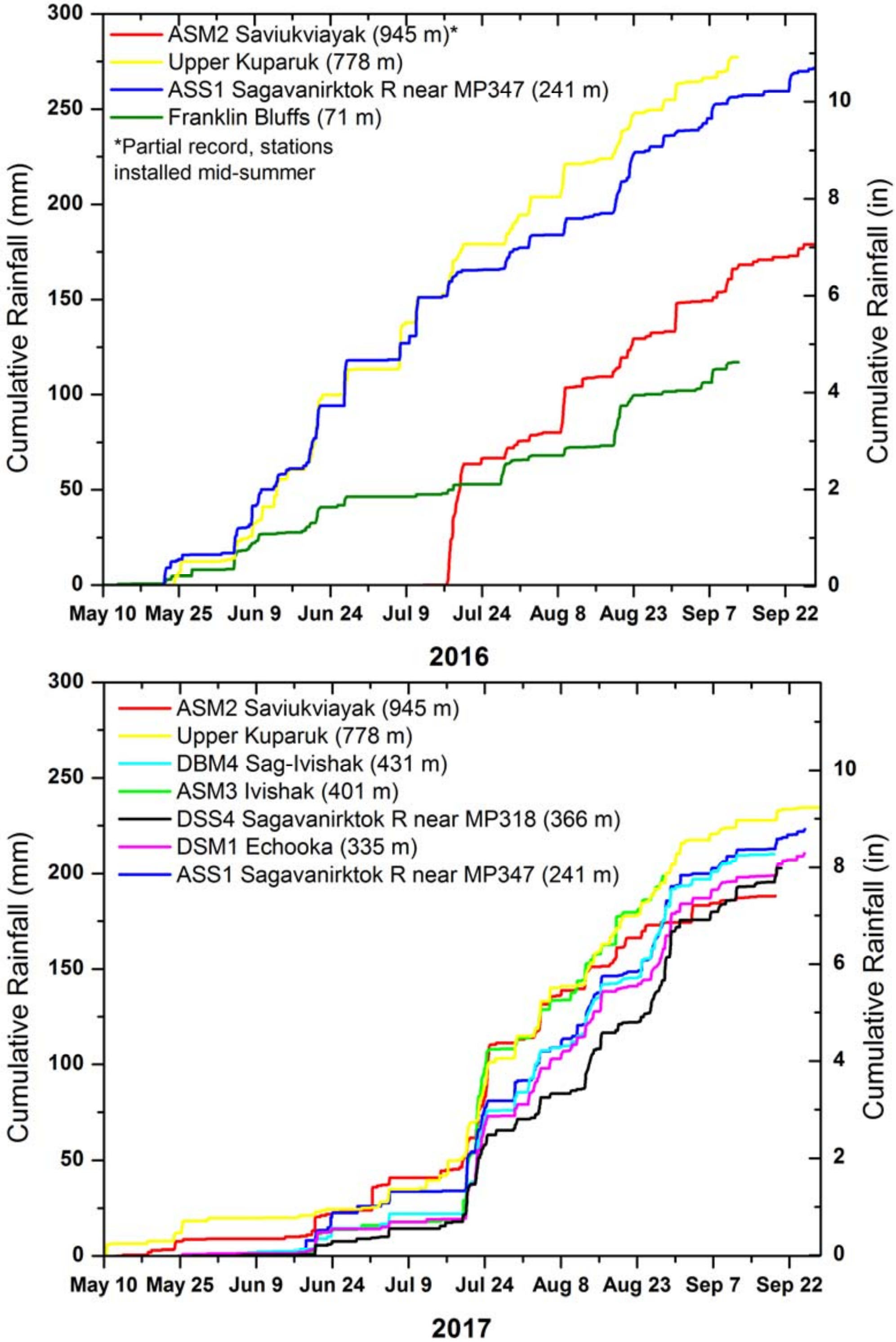


Figure 24. Cumulative rainfall at stations in or near the Sagavanirktok River basin, 2016 and 2017. For 2016, the total summer rainfall plotted is lower than the actual total because several stations were installed mid-summer (Upper Kuparuk, Franklin Bluffs data from Arp and Stuefer, 2017).

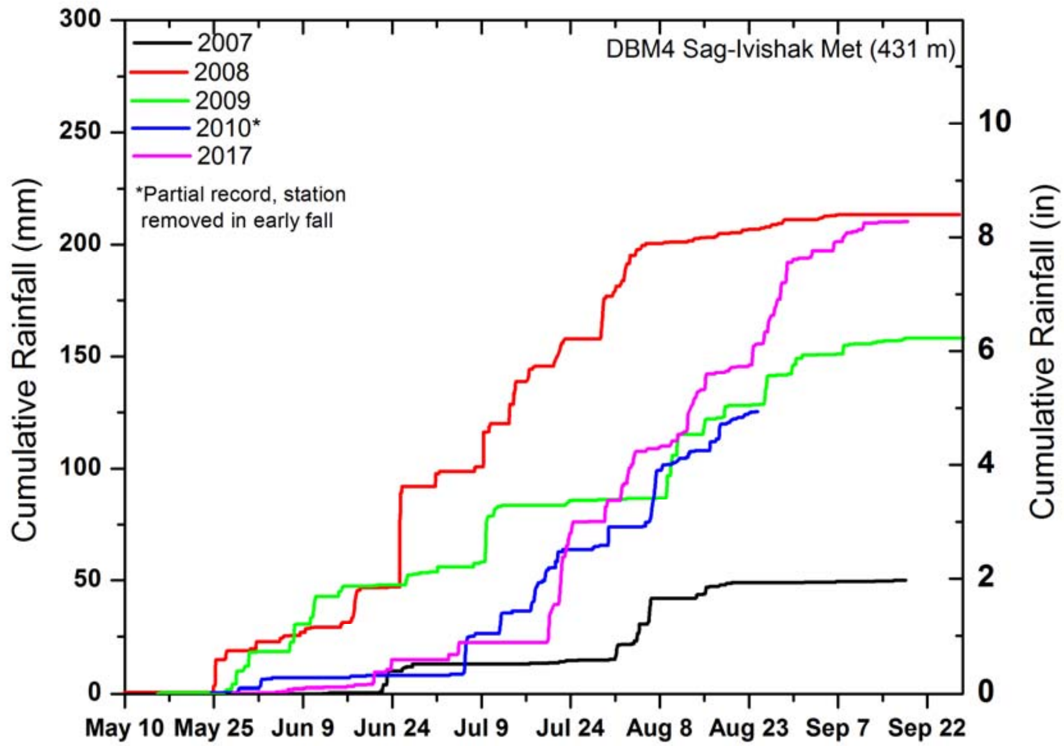


Figure 25. Cumulative rainfall at DBM4 Sag-Ivishak station for the period of record, 2007–2010 (Kane et al., 2012).

4.1.3 Wind Speed and Direction

Wind speed and direction are measured at the following stations within the Sagavanirktok River basin: Saviukviayak (ASM2), Ivishak (ASM3), Sag-Ivishak (DBM4), Sagavanirktok River near MP318 (DSS4), Sagavanirktok River near MP347 (ASS1), Sagavanirktok River at Happy Valley (DSS3), Echooka (DSM1), Sagavanirktok River below the Ivishak (DSS2), Sagavanirktok River at East Bank (DSS5), and Sagavanirktok River at MP405 (DSS1). Wind roses were plotted for each station for the (1) period of record, (2) summer months (May 15 through September 15), and (3) winter months (September 16 through May 14) (see Appendix C). Table 8 is a summary of the wind conditions at each station. Wind data for the Sagavanirktok River near MP347 (ASS1) presented in Toniolo et al. (2016a) were updated in this report because errors were found in the alignment of the sensor. Wind data from Accomplishment Creek (ASM1) that were reported in Toniolo et al. (2016a) should not be used due to an incorrect (unknown) sensor alignment, which will be fixed on the next station visit. Historical data for the Accomplishment Creek station, however, can be found in Kane et al. (2014).

Table 8. Summary of WRPLOT wind rose analysis for the period of record. Summer period is May 15 through September 15, and winter period is September 16 through May 14. See Appendix C for wind roses.

Station	Overall Average Hourly Wind Speed (m/s)	Summer Average Hourly Wind Speed (m/s)	Winter Average Hourly Wind Speed (m/s)	Overall Calm Winds (%)	Summer Calm Winds (%)	Winter Calm Winds (%)	Total Data Count (hr)	Missing Data (hr)
Sagavanirktok near Deadhorse (DSS1)	4.5	4.0	4.8	1.2	0.4	1.8	19597	1773
Sagavanirktok East Bank (DSS5)	4.3	3.6	4.8	2.2	0.8	3.2	20629	1969
Sagavanirktok near Ivishak (DSS2)	3.1	3.2	3.0	3.0	1.4	4.0	19606	3466
Sagavanirktok near MP 347 (ASS1)	2.4	2.6	2.4	5.3	2.4	6.7	17812	635
Echooka (DSM1)	3.2	3.0	3.3	5.7	1.9	7.8	8502	178
Sag-Ivishak (DBM4)	2.9	2.9	2.9	3.4	1.0	4.7	44244	2663
Sagavanirktok at Happy Valley (DSS3)	2.1	2.4	1.9	6.1	2.3	8.6	19665	1
Sagavanirktok near MP318 (DSS4)	1.7	1.8	1.6	8.0	4.3	10.4	19419	280
Ivishak (ASM3)	1.7	2.1	1.5	6.4	2.3	9.4	10838	2062
Saviukviayak (ASM2)	2.8	2.7	2.8	4.7	2.8	6.2	10694	175

At most of the stations throughout the region, winter winds blow from the south, and summer winds blow from the north-northeast. For stations located adjacent to the river, wind direction is often influenced by winds channeling up and down the valley bottom. At stations in the Brooks Range, such as Saviukviayak (ASM2) and Accomplishment Creek (ASM1), wind direction is affected by mountainous topography. Farther north on the coastal plain, near Franklin Bluffs at the Sagavanirktok River near MP405 (DSS1) and East Bank (DSS5) stations, winds blow from the east-northeast year-round, but in the winter months strong winds also blow from the southwest. Wind speeds are highest on the coastal plain; they decrease toward the south. The percentage of calm winds was higher in winter than in summer, but it is possible that riming of the wind sensor resulted in lower than actual wind speeds. Obvious periods of sensor riming were removed from the dataset.

4.2 Aufeis Extent

In this section, we present the results of efforts to delineate the aufeis deposit on the Sagavanirktok River near Deadhorse and Franklin Bluffs. In 2015, widespread flooding during spring breakup occurred due to extensive ice that had accumulated over the winter. The spring flooding resulted in significant damage to the Dalton Highway, and during that summer and fall, the road was rebuilt, up to 1.2 m (4 ft) higher in many places. In the winters of 2015/2016 and 2016/2017, additional efforts were taken to monitor the growth and extent of the ice formation with aerial imagery and field methods.

We used two approaches to delineate the aufeis extent for 2015, 2016, and 2017: (1) field GPS surveys of ice surface elevation and (2) aerial imagery. Here we describe the results of the elevation datasets (ground-based GPS survey and aerial surveys/imagery) and how we used the datasets to show change in the ice thickness and extent at Franklin Bluffs in 2015, 2016, and 2017.

4.2.1 Historical Aufeis at Franklin Bluffs

We used Landsat satellite imagery (NIR band) to examine the aufeis extent in the Sagavanirktok River floodplain near Franklin Bluffs, as described in Toniolo et al. (2016a) and in the methodology chapter (Section 3.3.2). Toniolo et al. (2016a) showed that, over the past two decades, aufeis has consistently formed within the Sagavanirktok River floodplain and the channel between MP392 and MP397. Here we updated the analysis to include the ice extent in 2017. Figure 26 through Figure 28 show the aufeis extent from 2000 to 2017. Table 9 shows the calculated aufeis area. In the years 2003, 2004, 2007, 2008, 2013, 2015, 2016, and 2017, aufeis formation at the end of winter extended well past Franklin Bluffs. Years 2009, 2010, and 2012 had the lowest extent of aufeis cover, and years 2015 and 2016 had the highest extent of aufeis cover. Ice extent in 2017 decreased from the maximum in 2015, but is the fifth highest on record (n=18) based on Landsat imagery (Table 9). The images in Figure 26–Figure 28 show that the location and extent of aufeis vary from year to year, but areas of ice formation are persistent in the main stem of the Sagavanirktok River near Franklin Bluffs and near the dikes at MP395 (Figure 28). Ice extent in 2017 shows patterns similar to ice extent the previous 2 years despite less ice formation; ice concentrated in relatively large fields near MP400 and from MP392 to MP397. In 2017, ice thickness increased in the floodplain between the east and west channels compared with ice thickness in 2016 and 2015 (Figure 28). As mentioned in Section 3.3.2, the method we used in this study may underestimate the extent of aufeis, because the method does not include areas with fresh or windblown snow on top of aufeis. The method may also overestimate the extent of aufeis, because it does not differentiate aufeis from river ice.

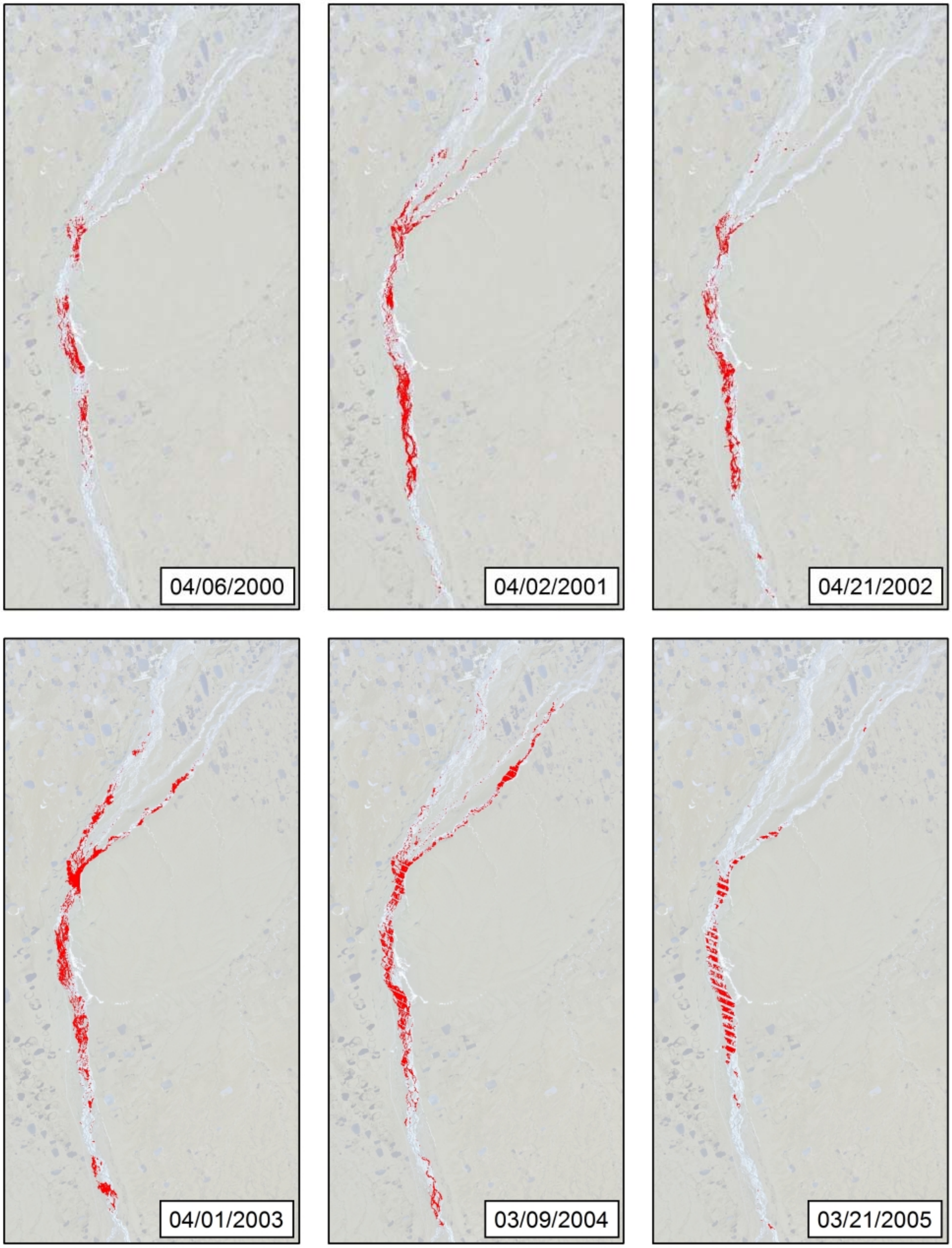


Figure 26. Landsat imagery of end-of-winter aufeis extent near Franklin Bluffs 2000–2005.

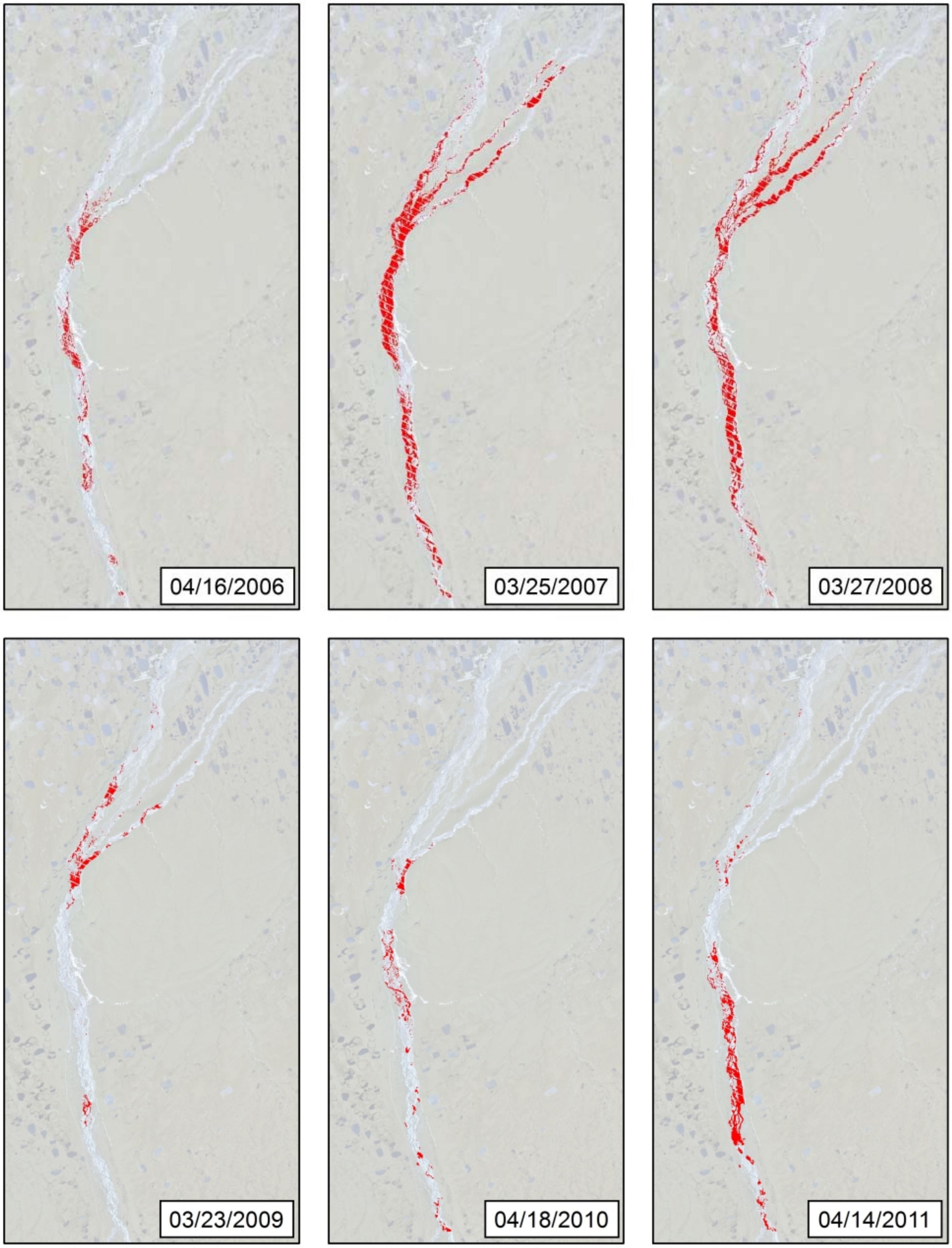


Figure 27. Landsat imagery of end-of-winter aufeis extent near Franklin Bluffs 2006–2011.

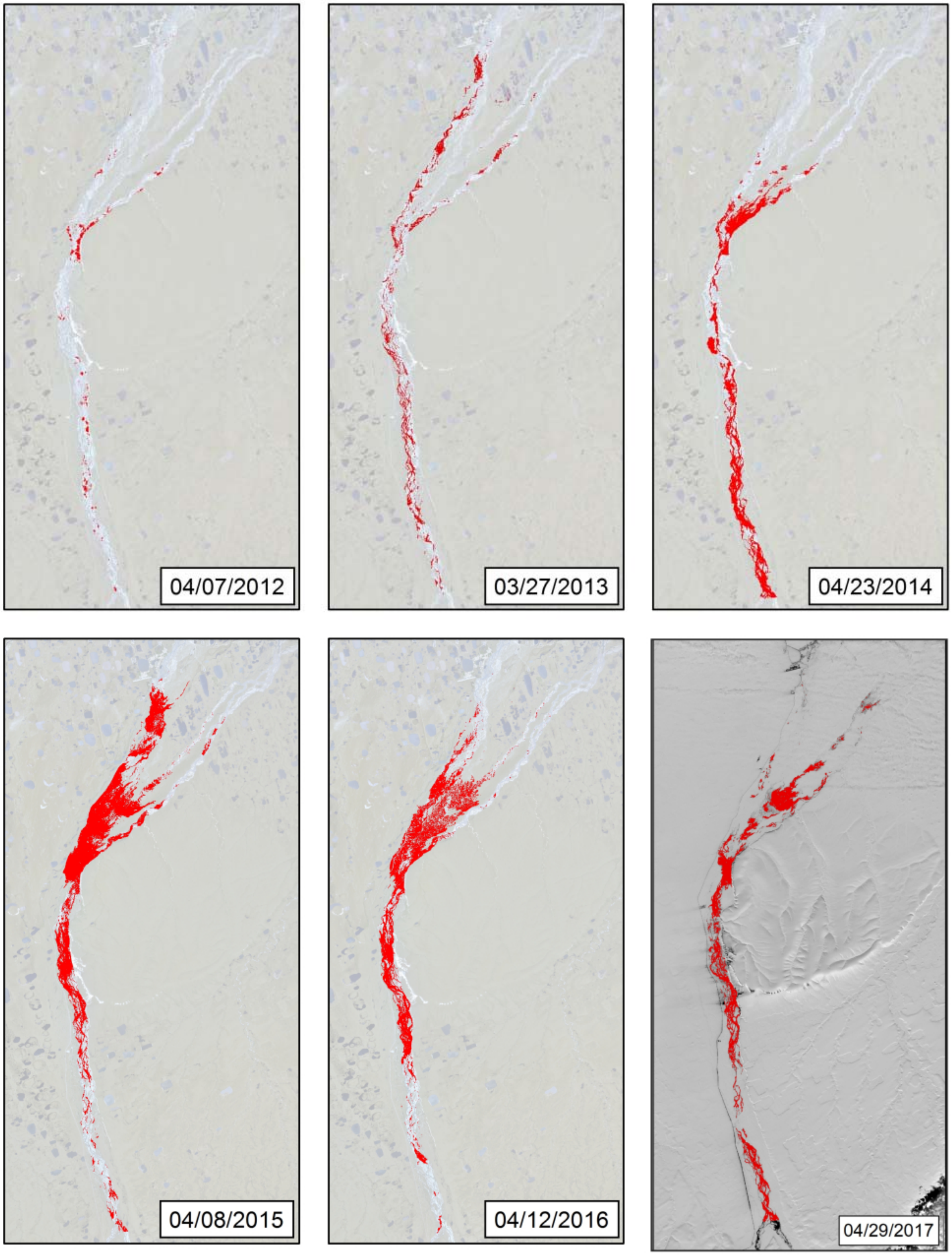


Figure 28. Landsat imagery of end-of-winter aufeis extent near Franklin Bluffs 2012–2017.

Table 9. Area of lower Sagavanirktok River aufeis based on Landsat imagery, 2000–2017.

Year	Aufeis Area (km^2)	Rank
2000	16.4	15
2001	33.1	10
2002	24.2	13
2003	43.9	8
2004	44.3	7
2005	29.5	11
2006	18.1	14
2007	73.5	3
2008	68.2	4
2009	13.7	16
2010	12.6	17
2011	29.3	12
2012	9.4	18
2013	33.3	9
2014	60.2	6
2015	116.7	1
2016	90.1	2
2017	60.3	5

4.2.2 Delineating Ice Surface Elevation with GPS and Aerial Imagery

Toniolo et al. (2016a) showed the development of aufeis in the Sagavanirktok River floodplain near Franklin Bluffs in 2016 using multiple differential GPS surveys of ice elevation. In 2017, only one GPS survey was conducted. This GPS survey, conducted on April 17, was used to calculate the thickness of the Sagavanirktok River aufeis field near Franklin Bluffs from MP386 to MP400. The 2017 GPS surveyed ice elevation data were also compared with ice elevation data from May 7, 2015, (LiDAR dataset) and May 10, 2016, (SfM dataset) for inter-year comparisons.

Figure 29 shows the ice thickness in the Sagavanirktok River floodplain in April 2017. Ice thickness was estimated using the July 2014 IfSAR DEM as the ground surface and the 2017 GPS surveyed ice surface elevation. In general, outside of the active river channel, the ice thickness is 0 to 1 m. The areas that show development of thickest ice (1 to 3 m) in 2017 are mostly in two areas: (1) east of MP392 to MP397, primarily in the eastern side of the channel, and (2) east of MP400 in between the east and west channels of the Sagavanirktok River. However, thick ice also develops along localized pressure ridges (see Figure 30). In 2017, the thickest ice near MP392 to MP397 was primarily along the steep bluffs on the east side of the channel. At the downstream end of the river (north of MP395), the main channel splits into an east channel and a west channel as the river flows to the Beaufort Sea. At the large ice field east of MP400, ice is thickest in the eastern part of the west channel and in the region between the east and west channels. The east channel of the Sagavanirktok River was not GPS surveyed in 2017; however, photographs from field crews show extensive ice both in the floodplain between the east and west channels and in parts of the east channel itself during spring breakup (Figure 31).

Figure 32 compares late winter ice thickness in 2017 with that in 2015. Figure 33 compares late winter ice thickness in 2017 with that in 2016. In general, ice thickness in both 2015 and 2016 was greater than in 2017 across most of the study area. However, many points in the figures show little to no change from year to year, suggesting aufeis accumulates in the Franklin Bluffs region each year. Outside of the main river channels, ice thickness in 2017 was less than in the two prior years. The exception to this was in the extensive ice fields to the east of MP392 to MP397 and MP400. In 2017, these two areas likely contained the highest volumes of ice. The ice appears to be thicker in 2017 than in both 2015 and 2016. The ice field east of MP392 to MP397 is relatively close to the highway, whereas the ice field east of MP400 extends eastward away from the highway and into the floodplain between the east and west river channels. These two ice fields are notable in the 2017 Landsat analysis of aufeis extent (Section 4.2.1), which shows these areas having the greatest lateral extent of aufeis.

We examined the difference between the 2015 and 2016 aufeis formations. We compared the LiDAR (May 2015) and the SfM (May 2016) ice elevation datasets at the location of the GPS survey points in 2017. Ice thickness in 2016 was generally thinner than in 2015 (Figure 34). The exception to this occurs near MP400 of the Dalton Highway (Figure 34), where thicker ice accumulated in a few areas between the east and west channels in 2016.

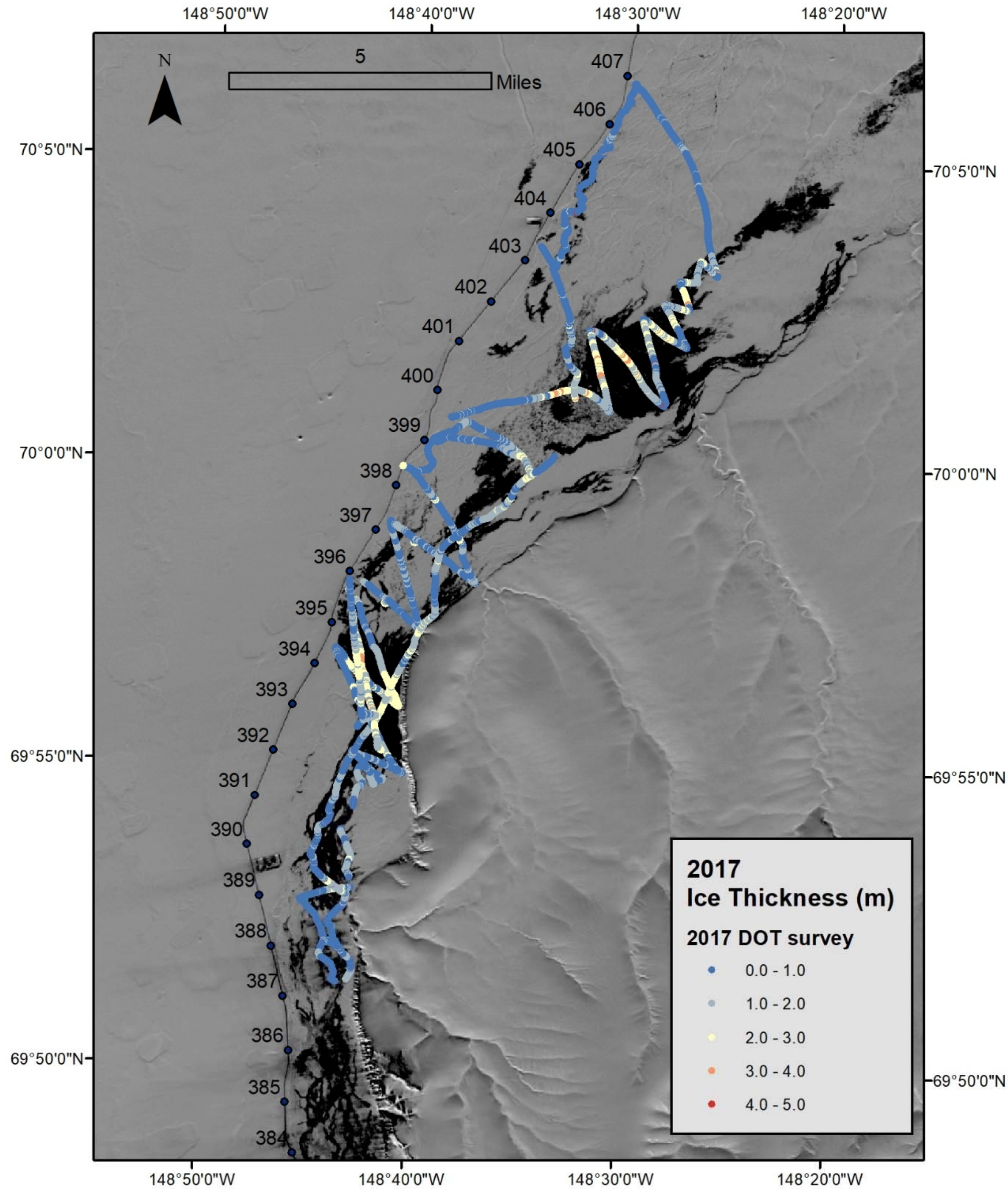


Figure 29. Ice thickness near Franklin Bluffs, derived from the GPS survey conducted on April 17, 2017. Ice was the thickest east of MP393 and in the floodplain between the east and west channels at MP400. Background image (Landsat 8) shows areas of active overflow (black) on April 29, 2017.

Figure 30. Example of pressure ridge in the Sagavanirktok River floodplain near Franklin Bluffs.

Figure 31. Southeast-facing photograph of the Sagavanirktok River west channel near MP400. Extensive aufeis is visible in between the east and west channels (beyond the flowing water) on May 31, 2017.

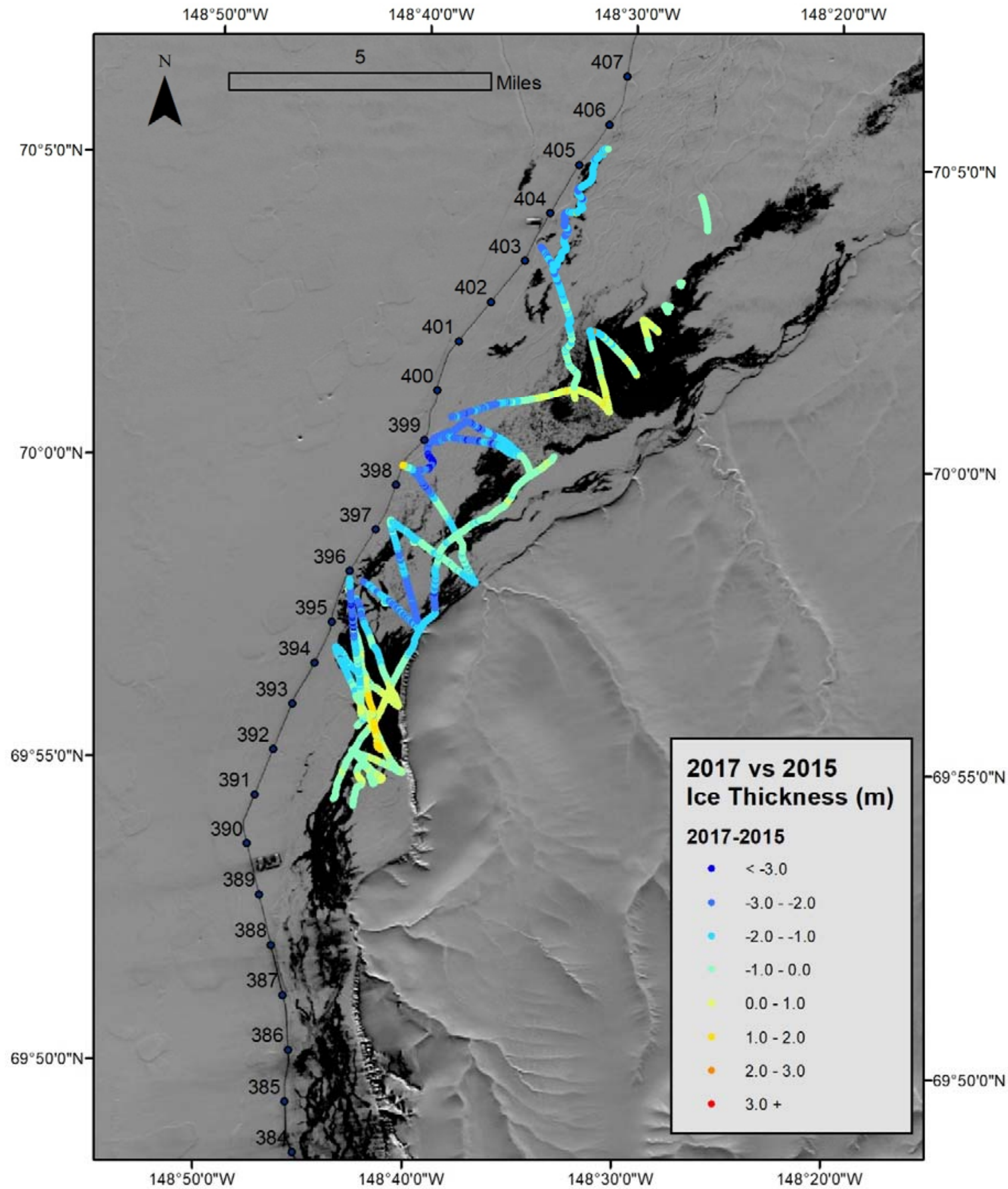


Figure 32. Calculated ice thickness difference between the years 2017 and 2015 near Franklin Bluffs. Most of the points show thinner ice in 2017. However, ice was thicker near MP393 and in parts of the floodplain between the east and west channels.

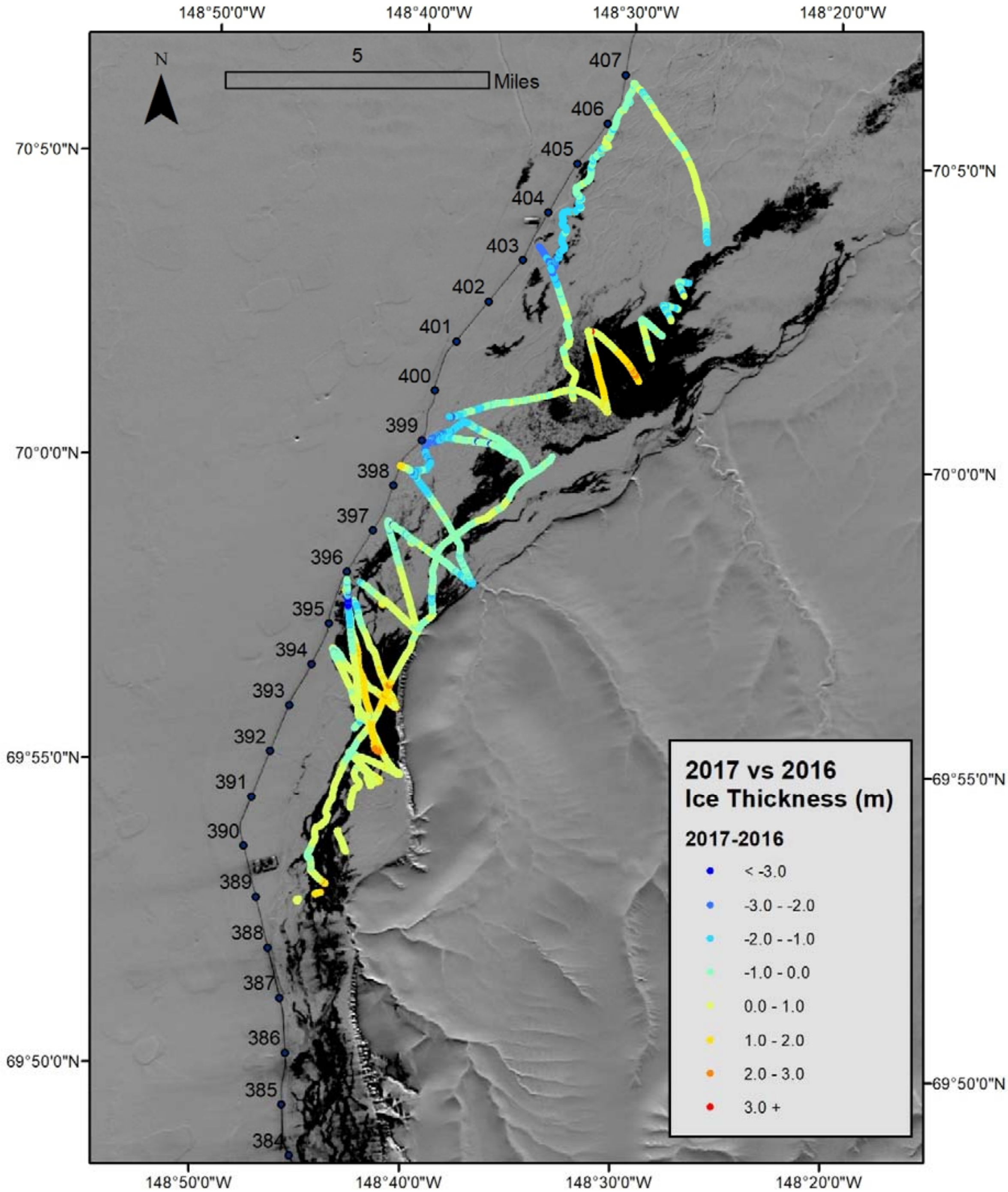


Figure 33. Calculated ice thickness difference between the years 2017 and 2016. Ice was 1–2 m thicker in 2016 in the area east of MP393 and the floodplain between the east and west channels. Ice was mostly thinner (1–3 m) in 2017 along the west side of the floodplain near the Dalton Highway.

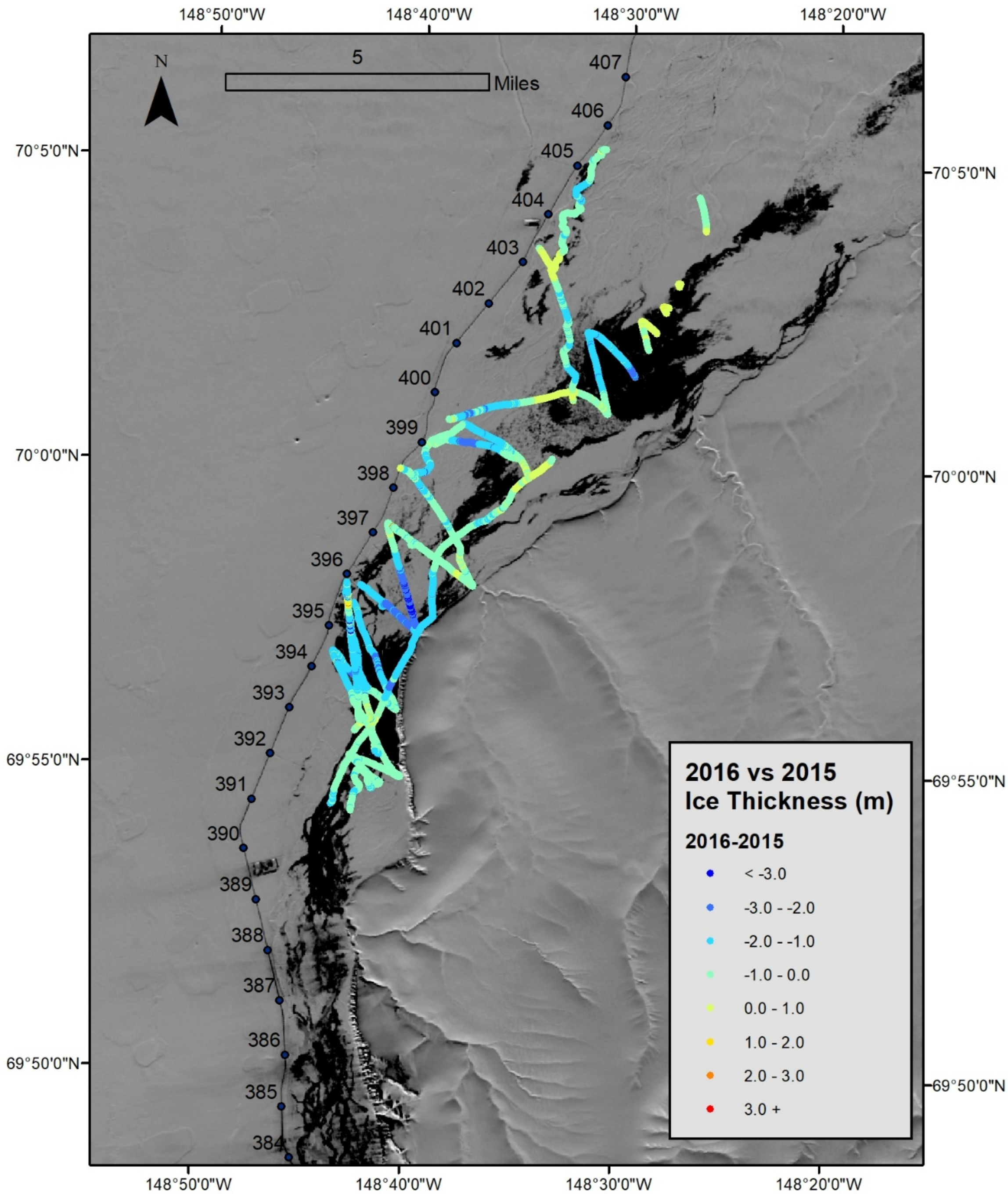


Figure 34. Calculated ice thickness difference between 2016 (using SfM-derived ice elevation) and 2015 (using LiDAR-derived ice elevation), at 2017 GPS survey points. Overall, ice thickness was less in 2016 than in 2015, with the exception of a few places in the northern part of the study area (shown in yellow).

4.3 Surface Water Hydrology

We collected hydrology data on the middle and lower reaches of the Sagavanirktok River from summer 2015 to fall 2017. We collected continuous measurements (pressure transducers) of water levels at six hydro-meteorological stations (near MP318 [DSS4], Happy Valley [DSS3], near MP347 [ASS1], below the confluence with the Ivishak River [DSS2], East Bank station [DSS5] near MP395, in the west channel near MP405 [DSS1], and at the BP bridge over the west channel in Deadhorse). We measured discharge near each station (except for the station near MP347 and the BP bridge) during the breakup period between May 10 and May 31, 2017 (see Appendix D and Appendix E for individual discharge measurements). We measured turbidity at each station (Section 4.4) and collected water samples for suspended sediment analysis (discussed in Sections 4.4 and 4.5.2). We surveyed river stage during both breakup and summer visits at each hydrological observation station (see Appendix D). All water-level elevation data collected at the hydro-meteorological stations were surveyed to the temporary benchmarks established by ADOT&PF in 2015; these data are reported in NAVD88 (using the GEOID12A model), with the exception of the station near MP347 (ASS1), which has an arbitrary datum.

In 2015, winter flooding of the Sagavanirktok River near Franklin Bluffs prompted monitoring of the river's water level and discharge during spring breakup. Flooding was widespread at Franklin Bluffs during breakup that year due to the buildup of aufeis across the river's floodplain and rapid warming of the entire basin. The results of monitoring during the flood event in 2015, along with monitoring breakup in 2016, were presented in Toniolo et al. (2015) and Toniolo et al. (2016a). Compared with the spring flooding of the Sagavanirktok River during breakup in 2015, spring breakup in this region in both 2016 and 2017 was mild. In 2015 and 2016, ADOT&PF dug trenches in the ice and created snow and ice berms near Franklin Bluffs to divert breakup runoff away from the Dalton Highway and toward the river's east channel. The ADOT&PF did not create berms in 2017, and river conditions were natural (not modified) (Figure 35). In 2016, water level and discharge were not measured at the west channel station near MP405 (DSS1) because of an extensive ice field near the station. In 2017, ice was not as extensive in the west channel, and spring breakup runoff was measurable.

Figure 35. Ice conditions near Franklin Bluffs on May 15, 2017. View is to the south.

Initial flows during breakup in 2017 reached the Sagavanirktok River near the MP318 (DSS4) station on May 16 (6 days later than in 2016). The flow front reached the station at East Bank (DSS5) near Franklin Bluffs on May 19. Although flows were mostly steady in spring 2017, the highest flow in the Sagavanirktok River during breakup probably occurred on May 25 at both MP318 (DSS4) and Happy Valley (DSS3), and on May 30 at the station below the Ivishak (DSS2), East Bank (DSS5), and near MP405 (DSS1). Spring peak flow dates in 2017 were approximately 12 to 15 days later than in 2016, and 9 days later than in 2015. In 2015, air temperatures remained warm throughout the basin for the entire breakup period; snowmelt was rapid, resulting in high breakup peak flows. In 2016, flows were initially high and earlier than normal, but flows dropped due to a freeze-back, then increased slightly after a warming period. In 2017, air temperatures remained cold throughout the breakup period, causing a much slower breakup. Air temperatures slowly warmed to above freezing beginning on May 11 in the upper basin. In the middle basin (foothills region), air temperatures generally remained below freezing until May 24. This gradual warmup throughout the basin, with air temperatures hovering near or below freezing for most of May, resulted in relatively low and steady flows without any large peaks. A similar pattern was observed on nearby rivers, such as the Upper Kuparuk, Imnavait, and Putuligayuk.

Figure 36 through Figure 39 show continuous water levels and runoff measurements for breakup at several of the stations. Maximum measured flow of 750 m^3/s (26,485 ft^3/s) on May 30, 2017, was observed at the Sagavanirktok River East Bank Station (DSS5) near Franklin Bluffs, compared with the maximum measured flow of 1560 m^3/s (55,090 ft^3/s) at the same station on May 20, 2015.

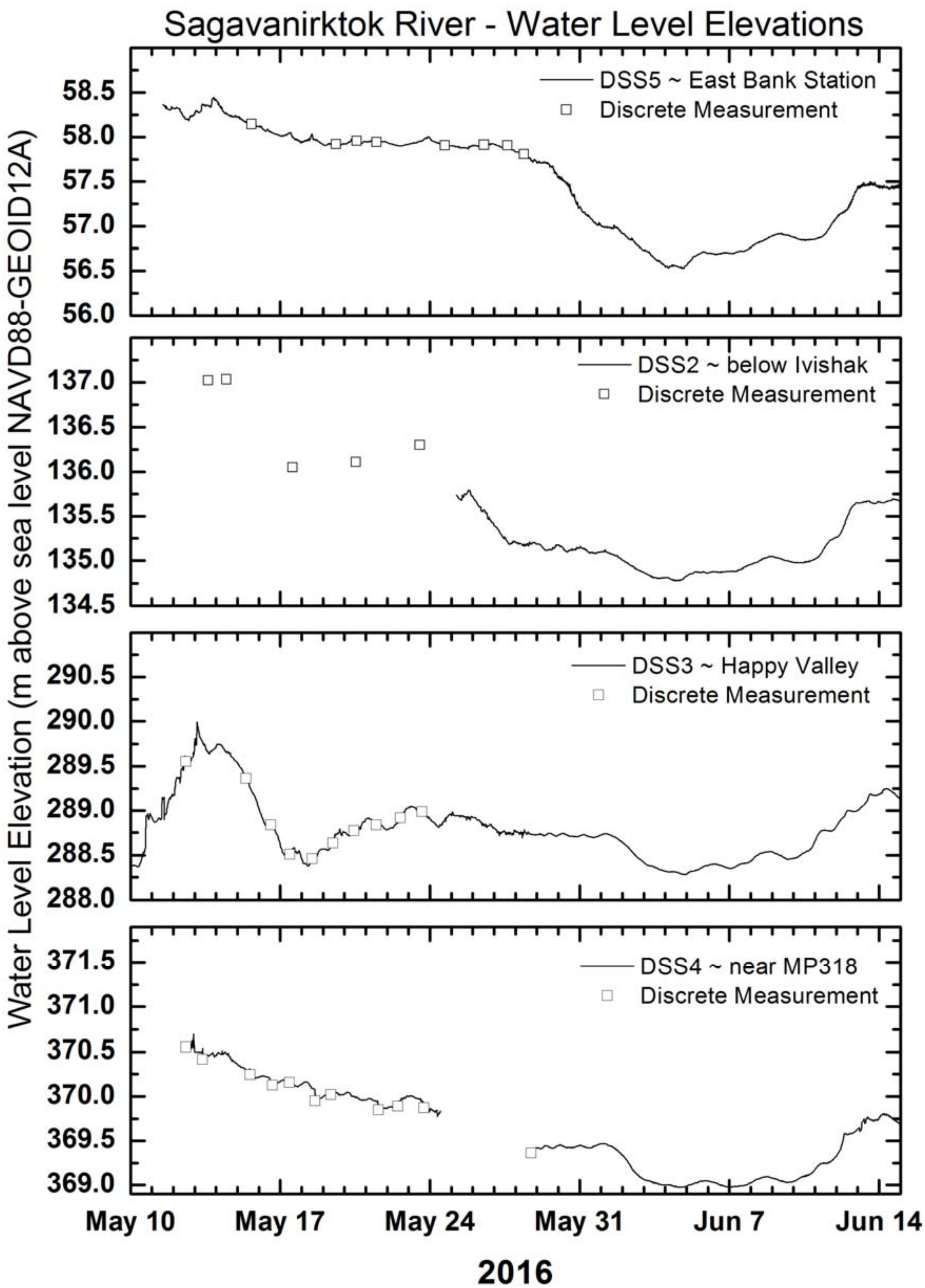


Figure 36. Water level elevations at four UAF stations on the Sagavanirktok River, spring 2016.

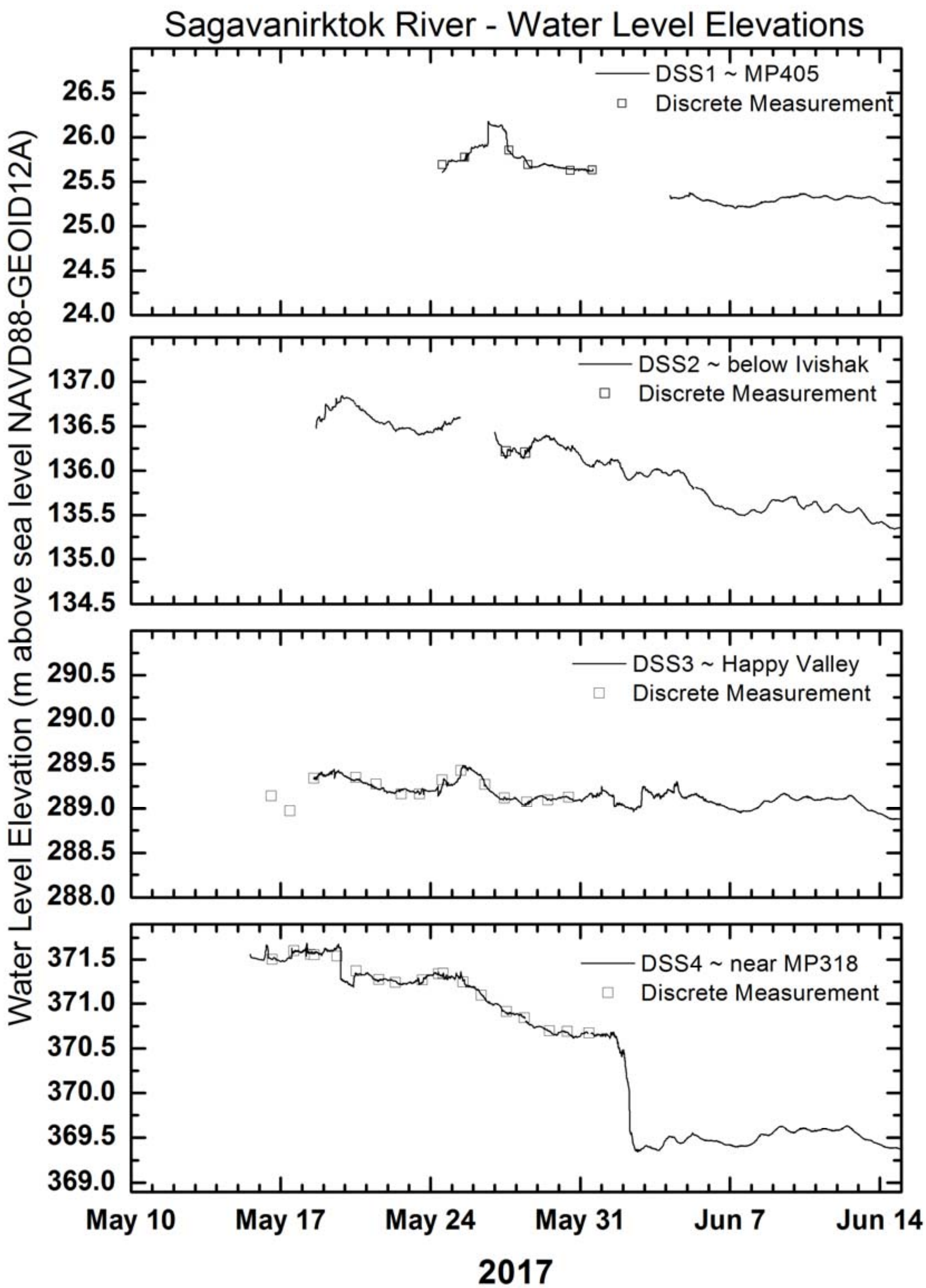


Figure 37. Water level elevations at four UAF stations on the Sagavanirktok River, spring 2017. Continuous water levels were not available at East Bank (DSS5) station for much of the breakup period in 2017 (see Section 4.3.5).

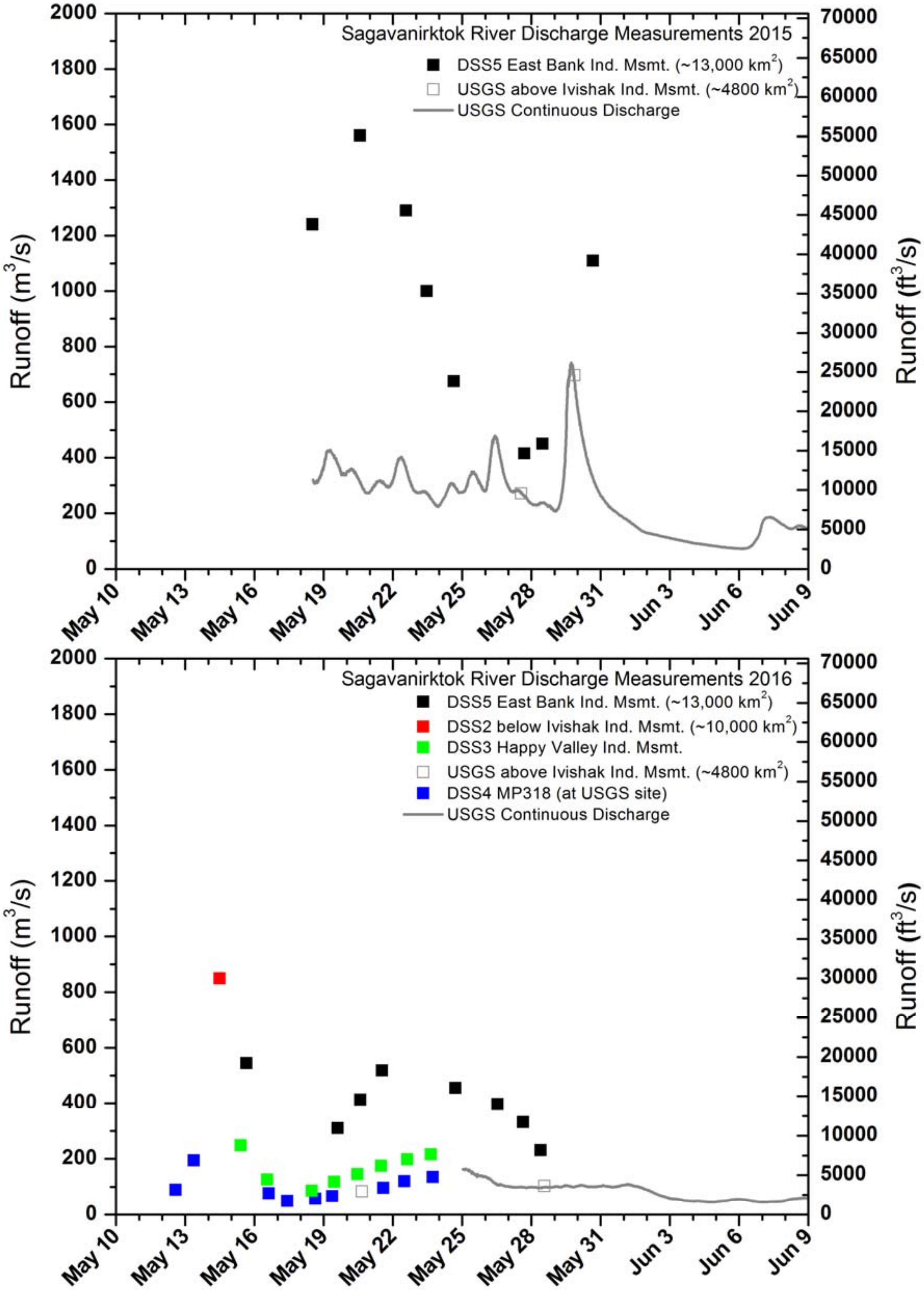


Figure 38. Individual measurements of discharge in the Sagavanirktok River for 2015 (top) and 2016 (bottom), along with continuous discharge at the USGS station.

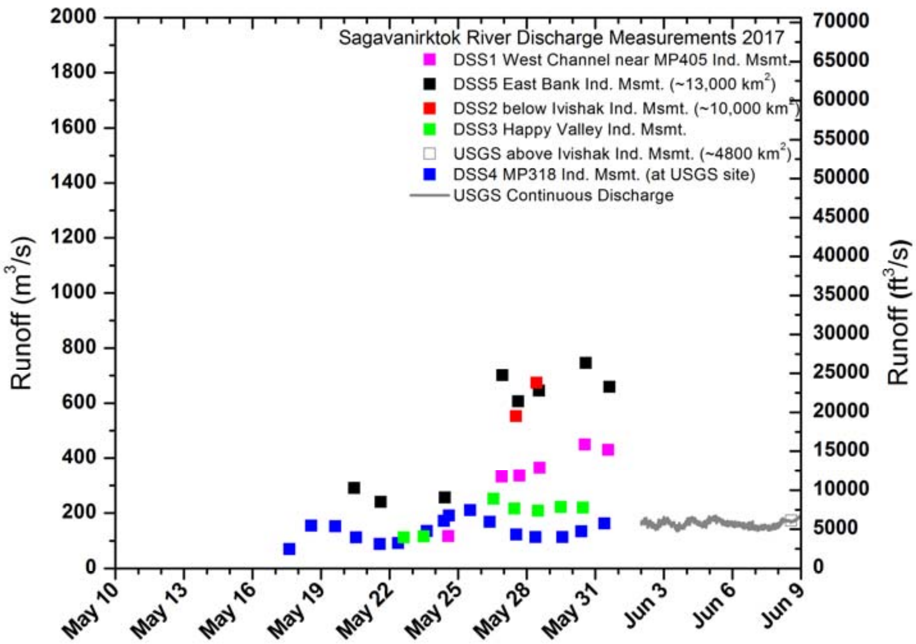


Figure 39. Individual measurements of discharge in the Sagavanirktok River for 2017, along with continuous discharge at the USGS station.

4.3.1 Sagavanirktok River at MP318 (DSS4)

We installed the Sagavanirktok River station at MP318 (DSS4) of the Dalton Highway in summer 2015; water levels and discharge measurements are observed during breakup and during summer/fall months. Figure 40 through Figure 42 and Appendix D1 and Appendix D2 (see Appendix D) show all water level and discharge observations for 2015 through 2017 at the DSS4 station. Ice persisted in the river channel again in 2017 at this reach of the river. Water levels at the Sagavanirktok River station near MP318 (DSS4) were high from May 15 through May 25 (Figure 43). The maximum water level elevation of 371.7 m occurred during the early part of breakup on May 18 (Figure 42, Appendix D1), when the channel was full of ice and 1 m higher than the May 12, 2016, maximum of 370.7 m (although it is possible that the initial ice-affected river stages were not measured in 2016). After May 25, 2017, river stage began to decline, until June 2, when it reached a minimum elevation of 369.4 m. Water levels were ice-affected through nearly all of breakup. We measured runoff sixteen times (Appendix D2 and Figure 39) during breakup 2017. Peak flow likely occurred near May 25 (compared with May 13 in 2016). We measured discharge during spring breakup at the nearby USGS station (7.2 km downstream) due to braiding at the UAF station.

We measured summer discharge three times in 2017. Discharge in early summer of 2017 was low due to the lack of rainfall throughout the basin in June and most of July (Figure 24). The largest flow event of the summer occurred on July 25, 2017, when a widespread storm from July 20 through 25 produced a significant amount of rain throughout the basin (Figure 24, Figure 42).

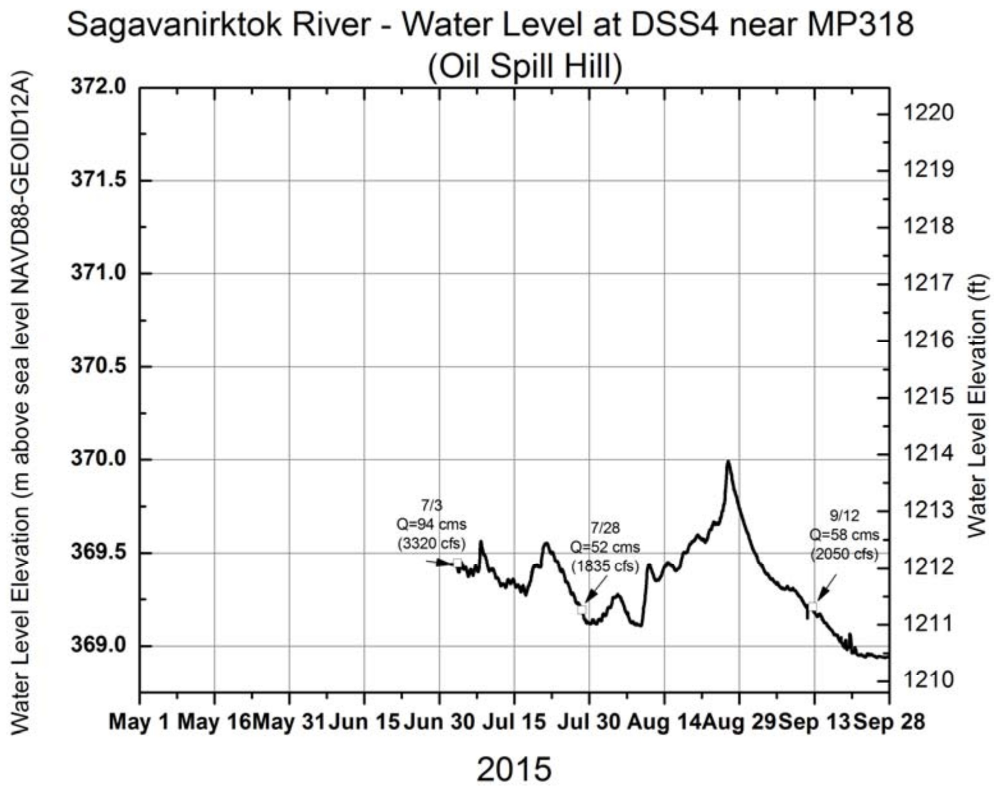


Figure 40. Water level elevations at the Sagavanirktok River near MP318 station in 2015.

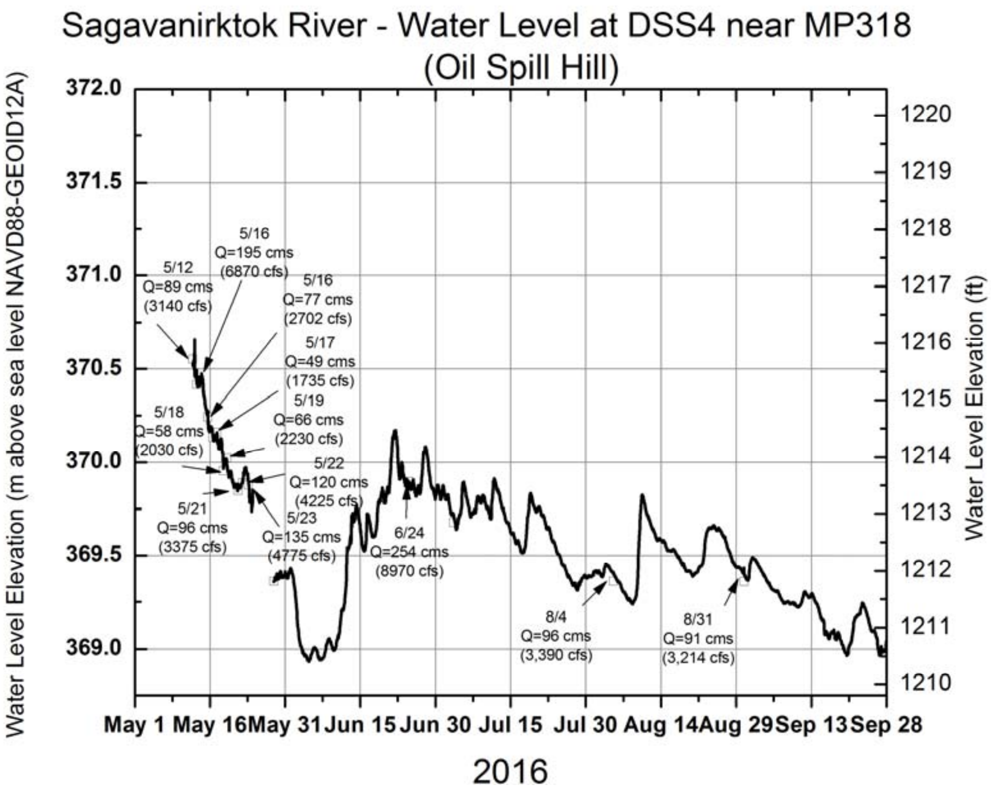


Figure 41. Water level elevations at the Sagavanirktok River near MP318 station in 2016.

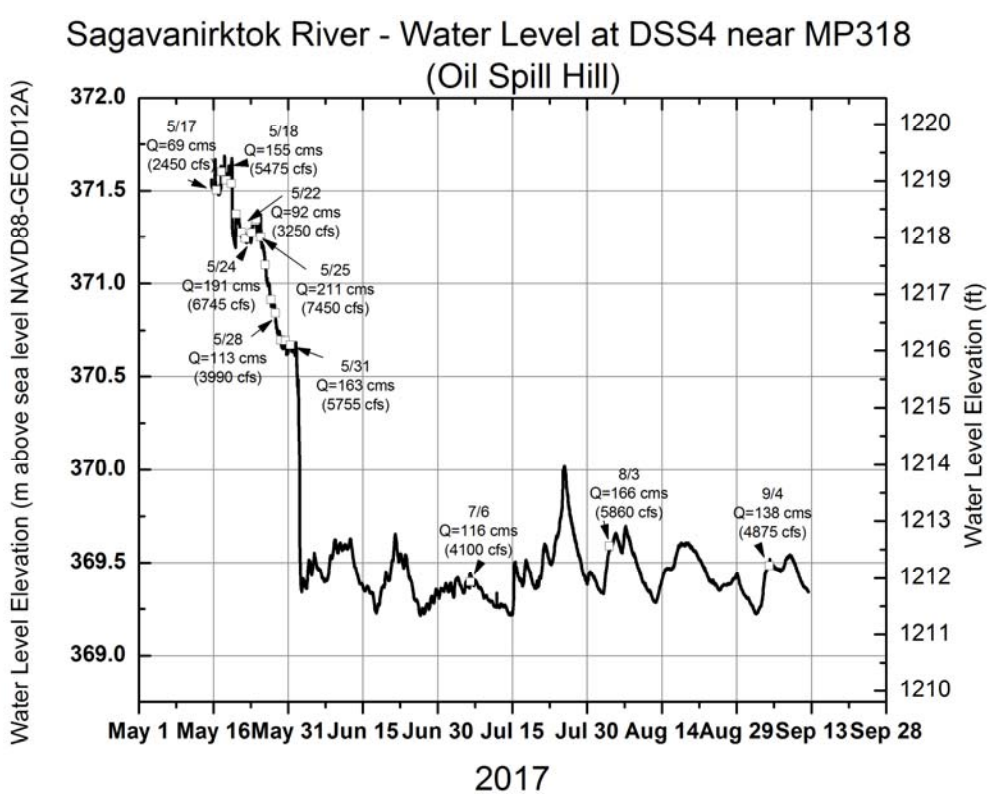


Figure 42. Water level elevations at the Sagavanirktok River near MP318 station in 2017.

Figure 43. Sagavanirktok River at MP318 (DSS4) on May 18, 2017. View is to the south.

4.3.2 Sagavanirktok River at Happy Valley (DSS3)

We installed the Sagavanirktok River station at Happy Valley (DSS3) in summer 2015. We observe water levels and measure discharge at this location during breakup and summer/fall months. Appendix D3, Appendix D4, and Figure 44 through Figure 46 show all water level and discharge observations for 2015 through 2017 at the station. Maximum water levels during breakup 2017 were lower than in 2016, and fluctuations were much less pronounced. Water levels fluctuated between 289.0 and 289.5 between May 16 and June 13, with a maximum of 289.5 m on May 25 (Figure 36 and Figure 46). We measured runoff seven times during breakup 2017 at the Happy Valley station (Appendix D4 and Figure 39). Figure 47 shows the station during early breakup (May 18, 2017), and Figure 48 shows late breakup (May 30, 2017). We made three summer discharge measurements. Similar to data from the Sagavanirktok River at MP318 (DSS4), the largest event of the summer was on July 25, in response to a widespread rain event. Discharge measurements at Happy Valley (DSS3) were similar to (but slightly higher than) the measurements at the USGS station. Happy Valley is approximately 10 river miles downstream of the USGS gauge site and 14 river miles downstream of the UAF gauge site at

MP318 (DSS4). The three stations are upstream of the confluence with the Ivishak River. The watershed area above the UAF station (DSS3) is approximately 5,810 km^2.

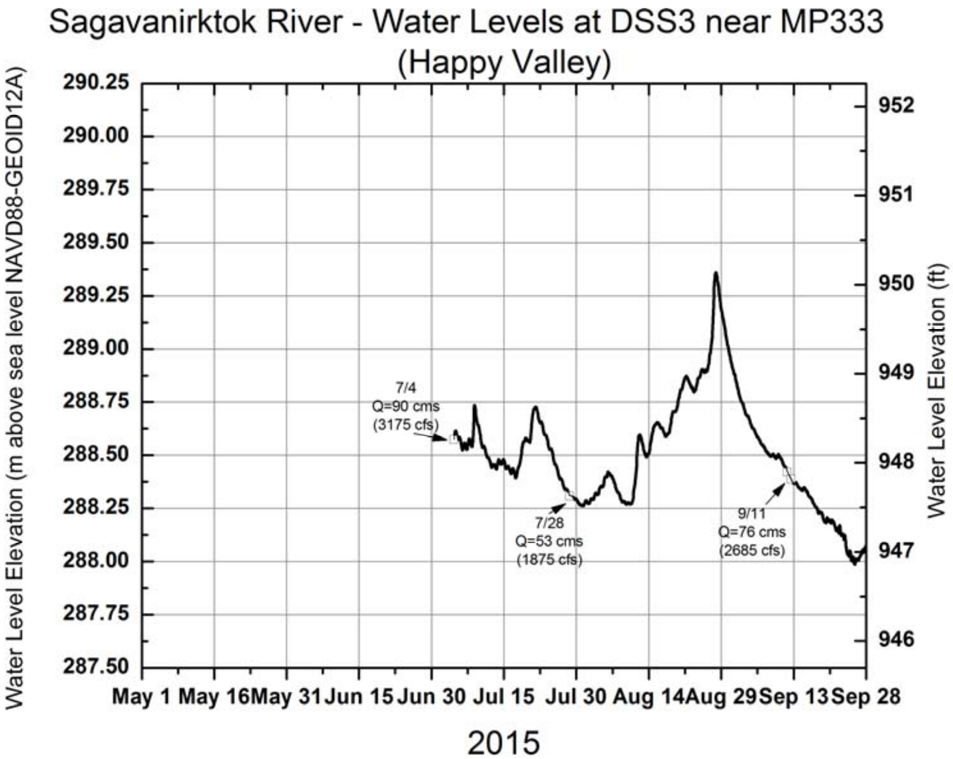


Figure 44. Water level elevations at the Sagavanirktok River at Happy Valley (DSS3) in 2015.

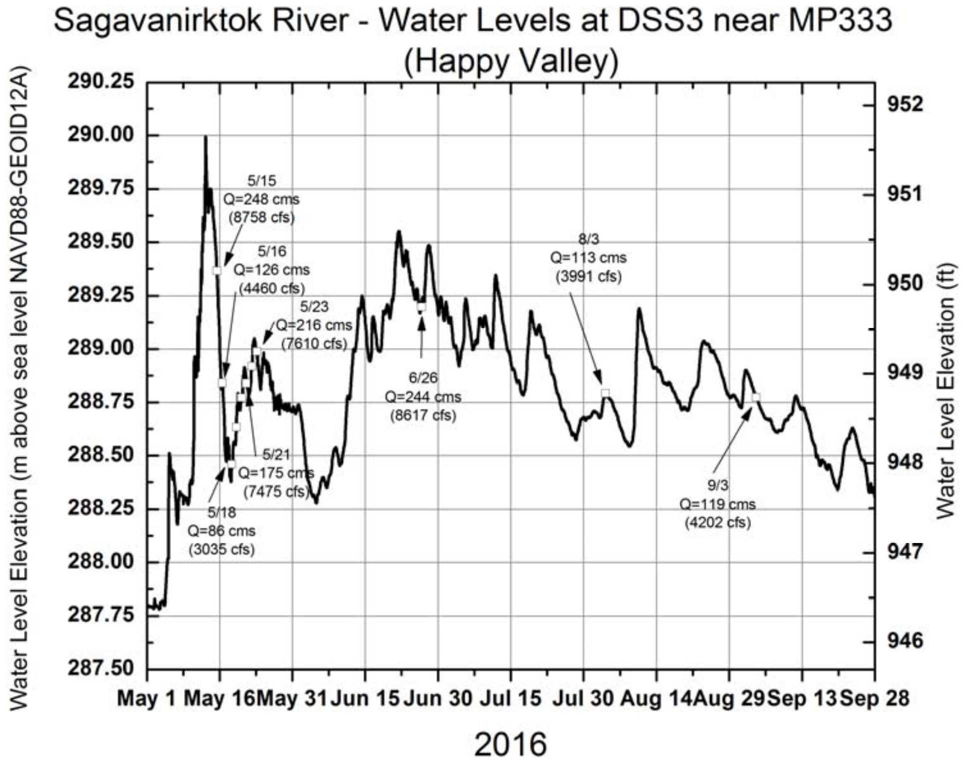


Figure 45. Water level elevations at the Sagavanirktok River at Happy Valley (DSS3) in 2016.

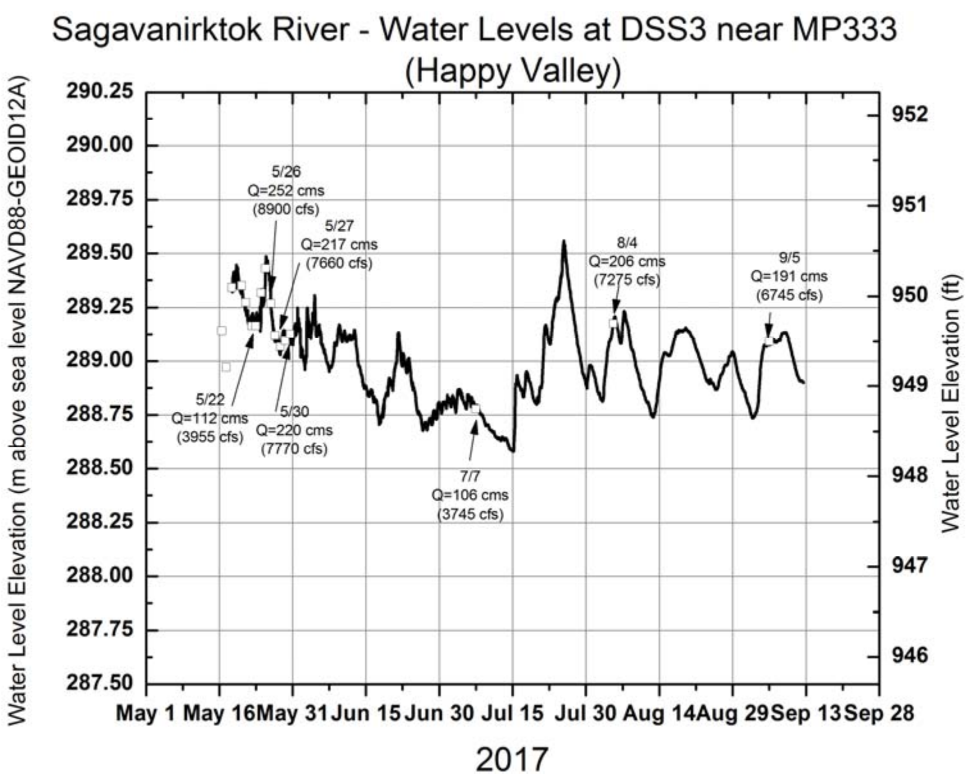


Figure 46. Water level elevations at the Sagavanirktok River at Happy Valley (DSS3) in 2017.

Figure 47. Sagavanirktok River at Happy Valley (DSS3) station on May 18, 2017. View is to the south.

Figure 48. Sagavanirktok River at Happy Valley (DSS3) station on May 30, 2017. View is to the south.

4.3.3 Sagavanirktok River near MP347 (ASS1)

We installed the hydro-meteorological station ASS1, located just above the confluence of the Sagavanirktok River with the Ivishak River (Figure 1), in fall 2015 for the Alyeska Pipeline Service Company. Water level data for this station are not available before mid-summer 2016, and spring breakup is not observed at this station. Figure 49 and Figure 50 present the continuous water level data for summers 2016 and 2017. We measured discharge four times at the station, in summer 2016 and 2017.

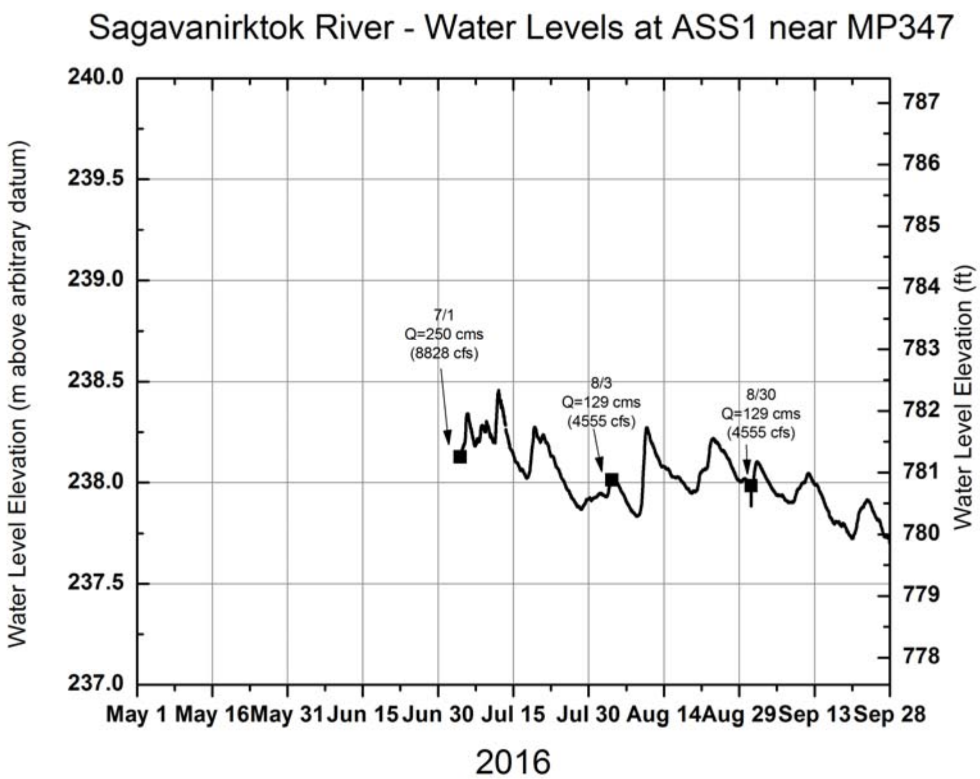


Figure 49. Water level elevations at the Sagavanirktok River near MP347 (ASS1) for 2016.

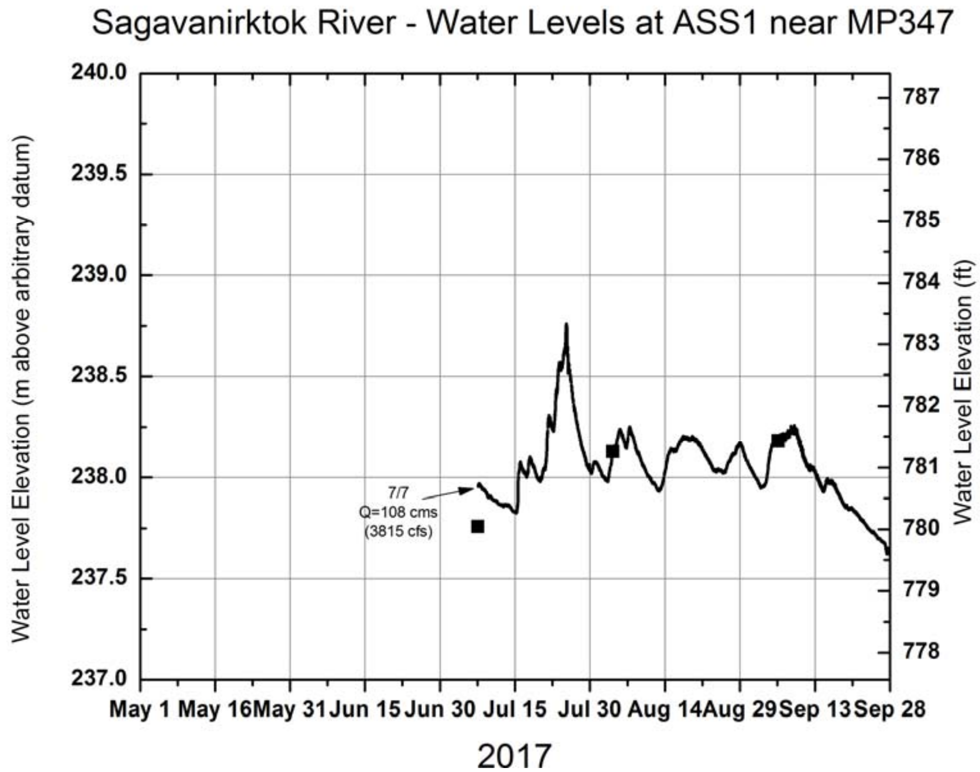


Figure 50. Water level elevations at the Sagavanirktok River near MP347 (ASS1) for 2017.

4.3.4 Sagavanirktok River below the Ivishak River (DSS2)

Measurements at the Sagavanirktok River station below the Ivishak River confluence (DSS2) are presented in Appendix D5 and Appendix D6 and in Figure 51 through Figure 53. This station is located on the Sagavanirktok River approximately 8 miles below the Ivishak River confluence; the drainage area above the station is approximately 11,800 km^2. In 2017, initial flows reached the station on May 18 (Figure 55). Water levels were initially high (136.8 m) and above bankfull from May 12 through 14 (see Figure 53, Appendix D5), but dropped steadily to a low of ~135.5 m on June 7 (Figure 36, Figure 53). Figure 55 shows the site near the end of breakup, and Figure 56 shows the location of the dry pit during breakup. Water appears more turbid (compared with early runoff) after anchor ice leaves the streambed later in breakup and sediment is transported. Water levels continued to drop through mid-July due to the lack of rainfall. We measured runoff only two times at this station (Appendix D6, Figure 39) during spring breakup 2017. The peak flow (~700 m^3/s) likely occurred at this station between May 27 and May 30 (compared with May 14 in 2016). We measured discharge three additional times in the summer. Similar to the other stations, water levels increased on July 25 in response to a large rain event throughout the basin (Figure 24, Figure 53).

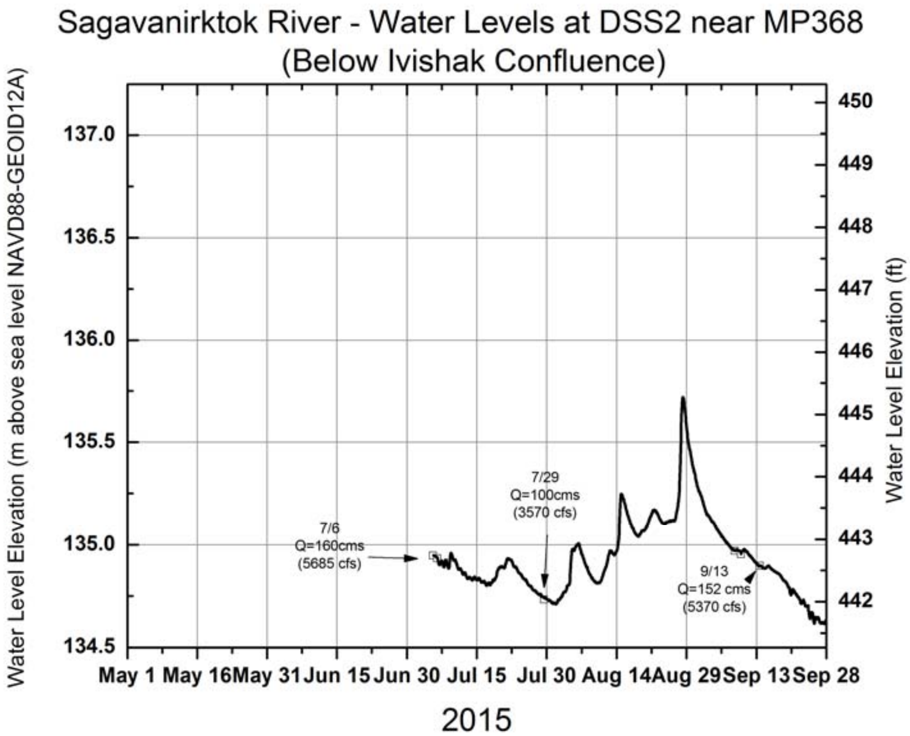


Figure 51. Water level elevations at the Sagavanirktok River below the Ivishak River confluence (DSS2) in 2015.

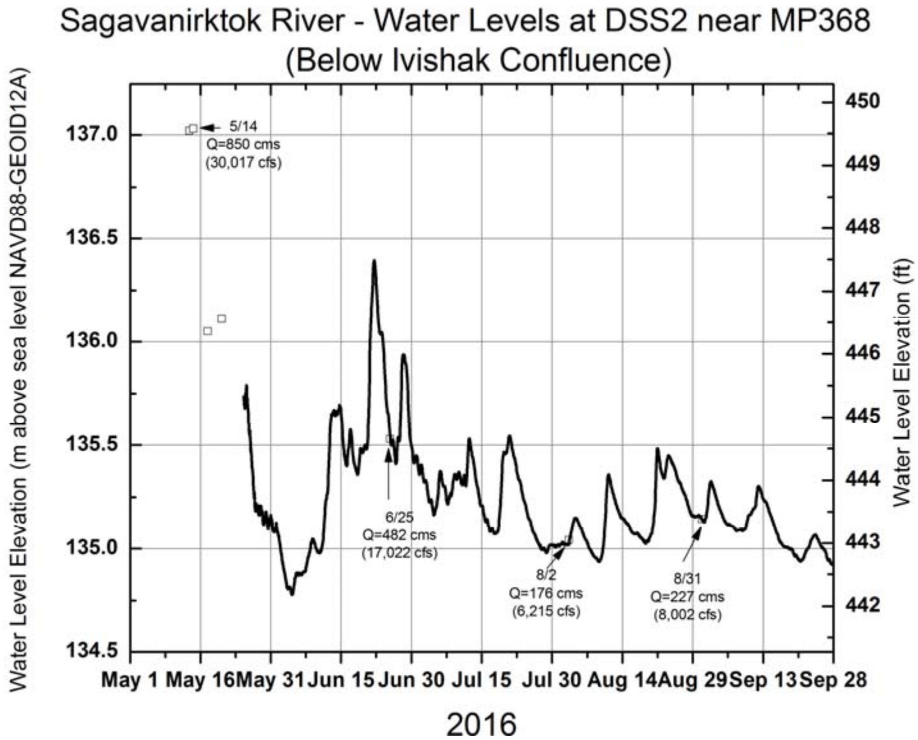


Figure 52. Water level elevations at the Sagavanirktok River below the Ivishak confluence (DSS2) in 2016.

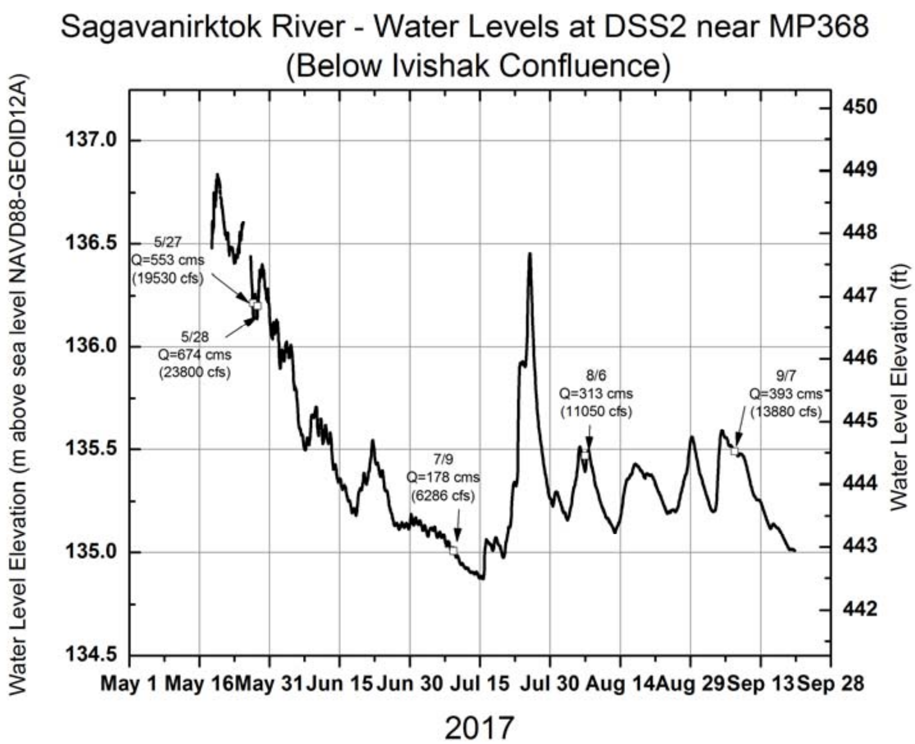


Figure 53. Water level elevations at the Sagavanirktok River below the Ivishak confluence (DSS2) in 2017.

Figure 54. Early spring breakup flow at the Sagavanirktok River below the Ivishak confluence (DSS2) station on May 19, 2017. View is to the south.

Figure 55. River conditions at the Sagavanirktok River below the Ivishak confluence (DSS2) station during spring breakup on May 27, 2017. View is to the north.

Figure 56. A detail view of the Sagavanirktok River below the Ivishak confluence (DSS2), facing north, on May 28, 2017. Oval indicates approximate dry pit location.

4.3.5 Sagavanirktok River at East Bank (DSS5) near Franklin Bluffs

We established the UAF station on the East Bank of the Sagavanirktok River near Franklin Bluffs (DSS5) in early May 2015 to monitor potential spring breakup flooding. The ADOT&PF built ice trenches/berms throughout the area in an attempt to divert winter (and subsequent breakup) flow away from the Dalton Highway and the pipeline, and into the east channel. Extensive flooding occurred during breakup that year, and we measured very high river stage and discharge at the station. To mitigate potential flooding in 2016, ADOT&PF constructed a continuous trench through the Sagavanirktok River ice near Franklin Bluffs to improve water flow, leading it away from the highway through winter and the subsequent breakup. This ice berm successfully diverted flow toward the east channel during breakup, probably due to lower river stage and flow that did not immediately overtop the berms as it did the previous year. In 2017, ice berms were not constructed, and the river was in its natural condition (Figure 57). Section 4.1 further describes the ice conditions just prior to breakup.

Figure 57. This south view depicts river-wide conditions on the Sagavanirktok River on May 19, 2017. Seen in the distant left are Franklin Bluffs. On the right are the lines and angles of the pipeline and curves of the Dalton Highway. Ice trenches and berms to divert breakup flows to the east were not constructed in 2017.

Continuous water levels are shown in Figure 58 to Figure 60; surveys of stage and discharge for the period of record are presented in Appendix D7 and Appendix D8. In 2017, due to cool air temperatures throughout May, the river began flowing at the East Bank station near Franklin Bluffs on May 19 (compared with May 12 in 2016). The highest water level elevations were recorded during the initial flows on May 19 and 20 at the station, as water flowed over ice. This year, the majority of the spring runoff flowed toward the west channel, instead of toward the east channel, as it did in 2016.

Maximum spring breakup water levels in both 2016 and 2017 were approximately 58.5 m, compared with a maximum of 59.5 m in 2015. Since much of the runoff went toward the west channel, river stage at this site was difficult to measure in 2017. There was a lack of water during low stages at the East Bank station, so periods of the continuous water level record are missing for this site (Figure 60). Eight measurements of runoff were made in 2017 (Appendix D8) near MP387 and MP389, upstream of the station. Flows were steady and relatively low due to gradual warming of the basin. Highest flows were steady, between 600 to 750 m^3/s (21,190 to 26,485 ft^3/s) from May 26 to 31 on the lower Sagavanirktok River near the East Bank station (above the east/west channel split). Peak measured spring runoff in 2017 was less than 50% of the 2015 peak measurement. No additional measurements were made in 2017. Figure 61 through Figure 68 are photographs showing the progression of spring breakup at the East Bank station in 2017. As breakup progresses, ice lifts off the streambed and water becomes increasingly turbid as sediment is transported downstream. Sediment transport is further discussed in Section 4.8.

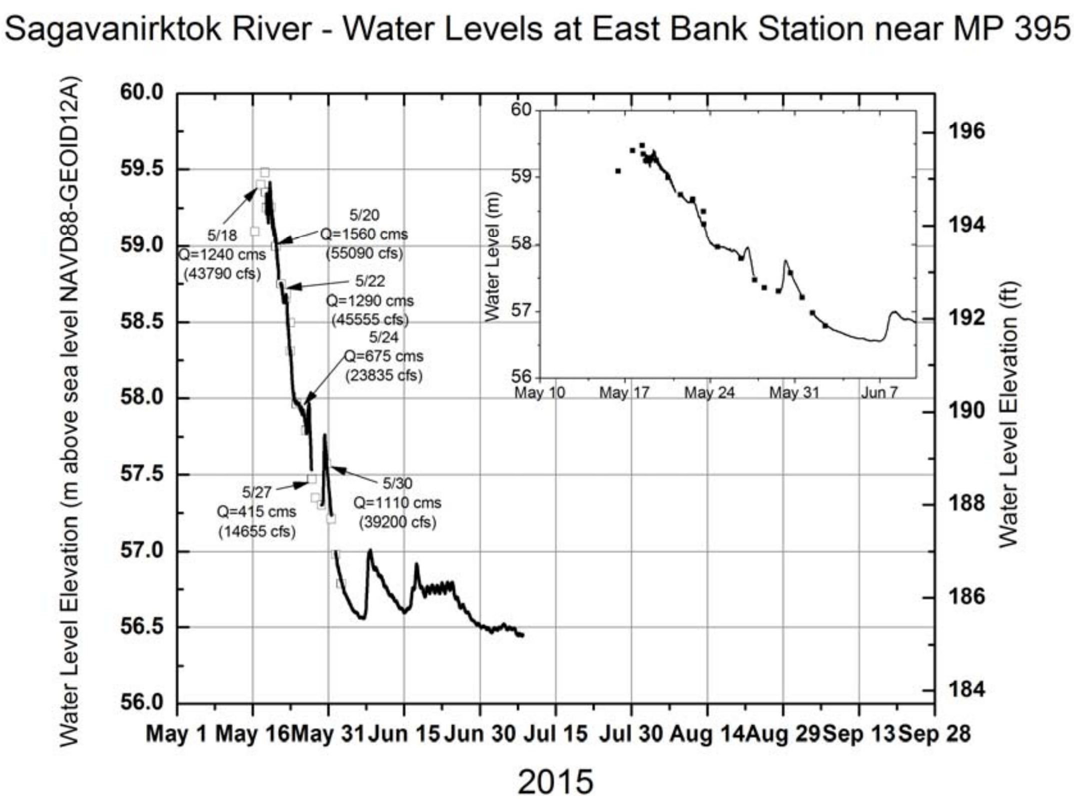


Figure 58. Water level elevations at the Sagavanirktok River East Bank (DSS5) in 2015.

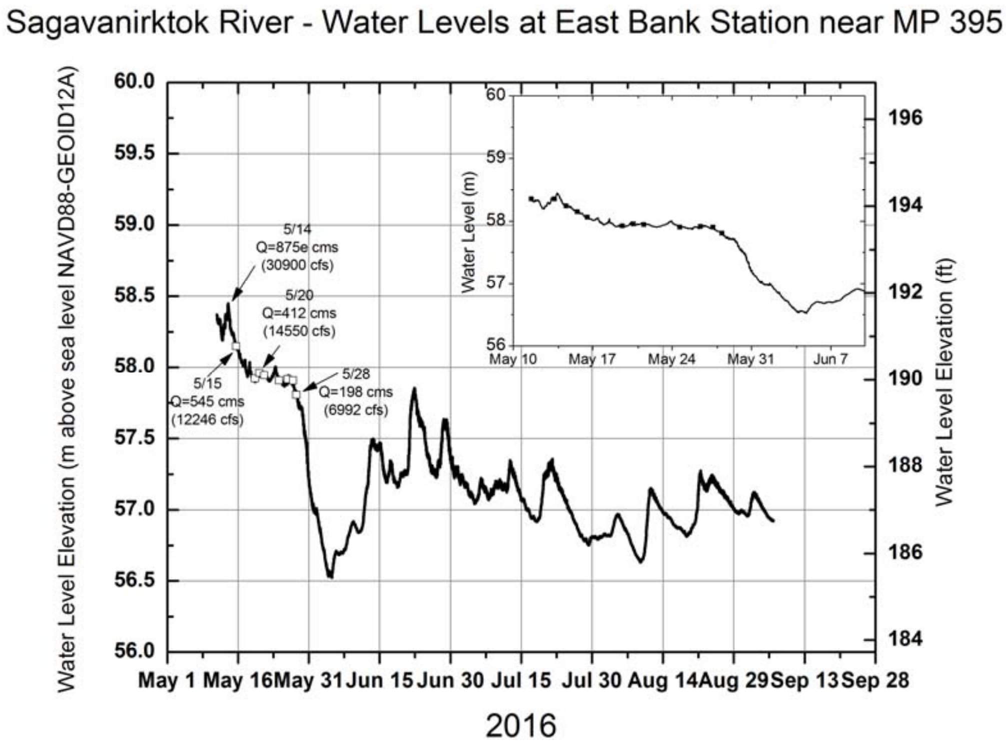


Figure 59. Water level elevations at the Sagavanirktok River East Bank (DSS5) in 2016.

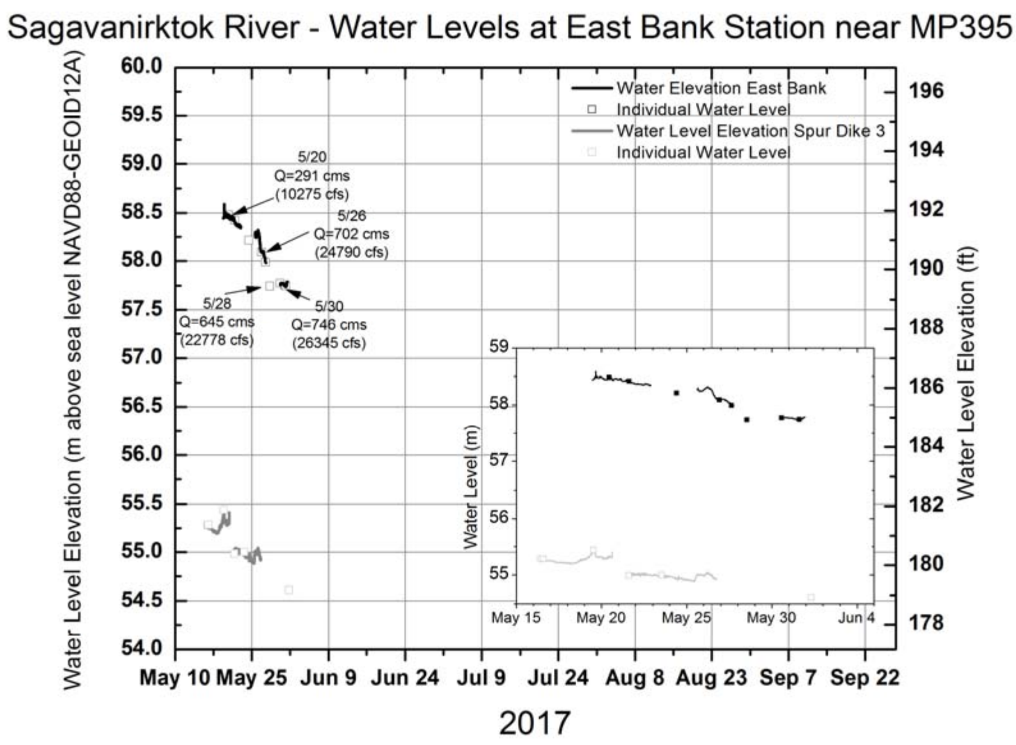


Figure 60. Water level elevations at the Sagavanirktok River East Bank (DSS5) in 2017. A temporary water level observation station was installed at Spur Dike 3 on the west side of the river (gray line).

Figure 61. This south-facing view shows the Sagavanirktok River near Franklin Bluffs (visible in left background) on May 20, 2017. The buried pipeline and the Dalton Highway are on the right.

Figure 62. This north-facing view shows the east channel of the Sagavanirktok River near the East Bank (DSS5) station during early breakup flows (May 21, 2107). Franklin Bluffs appear at the right.

Figure 63. The Sagavanirktok River east channel and Franklin Bluffs on May 24, 2017.

Figure 64. Condition of the Sagavanirktok River on May 27, 2017. Franklin Bluffs appear in the distance; the buried pipeline and the Dalton Highway are on the right. View is to the south.

Figure 65. A south-facing view of the Sagavanirktok River on May 28, 2017. On the right is the Dalton Highway—perpendicular structures are spur dikes over the buried pipeline. Franklin Bluffs is visible in the distance to the left.

Figure 66. This north view depicts conditions of the Sagavanirktok River near East Bank (DSS5) station on May 30, 2017. Franklin Bluffs appear on the right.

Figure 67. Sagavanirktok River near spur dikes on May 31, 2017 (south view). Franklin Bluffs appear in the distance to the left. The buried pipeline, spur dikes, and Dalton Highway are on the right.

Figure 68. Looking north, conditions on the Sagavanirktok River on May 31, 2017. Photo taken in vicinity of East Bank station (DSS5), located beneath Franklin Bluffs to the right.

4.3.6 Sagavanirktok River at MP405 (DSS1) West Channel

Appendix D9, Appendix D10, and Figure 69 through Figure 71 show water levels and manual discharge measurements at the Sagavanirktok River near Deadhorse (MP405) (west channel) from 2015 to 2017. The first year that we were able to measure spring runoff at this station (DSS1) was in 2017. In 2016, water level elevations and runoff were not observed at the Sagavanirktok River near MP405 because of extensive ice in the west channel. Due to ADOT&PF-constructed ice berms and lower river stage, snowmelt flowed toward the east channel in 2016. Figure 72 shows ice conditions near the station on May 27, 2016.

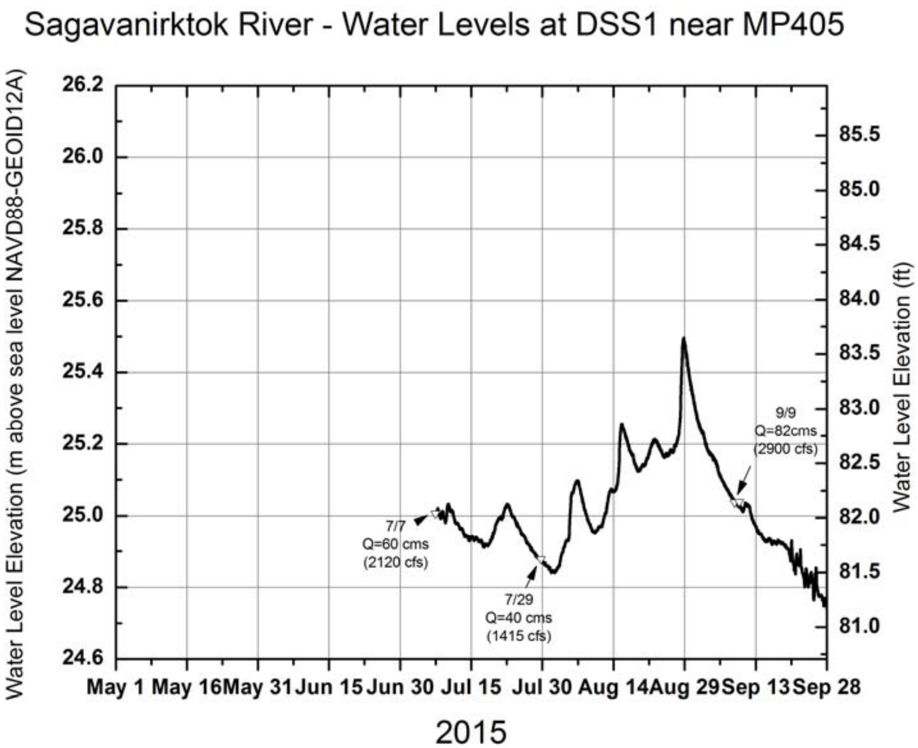


Figure 69. Water level elevations at the Sagavanirktok River near MP405 (DSS1) in 2015.

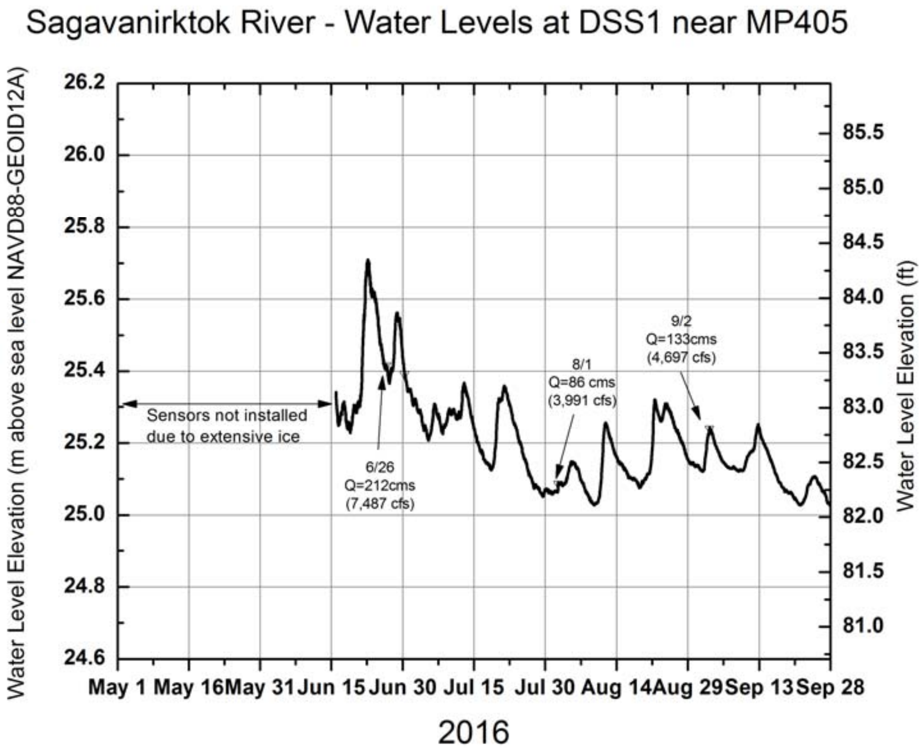


Figure 70. Water level elevations at the Sagavanirktok River near MP405 (DSS1) in 2016.

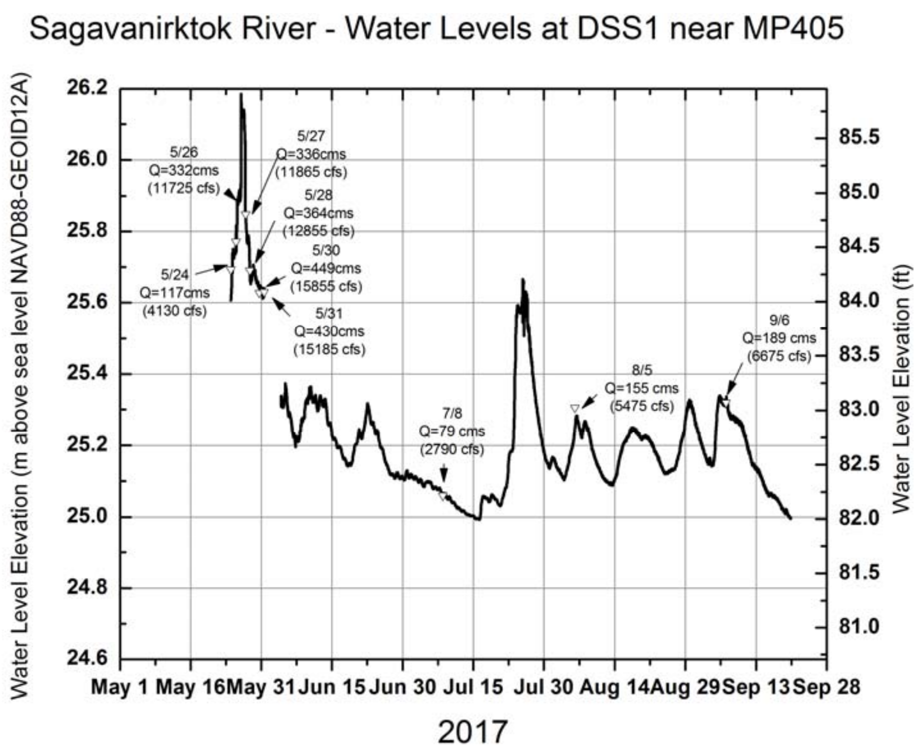


Figure 71. Water level elevations at the Sagavanirktok River near MP405 (DSS1) in 2017.

Figure 72. West channel of the Sagavanirktok River covered in ice on May 27, 2016. Open water is visible in the center of the picture. Location is downstream from the material site at MP405 (DSS1) (from Toniolo et al., 2016a).

In 2017, the ADOT&PF did not construct snow/ice berms in the channel to divert water, and most of the runoff during spring breakup flowed toward the west channel and the observation station at MP405 (DSS1) (Figure 73). The maximum stage of ~26.2 m for the year occurred on May 26, 2017, due to a nearby ice jam creating over bankfull conditions (Figure 74). This stage was higher than any summer stage recorded during the previous two warm seasons. However, it is likely that river stage at MP405 (DSS1) was even higher during the spring breakup flooding in 2015. Maximum measured breakup discharge at MP405 (DSS1) in the west channel was 450 m^3/s on May 30, which was 60% of the measured discharge of 750 m^3/s at East Bank (DSS5, May 30), just above the diverging channels.

Figure 73. Sagavanirktok River near MP405 (DSS1), westernmost channel on May 24, 2017. The station is located where the river bend and the Dalton Highway curve are at their closest.

Figure 74. High water levels due to an ice jam at the Sagavanirktok River near MP405 (DSS1) on May 26, 2017.

4.3.7 Additional Field Observations

We installed an SR50 sonic sensor on the BP bridge over the west channel of the Sagavanirktok River near Deadhorse in fall 2016. The sensor measures the distance to the water surface and converts the measurement to water level elevation. Water level data are presented for this site in Figure 75. River stage is the highest during spring breakup. During this period, it is ice-affected. Similar to other observations, the highest event of the summer was in late July.

The basin area at the mid-basin USGS gauge site is 4,790 km^2, and runoff is measured in the Sagavanirktok River above the confluence with the Ivishak River. The basin area just below the confluence with the Ivishak (at DSS2 station) is 11,790 km^2. Figure 76 through Figure 78 present runoff on the Upper Sagavanirktok River for 2015, 2016, and 2017 (USGS, 2017). The USGS measured discharge two times during spring breakup in 2016 at its Sagavanirktok River station, but did not measure discharge in 2015 and 2017 (USGS, 2017). In 2016 and 2017, the USGS measurements occurred after the breakup peak flow events on about May 14, 2016, and May 25, 2017 (see Figure 38 and Figure 39). Summer measurements of flow at the UAF stations above the confluence with the Ivishak River at MP318 (DSS4) and Happy Valley (DSS3) are comparable to the continuous runoff at the USGS station. However, few USGS measurements during the spring breakup period are available to compare.

Figure 79 is a hydrograph for the Upper Sagavanirktok River station showing river discharge during the past decade (2006 through 2017), although spring data are uncertain. Runoff during spring may not be measured manually due to ice conditions; it is typically estimated or reported as backwater and may be reported as mean daily discharge. Data are presented in a log scale to show winter baseflow measurements. The winters of 2013, 2014, and 2015 had the highest baseflow measurements recorded in the period, as shown in the figure.

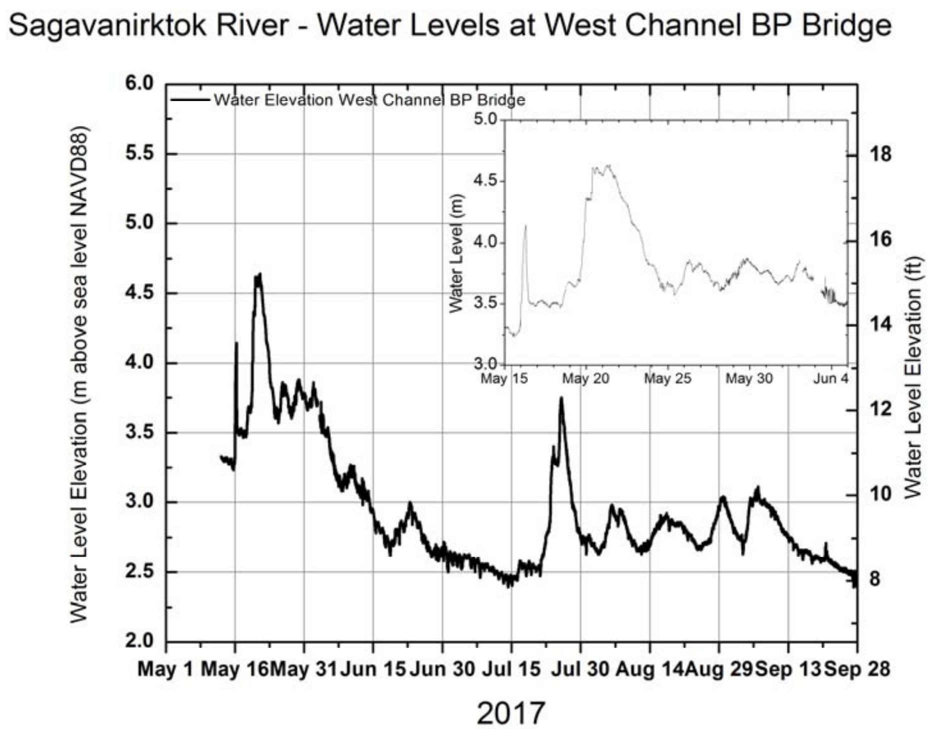


Figure 75. Water level observations, west channel of the Sagavanirktok River (at BP bridge) in 2017.

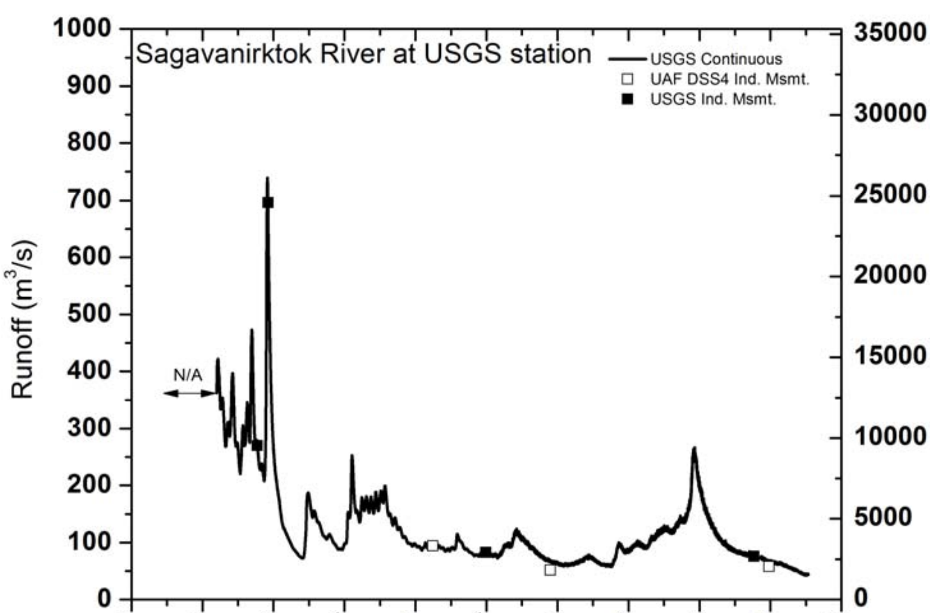


Figure 76. USGS continuous (black line) and individual measurements (black squares) of discharge at the upper Sagavanirktok River USGS station in 2015. UAF measurements (white squares) at the USGS station are also displayed. In 2015, peak breakup runoff occurred prior to May 20 and is not presented in the plot due to lack of measurements and ice-affected conditions. Peak flow likely occurred prior to May 18, and probably exceeded the secondary peak (due to widespread rainfall at the tail end of breakup) on May 29.

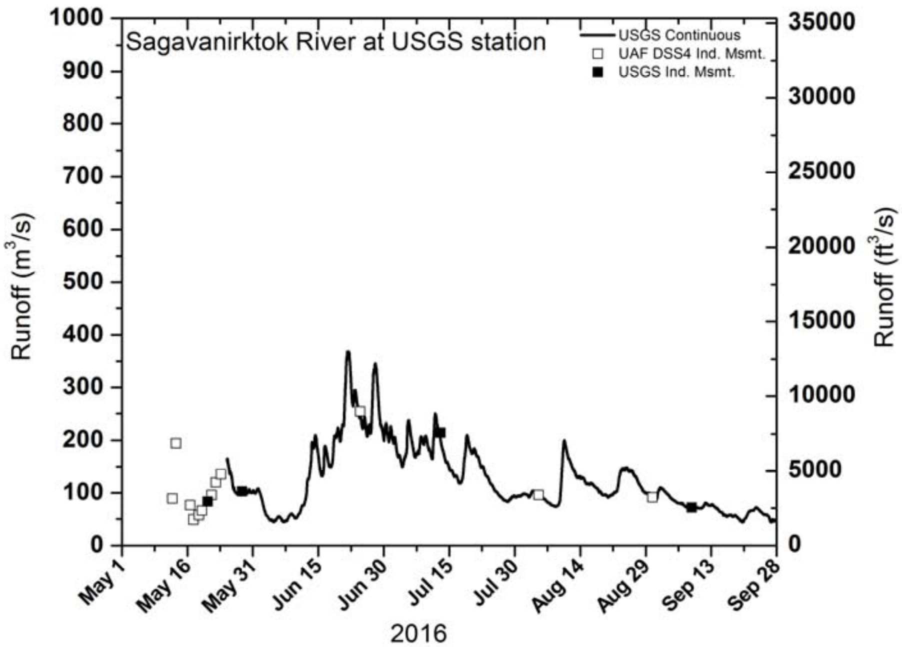


Figure 77. USGS continuous (black line) and individual measurements (black squares) of discharge at the upper Sagavanirktok River USGS station in 2016. UAF measurements (white squares) at the USGS station are also displayed.

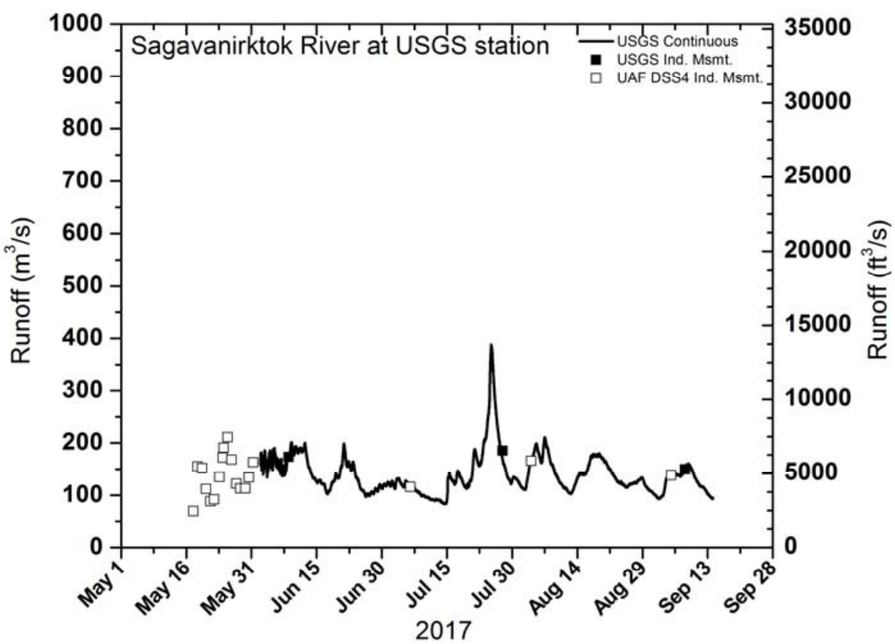


Figure 78. USGS continuous (black line) and individual measurements (black squares) of discharge at the upper Sagavanirktok River USGS station in 2017. UAF measurements (white squares) at the USGS station are also displayed.

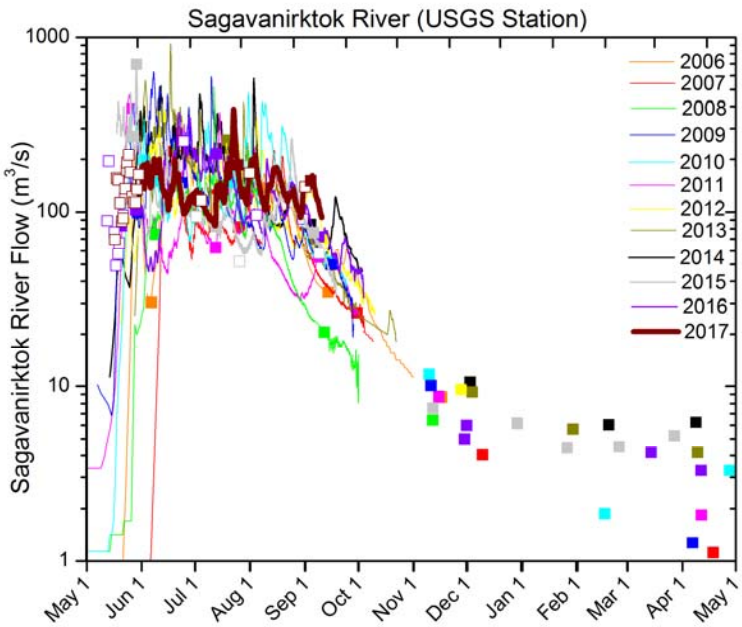


Figure 79. Upper Sagavanirktok River runoff, 2006 to 2017 (USGS, 2017), plotted on a logarithmic scale. The bold brown line indicates runoff for 2017. Individual measurements of discharge at USGS stations are plotted as colored squares; UAF is plotted as white squares.

4.3.8 Preliminary Rating Curves and Estimated Discharge

We are developing stage–discharge relationships (rating curves) to estimate the discharge for a range of stages at each station along the Sagavanirktok River. The stage is graphed against the discharge, and a best-fit curve is fitted through the “rating” points (and is represented by an equation). We attempt to collect discharge measurements at various river stages in order to have a good relationship at all river stages.

The number of rating points currently available is limited because most of the measurements were taken when the river was ice-affected and cannot be included in the development of the rating curve. Ice-affected measurements have a higher stage at a given discharge due to the presence of ice in the channel (and elevation of the water level). In addition, most of the existing summer and fall discharge measurements (i.e., measurements used in developing the rating curves) are in the mid to low range. Thus, we are not presenting the rating curves in this report. It is our hope that in the future, we can add measurements during high flows. Due to the braided river condition, however, high uncertainty in the estimated discharge at most of the sites is likely.

4.4 Stable Isotopes

The winters of 2013/2014 and 2014/2015 had the highest winter discharge at the Sagavanirktok River USGS station during the period of record (1983 to 2017, *n*=44) (Figure 80). Section 4.2.1 discusses the extent of the aufeis formation during recent years (2000–2017) using Landsat NIR imagery. The goal of the stable isotope analysis was to determine the source of the overflow that forms the aufeis feature on the lower Sagavanirktok River near Franklin Bluffs.

We included a lengthy analysis in the 2016 Sagavanirktok River spring breakup report (Toniolo et al., 2016a) that used trace metal concentrations to determine water source. Here, we used a similar approach, but analyzed for δ^2H (also referred to as deuterium) and $\delta^{18}O$ (also referred to as oxygen-18) isotopes. We collected water samples from both springs in the Brooks Range and the lower and middle Sagavanirktok River during the winter months (Figure 81). A sample collected by Arp (2017) in September 2015 from Roche Moutonnee Creek, a tributary of the upper Sagavanirktok River, was also included in the analysis for comparison. We collected samples of snow throughout the basin in April, during maximum snowpack conditions. Sampling locations are shown in Appendix F.

Our results compare with the snow and spring isotope signatures reported in Kane et al. (2013). Following graphical analysis, our samples grouped first by state (snow versus water), and then by sample collection date (Figure 82). Snow samples tended to be more depleted, while water samples were more enriched. Water samples became more depleted as winter progressed. Most importantly, the water samples from the lower (near Franklin Bluffs) and middle (USGS station) Sagavanirktok River were similar to samples collected during similar times from the mountain springs (Figure 83). Given that these mountain sources are thought to be perennial springs in an otherwise continuous permafrost landscape, the source of the Sagavanirktok River water that forms aufeis in late winter seems to be groundwater also, rising through taliks and flowing in the Sagavanirktok floodplain.

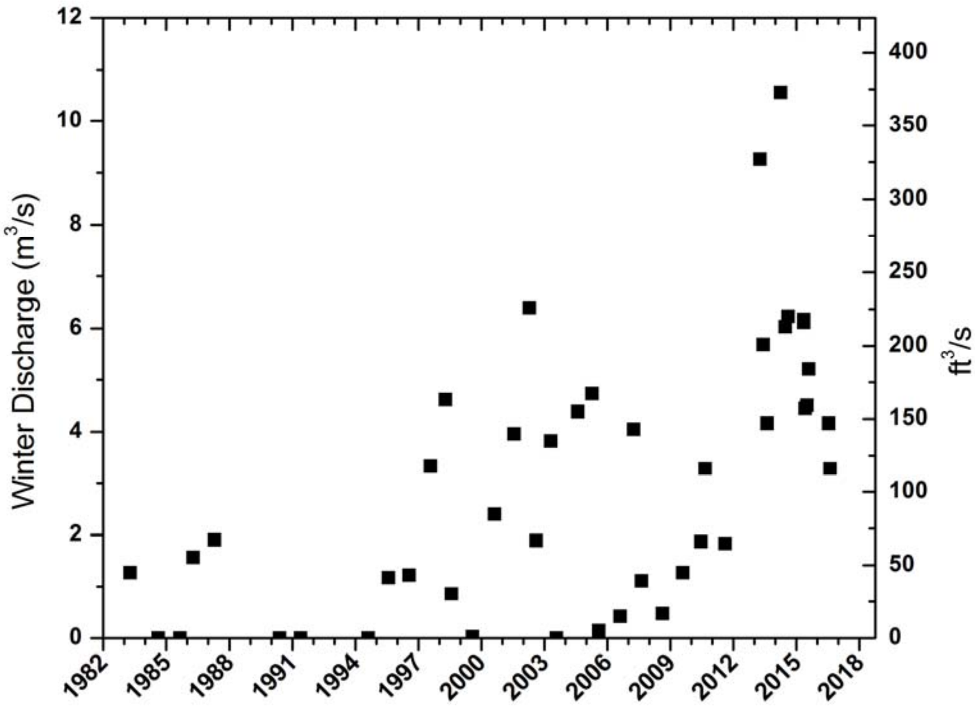


Figure 80. Historical USGS winter (December through April) discharge measurements at the Sagavanirktok River station (USGS, 2017).

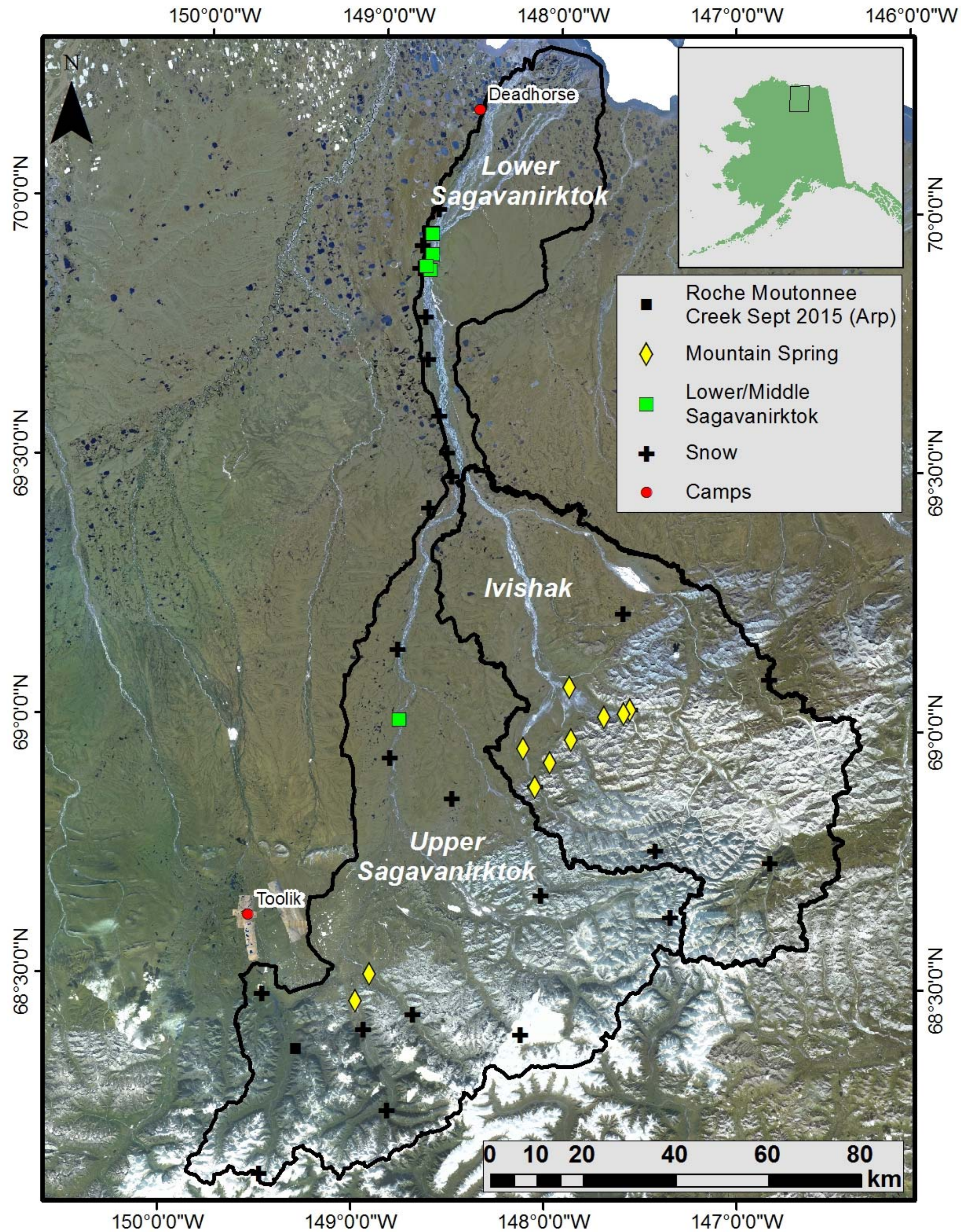


Figure 81. Map with locations of river water and snow samples collected and analyzed for this study.

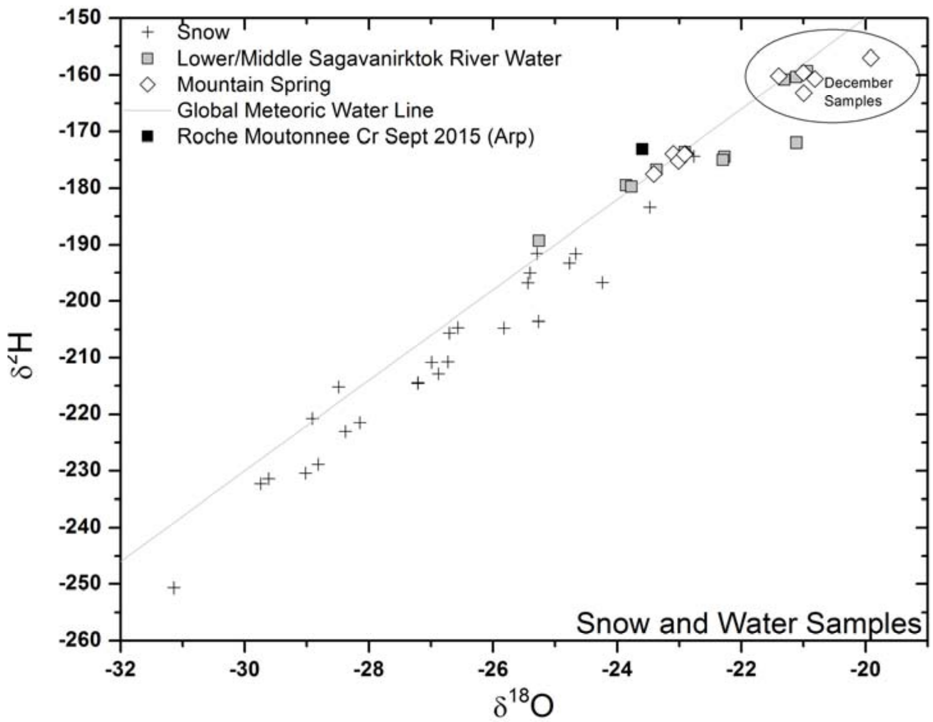


Figure 82. Graph of deuterium (δ^2H) versus oxygen-18 (δ^{18}O) isotopes. Samples differentiate themselves by timing of collection and by snow versus water. Water from the Sagavanirktok River during late winter, which creates the problematic aufeis feature at Franklin Bluffs, is isotopically similar to water emanating from mountain springs in the headwaters.

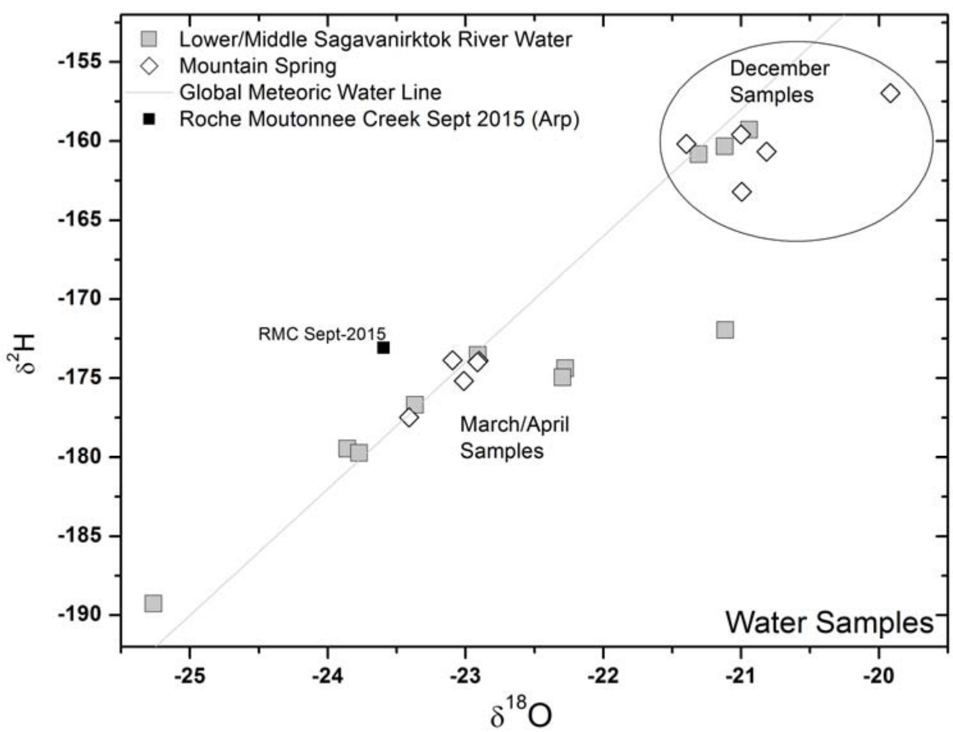


Figure 83. Graph of deuterium and oxygen-18 isotopes for water samples (subset of data shown in Figure 82). The temporal trend from December to April is apparent, as are the strong isotopic similarities from water emanating from the mountain springs and the lower Sagavanirktok River.

4.5 Sediment Grain Size Distribution

We collected numerous samples and photographs to characterize the bed and suspended sediment at the four research sites on the Sagavanirktok River. Toniolo et al. (2016b) and Tape et al. (2017) conducted surveys to determine the stability of the floodplain and characterize sediment at gravel and sand bars throughout the river. We also collected suspended sediment samples at each station. Several of these samples have been analyzed for grain size distribution. In this section of the report, we present a summary of the grain size analysis for suspended and streambed sediment.

4.5.1 Streambed Sediment Grain Size Distribution

Particle size of Sagavanirktok River streambed sediments at each sediment research site was calculated using photographs taken in 2015 of gravel bar sediment and using Digital Grain Size (Buscombe, 2013) software (Toniolo et al., 2016b). Figure 84 shows the resulting sediment particle-size distributions for each site. Each line represents a surface particle-size distribution determined from a photograph using the software. Multiple photographs were taken at each of the four stations. The median grain size, d_{50}, was calculated for each photograph of sediment, and an average d_{50} was then calculated for each site.

Particle sizes become finer downstream. The average d_{50} of the gravel bar sediment decreased from the uppermost sites above the Ivishak River confluence to the lower sites, near Deadhorse: 73 mm at MP318 (DSS4), 75 mm at Happy Valley (DSS3), 57 mm at the station below the Ivishak River confluence (DSS2), and 42 mm at the downstream site at MP405 (DSS1). The average d_{50} at each site corresponds to pebbles at the two downstream sites, and cobbles and boulders at the two upstream sites. Bed sediment at the station below the Ivishak (DSS2) has the greatest range in particle size distribution, possibly due to proximity to confluence with the Ivishak River.

A similar investigation of bed sediment occurred in 2017 (Tape et al., 2017), where photographs of bed sediment were taken at ~5 km intervals between MP326 (close to the USGS station) and MP406 (near the west channel DSS1 station). Photographs in Figure 85 are examples of the bed sediment near each station (Tape et al., 2017). Images were processed with Hydraulic Toolbox 4.2 (Federal Highways Administration, 2014). Tape et al. (2017) calculated d_{100}, d_{85}, d_{50}, d_{15}, and d_5, and found that all particle sizes decreased downstream.

On June 13, 2017, approximately 2 weeks after spring breakup, fine sediment was observed in the dry pit, on top of anchor ice, at the Sagavanirktok River below the Ivishak (DSS2) site. Two sediment samples were collected from the pit, as shown in Figure 86. Material deposited on top of the anchor ice in the pit was finer sediment (d_{50} of 0.4 mm to 7.4 mm), as shown in Figure 87.

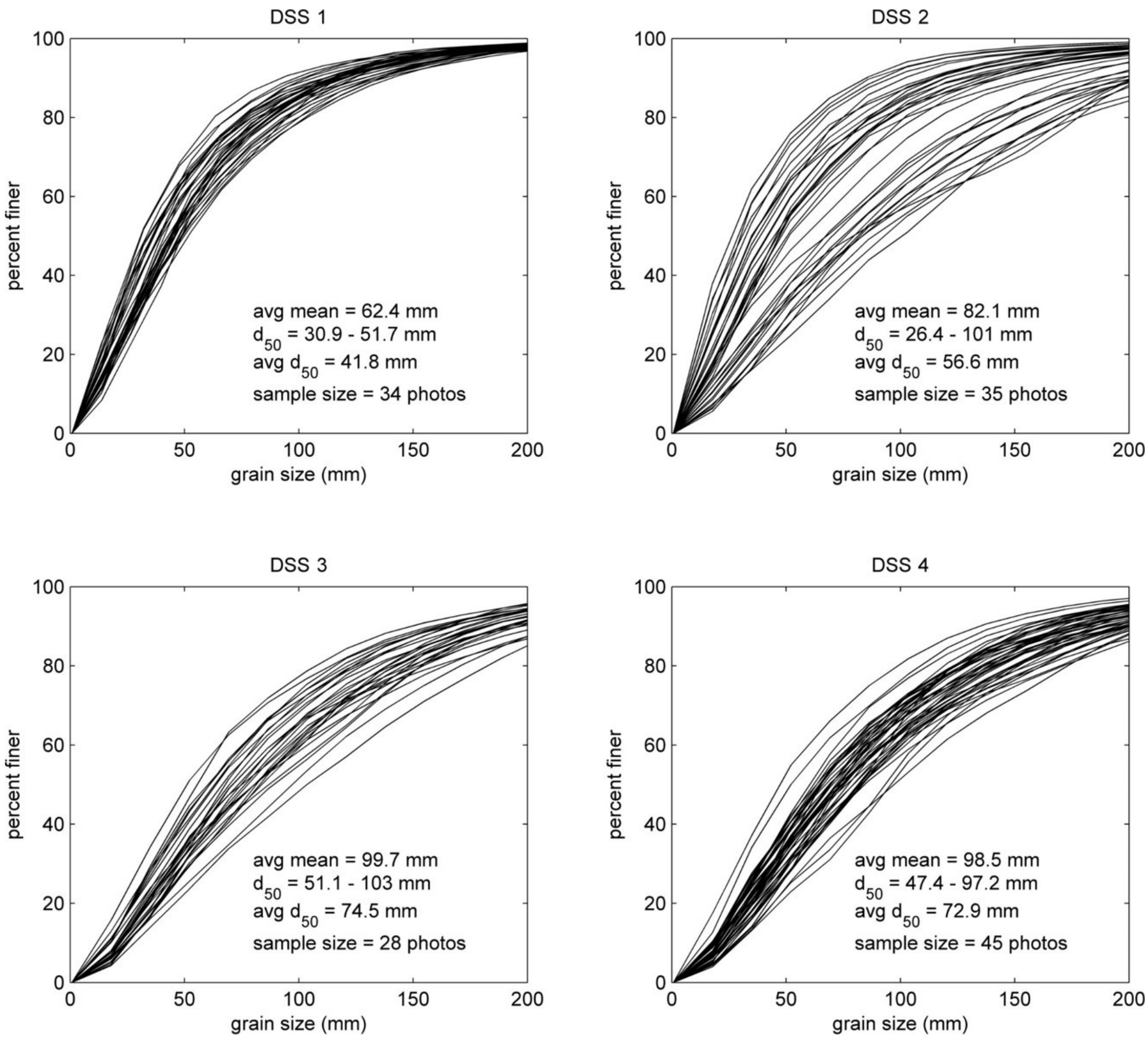


Figure 84. Particle size distribution of bed sediment at each station, based on photographs of gravel bar sediment. Sediment particles at the upstream sites (DSS3 and DSS4) are characterized (on average) as cobbles and boulders, while sediment particles at the downstream sites (DSS1 and DSS2) are characterized as pebbles.

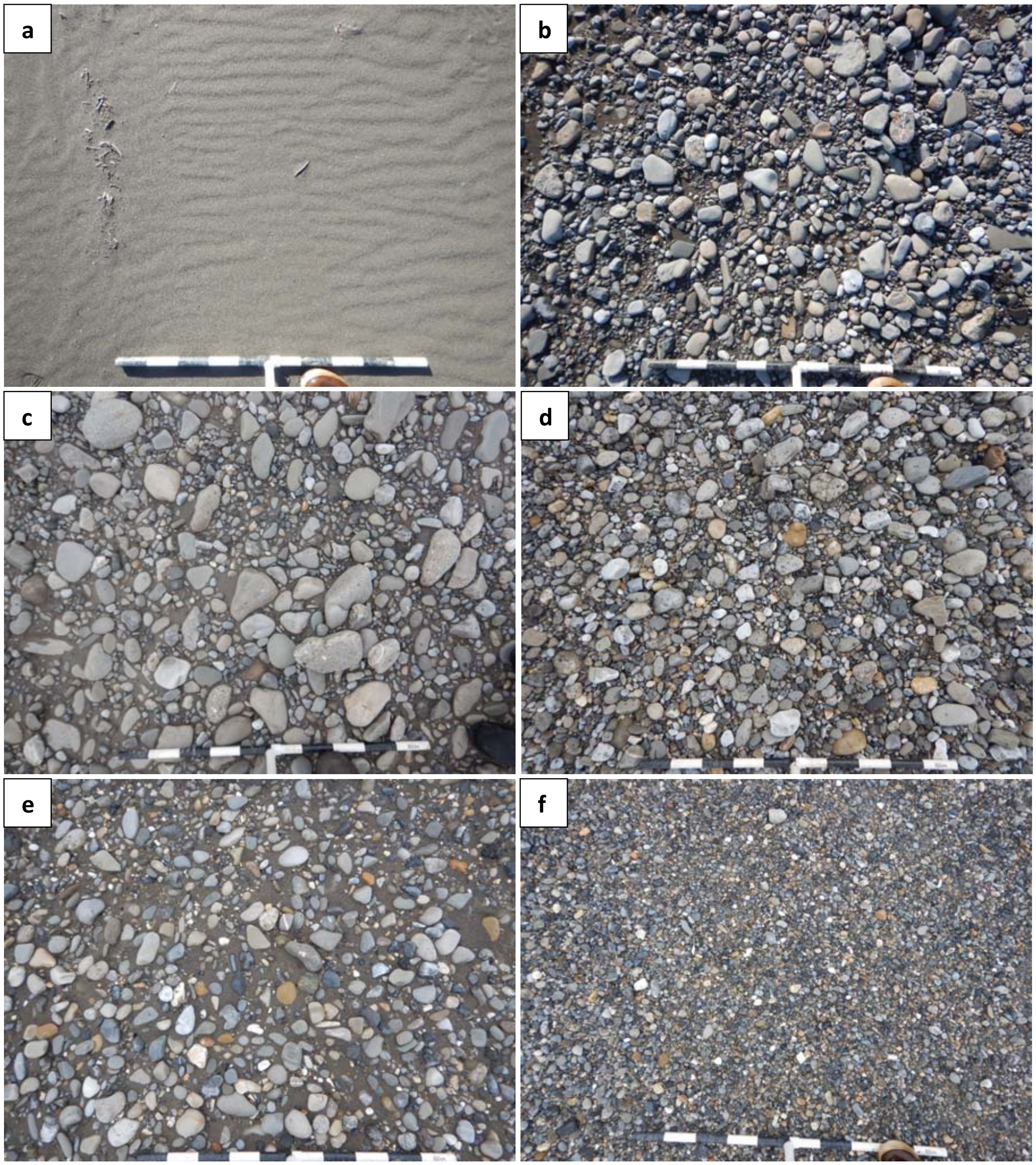


Figure 85. Example photographs of bed sediment near the sediment research sites from Tape et al. (2017). From top to bottom: (a) MP325 USGS station, (b) MP326 USGS station, (c) Happy Valley (DSS3), (d) below the Ivishak (DSS2), (e) East Bank (DSS5), (f) west channel near MP405 (DSS1).

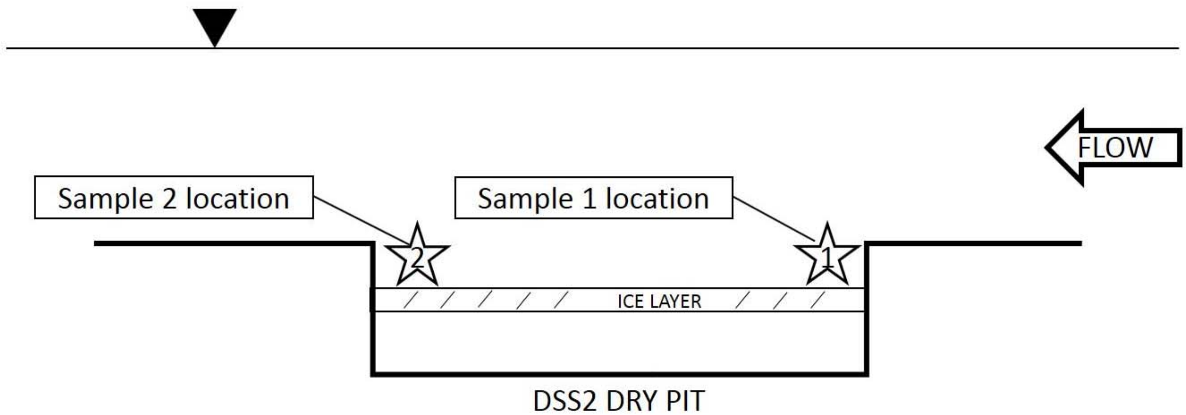


Figure 86. Sediment was deposited on top of the ice in the dry pit at the Sagavanirktok River below the Ivishak (DSS2) site. The schematic shows the location of the sample collection for grain size analysis.

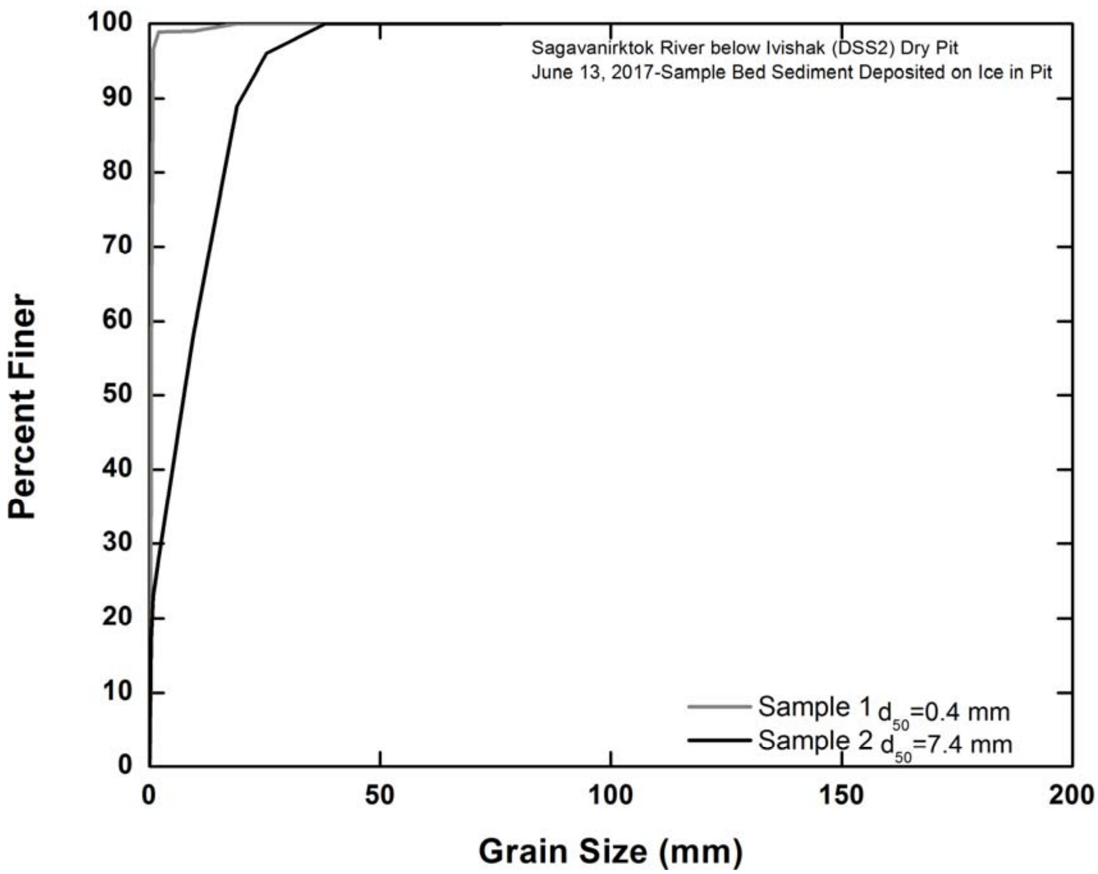


Figure 87. Grain size distribution of two sediment samples from the dry pit at the Sagavanirktok River below the Ivishak (DSS2) site. Sediment samples were collected from the top of anchor ice as shown in Figure 86. Both samples consisted of fine-grained particles.

4.5.2 Suspended Sediment Grain Size Distribution

Toniolo et al. (2016b) found that the average grain-size distribution (d_{50}) of suspended sediment at each site in 2016 ranged from 20 to 50 microns, which corresponds to silt-sized particles (ranging from medium to coarse silt). In 2017, we selected 19 water samples for sediment grain-size analysis (Table 10). Figure 88 shows the grain size distribution. Fourteen of these samples correspond to a flood event that occurred during the second half of July 2017; other samples correspond to samples we collected in June and early July 2017. The average grain size, d_{50}, for the first sub-group of samples ranged from 16 to 54 microns; samples from the other group ranged from 25 to 55 microns. All d_{50} were located in the medium-to-coarse silt range. Toniolo et al. (2016b) reported values within the same range at the same station and at other stations along the river (specifically, the Sagavanirktok River below the Ivishak River [DSS2] and the Sagavanirktok River near MP318 [DSS4]).

Table 10. Sample location, time, SSC, and measured d_{50}.

Station	Date	SSC (mg/L)	d_{50} (µm)
DSS3	3-Jun-17	918.4	25.35
DSS3	9-Jun-17	689.77	25.35
DSS3	22-Jun-17	421.01	25.35
DSS3	7-Jul-17	5.14	30.63
DSS3	11-Jul-17	51.37	55.45
DSS3	17-Jul-17	322.49	16.92
DSS3	18-Jul-17	199.83	13.63
DSS3	19-Jul-17	278.54	26.76
DSS3	20-Jul-17	50.72	40.11
DSS3	21-Jul-17	517.62	18.84
DSS3	22-Jul-17	323.72	22.15
DSS3	23-Jul-17	90.77	29.81
DSS3	24-Jul-17	713.94	44.68
DSS3	25-Jul-17	1419.11	34.12
DSS3	26-Jul-17	2146.1	42.34
DSS3	27-Jul-17	1334.9	18.84
DSS3	28-Jul-17	46.72	28.24
DSS3	29-Jul-17	171.98	36.99
DSS3	30-Jul-17	69.4	53.97

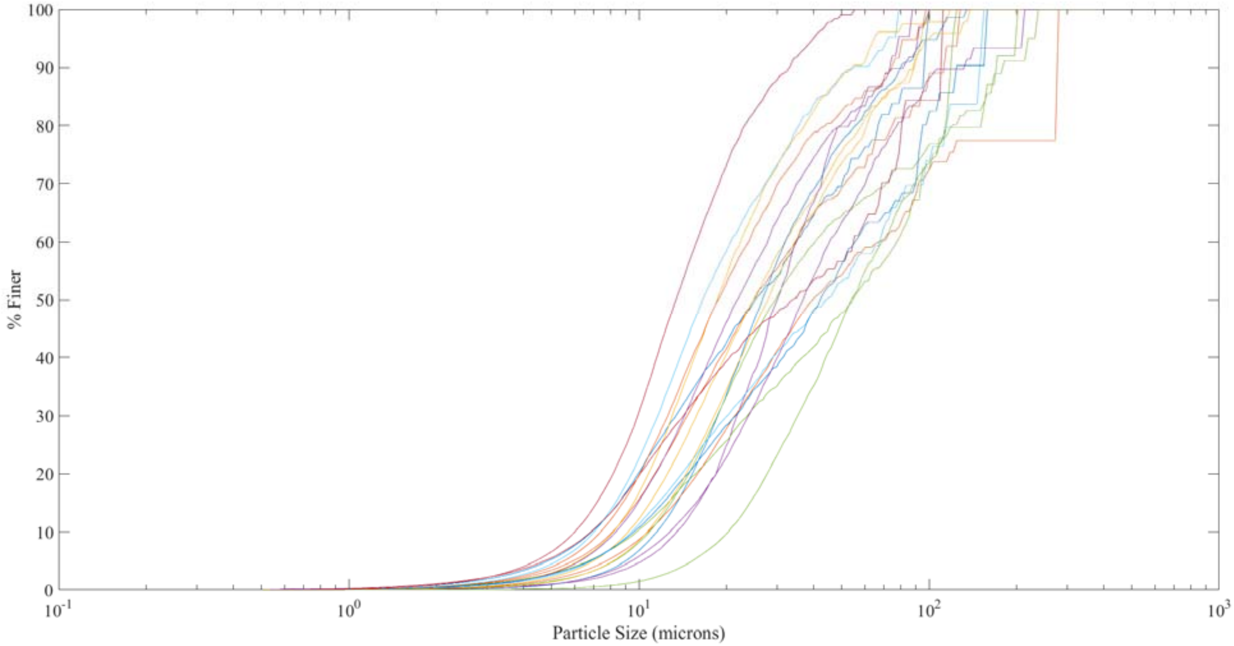


Figure 88. Grain size distribution of 19 samples collected from the Sagavanirktok River at Happy Valley (DSS3) from June and July 2017.

4.6 Suspended Sediment Concentration

We installed Isco 3700 autosamplers in the Sagavanirktok River stations to collect suspended sediment on a daily basis. We deployed two autosamplers at each site and programmed them to collect water samples every other day for the suspended sediment concentration (SSC) analysis described in Section 3.6. In the following section, we discuss the results of the SSC analysis in the Sagavanirktok River stations at MP318 (DSS4), Happy Valley (DSS3), below the Ivishak River (DSS2), the East Bank near Franklin Bluffs (DSS5), and the west channel near MP405 (DSS1) for 2015, 2016, and 2017.

4.6.1 Sagavanirktok River near MP318 (DSS4)

The uppermost station on the Sagavanirktok River is near MP318 (DSS4). This station is located in a slightly braided area of the river, with the site on the left channel. The aerial photographs in Figure 89 show the river during periods of relatively higher flow (turbid gray water with higher SSC) and during a period of lower flow (clear green-blue water with low SSC).

Figure 89. Sagavanirktok River near MP 318 (DSS4) showing the location of the autosampler on the left side of the river (yellow pin). The aerial photograph shows the river during three time periods: (a) turbid gray water on June 20, 2003 (streamflow of 184 m^3/s at USGS station), (b) clear water on August 25, 2013, during lower flow (113 m^3/s), and (c) turbid gray water on July 6, 2014 (north side of the photograph), during relatively higher stream discharge (225 m^3/s). The south side of the photograph in (c) was taken on August 25, 2013.

In early July 2015, we installed autosamplers by attaching the sampler intake tubes to rebar at the edge of the channel. Figure 90 (modified from Toniolo et al., 2016b) shows that during the second half of summer 2015, the SSC typically remained under 50 mg/L, with a high of 219 mg/L on July 9. High SSC occurred again on August 28, during a high flow event.

In early May 2016, we installed the autosampler, with the intake tube attached to rebar in the left channel. The highest SSC for 2016 was observed during spring breakup (Figure 91). The SSC increased as flows increased during the early part of breakup, but SSC decreased during a freezeback, described in Toniolo et al. (2016a). As air temperatures warmed again, flows increased, and a clear increasing trend in SSC was observed from May 18 through May 26. After breakup, SSC decreased during the summer months, but increased slightly in response to increased discharge from rain events in mid-June and again in late August. Overall, the SSC in the summer ranged from 0 to 100 mg/L, and averaged around 25 mg/L (Figure 91).

In mid-May 2017, we installed autosamplers at the DSS4 station during breakup by attaching the sampler intake tube to weights, which were then placed on top of shore ice or anchor ice. Figure 92 shows the SSC and water levels at MP318 (DSS4) in 2017. The SSC was low during early breakup, and increased slightly as breakup progressed. During early breakup flow, the water is typically low in suspended sediments, when the banks and streambed are ice-covered. As breakup progresses, the water becomes increasingly turbid as anchor ice lifts off the streambed and shore ice degrades. The photograph in Figure 93 shows somewhat turbid water later in spring breakup on May 27, 2017. Unfortunately, the autosampler collected no water samples immediately following spring breakup due to the large drop in water level, which resulted in the intake tubes being out of the river. In early July, we redeployed the intake sampler tubes deeper into the river channel. The SSC occasionally increased during various higher flow events (Figure 91). The highest SSC occurred on July 27, just after a rain event and increased streamflow. Compared with 2015 and 2016, the highest SSC occurred in 2017. However, as previously mentioned, these concentrations are likely higher than the actual concentration due to bottom sediment (rather than only suspended sediment) in the water sample.

Grab samples were collected during site visits in 2017 from various locations in the river channel near the MP318 station. For the most part, the SSC of the grab samples fall closely to the SSC of the samples taken by the autosampler. We collected the grab samples near shore during early spring breakup, before installing the autosampler, and the SSC of these grab samples is low, as expected. One grab sample, collected later in breakup, compares with the SSC from the autosampler. On July 6, 2017, the grab sample collected at shore had a SSC of 2 mg/L; the Isco sample contained a similar concentration of 4 mg/L. On August 3, we collected two grab samples near shore (68 mg/L and 66 mg/L); however, the autosampler had a higher SSC of 187 mg/L, which shows that the autosampler was probably taking in bed sediment. The intake tubes may have shifted after the higher flow event on July 25.

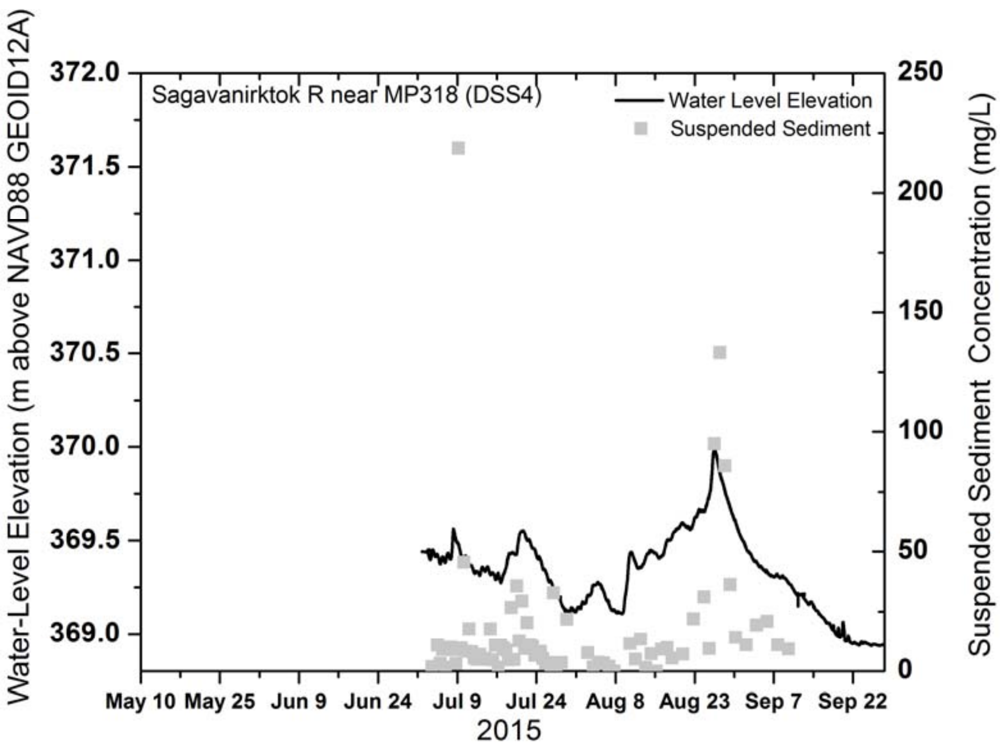


Figure 90. Suspended sediment concentration and water level elevation at the Sagavanirktok River near MP318 (DSS4) in 2015.

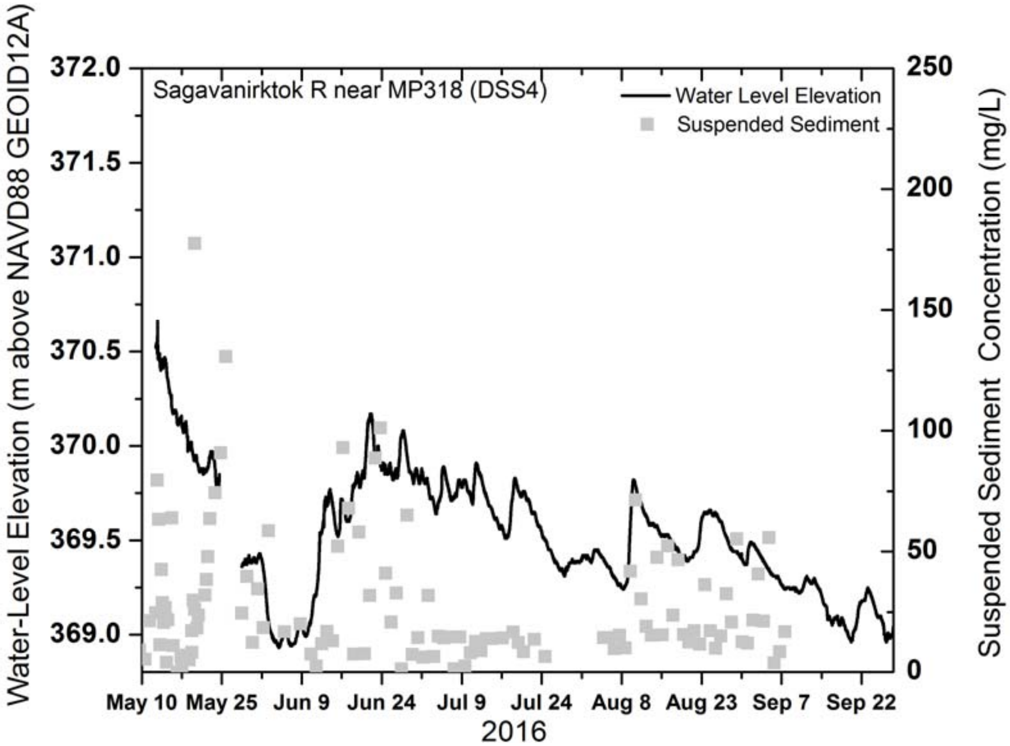


Figure 91. Suspended sediment concentrations and water level elevation at the Sagavanirktok River near MP318 (DSS4) in 2016.

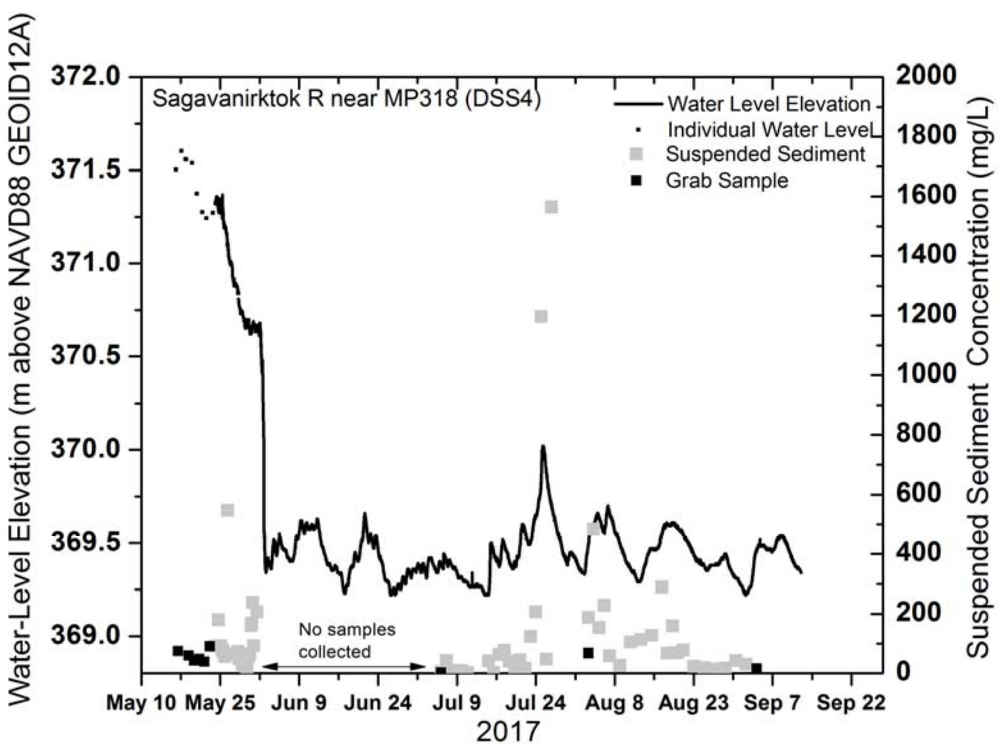


Figure 92. Suspended sediment concentrations and water level elevation at the Sagavanirktok River near MP318 (DSS4) in 2017.

Figure 93. Sagavanirktok River near MP318 (DSS4) on May 27, 2017, during spring breakup, showing more turbid water as breakup progressed.

4.6.2 Sagavanirktok River at Happy Valley (DSS3)

The station at Sagavanirktok River at Happy Valley (DSS3), shown in Figure 94, is situated near the main channel in periods of high flows and/or high river stage (such as during breakup). However, during periods of low flow, this location becomes an eddy with standing water; therefore, SSC at this location may not be entirely representative of the main channel during periods of low flow. The aerial images in Figure 94 show the river at Happy Valley (DSS3) during periods of high SSC and increased turbidity (gray and brown color), compared with a period of decreased turbidity (clear water).

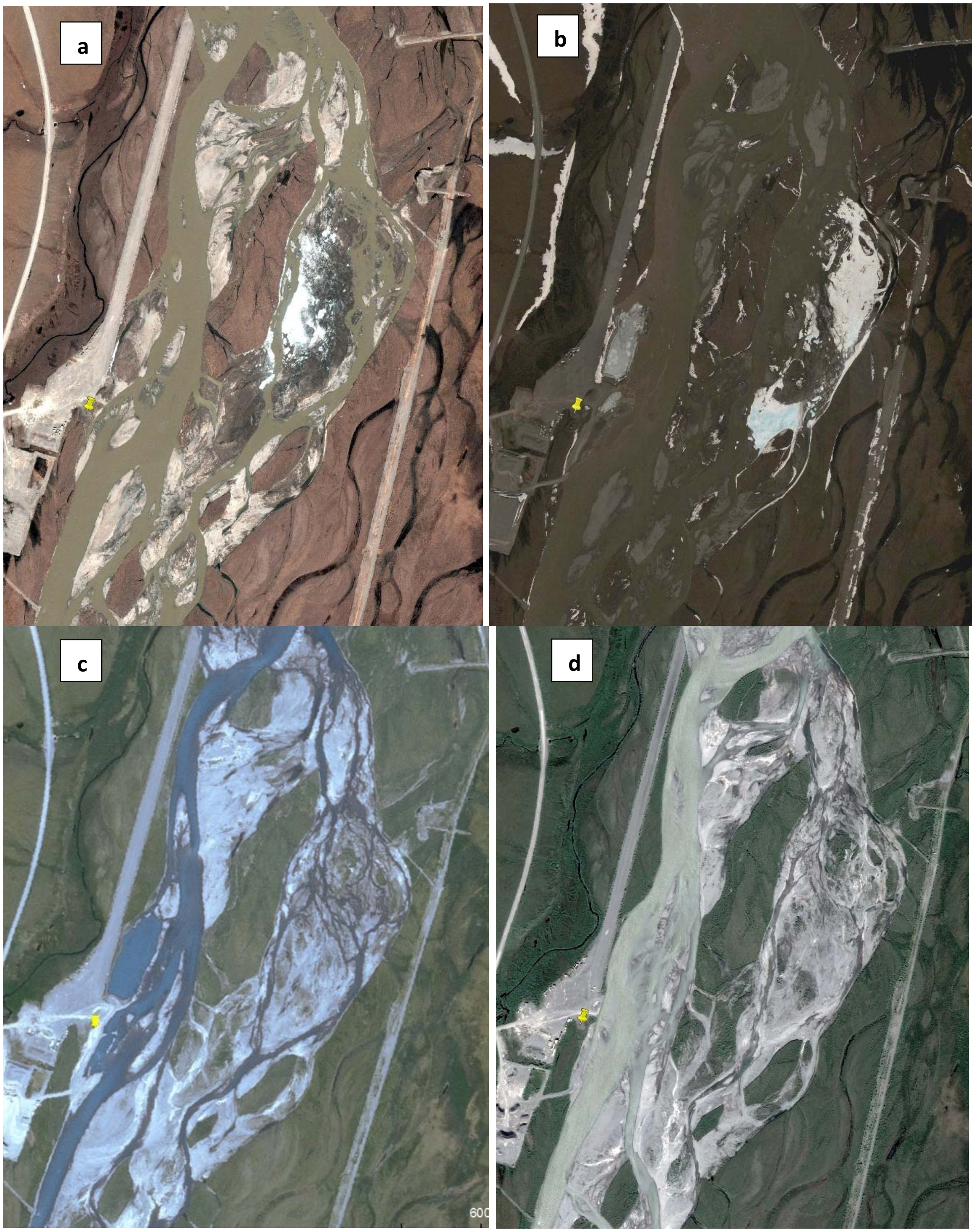


Figure 94. Sagavanirktok River at Happy Valley (DSS3) on (a) June 6, 2007 (283 m^3/s at USGS station: brown, turbid water), (b) May 24, 2009 (unknown flow: brown, turbid water), (c) late 2008 (unknown flow: clear water), and (d) July 6, 2014 (225 m^3/s at USGS station: gray, turbid water).
The river appears turbid in all photos except (c).

In late June 2015, we installed the suspended sediment autosamplers at Happy Valley (DSS3); in early September, we removed them. We attached the autosampler intake tubes to rebar in the channel near the station. Figure 95 (modified from Toniolo et al., 2016b) shows that for the second half of summer, the SSC remained under 150 mg/L, with an increase during a high flow event on August 28.

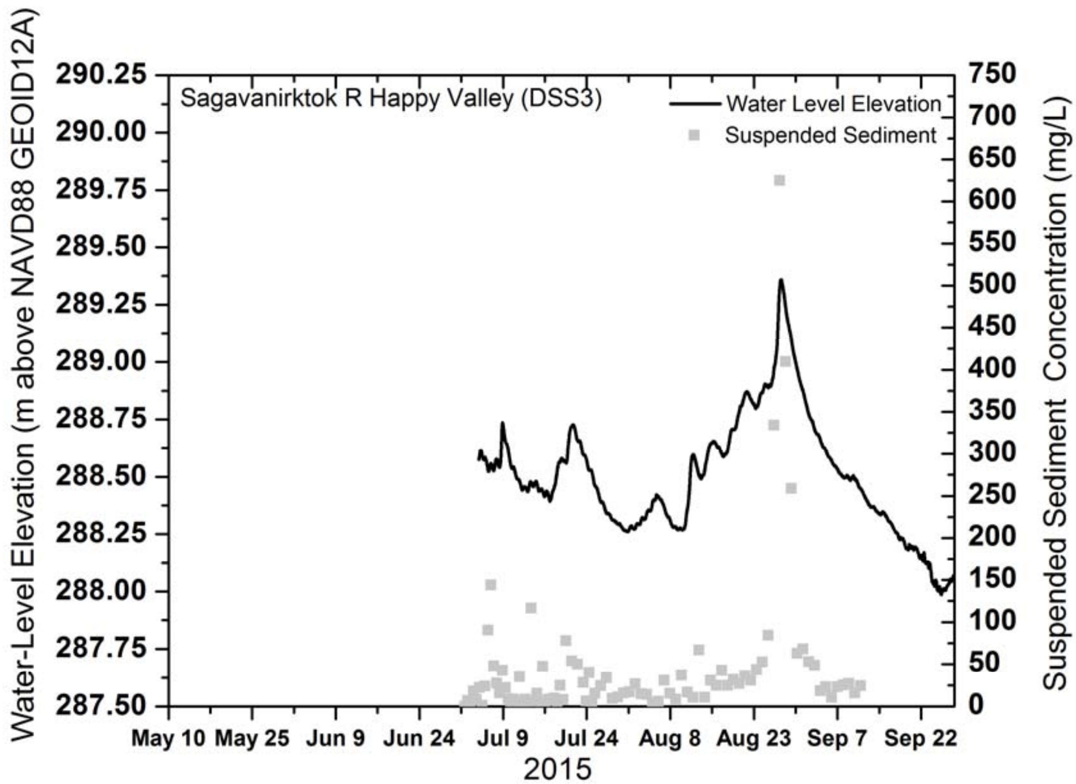


Figure 95. Suspended sediment concentrations and water level elevation at the Sagavanirktok River at Happy Valley (DSS3) in 2015.

In early May 2016, we installed autosamplers to capture SSC during spring breakup. We attached the intake tubing to rebar in the channel. Figure 96 shows the SSC and water level elevation at Happy Valley (DSS3) in 2016. Concentrations were initially low during breakup, when shore ice and anchor ice restrict the movement of sediment. As breakup progressed, SSC in the river increased when the ice detached from the bed or melted, allowing sediment transport. Similar to the SSC at MP318 (DSS4), SSCs decreased during the mid-May freezeback and then increased again in late May as flows increased. Through summer, SSCs remained under 50 mg/L, with occasional increases during a few higher flow events. The greatest SSC for 2016 was observed at the end of spring breakup on May 25.

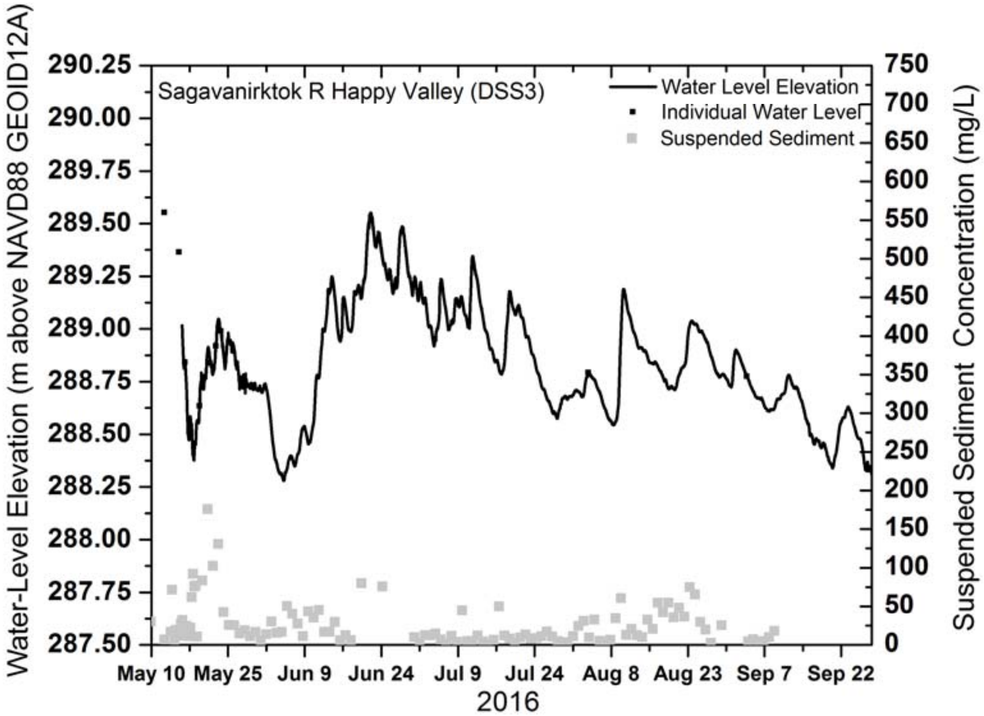


Figure 96. Suspended sediment concentrations and water level elevation at the Sagavanirktok River at Happy Valley (DSS3) in 2016.

In mid-May 2017, we installed autosamplers during spring breakup. We attached the sampler intake tubes to weights, which were then deployed on top of anchor ice or shore ice at the edge of the river. This method is not ideal, because the intake tube can move if the shore/anchor ice lifts off the streambed. Figure 97 shows the water level elevation and SSC in 2017. During breakup, SSC was initially low, but increased throughout breakup into early June. We redeployed the autosampler intake tubes into deeper water in early July, again attached to weights and placed on the streambed. A few of the samples were quite high (with an SSC of 18,000 mg/L on June 14), most likely caused by the sampler intake tube moving and subsequently taking in bottom sediment; these data are not presented. The photo in Figure 98 shows that the river had low turbidity on July 7, 2017, which corresponds to the low SSC of the water sample on that day. In 2017, the highest SSC was on July 25, during a period of increased stream discharge. Compared with 2015 and 2016, the year 2017 had the greatest SSC; however, these high concentrations may not be representative of the actual concentration because the intake tube probably took in streambed sediment.

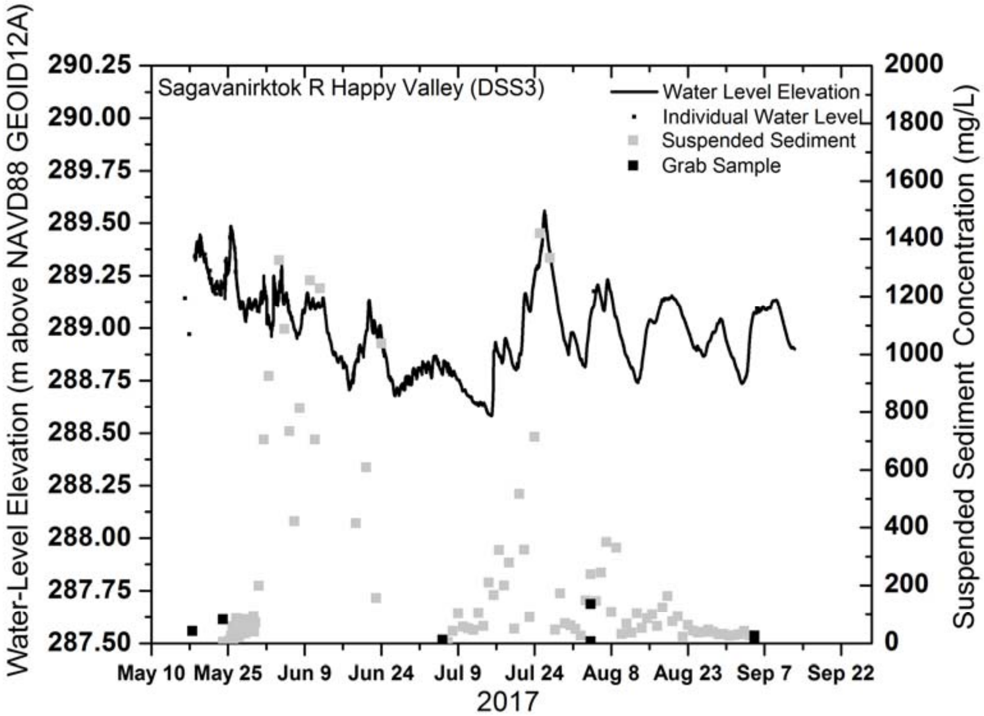


Figure 97. Suspended sediment concentrations and water level elevation at the Sagavanirktok River at Happy Valley (DSS3) in 2017.

Figure 98. Sagavanirktok River at Happy Valley (DSS3) on July 7, 2017 during a period of low SSC in early July.

As previously mentioned, during periods of low flow, a gravel bar located across from the station at Happy Valley (DSS3) becomes exposed, creating an area of backwater at the location of the autosampler. During these times, the autosampler may be collecting samples that are not representative of the main channel. We collected grab water samples from the main channel and near shore at Happy Valley (DSS3) in 2017 for comparison purposes. The grab sample collected from near shore on May 24 had a SSC of 83 mg/L, whereas the sample taken from the autosampler the same day had a SSC of 6 mg/L. Although this difference seems like a discrepancy, during breakup, we found that the SSC could vary over a 24-hour period. The grab sample taken on July 6 from near the bank was 12 mg/L, and the sample from the autosampler contained a similar concentration of 16 mg/L. On August 4, we collected two grab samples from the river at Happy Valley. One grab sample, collected near shore, had a concentration of 7 mg/L. The other grab sample, collected from the main channel downstream from the site, had a SSC of 135 mg/L. The SSC from the autosampler on August 4 was 238 mg/L, higher than the SSC of all grab samples that same day. This difference is probably due to the autosampler intake tube taking in bed sediment and increasing the concentration of the sediment in the water sample. The intake tube may have shifted closer to the streambed after the higher flow event on July 25. Additionally, the SSC of the grab sample taken near shore was less than the concentration in the main channel, indicating that samples from near shore may be less representative than samples from the main channel.

4.6.3 Sagavanirktok River below the Ivishak River (DSS2)

The Sagavanirktok River station below the confluence with the Ivishak River (DSS2) is located on a side channel of the main flow, as shown in Figure 99. The river at this location is extensively braided; at the station, the channel is typically a backwater pool (Figure 100) except during periods of high flow. Due to the less-than-ideal location of the autosamplers, the SSC may only be representative of the main channel during periods of very high flow or during high stages, such as breakup. At the DSS2 location, the watershed area of the Sagavanirktok River nearly doubles with the input of water from the Ivishak River. Figure 99 is an aerial photograph of the river on July 6, 2014, showing relatively clear water. Figure 101 is an aerial photograph of the Sagavanirktok River above the confluence of the Ivishak River at both Happy Valley (DSS3) and MP318 (DSS4), showing turbid water on July 6, 2014. The river becomes less turbid below the confluence with the Ivishak River at the DSS2 station. The aerial photograph at the confluence (Figure 101) shows a striking difference in SSC between the Ivishak (clear) and the Sagavanirktok (turbid) rivers on July 6, 2014. This difference in SSC and turbidity may be attributed to glacial melt. Presently, more glaciers exist in the upper Sagavanirktok drainage than in the Ivishak drainage (ESRI, 1991). Precipitation patterns could be another explanation for the differing turbidity in the two rivers. Isolated convective storms may not produce widespread rain throughout the entire watershed. There also may be a pattern of decreased precipitation from west to east across the Brooks Range, as described in Kane et al. (2015).

Figure 99. Sagavanirktok River below the Ivishak River confluence (DSS2) on July 6, 2014; the autosampler is placed on the left side of the river near the spur dikes. Water becomes clear downstream of the Ivishak at this location, compared with the same aerial photograph showing very turbid water at the sites above the Ivishak confluence (Happy Valley and MP318). Aerial imagery from the Ivishak-Sagavanirktok confluence on this day (Figure 101) shows that the Ivishak is clear, while the Sagavanirktok (above the Ivishak) is turbid.

Figure 100. Photograph of the location of the autosampler and the turbidimeters in the Sagavanirktok River below the confluence with the Ivishak (DSS2).

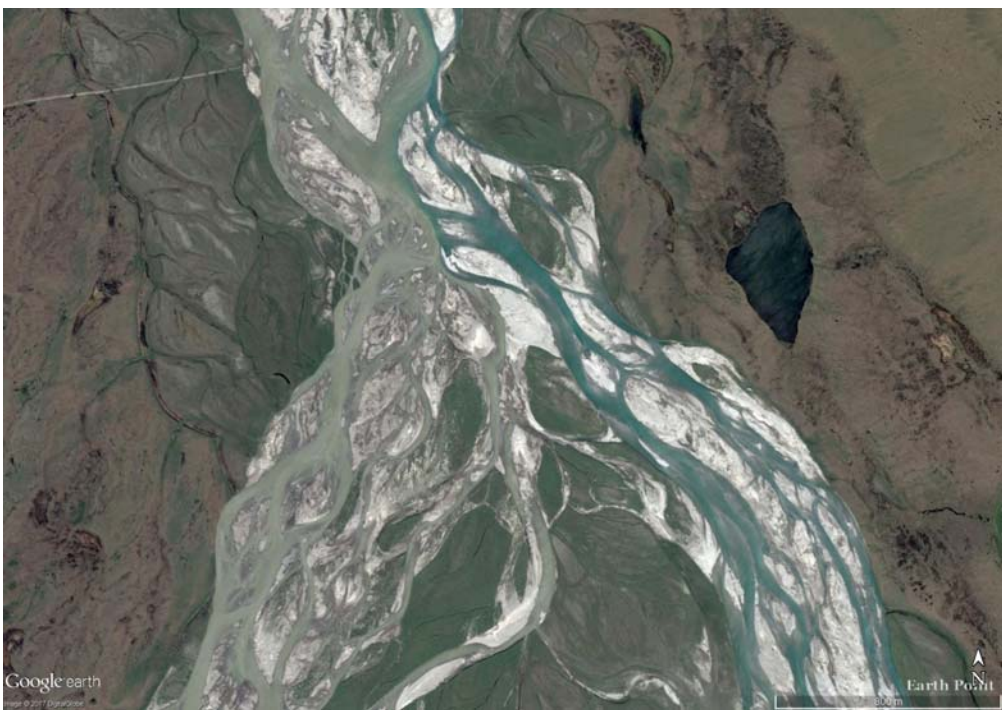


Figure 101. Sagavanirktok River (left: gray, turbid water) and Ivishak River (right: clear water) confluence on July 6, 2017, showing the difference in turbidity in the two rivers.

In 2015, we attached the water autosampler intake tubes to rebar in the channel next to the station; we collected samples from early July to early September. Figure 102 (modified from Toniolo et al., 2016b) shows that SSC remained under 50 mg/L for most of the summer, but increased on July 8 and after a high flow event on August 28.

In early May 2016, we deployed autosamplers for spring breakup by attaching the intake tubes to rebar in the channel near the station. The SSC increased through spring breakup, with the higher SSC occurring later in breakup as ice melted or moved downstream, exposing sediment. The highest recorded SSC for the year 2016 occurred on May 24 during breakup. SSC remained under 75 mg/L for most of the summer (Figure 103). Various small increases in SSC were observed in late June and mid to late August, likely due to increased stream discharge.

In 2017, we deployed autosamplers from mid-June (after spring breakup) to early September. This time, the sampler intake tubes were attached to weights, which were placed on the streambed. Figure 104 shows that most of the time the SSC was under 100 mg/L, with a few increases during late June and again on July 25, during periods of higher flow. Six samples had erroneous SSC (3,000 to 20,000 mg/L) in late June and early July; these samples are not presented. It is likely that the sampler intake tube was too close to the bed and took in streambed sediment.

In 2017, we collected grab water samples from the river at various locations (near DSS2) to compare with the autosampler results from 2017. The SSC of the grab samples were comparable to the SSC from the autosampler during periods of low suspended sediment. The grab sample taken on July 9 from near shore had a concentration of 19 mg/L. The sample from the autosampler on July 9 had a concentration of 167 mg/L. The higher concentration in the July 9 sample collected by the autosampler may have been caused by bed sediment in the water sample. On August 6, the grab sample we collected near the location of the autosampler had a SSC of 19 mg/L, and the sample from the autosampler had a SSC of 81 mg/L, demonstrating that the autosampler was probably taking in some bed sediment with the water sample.

On September 6, 2017, we collected two grab samples: the one from the middle of the channel had a SSC of 105 mg/L; the other from near the bank had a SSC of 103 mg/L. On the same day, the sample collected by the autosampler had a SSC of 32 mg/L. On September 7, we collected two more grab samples; the one taken from the main channel had a concentration of 62 mg/L; the one taken near the autosampler intake tube had a SSC of 13 mg/L. Unfortunately, the autosampler did not collect a sample that day. Therefore, the data show that SSC varies significantly on a daily basis in the entire river cross section.

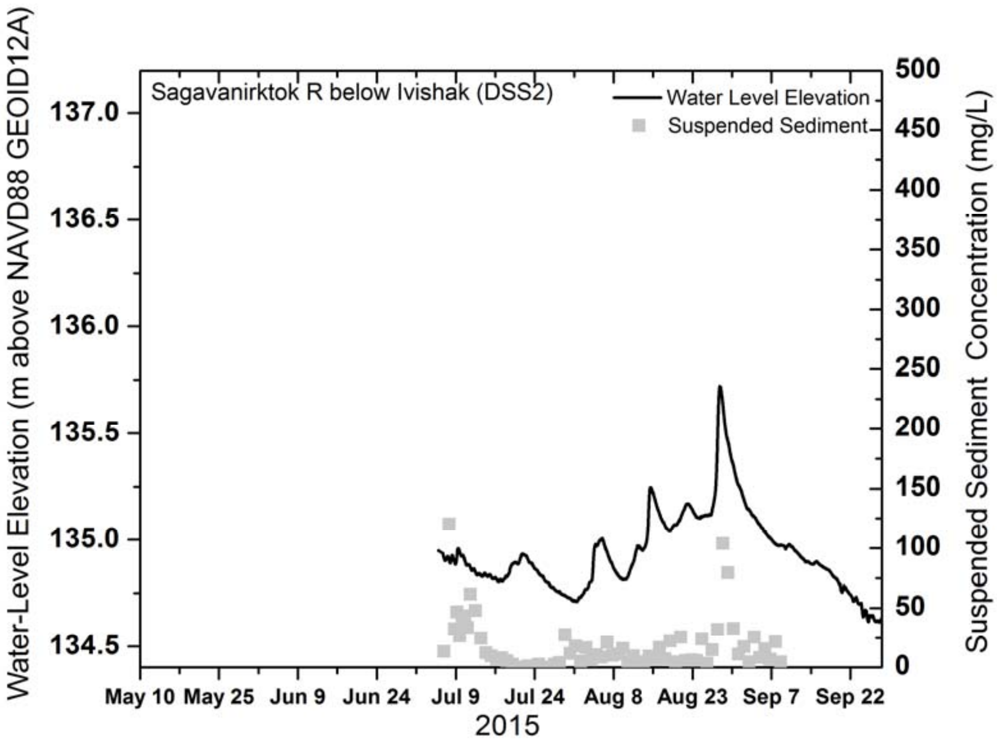


Figure 102. Suspended sediment concentrations and water level elevation at the Sagavanirktok River below the Ivishak River confluence (DSS2) in 2015.

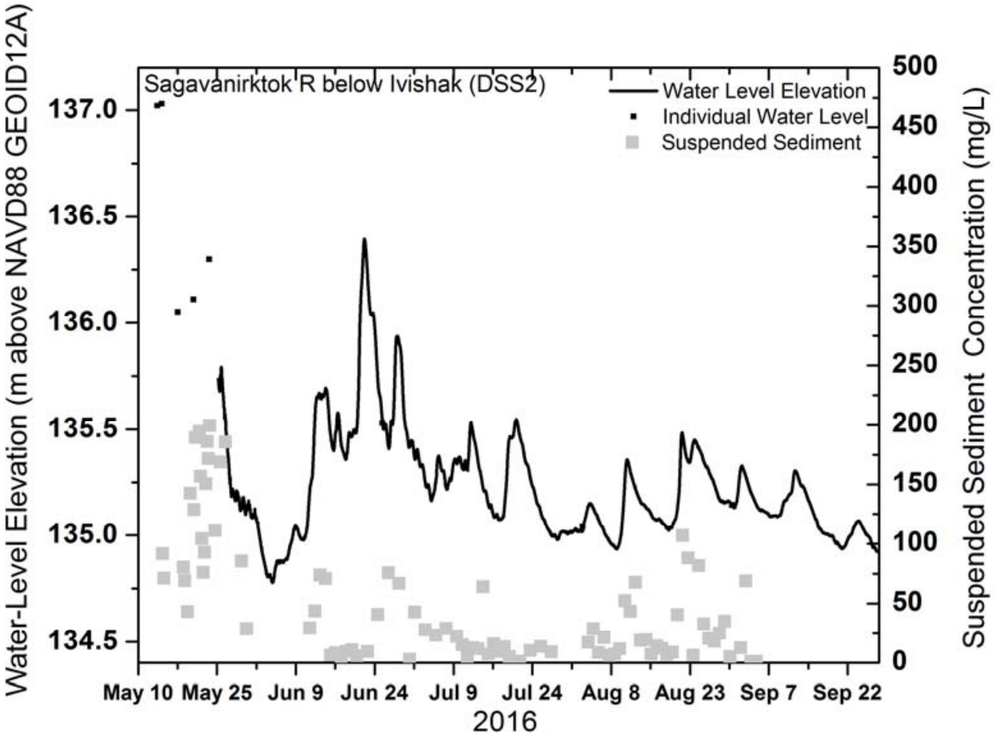


Figure 103. Suspended sediment concentrations and water level elevation at the Sagavanirktok River below the Ivishak River confluence (DSS2) in 2016.

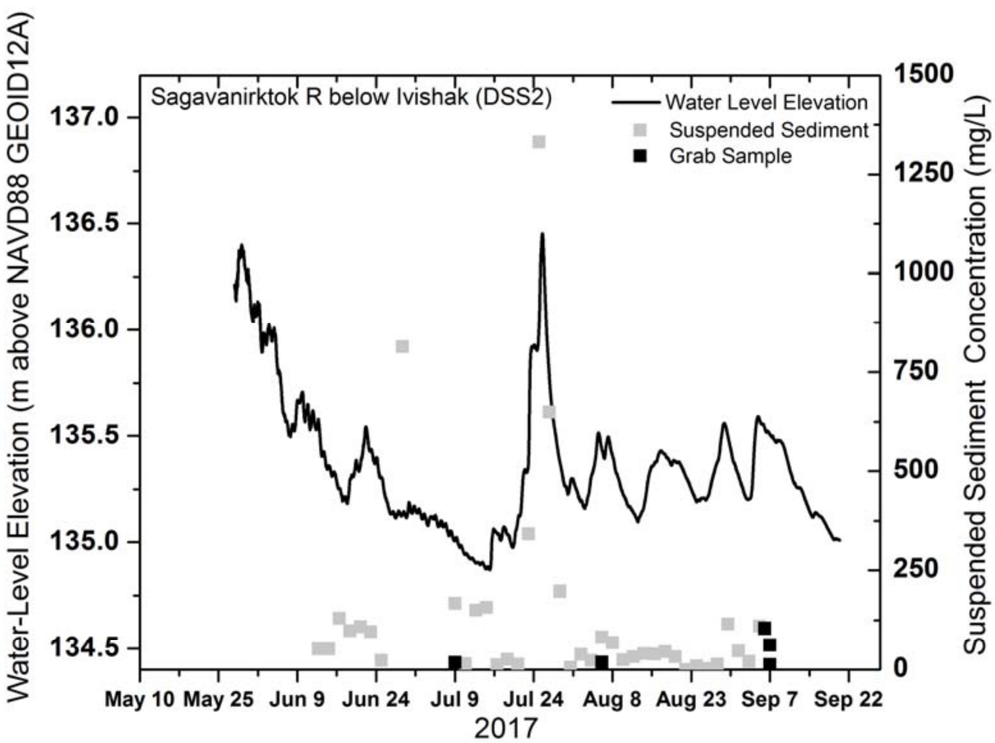


Figure 104. Suspended sediment concentrations and water level elevation at the Sagavanirktok River below the Ivishak River confluence (DSS2) in 2017.

4.6.4 Sagavanirktok River near MP405 (DSS1)

The station on the Sagavanirktok River near MP405 (DSS1) is located on the left bank of the westernmost channel (near the Dalton highway). This section of the river near Deadhorse is extremely braided, as shown in Figure 3. The autosamplers at this site are located in one of the main channels, shown in Figure 105, and even during periods of low flow, data should be representative of the main flow. We measured SSCs in the river at the nearby East Bank station (DSS5) during spring breakup in 2015 and 2016 (discussed in Section 4.6.5). We installed the autosamplers at MP405 (DSS1) in early July to early September by attaching the intake tubes to rebar in the main channel. Figure 106 shows SSCs and water level elevations at the station near MP405 (DSS1) in 2015 (modified from Toniolo et al., 2016b). Through the summer, SSC was low (less than 50 mg/L) until August 28, when the SSC increased during a high flow event.

In 2016, we attached the autosampler intake tubes to rebar in the stream channel; the autosampler operated from the last week of June to late August. Figure 107 shows that in 2016, the SSC was variable, between 0 and ~100 mg/L, and increased after early July and again in mid-August. Increases in July and August may be a result of activity at the material extraction site, but we do not have photographs during those periods for confirmation.

In 2017, we deployed autosamplers from mid-June to early September. We attached the sampler intake tubes to weights that we placed on the streambed. Figure 108 shows that, most of the time, SSC in the river remained below 50 mg/L, with increases during higher flow events on June 24 and July 25. The intake tube of one of the autosamplers likely moved after the July 25 high flow event, resulting in erroneously high SSC for all of August. We removed these results from the dataset.

We also collected grab samples from various locations in the river in 2017 to compare with the autosampler results. On August 5, we collected two grab samples: one near the location of the autosampler, which had a SSC of 40 mg/L, and the other in the main channel, which also had a concentration of 40 mg/L. The SSC recorded by the one working autosampler had a concentration of 40 mg/L.

Figure 105. Sagavanirktok River near MP405 site 042 (DSS1), near Deadhorse and the Dalton Highway, during a period of clear water and relatively low flow on September 6, 2014. The station is on the left bank of the west channel. Although the river is low in the image, the autosampler is placed at the main channel; thus, data are representative at this site.

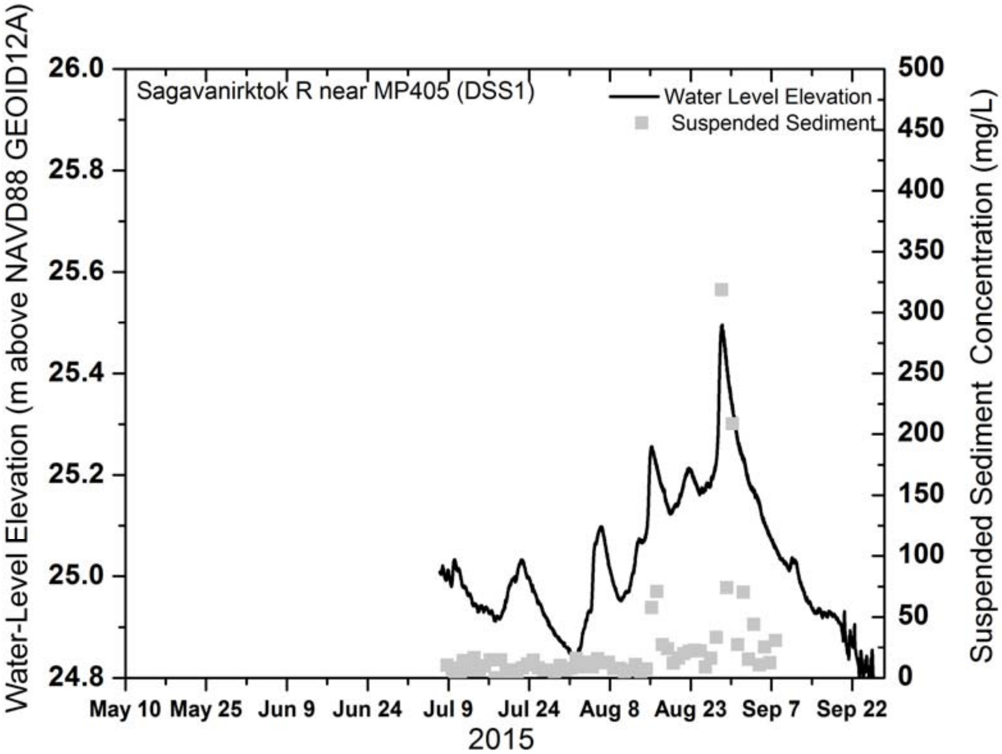


Figure 106. Suspended sediment concentrations and water level elevation at the Sagavanirktok River near MP405 (DSS1) in 2015.

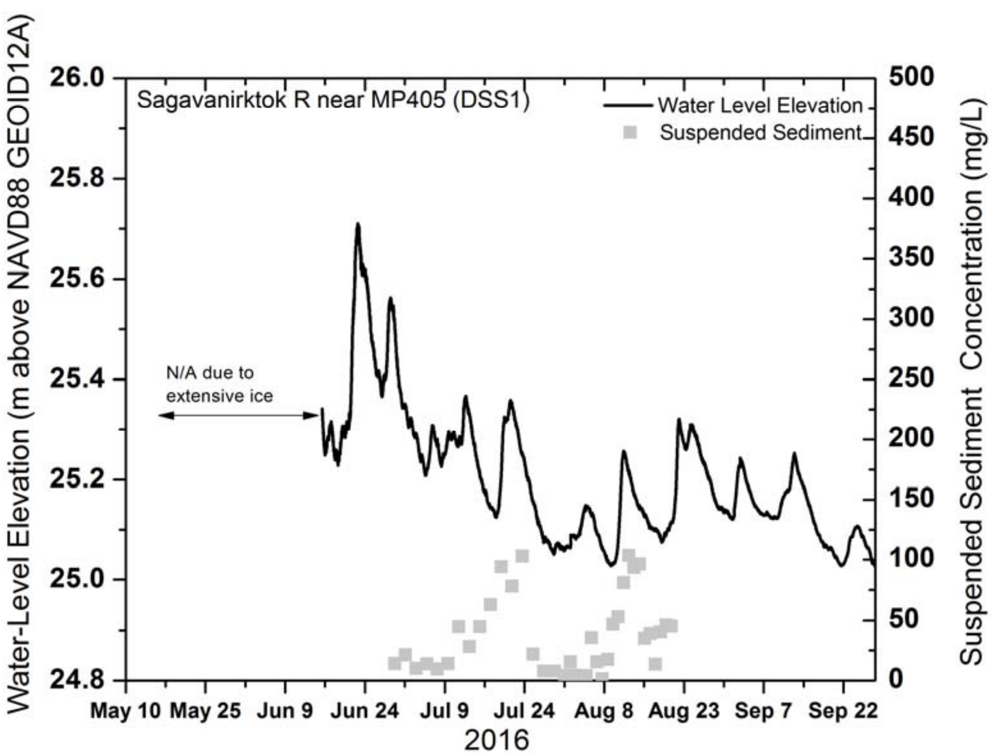


Figure 107. Suspended sediment concentration and water level elevation at the Sagavanirktok River near MP405 (DSS1) in 2016.

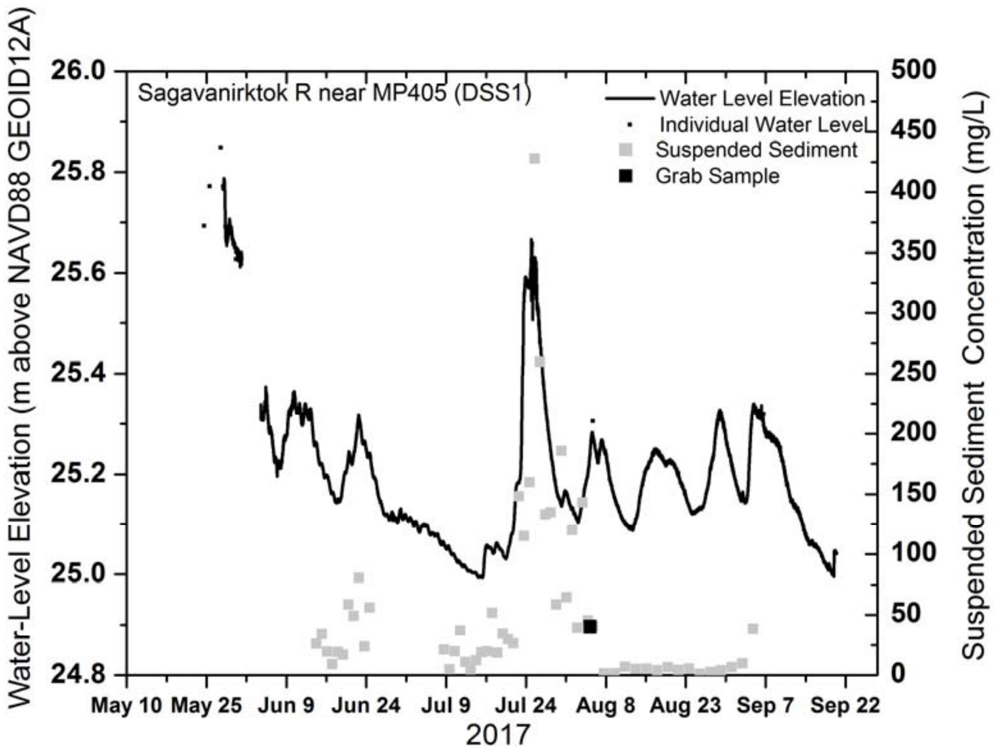


Figure 108. Suspended sediment concentration and water level elevation at the Sagavanirktok River near MP405 (DSS1) in 2017.

4.6.5 Discussion

The autosampler installation in 2017 differed from installations in previous years. The SSCs in summer 2017 were, for the most part, higher than the SSCs in summer 2015 and 2016. It is probable that the summer results were higher in 2017 because the water samples contained bed sediment, not because more suspended sediment was in the river.

We reviewed a series of higher flow events to look for changes in SSC by site location. We first compared the SSC results collected during spring breakup for 2015, 2016, and 2017. During spring breakup in 2015, we took samples from the Sagavanirktok River East Bank (DSS5) station near Franklin Bluffs, as reported in Toniolo et al. (2015). The SSC was initially low, the first few days of breakup, but as flow increased and ice was flushed out of the river, the SSC increased. Maximum SSCs of ~4,500 mg/L were reported on May 22, 2015 (Toniolo et al., 2015).

In spring breakup 2016, SSCs were initially low. Toward the end of breakup, they increased to a range of 175 to 225 mg/L at the sites. The SSCs in 2016 were much lower than the SSCs at East

Bank (DSS5) during spring breakup 2015. In 2017 the SSC at MP318 (DSS4) during spring breakup reached ~500 mg/L (May 27), and at Happy Valley (DSS3), the maximum SSC was 1300 mg/L (June 4). These SSCs are higher than the SSCs observed during breakup 2016, but lower than the SSCs at East Bank (DSS5) in 2015. The SSC was not measured at any station below the confluence with the Ivishak River during breakup 2017 (due to river ice).

The high SSCs found in the Sagavanirktok River at the East Bank station near Franklin Bluffs in 2015 exceeded the SSCs observed in both 2017 and 2016. A major difference between the spring breakup of 2015, compared with breakup in 2016 and 2017, was the peak discharge: in 2015, it was much greater (at least double) and the duration of breakup was shorter. In 2015, breakup was very rapid due to the widespread warm air temperatures throughout the entire basin, and it was a mechanical breakup, rather than a thermal breakup, of river ice. In both 2016 and 2017, with lower breakup flow, there was less energy for suspended sediment transport. In the slower breakup of 2016 and 2017, much of the river ice decayed thermally in place, rather than mechanically; therefore, sediment was protected by ice and not readily available for transport.

We reviewed a few summer high-flow events to look for trends in the SSC between sites. On August 28, 2015, the SSCs were 318 mg/L, 104 mg/L, 645 mg/L, and 85 mg/L near MP405 (DSS1), below the Ivishak River (DSS2), at Happy Valley (DSS3) and near MP318 (DSS4), respectively. No relationship was obvious between SSC and the distance downstream, other than that SSC increased downstream above the confluence with the Ivishak River (between DSS4 and DSS3), and it increased again below the confluence with the Ivishak River (between DSS2 and DSS1). In 2016, a series of higher flow events took place in mid to late June, and the SSC was similar at the stations. The highest SSC was 101 mg/L at MP318 (DSS4) on June 23. The SSC at Happy Valley (DSS3), below the Ivishak River (DSS2), and near MP 405 (DSS1) remained below 80 mg/L during the June high flow events. In 2017, the highest event of the summer occurred on June 25, resulting in increased SSC at all stations. Because of the uncertainty in the magnitude of SSC during summer 2017, we did not compare the data from each station. As explained previously, glacial melt may increase SSCs and turbidity in the river during the summer, even with only small increases in discharge. The gray, turbid water of the Sagavanirktok River, in contrast to the clear water of the Ivishak River (see aerial photograph in Figure 101) is probably due to melting of glaciers in the upper Sagavanirktok basin.

4.7 Turbidity

In addition to measuring suspended sediment concentration (SSC), we installed Campbell Scientific OBS500/501 turbidimeters in the Sagavanirktok River near MP318 (DSS4), Sagavanirktok River at Happy Valley (DSS3), Sagavanirktok River below the confluence with the Ivishak River (DSS2), and Sagavanirktok River west channel near Deadhorse at MP405 (DSS1). Unlike SSC, which is a direct measurement of suspended sediment in the river, turbidity from the OBS500/501 meter is more difficult to quantify. Sensor output can vary substantially due to type of sensor used, sensor calibration, and even the size and shape of the particles in the river (Anderson, 2005). Additionally, fouling of the sensor, which is a buildup of material on the optical sensor, can cause erroneous results. We programmed the turbidimeters to open and close a shutter over the optics, presumably cleaning the buildup of material on the sensor once every 4 hours. The turbidimeters were factory repaired and recalibrated in winter 2016/2017. For these reasons, comparisons of turbidity magnitude for individual flow events, along with year-to-year comparisons, are difficult to interpret.

Each summer, we installed the sensors near the station at the river's edge by attaching them to stakes in the channel. These sensors, typically located close to the suspended sediment autosampler intake tubes, are installed in early July and removed by early September, before winter. In this section of the report, we describe the results of turbidity observations for the period of record (2015 to 2017) at the Sagavanirktok River stations.

4.7.1 Sagavanirktok River near MP318 (DSS4)

We installed the turbidity sensor at the uppermost Sagavanirktok River station, near MP318 (DSS4), in a slightly braided reach of the river (see Figure 89), where it divides into two channels.

In 2015, as reported in Toniolo et al. (2016a), we installed the tubidimeter in early July and it operated until July 29, when the sensor malfunctioned (Figure 109). During the period it was operating, the sensor recorded slightly increased turbidity during increased flow events. A few of the higher peaks in turbidity in early July could have resulted from fouling of the optical sensor, or they could be attributed to turbid water during glacial melt. Figure 110 presents the water level elevations and turbidity near MP318 (DSS4) in 2016. In 2016, the turbidity in the river near MP318 was similar to the turbidity results in 2015, with increases during higher flow events and decreases during periods of low flow. A photograph at the site taken on August 3, 2016, shows clear water, which corroborates the low turbidity measured by the turbidity sensor (Figure 111). Figure 112 shows the turbidity and water levels in 2017. Turbidity readings appear noisy, but typically follow the change in water levels, with a high on July 24, during a summer high flow event. The magnitude of the turbidity appears to have increased in 2017, but this does not necessarily mean the river was more turbid. Year-to-year comparisons cannot be easily made due to the inherent limitations of the turbidimeters (described above).

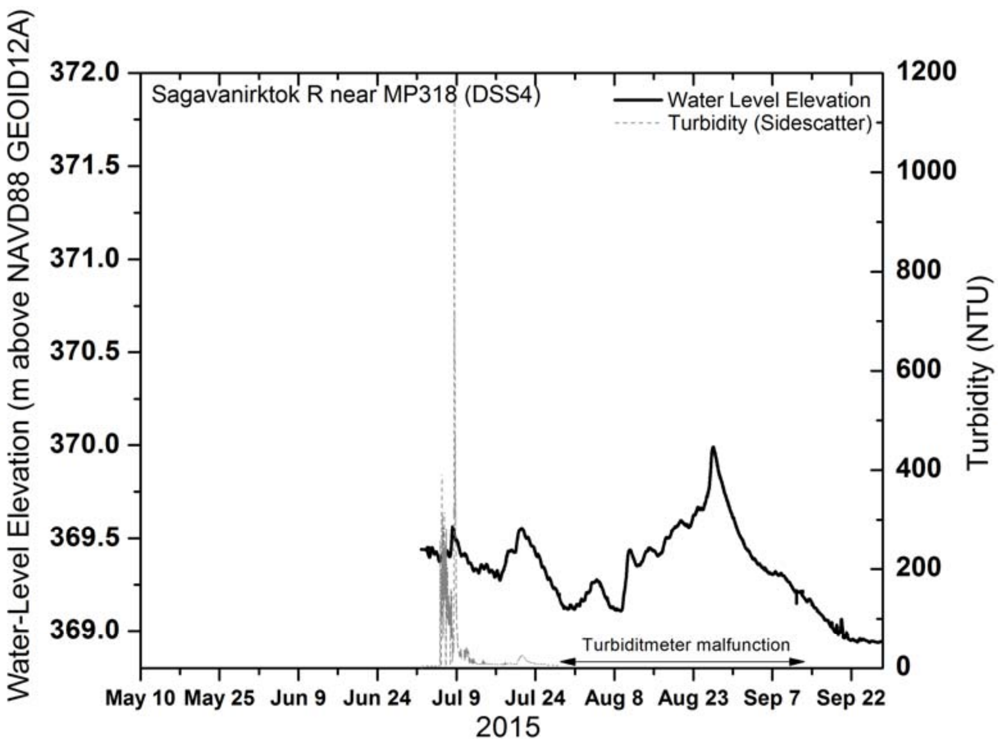


Figure 109. Water level elevations and turbidity (sidescatter) at the Sagavanirktok River near MP318 (DSS4) in 2015 (modified from Toniolo et al., 2016b).

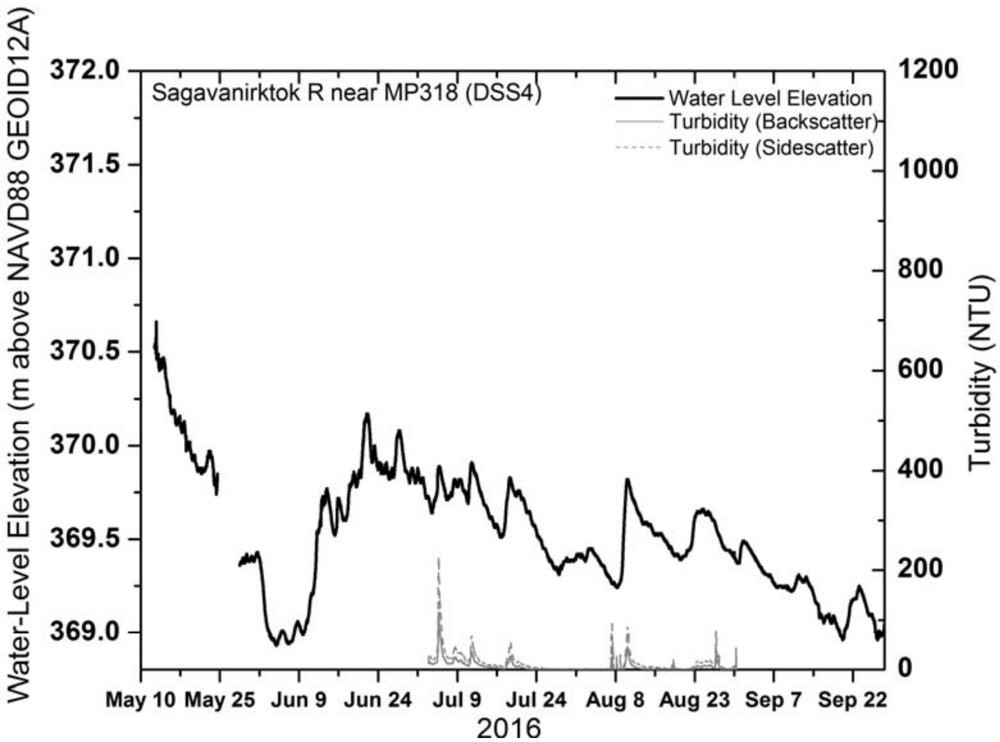


Figure 110. Water level elevations and turbidity (backscatter and side scatter) at the Sagavanirktok River near MP318 (DSS4) in 2016.

Figure 111. Sagavanirktok River near MP318 (DSS4) on August 3, 2017, showing clear water. The dry pit is located at the left of the photo.

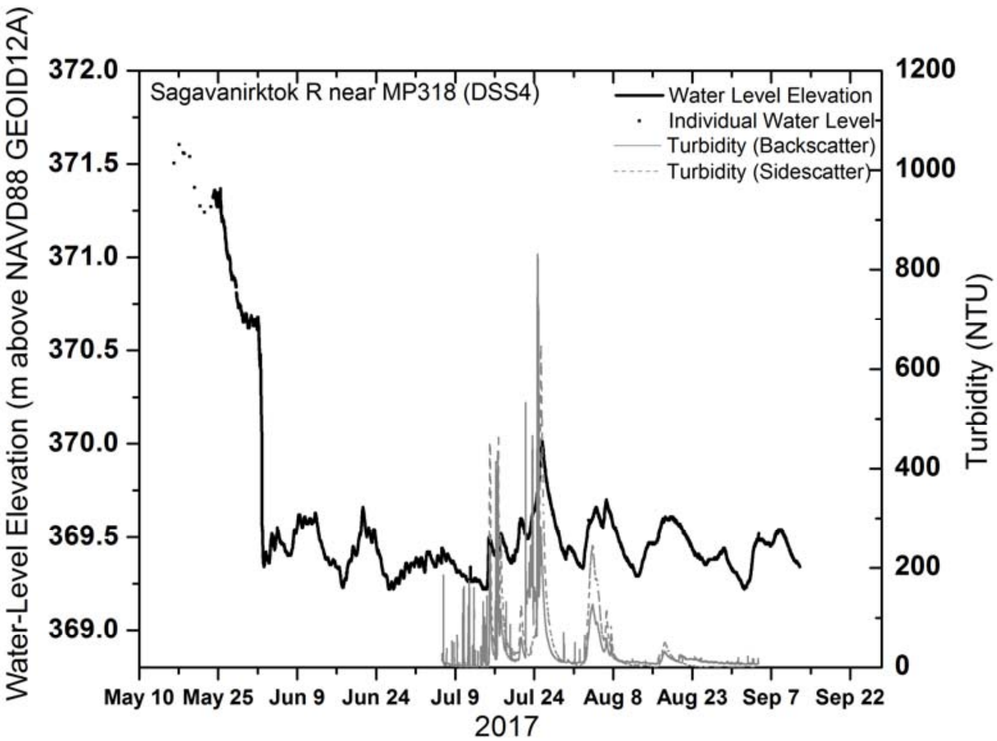


Figure 112. Water level elevations and turbidity (backscatter and sidescatter) at the Sagavanirktok River near MP318 (DSS4) in 2017.

4.7.2 Sagavanirktok River at Happy Valley (DSS3)

We installed the turbidimeter at the station near Happy Valley (DSS3) near the main channel (see Figure 94); however, during periods of lower flow, the area becomes a backwater pool due to a gravel bar near the station. Therefore, during periods of low stream discharge, results may not be representative of the turbidity in the main channel. In 2015 (Figure 113), anomalous peaks of turbidity occurred in early July and early August, which may have resulted from fouling of the optical sensor (Toniolo et al., 2016b) or may have resulted from glacial melt. However, these anomalous turbidity peaks do not correlate well with SSC. Additionally, the data appear to be noisy, with drifting of the sidescatter sensor in August.

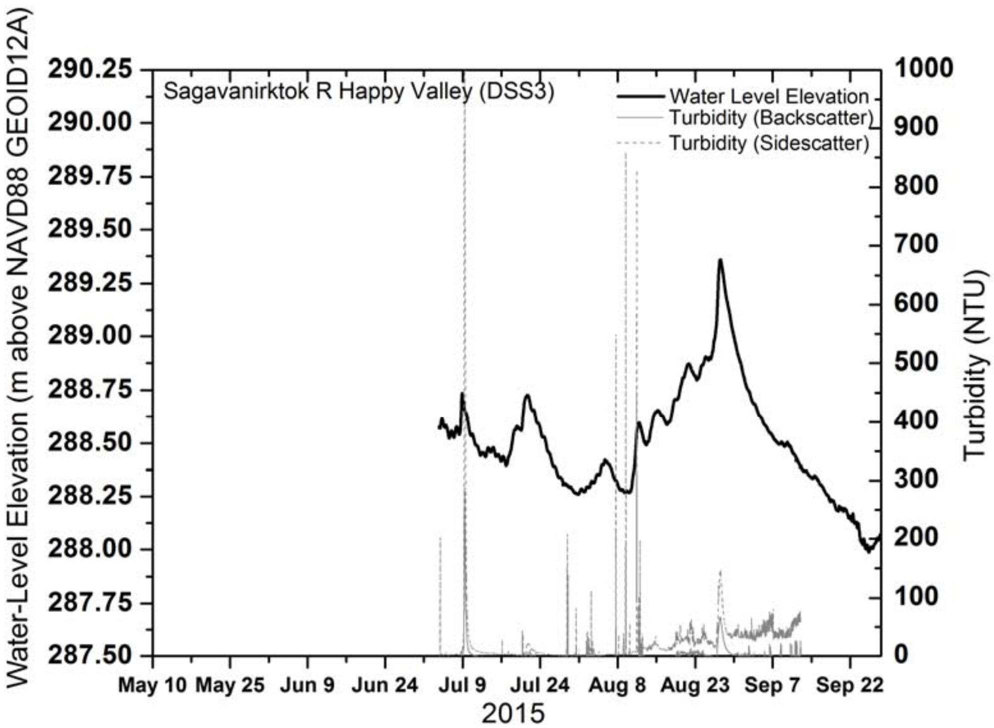


Figure 113. Water level elevations and turbidity (backscatter and sidescatter) at the Sagavanirktok River near Happy Valley (DSS3) in 2015 (modified from Toniolo et al., 2016b).

Figure 114 presents water level elevations and turbidity data in the river near Happy Valley (DSS3) in 2016. As with 2015, the turbidity data are noisy, but generally, the turbidity increases occur during times of increased flow and SSC. Data were not collected for a brief period in early June because the water level dropped below the sensor. The highest turbidity occurred on June 29, during a high flow event. Smaller flow events occurred in the month of August and in late May, resulting in increases in turbidity. During periods of lower stream discharge, turbidity dropped. Again, fouling of the sensor may have occurred, as turbidity tended to be very noisy in early August, and sidescatter data drifted in late August.

Water levels and turbidity in 2017 are shown in Figure 115. The turbidity data for 2017 were less noisy and seemed to correlate better with the SSC data. There was low turbidity in early July, which corresponds to the low discharge and SSC, but both turbidity and SSC increased on July 17, which could be due to the slight rise in stream discharge. On July 25, both the turbidity and the SSC increased during a high flow event. During periods of lower flow, turbidity decreased, similar to the SSC dataset.

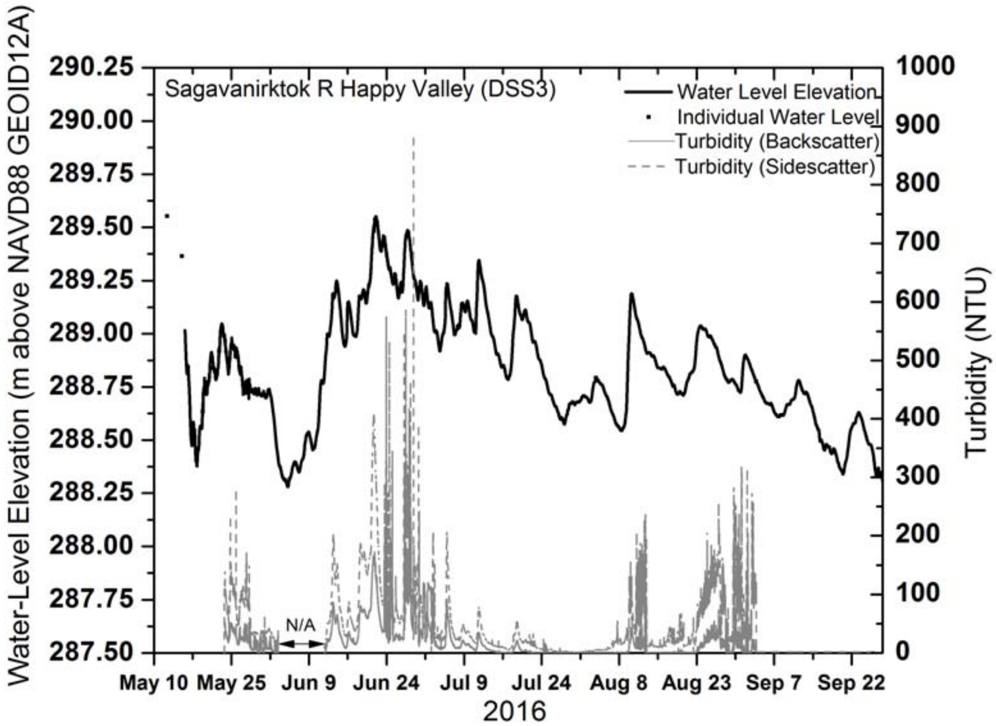


Figure 114. Water level elevations and turbidity (backscatter and sidescatter) at the Sagavanirktok River near Happy Valley (DSS3) in 2016.

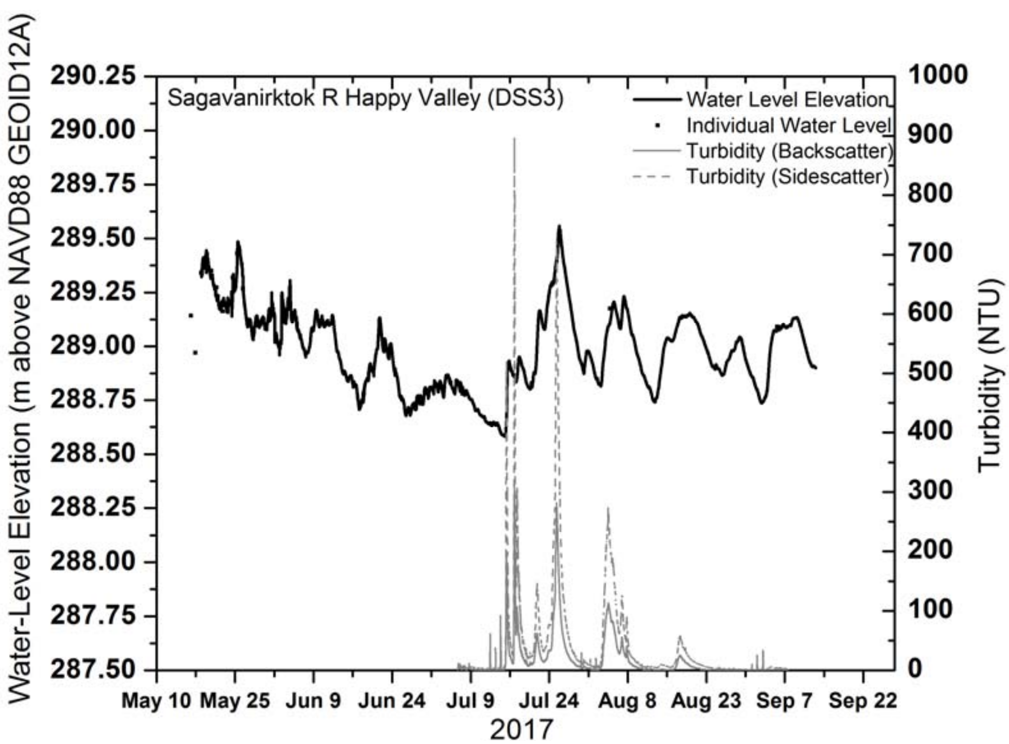


Figure 115.Water level elevations and turbidity (backscatter and sidescatter) at the Sagavanirktok River near Happy Valley (DSS3) in 2017.

We use photographs of the river during site visits to confirm the sensor turbidity and the SSC of the river. Although sensors were not yet installed, Figure 116 is a photograph of the river at Happy Valley (DSS3) on May 23, 2017, during spring breakup. The water became increasingly turbid as breakup progressed. Figure 117 is a photograph of the river during a measurement on August 4, 2017, showing turbid water. This increase in turbidity in August is confirmed in the time series plot of turbidity in Figure 115. In early September, during a brief period of low stream discharge, the water was very clear, and sensor turbidity decreased to near 0 NTU, as shown in the time series plot (Figure 115) and the photograph in Figure 118.

Figure 116. Sagavanirktok River near Happy Valley (DSS3) on May 23, 2017, during early spring breakup showing increased turbidity.

Figure 117. Sagavanirktok River near Happy Valley (DSS3) on August 4, 2017, showing gray, turbid water.

Figure 118. Sagavanirktok River near Happy Valley (DSS3) on September 5, 2017, showing low turbidity. The downstream end of the dry pit is at the right of the photo.

4.7.3 Sagavanirktok River below the Ivishak (DSS2)

The turbidimeter installed at the Sagavanirktok River below the confluence with the Ivishak (DSS2) station is located in a backwater pool, which typically is not connected to the main channel (Figure 99). This measurement location is a problem, because only during periods of high stream discharge are the turbidimeter data representative of the turbidity in the main channel. However, due to the extensive braiding of the river, it is not possible to place the sensors in the main channel.

The turbidity and water level elevation in 2015 are shown in Figure 119. Turbidity increased on August 28 during a high flow event. In 2015, the turbidity appears to be well correlated with the SSC data. In 2016, we deployed the turbidimeter in May and removed it in early September. Unfortunately, data were determined to be invalid during May and June. The turbidimeter reported a water temperature equal to air temperature, indicating the water surface had dropped below the turbidimeter. Despite some slight increases in stream discharge, the turbidity stayed low, except during one of the high flow events in July, when turbidity increased (Figure 120). In 2017, we installed turbidimeters in early July. The sensors showed that for most of the summer the turbidity increased with increased flow. The highest turbidity occurred during the event on July 25, shown in Figure 121. Turbidity data seem to correlate with SSCs in 2017. It appears that turbidity increased in 2017 (compared with 2015 and 2016), but as mentioned earlier, inter-year comparisons are not accurate due to the limitations of the sensors.

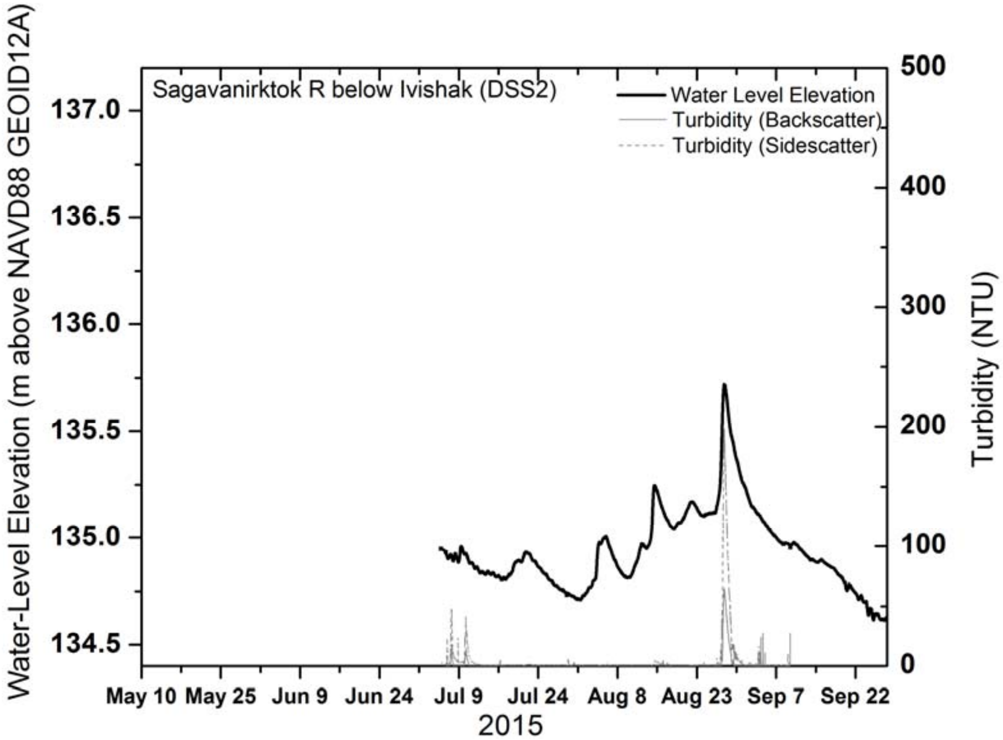


Figure 119. Water level elevations and turbidity (backscatter and sidescatter) at the Sagavanirktok River below the Ivishak River (DSS2) in 2015 (modified from Toniolo et al., 2016b).

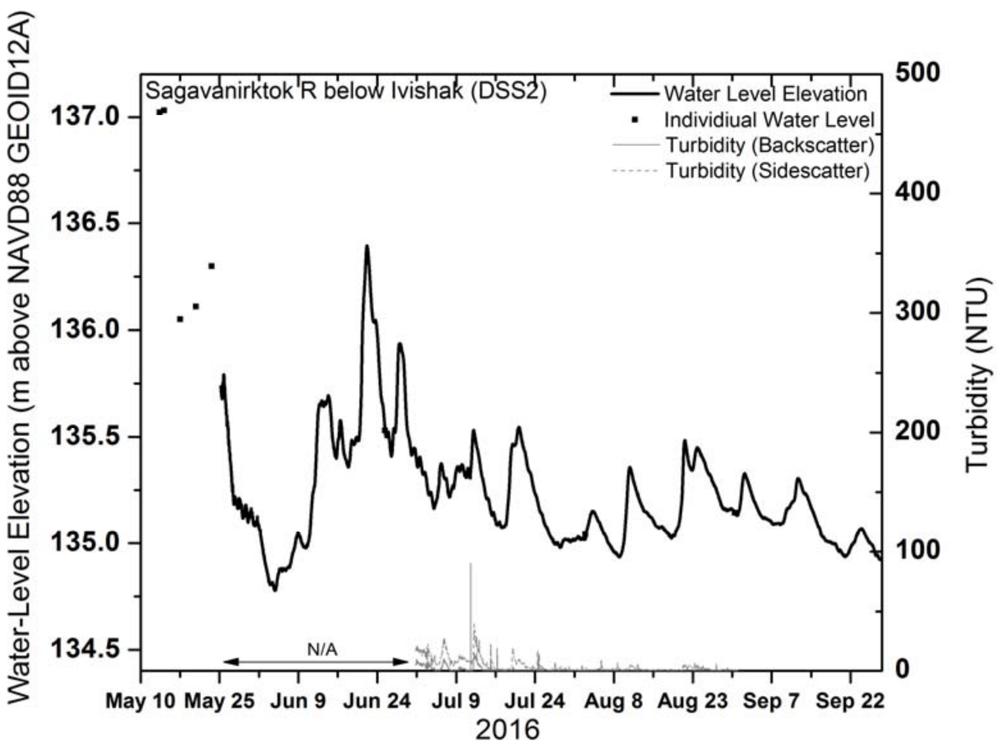


Figure 120. Water level elevations and turbidity (backscatter and sidescatter) at the Sagavanirktok River below the Ivishak River (DSS2) in 2016.

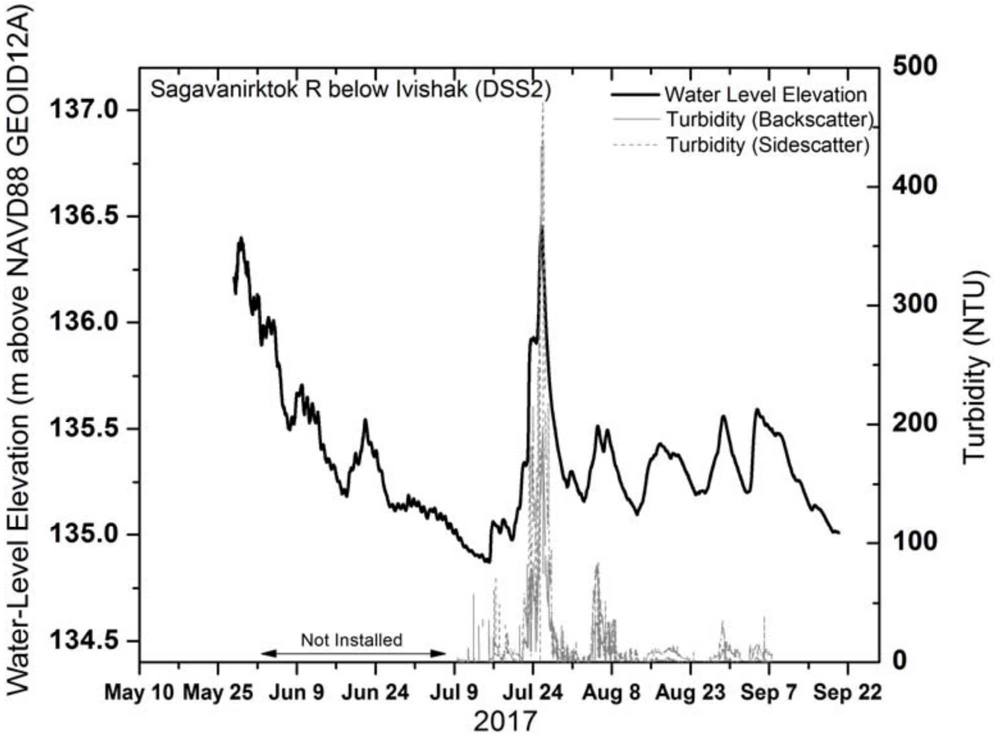


Figure 121. Water level elevations and turbidity (backscatter and sidescatter) at the Sagavanirktok River below the Ivishak River (DSS2) in 2017.

4.7.4 Sagavanirktok River near MP405 (DSS1)

We installed the turbidity sensor at the station located in the west channel near MP405 (DSS1) in the main channel (see Figure 105). In 2015, we deployed the turbidimeter in early June, but it failed shortly after installation (Toniolo et al., 2016b). We replaced it on July 25, 2015. River turbidity increased during high flow events, with the highest turbidity during the corresponding highest flow event on August 28 (Figure 122). Toniolo et al. (2016b) reports that periodic breaching of the temporary levy at the nearby active material site, upstream of the stations at MP405 (DSS1), could have caused small increases in turbidity.

Figure 123 presents the water level elevation and turbidity in the river near MP405 (DSS1) in 2016. We installed the turbidimeter in late June 2016 and removed it in mid-September. From July 14 to August 2, turbidity data were not recorded due to a sensor malfunction. Despite periods of missing data in 2016, it was observed, in general, that the turbidity of the river increased during times of increased flow.

Figure 124 presents the water level elevations and turbidity data at the station near MP405 (DSS1) in 2017. We installed the turbidimeter in early July 2017. Backscatter data from the turbidimeter are not presented because the sensor failed in 2017. The highest turbidity occurred on July 25, during the highest summer flow event of 2017.

Figure 125 is a photograph of the west channel near the spur dikes at MP396, taken on May 20, 2017, during early spring breakup. The photograph shows that the water flowing over the anchor ice is clear with low turbidity. As spring breakup progressed, turbidity in the river increased due to anchor ice lifting off the streambed or melting in place, allowing increased transport of sediment. A photograph taken later in breakup (May 30) at the first spur dike in the vicinity of MP396 shows increased turbidity in the lower Sagavanirktok River (Figure 126).

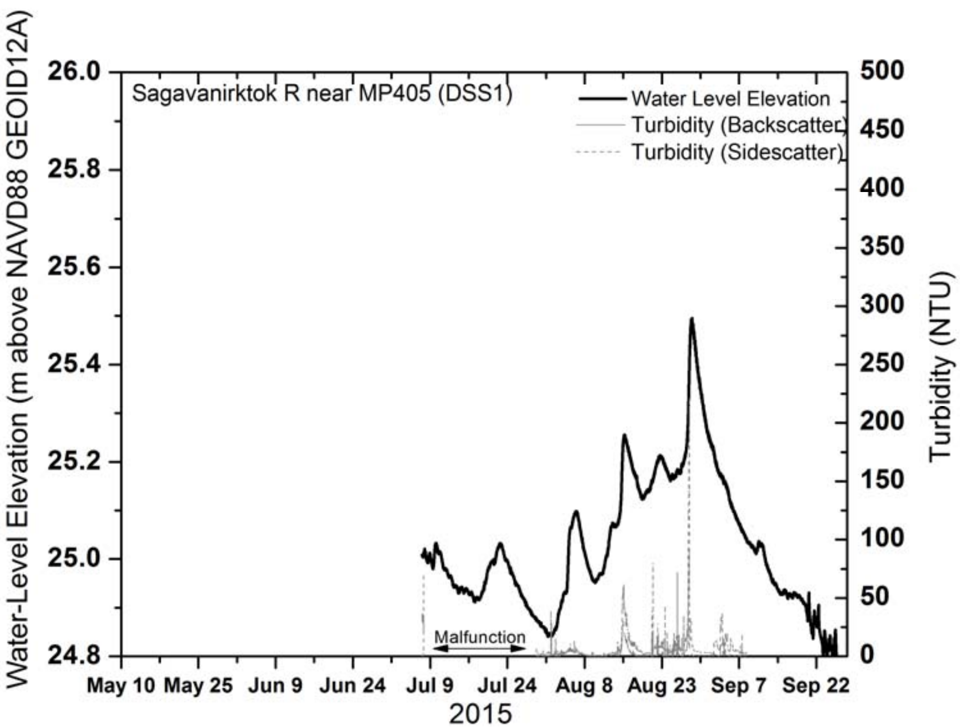


Figure 122. Water level elevation and turbidity (backscatter and sidescatter) at the Sagavanirktok River near MP405 (DSS1) in 2015 (modified from Toniolo et al., 2016b).

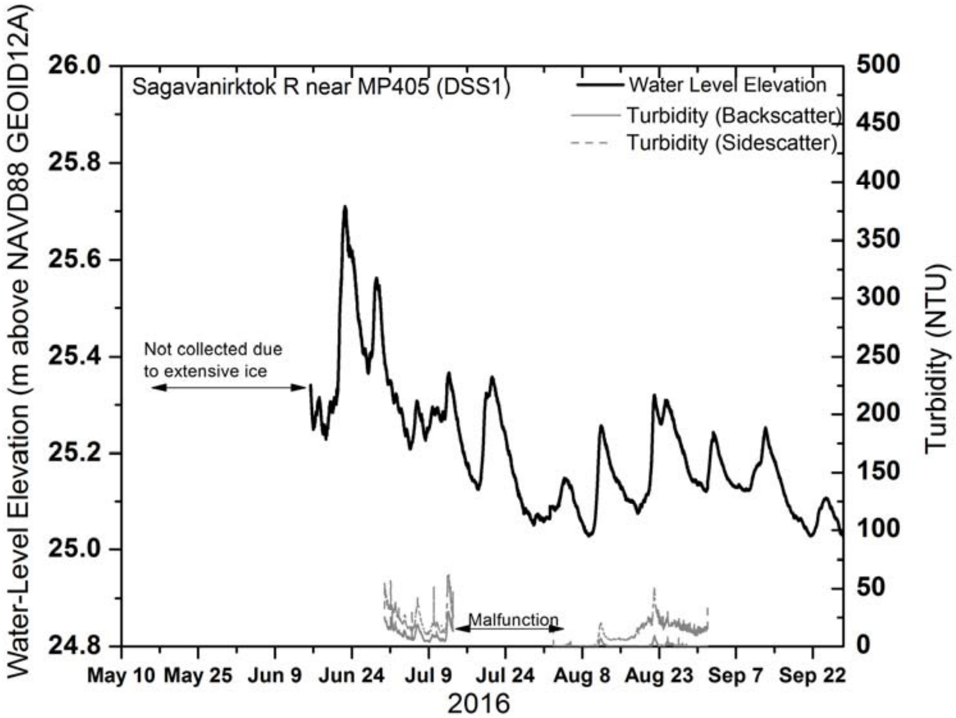


Figure 123. Water level elevations and turbidity (backscatter and sidescatter) at the Sagavanirktok River near MP405 (DSS1) in 2016.

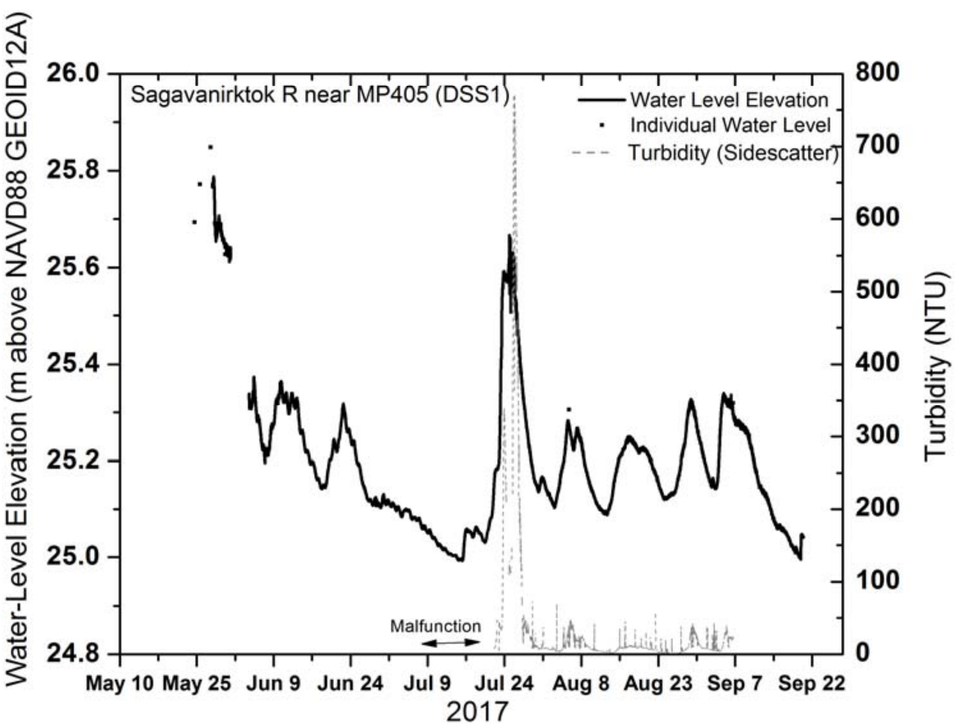


Figure 124. Water level elevations and turbidity (sidescatter) at the Sagavanirktok River near MP405 (DSS1) in 2017.

Figure 125. Sagavanirktok River at Spur Dike 2 near Dalton MP396 on May 20, 2017, during early spring breakup. Water is clear and flowing over anchor ice.

Figure 126. Spur Dike 1 partially breached (within oval) on the Sagavanirktok River near Dalton MP396 on May 30, 2017, during spring breakup. The water is increasingly turbid at the end of spring breakup.

4.7.5 Discussion

Turbidity alone is not a direct measurement of the SSC present in the stream. Although turbidity and suspended sediment may be correlated, turbidity is affected by organic material, air bubbles, algae, and other environmental factors (Anderson, 2005). These factors may cause turbidity results that are quite variable at a specific SSC.

Several anomalies appear in the turbidity data. These anomalies could be the result of reasons such as nearby bank erosion, malfunction of the turbidimeters, or fouling of the optical sensors. In some instances, higher turbidity may be attributed to increases in glacial melt, despite only small increases in river discharge. In the case of sites with nearby material extraction from the channel or floodplain (near MP405 [DSS1] and MP367 [near DSS2]), active mining could cause brief increases in turbidity that do not correlate with changes in streamflow. At each station along the Sagavanirktok River, turbidity generally increased during periods of higher streamflow (i.e., August 28, 2016, and July 25, 2017) and decreased during periods of low flow.

4.8 Analysis of Pits

4.8.1 Photographs of Pits

This section of the report is a compilation of photographs taken during the excavation of the pits, along with photographs taken during subsequent site visits in the summer months. Figure 127 shows the excavation of the pit at the Sagavanirktok River near MP405 site 042 (DSS1) in September 2015. This site is located in the west channel of the river (see Figure 3), several hundred meters downstream of an active material site that was operating during the summers of 2015, 2016, and 2017

Figure 127. Digging the wet pit at the Sagavanirktok River near MP405 (DSS1) on September 9, 2015 (from Toniolo et al., 2016b).

Figure 128 through Figure 132 are photographs of the dry pit at the Sagavanirktok River below the confluence with the Ivishak (DSS2) site. A series of spur dikes that protect the trans-Alaska pipeline are located near the pits (see Figure 7). Approximately 1.6 km upstream of DSS2 is an active material extraction site, operated by Cruz Construction. Excavation work on this site started during summer 2017 (see Section 4.9). Photographs of the wet pit are not available, as the pit is located closer to the main channel. Figure 128 shows the pit just after it was excavated. Figure 129 shows the pit when the river is full of ice during early breakup on May 19, 2017. The pits are typically filled with bottom-fast ice during breakup, although fine sediment is found in the pits after breakup as shown in Figure 131. Figure 132 shows the pit during the last site visit, in September 2017.

Figure 128. Dry pit at the Sagavanirktok River below the Ivishak confluence (DSS2) on September 13, 2015, a few days after excavation (from Toniolo et al., 2016b).

Figure 129. Dry pit at the Sagavanirktok River below the Ivishak confluence (DSS2) (approximately encompassed by oval), covered with ice as water begins to flow over the area on May 19, 2017.

Figure 130. Sagavanirktok River below the Ivishak confluence (DSS2) dry pit on July 9, 2017. View is to the southeast.

Figure 131. Sagavanirktok River below the Ivishak (DSS2) dry pit (north-facing view) on June 13, 2017. A researcher collects a sample of deposited sediment from the top of bottom-fast ice in the pit.

Figure 132. Downstream end of the Sagavanirktok River below the Ivishak (DSS2) dry pit on September 7, 2017.

Figure 133 through Figure 137 are photographs of the dry pit at the Sagavanirktok River at Happy Valley site 005 (DSS3). The site is located approximately 40 km upstream from the confluence with the Ivishak River. The pits are located near an inactive gravel extraction site. The pits are located at the north end of the runway, as shown in Figure 5. Figure 133 is a photograph of the dry pit just after excavation in September 2015. Figure 134 shows ice in much of the pit toward the end of breakup on May 27, 2017. Figure 135 and Figure 136 show the dry pit at Happy Valley (DSS3) during periods of low river stage in summer 2017. Figure 137 shows the dry pit during a period of high river stage in September 2017.

Figure 138 is a photograph of the dry pit at the Sagavanirktok River at Happy Valley site 005 (DSS3) in August 2017.

Figure 133. Dry pit at the Sagavanirktok River at Happy Valley (DSS3) on September 18, 2015, looking north (from Toniolo et al, 2016b).

Figure 134. Dry pit at the Sagavanirktok River at Happy Valley (DSS3) on May 27, 2017. The photographer stood at the downstream end, facing south.

Figure 135. Dry pit at the Sagavanirktok River at Happy Valley (DSS3) on July 7, 2017, looking south. River stage is low.

Figure 136. Dry pit at the Sagavanirktok River at Happy Valley (DSS3) on July 7, 2017. View is north.

Figure 137. Upstream end of the dry pit at the Sagavanirktok River at Happy Valley (DSS3) on September 5, 2017, facing east.

Figure 138. Dry pit at the Sagavanirktok River at Happy Valley (DSS3) on August 4, 2017. View is southeast.

The pits at the Sagavanirktok River near MP318, site 066 (DSS4), are shown in Figure 4; they are located in the western channel near the station. Figure 139 is a photograph of the excavation of the wet pit in the middle of the west channel in September 2015. Figure 140 through Figure 142 show the dry pit. Figure 143 shows the location of both pits during a period of relatively low water in summer 2017.

Figure 139. Digging the wet pit at the Sagavanirktok River near MP318 (DSS4) on September 15, 2015 (from Toniolo et al., 2016b).

Figure 140. Dry pit at the Sagavanirktok River near MP318 (DSS4) on September 15, 2015 (from Toniolo et al., 2016b). The view is south.

Figure 141. Dry pit at the Sagavanirktok River near MP318 (DSS4) on September 18, 2015 (from Toniolo et al., 2016b). The view is southeast.

Figure 142. Dry pit at the Sagavanirktok River near MP318 (DSS4) on August 3, 2016. View is northwest.

Figure 143. A southeast view of conditions at the Sagavanirktok River near MP318 (DSS4) on July 6, 2017. Water is relatively low. Ovals indicate locations of pits.

4.8.2 GIS Analysis of Pit Bathymetry

Bathymetric survey data were imported and plotted in ArcMap 10.5. The horizontal datum used was NAD83 State Plane Zone 4; the vertical datum used was WGS84 (Ellipsoid GRS80) and NAVD88 (GEOID 12A). Areas of overlapping surveys from one to the next were used to create difference maps during each project year, and over the duration of the project, indicating when and where significant erosion or deposition events occurred. Difference maps were also created from initial (September 2015) to final (September 2017) surveys to indicate which pits changed the most over the study period. Pit volumes were calculated by taking the average height of the ground surface where it intersects with the initial pit outline, and using that average value to define a reference plane, below which to calculate the volume of the pit. Due to expected changes downstream of the pits, volume change was also calculated for areas downstream of the pits where surface changes were observed. The GIS tool used for the volume calculations was Zonal Statistics As a Table. Negative values indicate sediment being removed from the domain, and positive values indicate sediment being deposited within the domain.

By using an adjustable reference plane, these calculations of sediment capture are independent of sediment deposition and erosion that occur as part of the natural background processes (Figure 144). The greatest reference plane adjustment was 0.4 m, which becomes significant once it is integrated over the area of the top of the pit. It is thus appropriate to be aware of this background sediment transport, but to remove it when calculating the specific influence of the pit on sediment transport processes.

The reference plane method used herein differs somewhat from the method used in 2015 (Toniolo et al., 2016b). In 2015, we used an interpolated plane as the upper plane; this year, we consistently used a horizontal reference plane derived from rim values. Due to these differing techniques for calculating volume, the initial pit volumes presented in 2015 are 1–30% larger than the pit volumes reported herein for 2015.

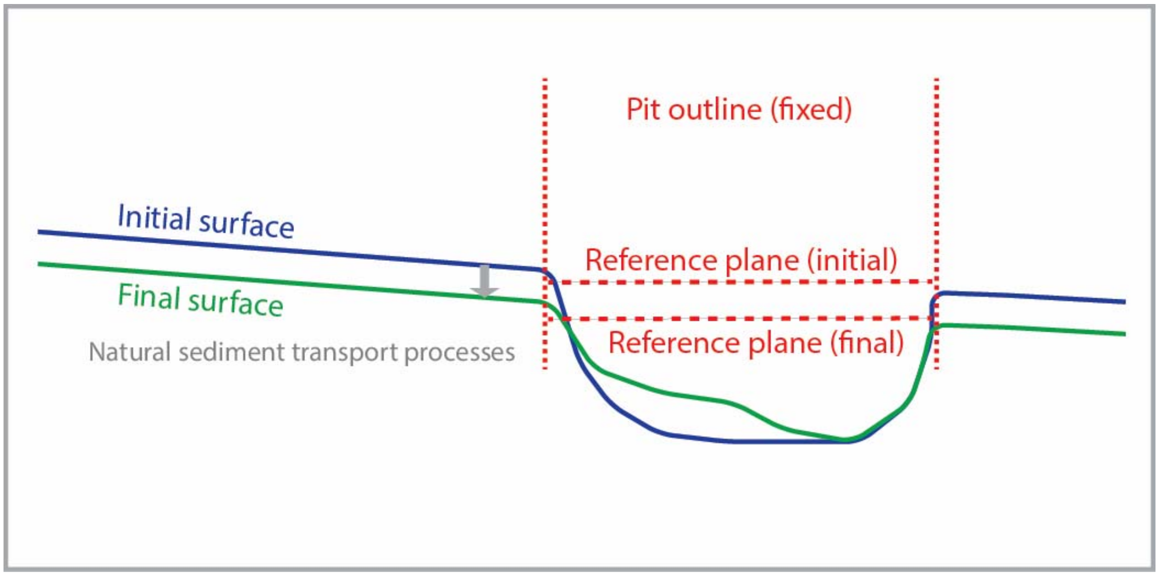


Figure 144. Conceptual diagram showing adjustable reference plane according to average height of edge of pit. Diagram shows sediment deposition in the pit between initial and final topo-bathymetric surveys, as well as the background erosive process (exaggerated for graphic) lowering the entire surface. Calculations thus factor out the natural sediment transport processes and focus on the pit's sedimentation.

4.8.3 Pit Sedimentation

Figure 145 through Figure 151 paired with Table 11 through Table 17 include the spatial and quantitative results for every site. Pits ranged in volume from 77.6 m^3 to 264.3 m^3. Table 11 through Table 17 show the volume changes for each pit through September 2017. Sediment deposition or erosion was observed in the 8 surveys of 7 total pit sites. For example, in the pit at MP405 site 042 (DSS1), the initial volume in September 2015 was 264 m^3. By September 2016, that volume of the pit had decreased to 135 m^3, a reduction of 48.8% from initial volume, indicating net sediment deposition. By 2017, the volume of the pit was 145 m^3, indicating some erosion occurred on the lateral boundaries, probably due to collapsed walls, between September 2016 and September 2017. The pit volume over the entire 2-year interval decreased from 264 m^3 to 145 m^3, a reduction of 45.1% from initial volume, indicating net sediment deposition within the pit boundary (Table 11). Contour plots of all topo-bathymetric surveys of all locations are presented in Appendix G.

Between September 2015 and September 2017, sediment was deposited in all 7 pits, reducing their volume. The amount of sediment deposited in the pits ranged from 14.6 to 219.9 m^3. The wet pit at DSS2 completely filled in with sediment (Figure 147), but because it is on a sloping surface, the reference plane still registers an artificial 12% of the initial volume remaining. This remaining volume is due to the reference plane creating artificial results once the concavity of the pit is filled in (Figure 144). All other pits were still recognizable pits in September 2017. Net sediment capture in the pits ranged from 15 m^3 (DSS4 wet) to 220 m^3 (DSS2 dry). More net deposition occurred at all pits between September 2015 and September 2016 than between September 2016 and September 2017. The pit at MP405 (DSS1) actually increased slightly in volume between September 2016 and September 2017 due to collapsing walls.

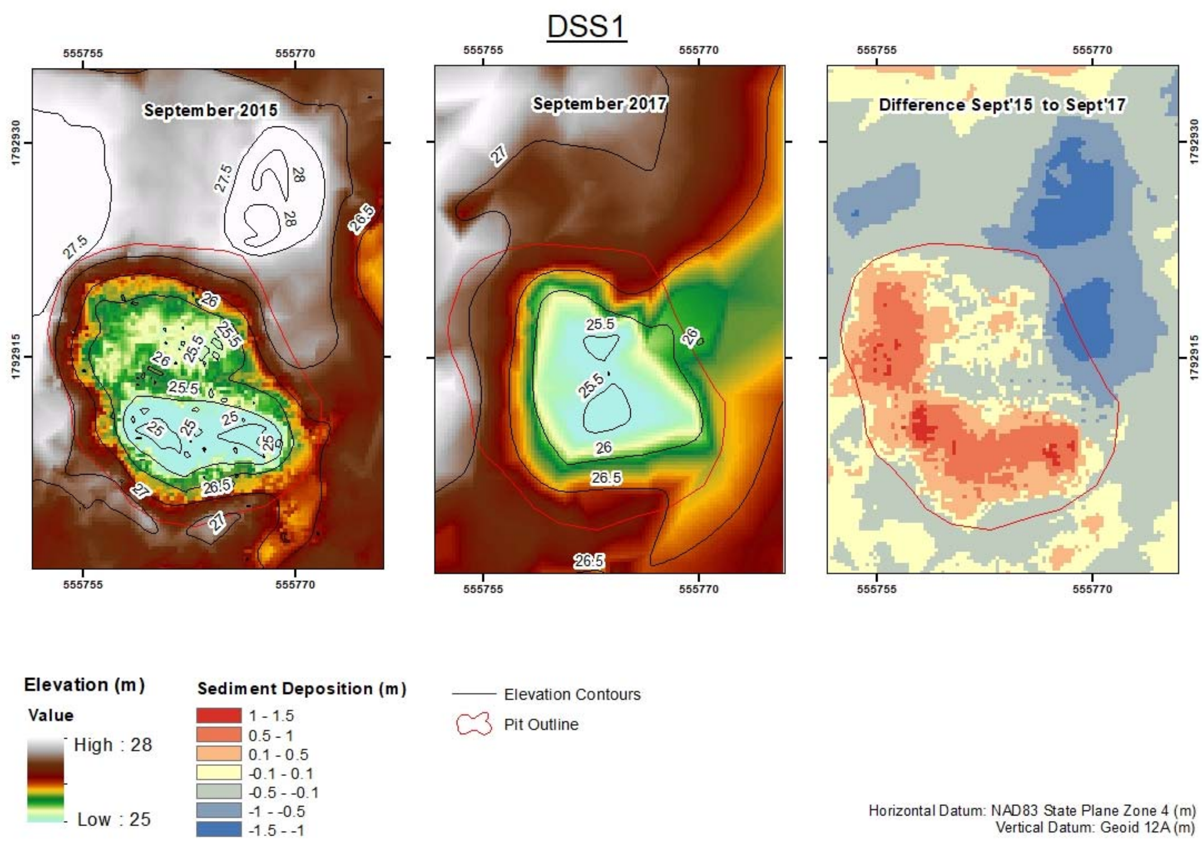


Figure 145. Sagavanirktok River near MP405 pit (DSS1), bathymetry from the initial survey (left: September 2015), final surveys (middle: September 2017), and plot of difference indicating erosion and deposition between initial and final (right).

Table 11. Volume changes for the pit at the Sagavanirktok River near MP405 (DSS1), 2015–2017.

Pit DSS1	Ref plane height (m)	Volume (m^3)	Deposition since 2015 (m^3)	Change since 2015 (%)
Sep-15	27.0	264.3		
Sep-16	26.7	135.4	128.8	48.8
Sep-17	26.7	145.1	119.2	45.1

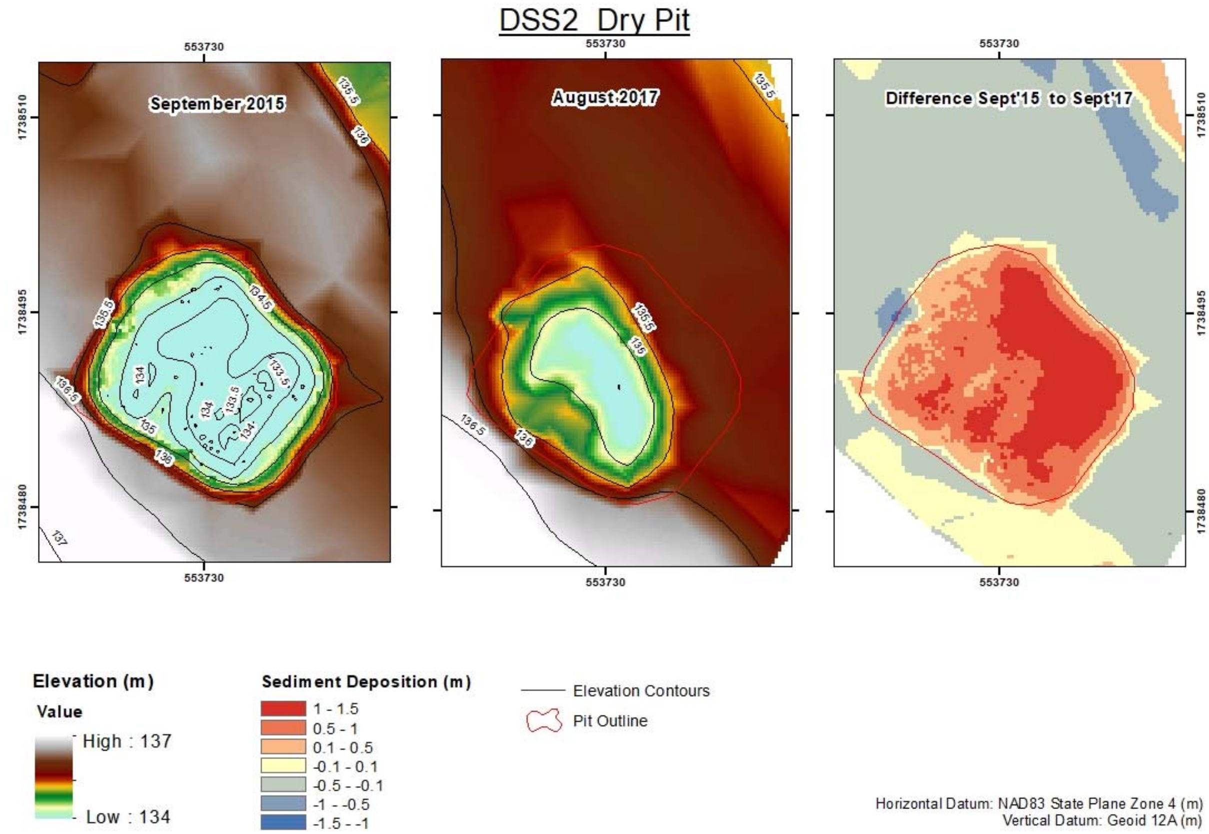


Figure 146. Sagavanirktok River below the Ivishak River confluence (DSS2), dry pit bathymetry from the initial survey (left: September 2015), final surveys (middle: September 2017), and plot of difference indicating erosion and deposition between initial and final (right).

Table 12. Volume changes for dry pit at the Sagavanirktok River below the Ivishak River (DSS2), 2015–2017.

DSS2 Dry Pit	Ref plane height (m)	Volume (m^3)	Deposition since 2015 (m^3)	Change since 2015 (%)
Sep-15	135.8	350.0		
Sep-16	135.9	215.2	134.8	38.5
Sep-17	135.8	130.1	219.9	62.8

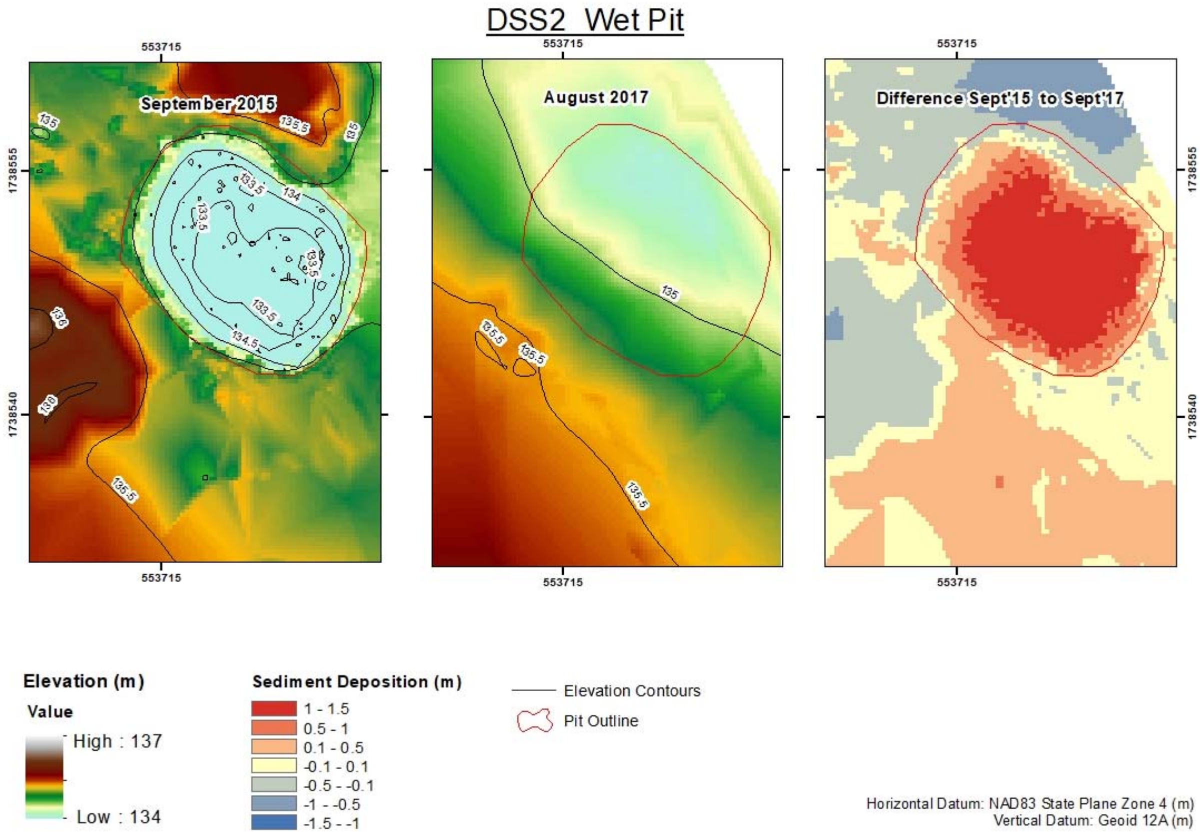


Figure 147. Sagavanirktok River below Ivishak (DSS2), wet pit bathymetry from the initial survey (left: September 2015), final surveys (middle: September 2017), and plot of difference indicating erosion and deposition between initial and final (right).

Table 13. Volume changes for the wet pit at the Sagavanirktok River below the Ivishak River (DSS2), 2015–2017.

DSS2 Wet Pit	Ref plane height (m)	Volume (m^3)	Deposition since 2015 (m^3)	Change since 2015 (%)
Sep-15	135.0	155.3		
Sep-16	134.9	24.4	130.8	84.3
Sep-17	135.0	18.6	136.6	88.0

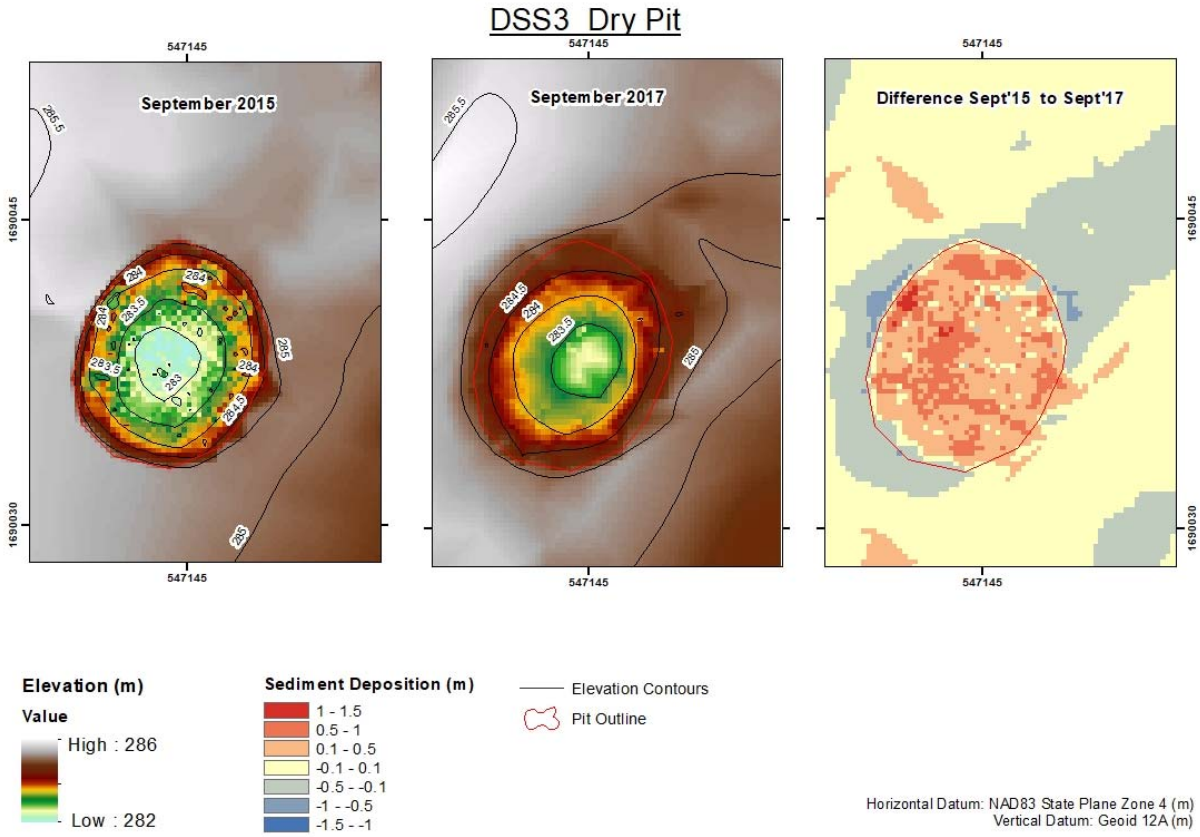


Figure 148. Sagavanirktok River at Happy Valley (DSS3), dry pit bathymetry from the initial survey (left: September 2015), final surveys (middle: September 2017), and plot of difference indicating erosion and deposition between initial and final (right).

Table 14. Volume changes for the dry pit at the Sagavanirktok River at Happy Valley (DSS3), 2015–2017.

DSS3 Dry Pit	Ref plane height (m)	Volume (m^3)	Deposition since 2015 (m^3)	Change since 2015 (%)
Sep-15	284.8	82.6		
Sep-16	284.7	61.6	21.1	25.5
Sep-17	284.8	51.1	31.5	38.1

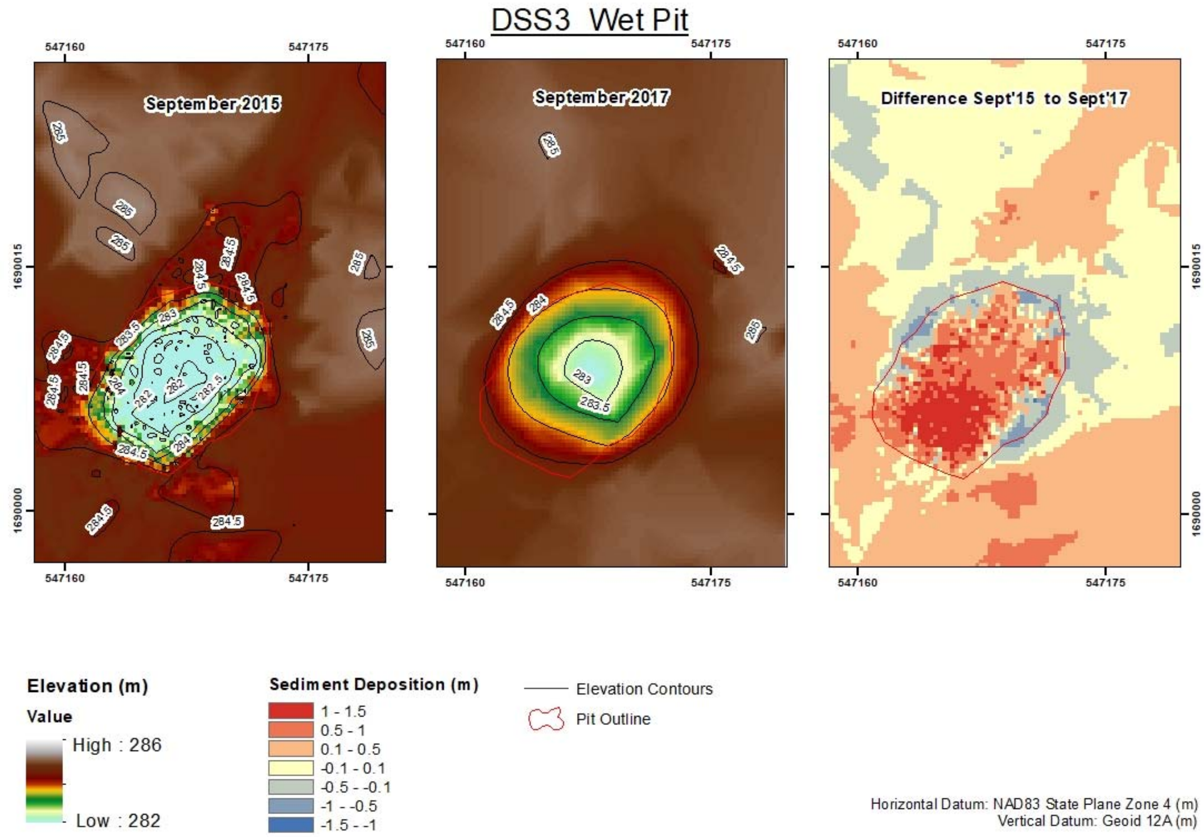


Figure 149. Sagavanirktok River at Happy Valley (DSS3), wet pit bathymetry from the initial survey (left panels: September 2015), final surveys (middle panels: September 2017), and plot of difference indicating erosion and deposition between initial and final (right).

Table 15. Volume changes for the wet pit at the Sagavanirktok River at Happy Valley (DSS3), 2015–2017.

DSS3 Wet Pit	Ref plane height (m)	Volume (m^3)	Deposition since 2015 (m^3)	Change since 2015 (%)
Sep-15	284.4	120.8		
Sep-16	284.1	55.2	65.6	54.3
Sep-17	284.2	54.0	66.9	55.3

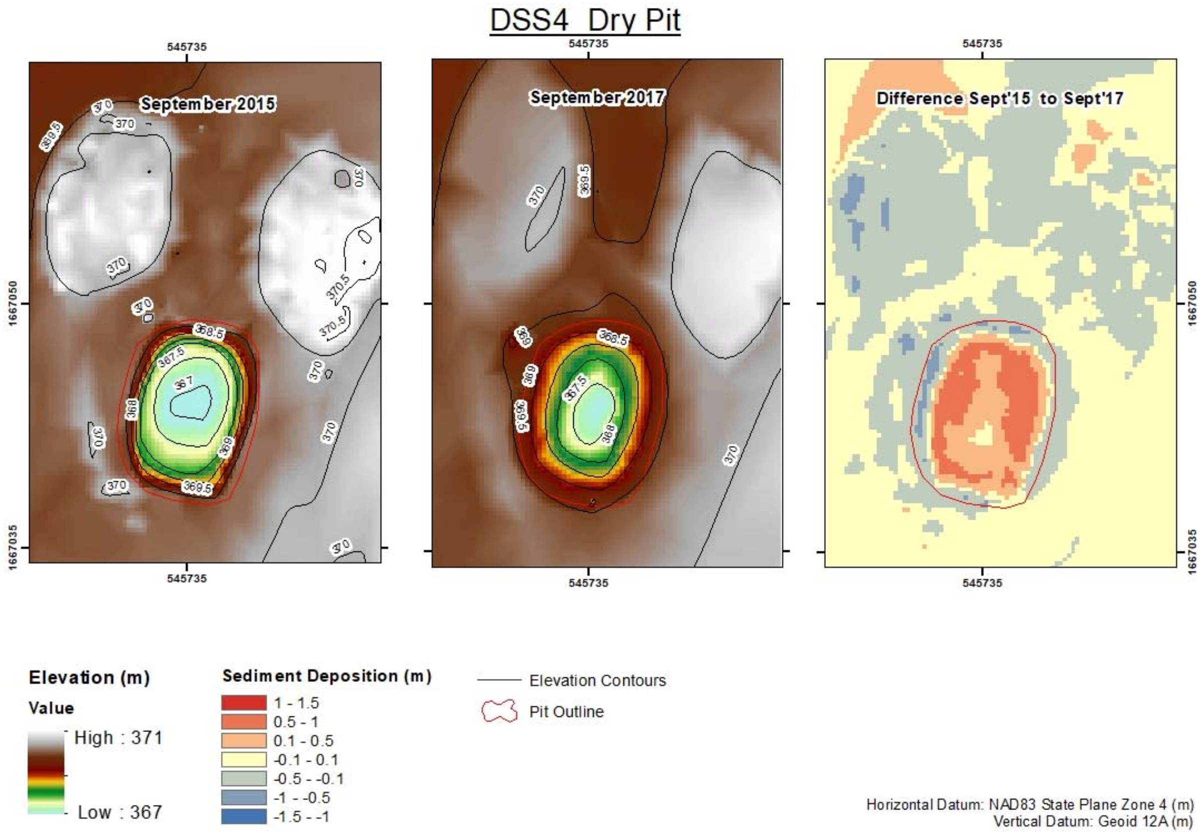


Figure 150. Sagavanirktok River near MP318 (DSS4), dry pit bathymetry from the initial survey (left panels: September 2015), final surveys (middle panels: September 2017), and plot of difference indicating erosion and deposition between initial and final (right).

Table 16. Volume changes for the dry pit at the Sagavanirktok River near MP318 (DSS4), 2015–2017.

DSS4 Dry Pit	Ref plane height (m)	Volume (m^3)	Deposition since 2015 (m^3)	Change since 2015 (%)
Sep-15	369.7	113.9		
Sep-16	369.3	78.7	35.2	30.9
Sep-17	369.4	71.2	42.7	37.5

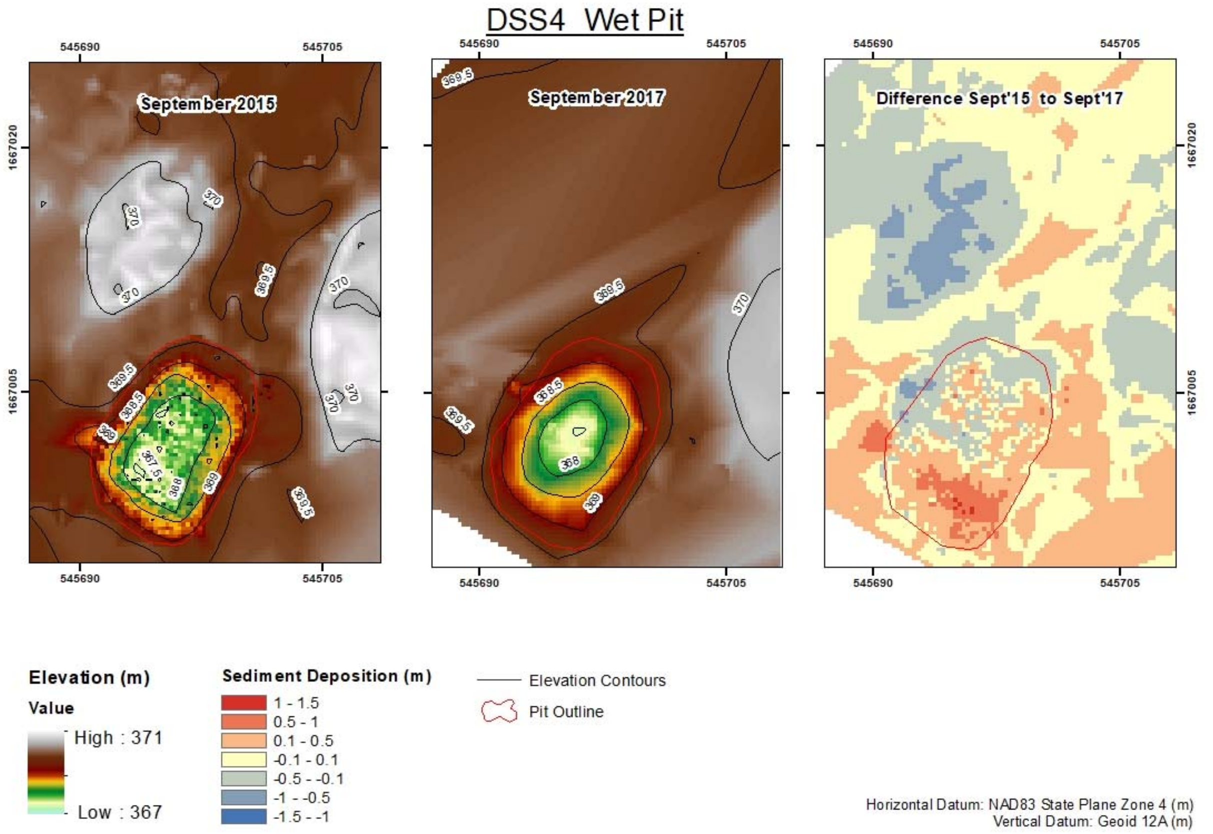


Figure 151. Sagavanirktok River near MP318 (DSS4), wet pit bathymetry from the initial survey (left panels: September 2015), final surveys (middle panels: September 2017), and plot of difference indicating erosion and deposition between initial and final (right).

Table 17. Volume changes for the wet pit at the Sagavanirktok River near MP318 (DSS4), 2015–2017.

DSS4 Wet Pit	Ref plane height (m)	Volume (m^3)	Deposition since 2015 (m^3)	Change since 2015 (%)
Sep-15	369.3	77.6		
Sep-16	369.3	67.7	9.8	12.7
Sep-17	369.3	62.9	14.6	18.9

4.8.4 Erosion Surveys

Due to expected surface changes occurring downstream of the pits, we calculated changes in surface volume for a delineated area downstream. Again, using the pit at the Sagavanirktok River MP405 site 042 (DSS1), for example, the initial volume in September 2015 of the delineated area downstream (using a reference plane described in Section 4.8.2) was 32.4 m^3. By September 2016, this volume had increased to 43.0 m^3, indicating 9.6 m^3 of erosion at the site. By

September 2017, the volume had increased to 43.4 m^3, indicating a negligible increase in volume since 2016. Figure 152 through Figure 158 paired with Table 18 through Table 24 show these spatial and quantitative results for areas downstream of every pit.

Downstream, erosion occurred at 4 sites, deposition occurred at 2 sites, and change was negligible at 1 site. Volume changes over the 2-year interval ranged from -11.4 m^3 at the dry pit at site DSS2 to 3.4 m^3 at the wet pit near MP318 (DSS4). Timing of deposition and erosion was variable among sites.

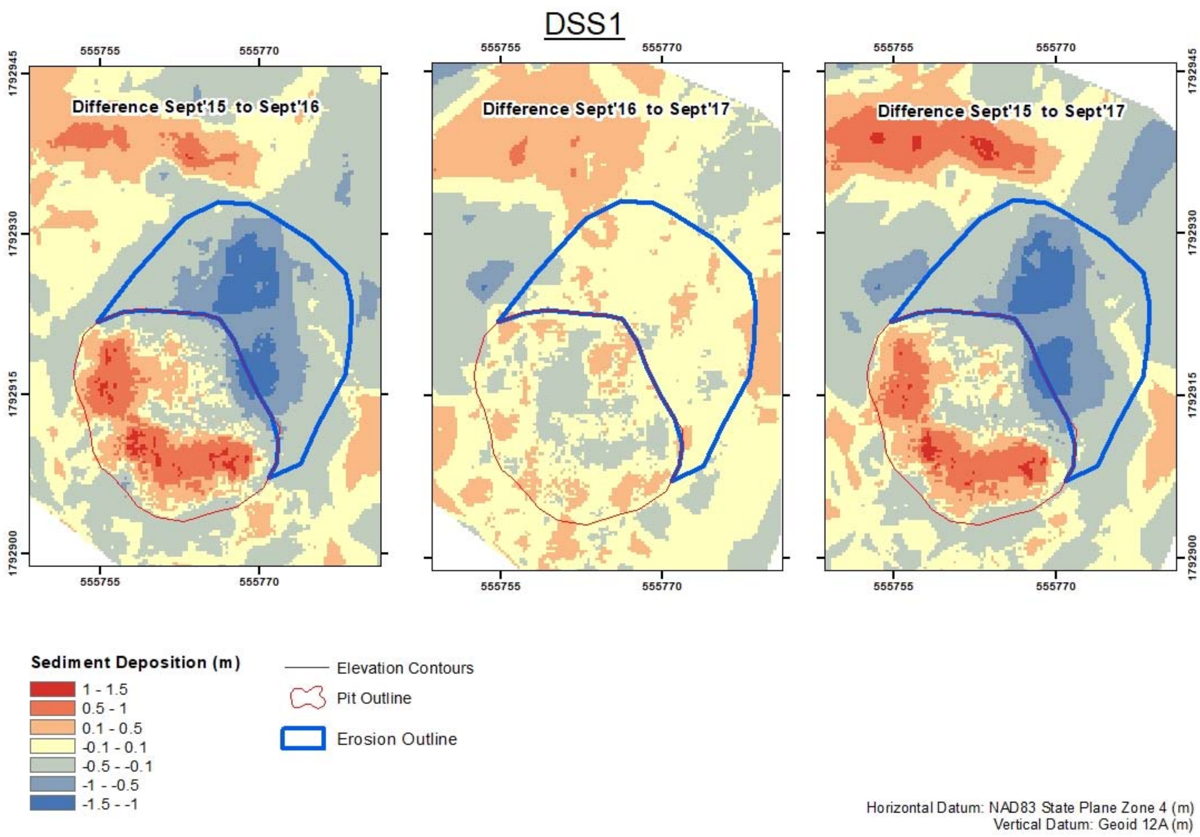


Figure 152. Sagavanirktok River at MP405 (DSS1). Plots of surface difference over given time intervals for the area delineated by the blue line downstream of the pit.

Table 18. Volume changes for the area delineated by the blue line downstream of pit, Sagavanirktok River at MP405 (DSS1).

DSS1 Wet Pit	Ref plane height (m)	Volume (m^3)	Change since 2015 (m^3)
Sep-15	27.0	32.4	
Sep-16	26.6	43.0	-10.6
Sep-17	26.6	43.4	-11.1

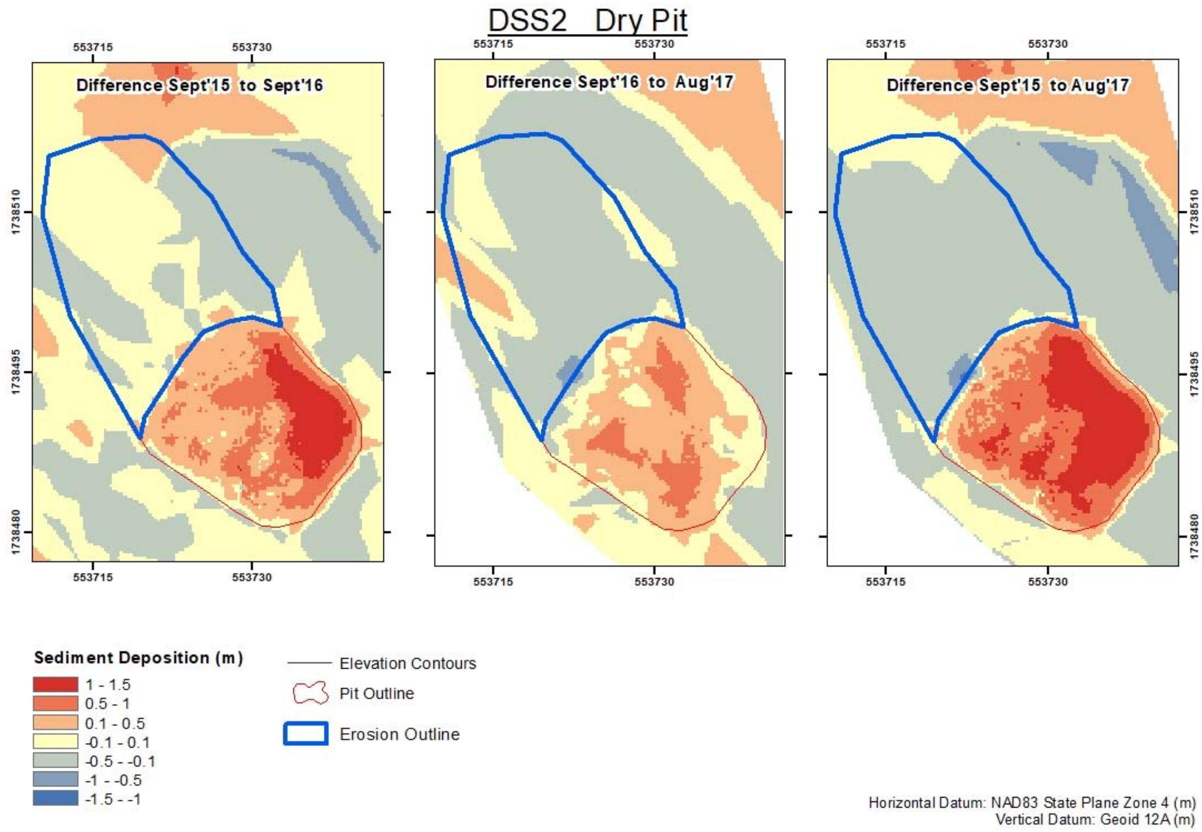


Figure 153. Dry pit at the Sagavanirktok River below the Ivishak confluence (DSS2). Plots of surface difference over given time intervals for the area delineated by the blue line downstream of the pit.

Table 19. Volume changes for the area delineated by the blue line downstream of the dry pit at the Sagavanirktok River below the Ivishak confluence (DSS2).

DSS2 Dry Pit	Ref plane height (m)	Volume (m^3)	Change since 2015 (m^3)
Sep-15	136.1	10.4	
Sep-16	136.0	8.3	2.1
Sep-17	135.9	21.8	-11.4

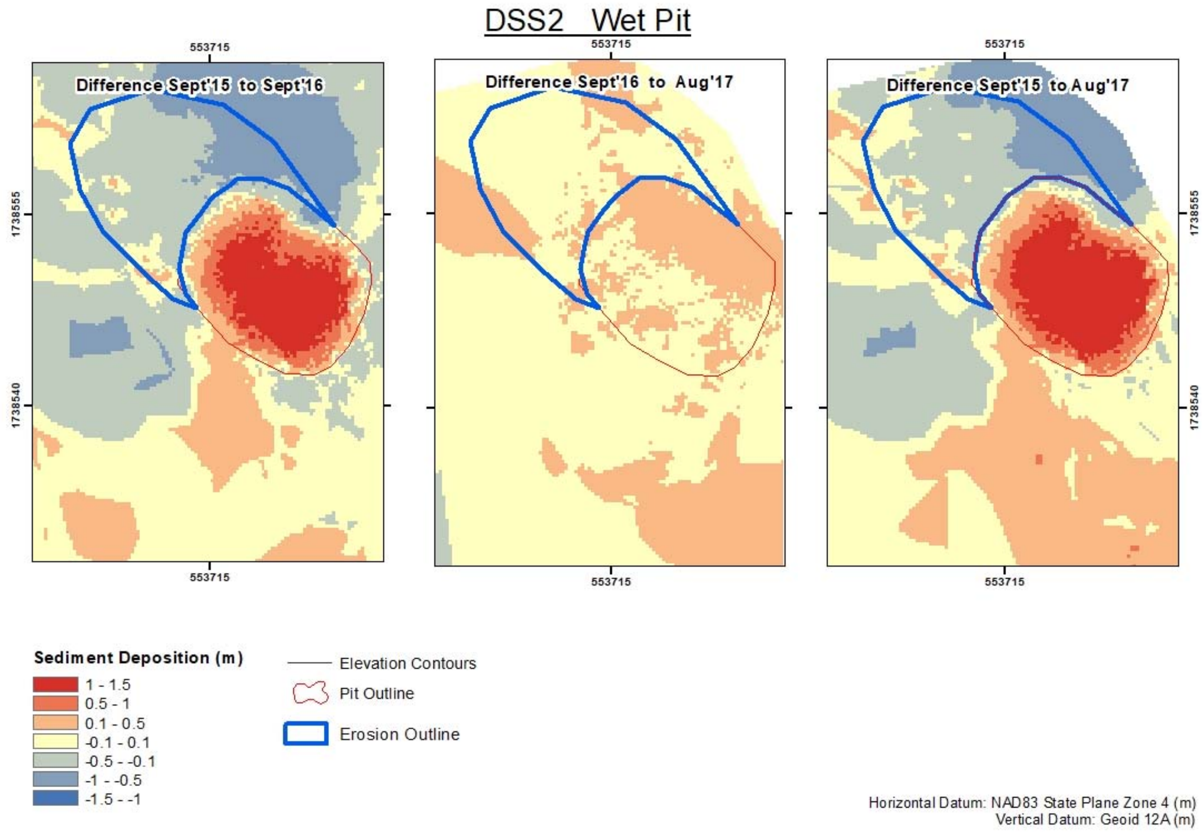


Figure 154. Wet pit at the Sagavanirktok River below the Ivishak River confluence (DSS2). Plots of surface difference over given time intervals for the area delineated by the blue line downstream of the pit.

Table 20. Volume changes for the area delineated by the blue line downstream of wet pit at the Sagavanirktok River below the Ivishak confluence (DSS2).

DSS2 Wet Pit	Ref plane height (m)	Volume (m^3)	Change since 2015 (m^3)
Sep-15	135.3	10.8	
Sep-16	134.9	7.1	3.8
Sep-17	135.0	8.7	2.1

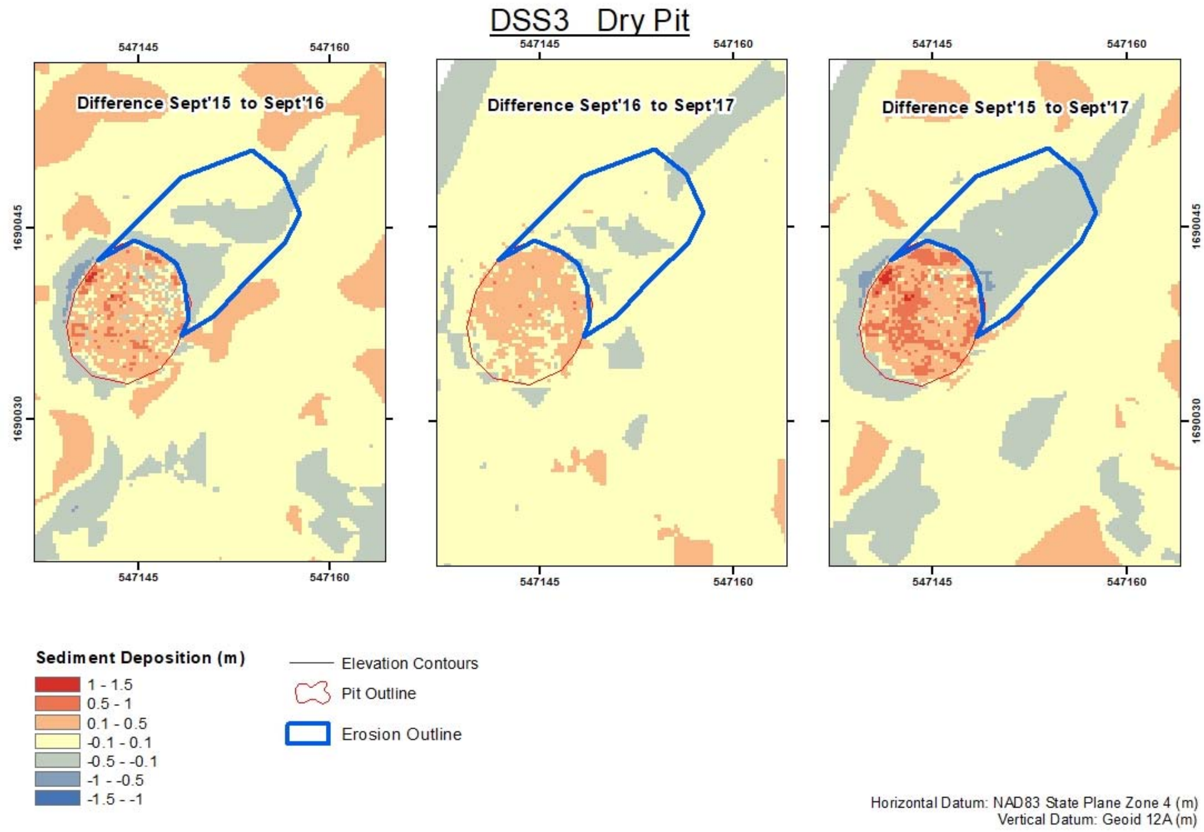


Figure 155. Dry pit at the Sagavanirktok River at Happy Valley (DSS3). Plots of surface difference over given time intervals for the area delineated by the blue line downstream of the pit.

Table 21. Volume changes for the area delineated by the blue line downstream of the dry pit at the Sagavanirktok River at Happy Valley (DSS3).

DSS3 Dry Pit	Ref plane height (m)	Volume (m^3)	Change since 2015 (m^3)
Sep-15	285.0	0.1	
Sep-16	285.0	1.5	-1.3
Sep-17	284.9	2.8	-2.7

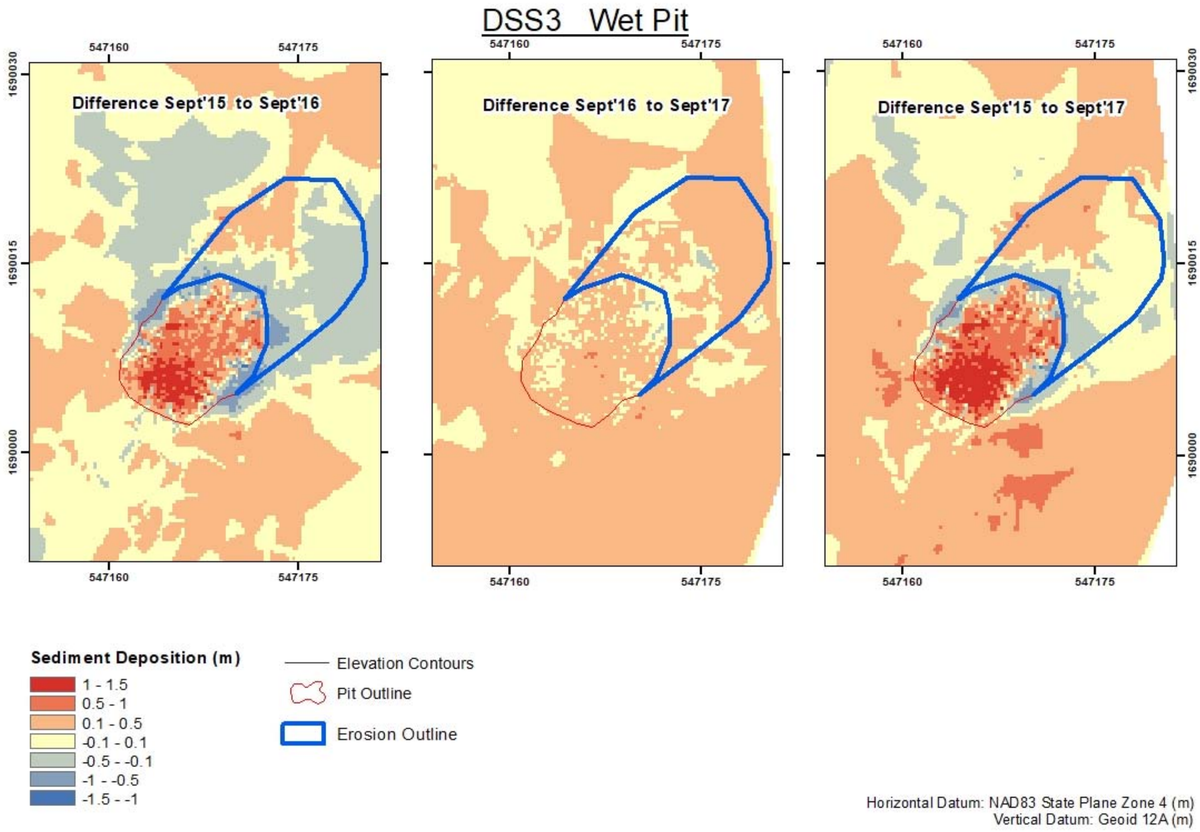


Figure 156. Wet pit at the Sagavanirktok River at Happy Valley (DSS3). Plots of surface difference over given time intervals for the area delineated by the blue line downstream of the pit.

Table 22. Volume changes for the area delineated by the blue line downstream of wet pit Sagavanirktok River at Happy Valley (DSS3).

DSS3 Wet Pit	Ref plane height (m)	Volume (m^3)	Change since 2015 (m^3)
Sep-15	284.6	4.7	
Sep-16	284.4	5.3	-0.6
Sep-17	284.5	4.6	0.1

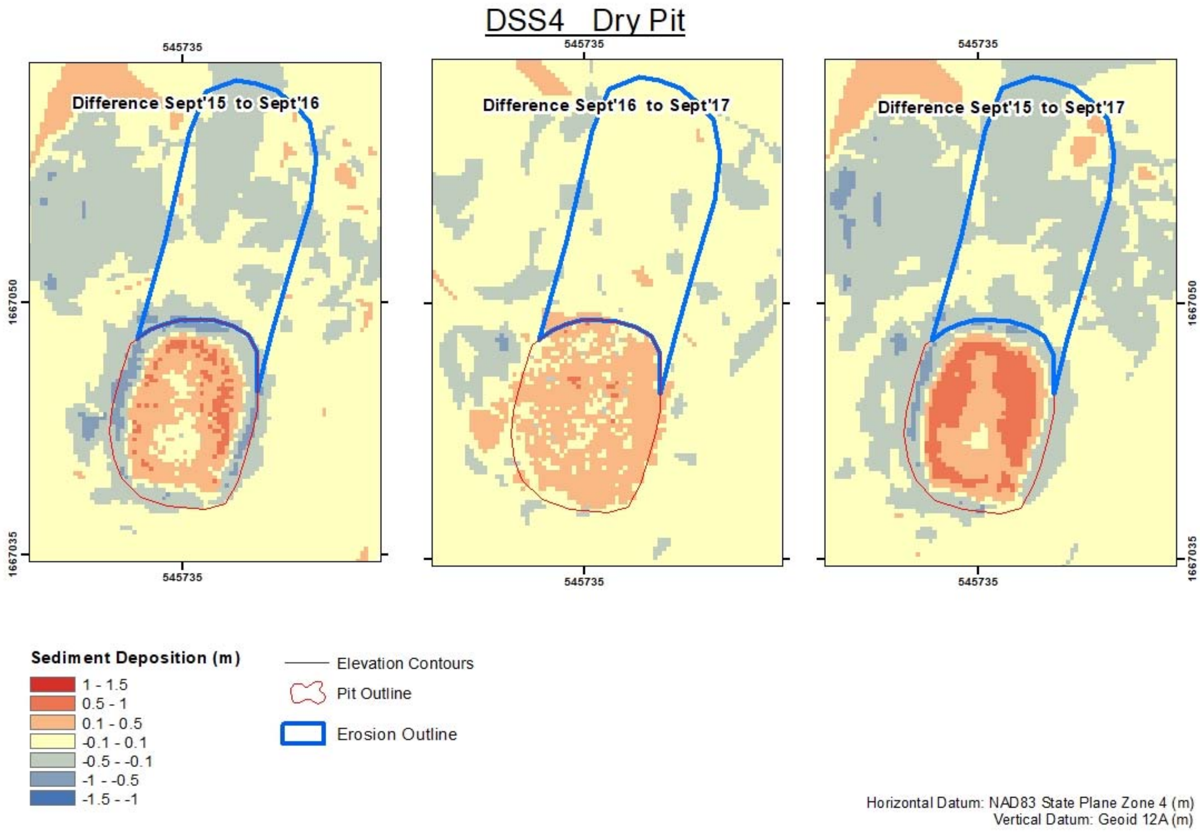


Figure 157. Dry pit at the Sagavanirktok River near MP318 (DSS4). Plots of surface difference over given time intervals for the area delineated by the blue line downstream of the pit.

Table 23. Volume changes for the area delineated by the blue line downstream of dry pit Sagavanirktok River near MP318 (DSS4).

DSS4 Dry Pit	Ref plane height (m)	Volume (m^3)	Change since 2015 (m^3)
Sep-15	369.8	12.7	
Sep-16	369.6	10.0	2.6
Sep-17	369.7	12.3	0.3

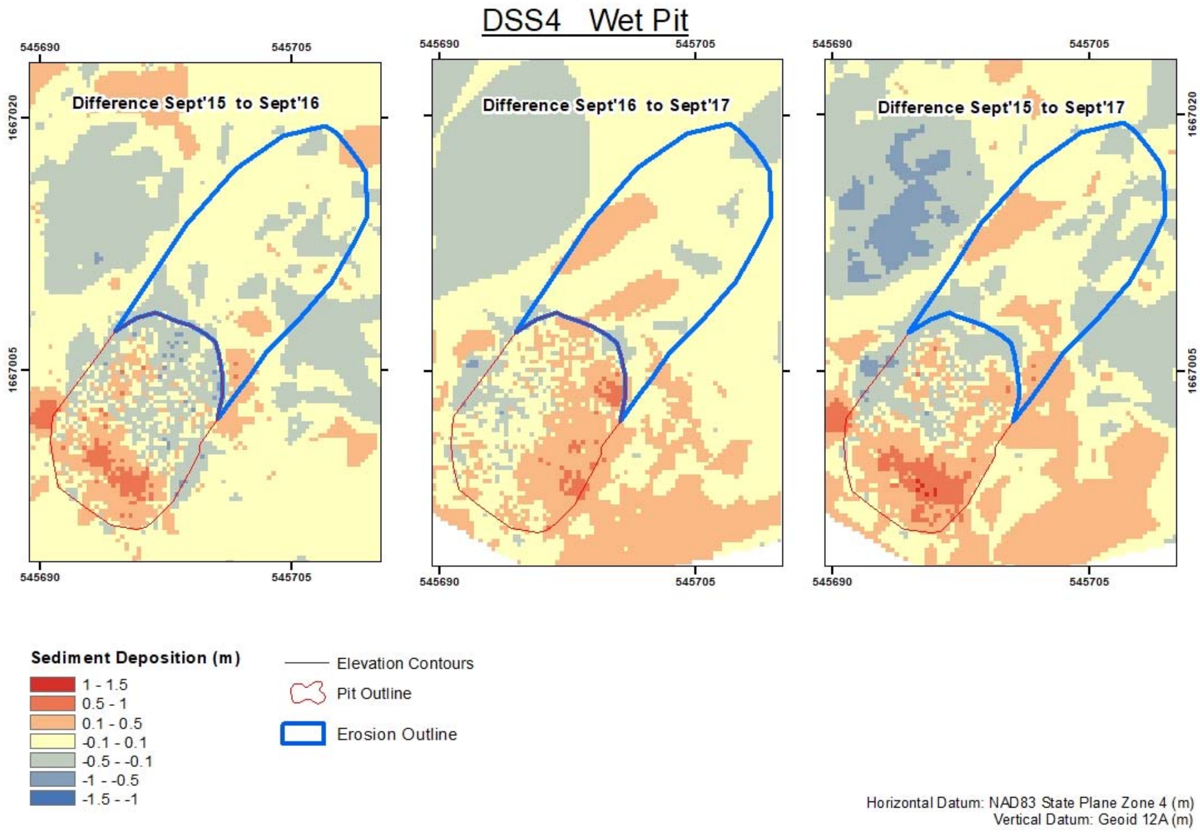


Figure 158. Wet pit at the Sagavanirktok River near MP318 (DSS4). Plots of surface difference over given time intervals for the area delineated by the blue line downstream of the pit.

Table 24. Volume changes for the area delineated by the blue line downstream of wet pit at the Sagavanirktok River near MP318 (DSS4).

DSS4 Wet Pit	Ref plane height (m)	Volume (m^3)	Change since 2015 (m^3)
Sep-15	369.7	9.6	
Sep-16	369.6	9.0	0.5
Sep-17	369.6	6.2	3.4

4.8.5 Patterns of Sediment Transport Along the River

Table 25 shows that deposition in the pits greatly exceeded erosion in the surrounding areas. The fourfold increase in sediment volume transported between locations above (Happy Valley [DSS3]) and locations below (DSS2) the confluence with the Ivishak River shows the important water contributions (i.e., additional energy to move the riverbed sediments) made by the Ivishak River to the Sagavanirktok River. At MP318 (DSS4), the greater transport at the dry pit than at the wet pit indicates that the river channel shifted and deposited more sediment at the dry pit.

Table 25. Summary of changes in deposition and erosion during the study period.

Site ID	Initial pit volume* (m^3)	Final pit volume* (m^3)	Change in pit volume (m^3)	Change in volume outside of pit (m^3)	Site volume change (m^3)
DSS1	264.3	145.1	119.2	-11.1	108.1
DSS2 Dry	350	130.1	219.9	-11.4	208.5
DSS2 Wet	155.3	18.6	136.6	2.1	138.7
DSS3 Dry	82.6	51.1	31.5	-2.7	28.8
DSS3 Wet	120.8	54	66.9	0.1	67.0
DSS4 Dry	113.9	71.2	42.7	0.3	43.0
DSS4 Wet	77.6	62.9	14.6	3.4	18.0

* Initial/final surveys: September 2015 and September 2017

The water level and streamflow data for each Sagavanirktok River station, including the USGS station (see Section 4.3), show that after the pits were excavated in September 2015, river stage dropped and was in low flow conditions by the end of September. The next flow events that could cause significant sediment deposition in the pits would not occur until summer 2016. Although peak flow for 2016 likely occurred during spring breakup, we observed anchor ice in most of the pits. Transport of bed sediment may occur during spring breakup, after anchor ice melts or lifts off the streambed. However, the presence of anchor ice within the pit would limit it from filling in with significant sediment during breakup. Some fine sediment was found deposited in the dry pit at the Sagavanirktok River below the Ivishak River (DSS2) on June 13, 2017, as shown in Section 4.5.1; however, we speculate that the majority of pit sedimentation occurred during a high flow event on June 21, 2016 (see Figure 52). According to the bathymetric survey data, most deposition occurred prior to the survey on June 27, 2016. Deposition was lower on subsequent bathymetric surveys in 2016 and 2017. In 2017, aside from the spring breakup peak flow event in late May, only one other high flow event occurred on the Sagavanirktok River, which was on July 25, 2017. Less sediment deposition in the pits occurred in 2017.

Deposited sediment volumes reported in Table 11 to Table 17 provide some insights on bed sediment transport capacity along the stream during the study period. For instance, the calculated sedimentation volumes between September 2015 and September 2016 are practically constant (≈ 130 m^3) for pits located downstream of the Ivishak River confluence (i.e., DSS1, DSS2 dry and wet pits). During the same timeframe, smaller volumes were calculated for the remaining pits (≈

65 m^3, DSS3 wet pit; ≈ 35 m^3, DSS4 dry pit). The data also indicate that the main channel is changing location at MP318 (DSS4), because the deposited sediment volume is smaller in the DSS4 wet pit (≈ 10 m^3) than in the DSS4 dry pit. Preliminary—and rough—estimates of bed slope, using the June 2016 SfM digital elevation model of the Sagavanirktok River floodplain, in each of the sites revealed values of 0.003 for DSS1, DSS2, DSS4, and 0.006 for DSS3.

The main reasons for this markedly different filling volume are (1) the Ivishak River discharge contribution, which can be considered equivalent to the Sagavanirktok River discharge upstream of the Ivishak–Sagavanirktok confluence (see Toniolo et al., 2015) and (2) the reduction in sediment particle sizes at DSS1 and DSS2 compared with DSS3 and DSS4 locations (see Figure 84). Thus, the river has more energy to move smaller sediments downstream of the confluence. This finding is important, as it could potentially help ADOT&PF engineers during the planning of material site locations along the Sagavanirktok River.

An analysis of the deposited sediment volumes during the period September 2016 to September 2017 suggests that the main channel is changing locations at MP405 (DSS1), since no sedimentation was observed in the DSS1 pit during 2016–2017, and at Happy Valley (DSS3) (≈ 10 m^3, DSS3 dry pit; ≈ 0 m^3, DSS3 wet pit).

4.9 Hydraulic Modeling

The Sagavanirktok River hydro-sedimentological study includes a secondary project focused on determining baseline riverbed and floodplain elevations prior to ADOT&PF's excavation of sediments from the Sagavanirktok River at MP367 (Figure 159). While modeling was not proposed in the current project, the availability of the topo-bathymetric data provides an excellent opportunity to examine probable impacts of extracting sediments from the floodplain using hydraulic models. The study area is the Sagavanirktok River at Dalton Highway MP367, approximately 1.6 km upstream of the Sagavanirktok River below the Ivishak River (DSS2) hydro-meteorological station (see Figure 1**)**. The ADOT&PF and its contractor Cruz Construction are planning to extract sediment from the floodplain to use as part of the road material for the Dalton Highway. The proposed pit dimensions are 100 m wide × 1600 m long × 6 m deep. Over time, these sites will likely fill with sediment. The purpose of the work reported here was to develop a preliminary model configuration from the land surface elevation data to reflect river conditions and cross-section geometry prior to excavation.

Two models—Surface-Water Modeling System (SMS) and Sedimentation and River Hydraulics (SRH-2D)—are being used for evaluating hydrologic conditions and input parameters. The SMS is a graphical user interface that aids in pre- and post-processing for the numerical model of choice, which in this case is SRH-2D, a hydraulic finite element numerical model developed by the U.S. Bureau of Reclamation that considers two-dimensional hydraulics as well as some refined assumptions. Simulation outputs by SRH-2D include shear stress, Froude number, velocity magnitude and vector, water depth, and water level elevation. The combination of this software provides the essentials for creating and running a hydraulic model.

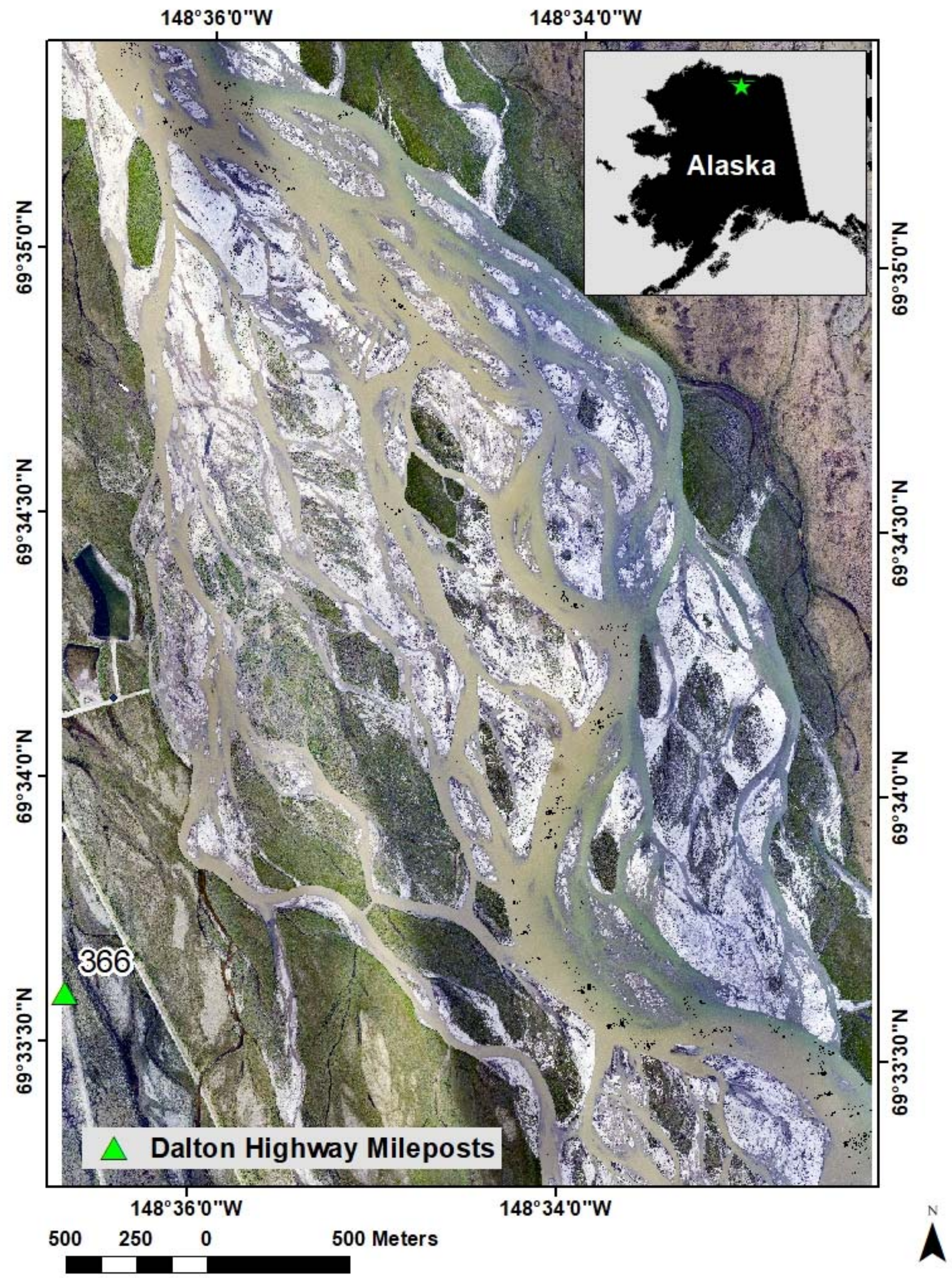


Figure 159. Location near MP 367 of model domain.

4.9.1 Model Development

The elevation input data used for the basis of this hydraulic model are a composition of UAF and Cruz Construction bathymetric survey data and a SfM digital elevation model of the surrounding topography. The 0.2 m digital elevation model was resampled to 10 m × 10 m raster pixel size to improve the efficiency of the model run time. The raster elevation data were converted to scatter elevation data (*x*, *y*, *z* coordinate data), shown in Figure 160.

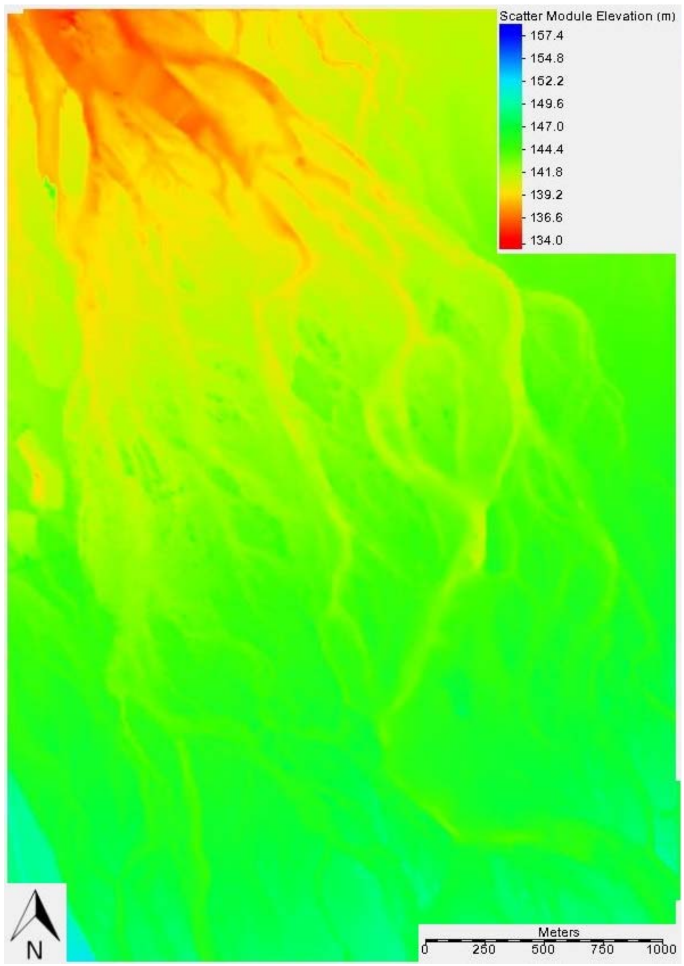


Figure 160. Digital elevation model of the study reach (scatter elevation dataset).

The model domain was created by drawing a perimeter around the scatter data. The perimeter arc vertices were then distributed to a spacing of 15 m, and a polygon was created consisting of each of the arcs drawn to encompass the domain. Following this step, the scatter elevation dataset was set as the bathymetry source for the creation of a mesh.

In order for the simulation to be carried out, four important steps must be taken:

1. Create mesh
2. Define boundary conditions
3. Identify material input parameters
4. Establish monitor points

A 2D mesh was generated from the scatter elevation dataset. The mesh is defined by node locations and connectivity between the nodes to form elements that take on the shape of rectangles or triangles. In the case of this model, all elements are triangular. The visible change in size of the domain area from the scatter elevation dataset in Figure 160 to the mesh in Figure 161 suggests that water will not likely inundate the upper northeast section and the lower southwest section of the domain given the difference in elevations. To shorten the computation time, those areas were removed from the model.

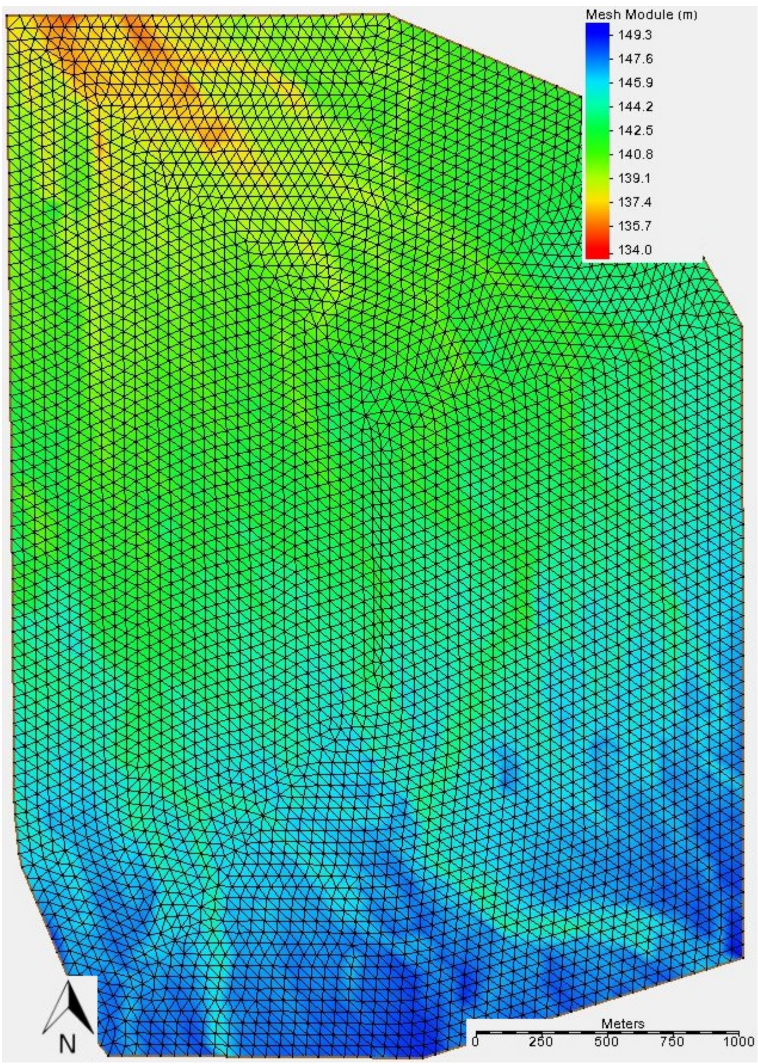


Figure 161. Mesh with elevation contours.

In the next step, we established the boundary conditions. The inflow and outflow arcs are defined where an arc symbolizes an opening in the mesh from which water can enter and exit. The inflow arc was assigned a discharge of 500 m^3/s. The outflow arc was populated, by an internal model calculation, with a water level elevation by inputting a composite Manning's *n* of 0.0375, a water surface slope of 0.0041, and a discharge of 500 m^3/s. The resulting water level elevation was set to 137 m at the outflow. Figure 162 shows the mesh and locations of inflow on the southern boundary and the outflow on the northern boundary.

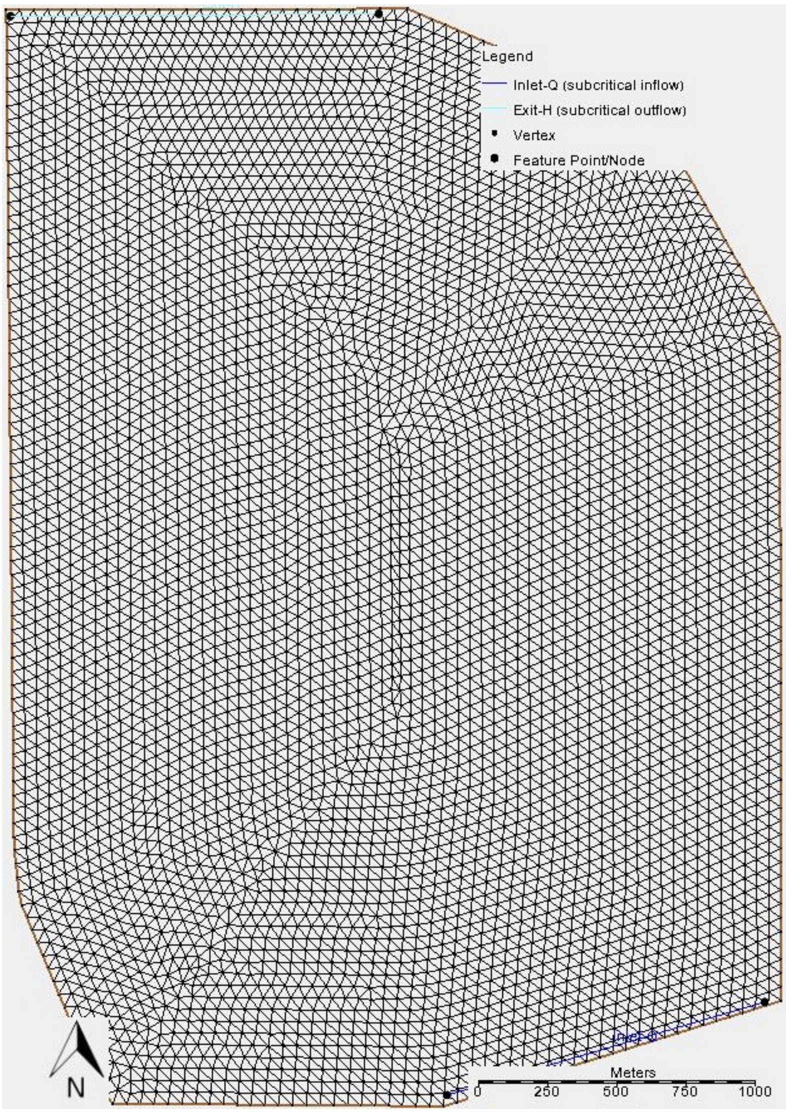


Figure 162. Mesh showing the location of the boundaries. The inlet is at the bottom of the mesh and the outlet is at the top.

We defined the input parameter, the hydraulic roughness (or Manning's *n*) for the materials, and classified the model domain as two distinct zones: (1) active river channel streambeds and (2) the surrounding sand/gravel bars and vegetation. The active river channel zone was given a Manning's *n* of 0.035 to denote a winding channel with some deep pools and stones. Because it was difficult to differentiate between materials outside the main channel, we assigned a single Manning's *n* of 0.040 to sand bars, gravel bars, and vegetation. We obtained the roughness coefficients from Chow (1959). The roughness coefficients represent first approximations that will probably be adjusted in future simulations. The distribution of each material zone is shown in Figure 163**.**

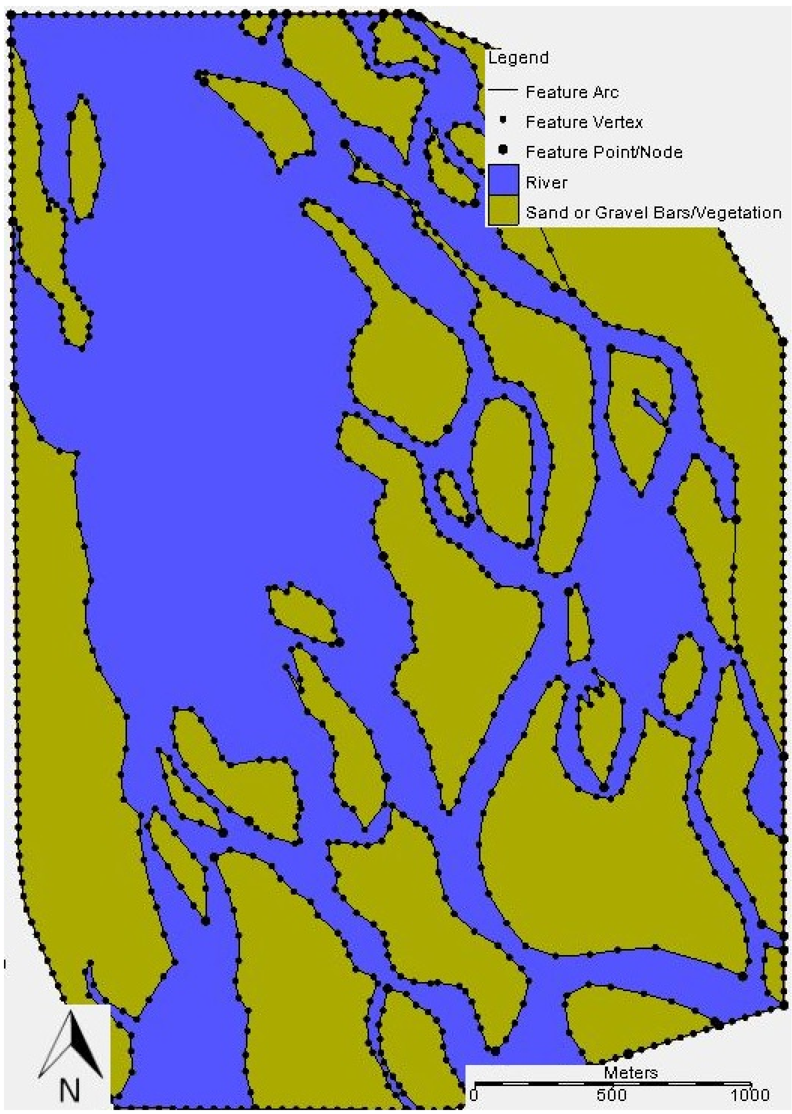


Figure 163. Map showing the two zones of Manning's *n* roughness coefficient for (1) river channel and (2) sand/gravel, vegetation.

Lastly, we established the model monitor points. Placing a monitor point near the inflow and outflow allows evaluation of water level elevations during simulation. While the simulation runs, the water level elevation at each monitor point is displayed and helps track simulation progress to ensure that steady-state conditions have been met.

We set the simulation initial time at 0 (hour), the time step, which is used by SRH-2D to make internal calculations, at 0.25 sec, the run period to 5 hr, and the results output frequency to 0.1 hr.

4.9.2 Results of Simulation

The results of the initial simulation at the 5 hours are shown in Figure 164 and Figure 165. Running the simulation at a discharge of 500 m3/s over a period of 5 hr and a time step of 0.25 sec yielded a steady-state flow condition. The water depth in the main channels remained constant at a depth of about 1.6 m, with changes along the domain of ± 0.4 m, as shown in Figure 164. The deepest channels attained water depths closer to 2 m. Outside the main channels, the water depth ranged from 0 to 1 m. Figure 165 shows the change in elevation moving from the inflow to the outflow across the model domain. Velocity vectors and magnitudes at 5 hours are presented in

Figure 166. Velocities appear highest at the inflow and outflow regions; however, these areas are impacted by the boundary conditions. Velocities through the main channels, ranged from 0.7 to 2.1 m/s. Closer inspection shows that at the more pronounced bends, velocities are higher. Outside the main channel, velocities are considerably lower (less than or equal to 1 m/s).

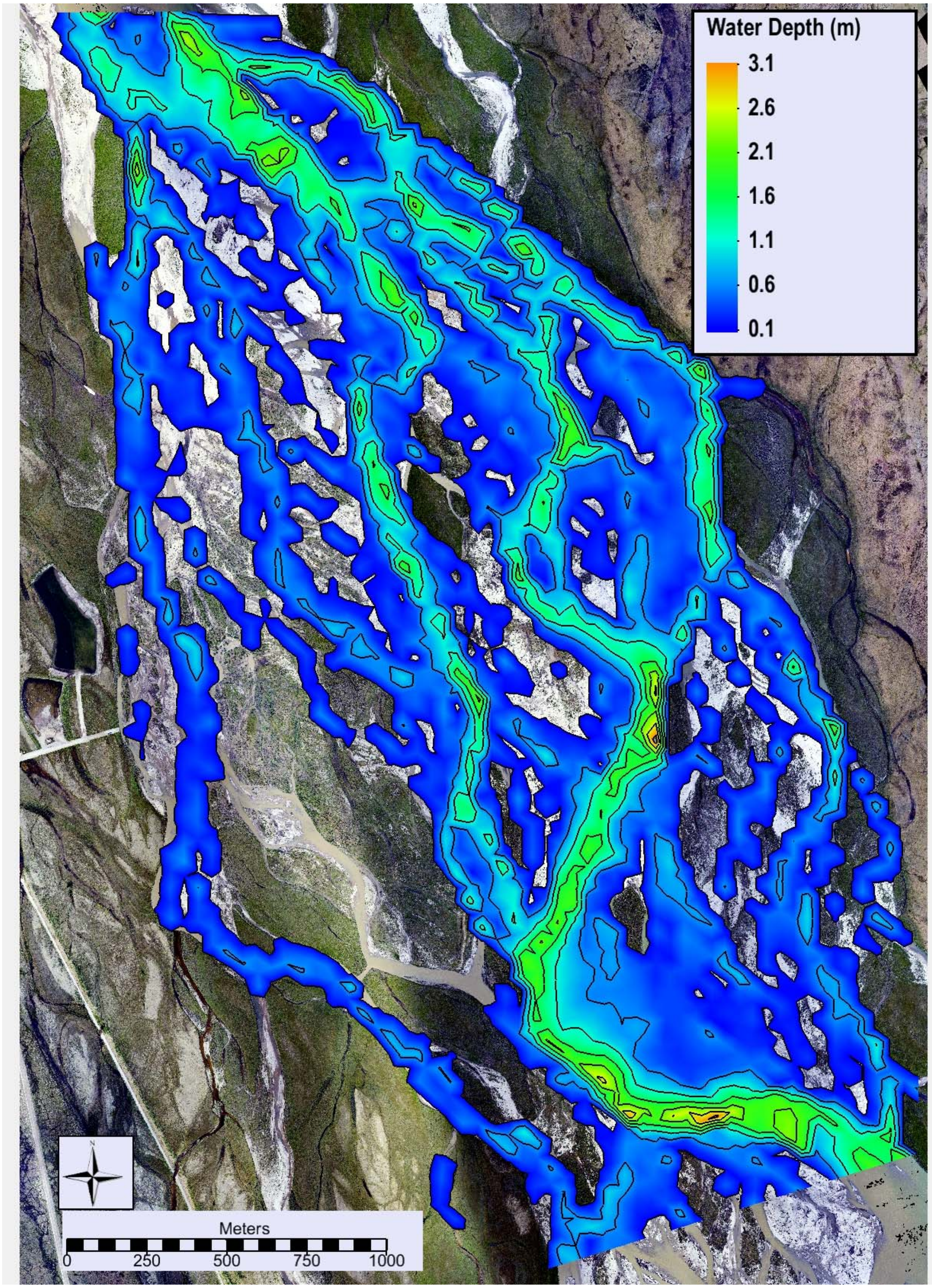


Figure 164. Water depth 5 hours into the simulation at steady state.

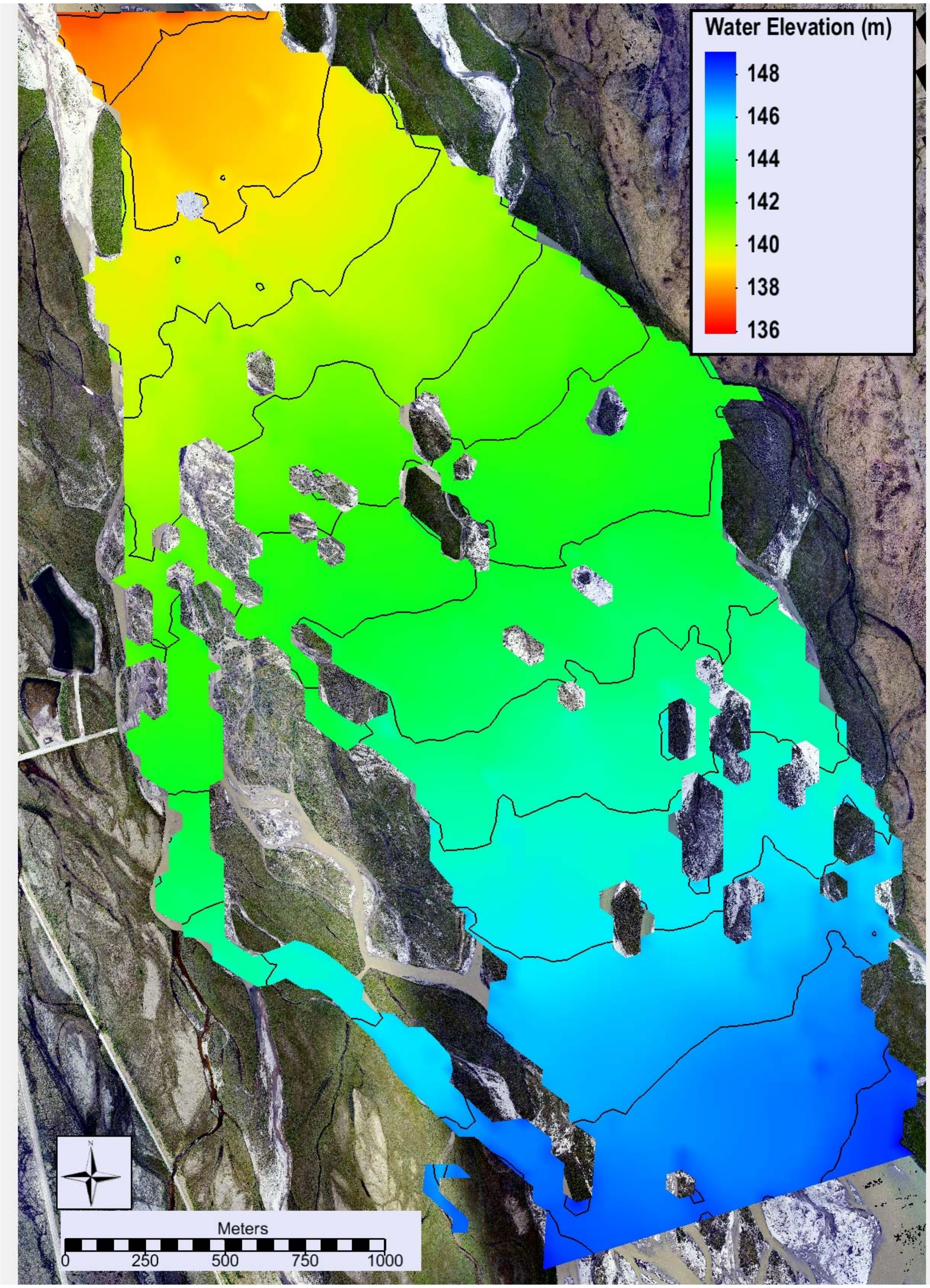


Figure 165. Water elevation 5 hours into the simulation.

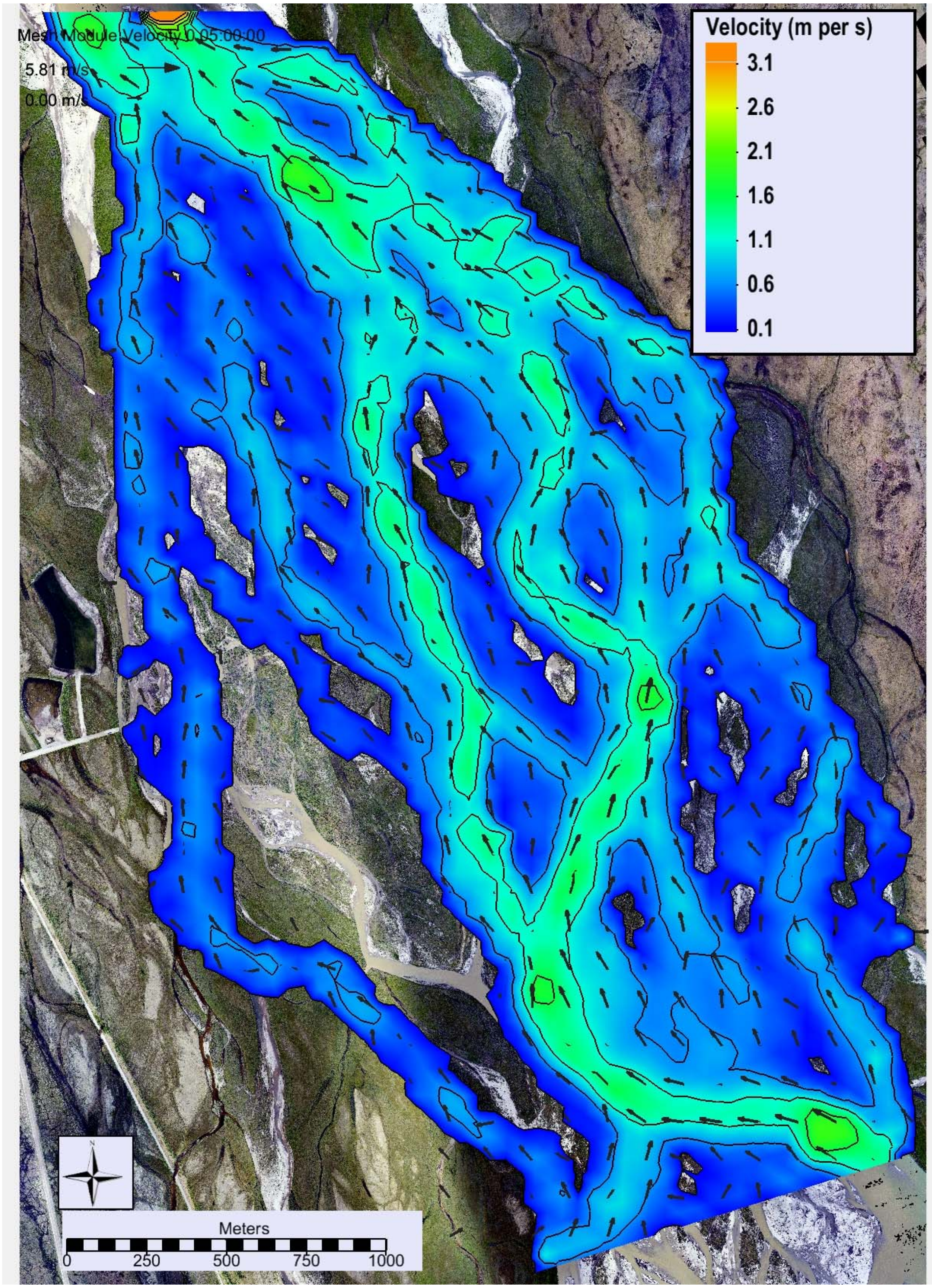


Figure 166.Velocity vectors corresponding to 5-hour simulation time.

The current mesh, input variables, parameters, and boundary conditions for the simulation provide realistic results for water depth, water level elevation, and velocity for this reach of the

Sagavanirktok River as compared with observed data collected from the Sagavanirktok River below the Ivishak (DSS2) station 1.6 km downstream. Figure 167 shows measured velocities and river depths that reflect a similar range of velocities and water depths as the model results. One objective was to ensure that results were realistic and could be attained in a time-efficient manner. However, the mesh and input parameters will likely be altered in future simulations to represent the topography and bathymetry of the region more accurately. Consequently, as the mesh becomes increasingly complex with the addition of elements, the iterative process will lengthen the run time. At the current run time of 5 hr, a quick visual inspection suggests that steady-state flow has been achieved at the 2-hr mark. Based on this information, we suspect that future run times will increase dramatically as mesh complexity grows.

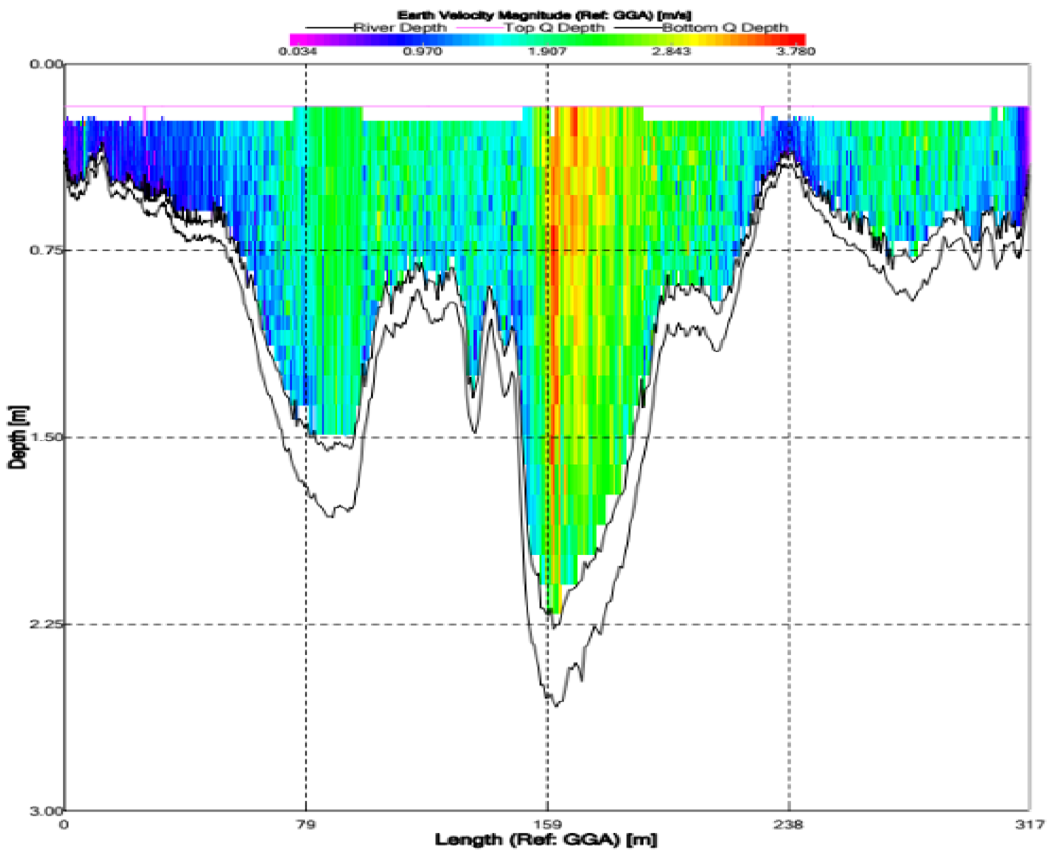


Figure 167. Observed velocity cross section at the Sagavanirktok River below the Ivishak River confluence at DSS2 on June 24, 2016, at measured flows of ~500 m^3/s. Measured velocities range from 0 (pink) to 3.8 m/s (red).

Using this hydraulic model as a baseline, we can provide the ultimate goal of a comprehensive analysis concerning sediment transport at the excavation site. This work will target the potential change in morphology of the reach due to extensive sediment removal. It will be desirable to establish a range of time, for a variety of simulations, when the excavated sites will be filled by upstream sediment. Scour on the downstream face of the excavation site will be investigated in conjunction with this process to determine any appreciable increase in the time it takes for this site to refill. Because the excavation sites are at a higher elevation than the main channel, higher discharges will be a likely focus for future simulations of sediment transport.

In conducting this investigation, we will use the sediment transport model offered in SRH-2D to evaluate both pre-excavation and post-excavation conditions, as the data become available. Because of the size of the domain and the complexity of the river's morphology, lengthy simulation periods are probable. Further, due to uncertainties associated with lengthy sediment transport simulations, additional models may be necessary to determine the time it will take for the excavation sites to refill.

5 CONCLUSIONS

Since 2015, a research team at the University of Alaska Fairbanks has been performing hydro-sedimentological studies of the Sagavanirktok River, where it parallels the Dalton Highway. The research encompasses the monitoring of river conditions and meteorological conditions along the river and within the entire watershed. The studies are funded by the State of Alaska through the Alaska Department of Transportation and Public Facilities and by the Alyeska Pipeline Service Company. We have produced reports each year since 2015 to describe river conditions during breakup (see Toniolo et al., 2015, and Toniolo et al., 2016a). Last year we reported the initial results on bed-sediment transport conditions in the Sagavanirktok River (Toniolo et al., 2016b). In the present report, we focus on new data and analyze it in the context of previous data. The main conclusions related to specific topics such as aufeis thickness and extent, spring breakup conditions, grain-size distribution (suspended and bed deposits), and pit sedimentation are provided in the following paragraphs.

We calculated ice thickness for 2015, 2016, and 2017 based on ground elevations from a 2014 ifsar DEM and different types of ice elevation surveys (such as LIDAR, SfM, and GPS). Inter-year comparisons indicate that, in general, ice thickness for both 2015 and 2016 was greater than in 2017 across most of the study area. Aufeis extent was estimated annually for the period 2000–2017 using Landsat IR satellite imagery. Ranks of aufeis aerial extent for 2015, 2016, and 2017 are first, second, and fifth, respectively. Thus, the aufeis extent for 2017 was smaller than for the previous 2 years, but even so, it was not a minor event.

An analysis of cumulative rainfall during the summer months at the meteorological stations located in the study area shows that the warm season of 2016 was relatively wet compared with the same season in 2017. Summer 2017 was dry in June and early July. However, late summer and early fall were wet, beginning with a widespread rain event from July 20 through 25 that caused an increase in discharge in the Sagavanirktok River.

We conducted snow surveys in April 2017 at 32 sites distributed at various elevations throughout the entire watershed. A helicopter was required to access nearly half of the sites; the rest of the sites were located in the vicinity of the Dalton Highway. We compared end-of-winter SWE in 2017 with historical measurements for each snow survey site. The comparison shows that average SWE for the Sagavanirktok basin was near normal for winter 2016/2017, similar to what was observed in winter 2015/2016.

The general pattern for air temperatures observed in 2017 was similar to the pattern in 2016: warming conditions initiated spring runoff, then the air temperatures dropped, causing breakup to progress gradually with lower flows. In 2016, air temperatures in the coastal plain increased to above freezing in late May, whereas in 2017, air temperatures did not increase until well into June. The air temperature patterns recorded in 2016 and 2017 were remarkably different from the observed pattern in 2015, which was characterized by widespread warming throughout the Sagavanirktok River basin in May 2015. This strong warming resulted in rapid snowmelt and high peak discharges during the 2015 breakup. Numerous times during spring breakup and at least three times during the summer months, we conducted discharge measurements using an ADCP and a GPS system capable of providing RTK correction. The equipment was attached to a jet boat, an inflatable boat, a kayak, or a helicopter, based on river conditions at the time of the measurements.

Due to low May air temperatures throughout the region, many North Slope rivers had a long and gradual breakup in 2017. The peak breakup flows occurred in late May to early June, compared with mid-May in 2015 and 2016. In 2017, the maximum discharge measured in the Sagavanirktok River (at the East Bank station) was 750 m^3/s (26,485 ft^3/s) on May 30, 2017; the maximum measured flow was 1560 m^3/s (55,090 ft^3/s) at the same station on May 20, 2015. Concurrent discharge measurements during breakup 2017 as well as the difference in water levels at DSS5 and Spur Dike 3 indicate that more than 50% of the water flows in the west channel, at least during breakup. Summer discharge measurements occurred during low flows, which poses a problem since the development of stage–discharge rating curves requires measurements of both high- and low-flow conditions.

A stable isotope analysis was conducted to determine the source of the overflow that forms the aufeis feature on the lower Sagavanirktok River near Franklin Bluffs. This analysis revealed that water samples from the lower sections of the river are very similar to samples collected during the same time from the mountain springs. Given that these mountain sources are thought to be perennial springs in an otherwise continuous permafrost zone, the source of the Sagavanirktok

River water that forms aufeis in late winter seems to be groundwater that rises through taliks and flowing in the Sagavanirktok floodplain.

We characterized bed sediment deposits that form gravel bars at four of the Sagavanirktok River pits. The average d_{50} of bed sediment at both stations above the Ivishak River confluence (DSS4 and DSS3) was similar (approximately 73 mm); the average d_{50} of sediment at the stations below the Ivishak River confluence was 57 mm at DSS2 and 42 mm at DSS1. Thus, streambed grain size becomes finer downstream. The sediment from the station just below the Ivishak River confluence (DSS2) has the greatest range in grain size distribution, possibly due to its proximity to the confluence with the Ivishak River. Average grain size distributions of suspended sediment along the river ranged from medium to coarse silt during the study period.

We compared suspended sediment concentration (SSC) in the Sagavanirktok River during the last 3 years. Comparing results from spring breakup, the highest concentrations occurred during 2015; SSC was higher during the 2017 breakup than during the 2016 breakup. Summer SSC results demonstrate the importance of the Ivishak River to the sediment transport processes. The record shows that sometimes the value of SSC is relatively constant along the entire river, while other times, it is not, with the changes occurring downstream of the Ivishak–Sagavanirktok confluence.

All sediment pits had deposition, and most occurred in early summer 2016. The wet pit at the station below the Ivishak River confluence (DSS2) has completely filled in with sediment. Calculated sedimentation volumes in each of the sediment traps show the influence of the Ivishak River in bed-sediment transport capacity of the river. In addition, the comparison between dry and wet pits sedimentation volumes in some of the stations proves the complexity of a braided river, which is characterized by frequent channel shifting.

We are developing a 2D hydro-sedimentological numerical model for an existing material site to estimate the time it will take for the pit to refill with sediment. Preliminary hydraulic simulations have provided satisfactory results.

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7 APPENDICES

Appendix A – Air Temperature and Relative Humidity

Appendix B – Precipitation

Appendix C – Wind Speed and Direction

Appendix D – Stage and Discharge Measurement Tables

Appendix E – ADCP Discharge Measurement Summary Forms

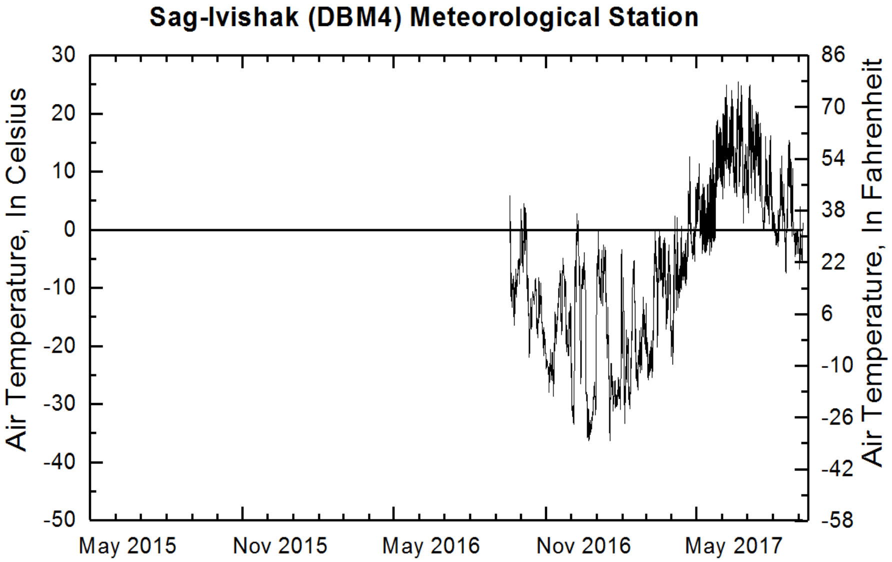
Appendix F – Stable Isotopes

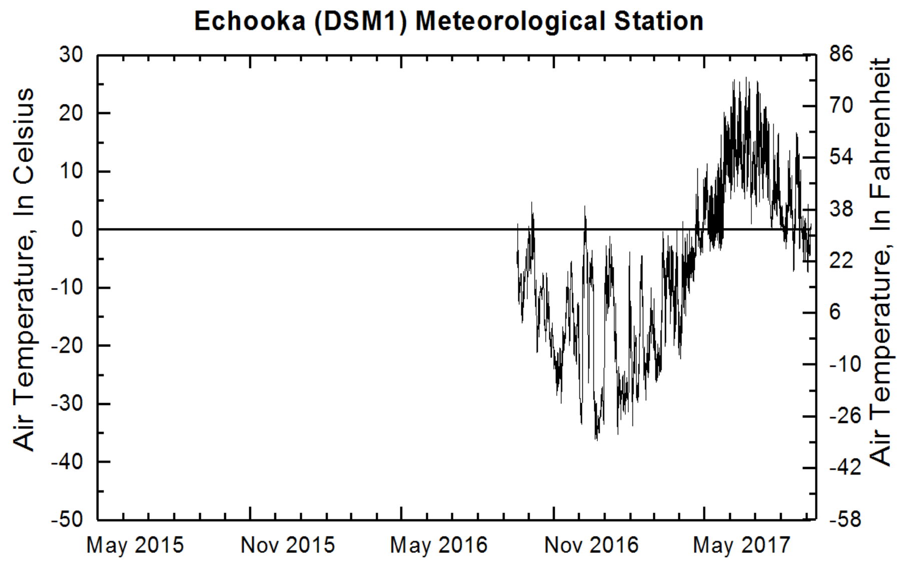
Appendix G – Pit Bathymetry

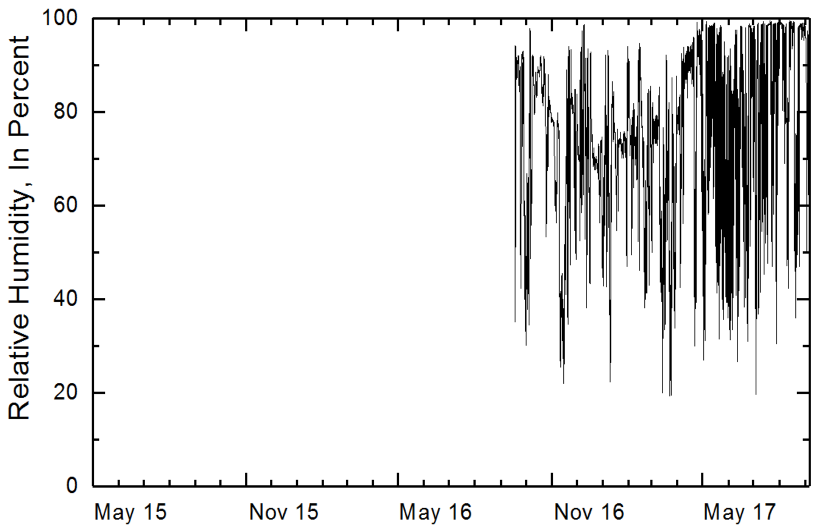
Appendix H – Data DVD

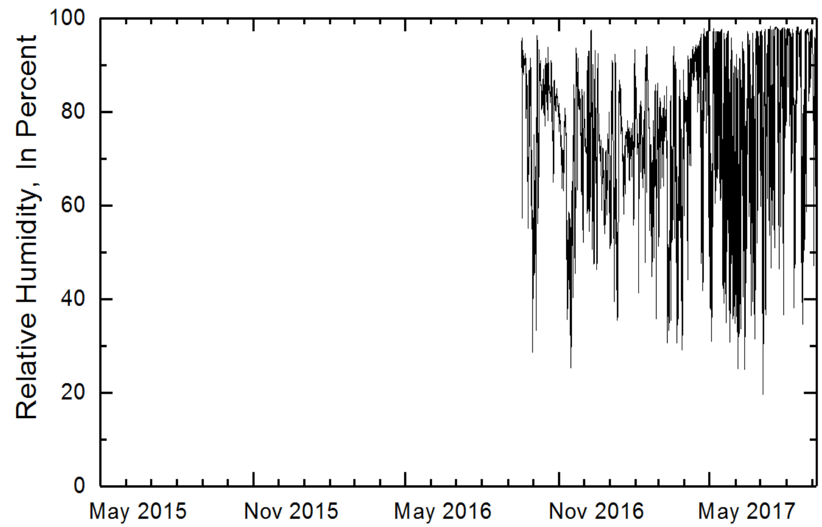
APPENDIX A

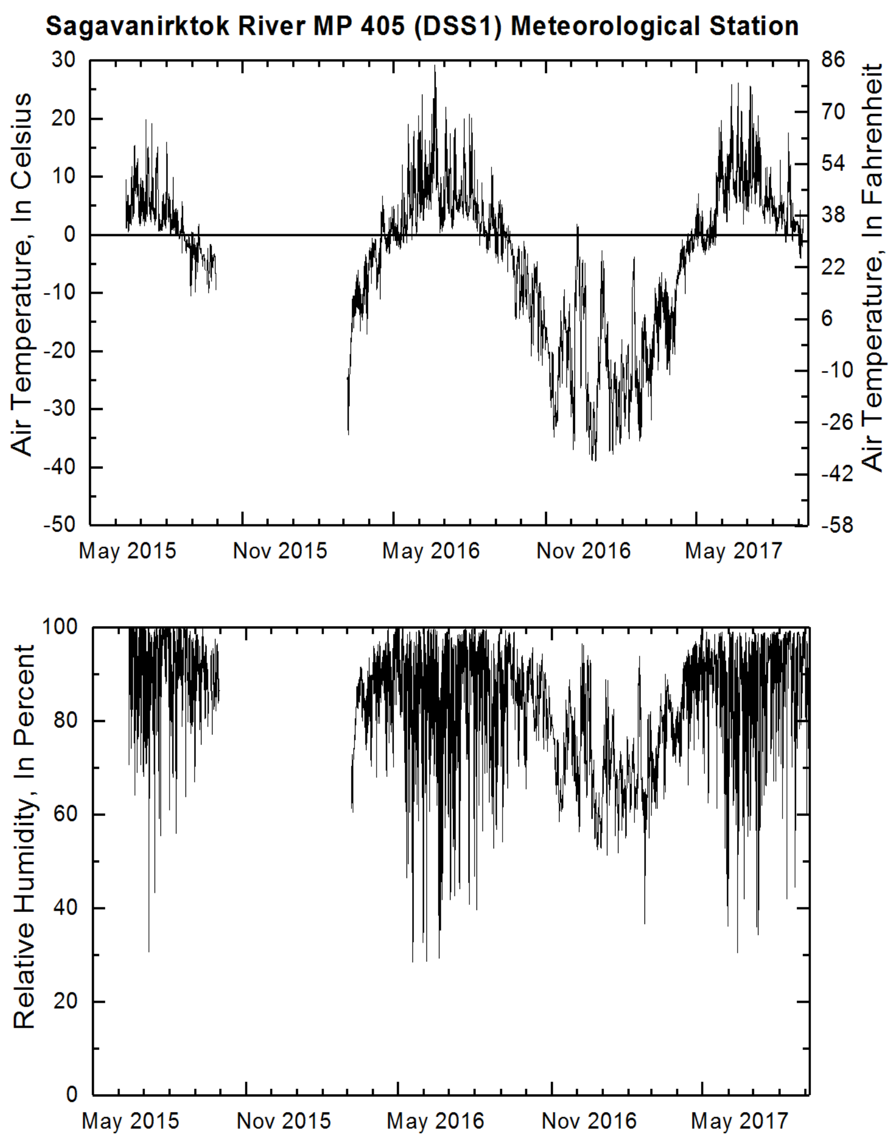
Air Temperature and Relative Humidity

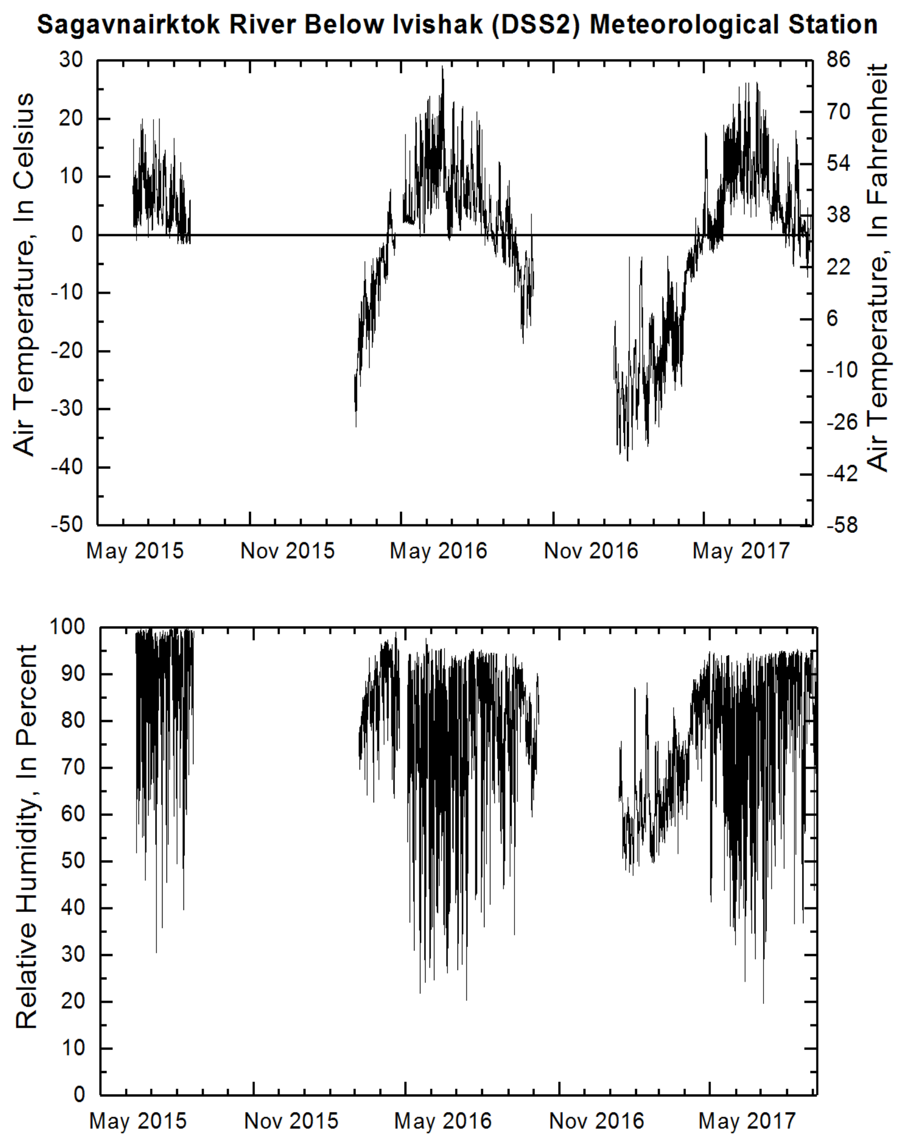

Sag-Ivishak (DBM4) Meteorological Station
Air Temperature, In Celsius
Air Temperature, In Fahrenheit
30
20
10
0
-10
-20
-30
-40
-50
86
70
54
38
22
6
-10
-26
-42
-58
May 2015
Nov 2015
May 2016
Nov 2016
May 2017


Echooka (DSM1) Meteorological Station
Air Temperature, In Celsius
Air Temperature, In Fahrenheit
30
20
10
0
-10
-20
-30
-40
-50
86
70
54
38
22
6
-10
-26
-42
-58
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

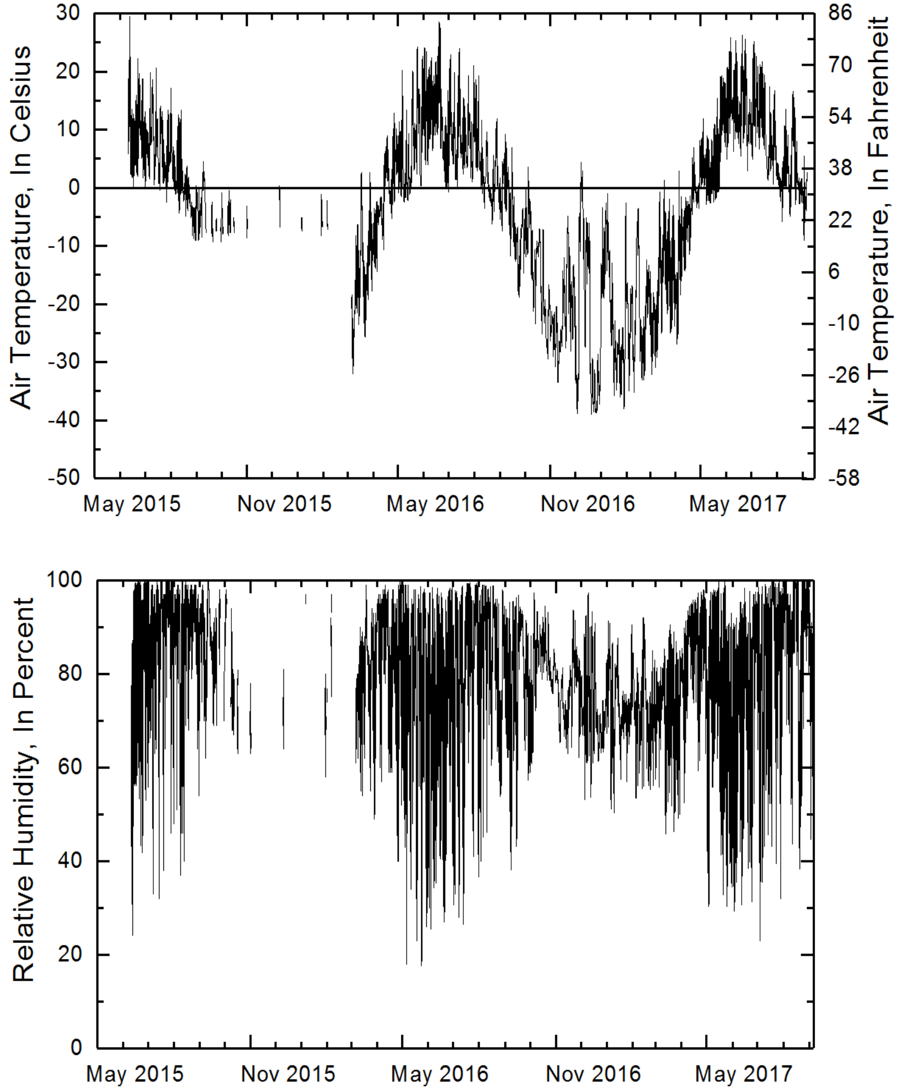

Relative Humidity, In Percent
100
80
60
40
20
0
May 15
Nov 15
May 16
Nov 16
May 17


Relative Humidity, In Percent
100
80
60
40
20
0
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

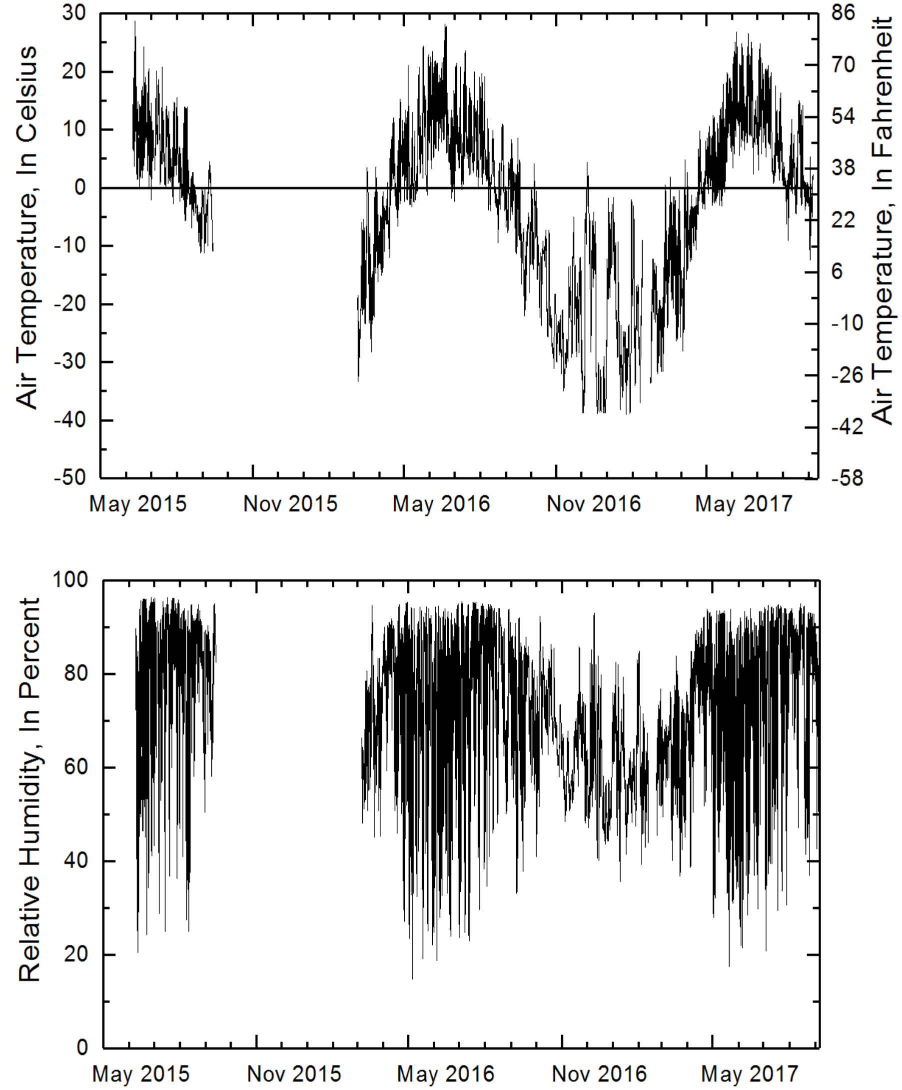

Sagavanirktok River MP 405 (DSS1) Meteorological Station
Air Temperature, In Celsius
Air Temperature, In Fahrenheit
30
20
10
0
-10
-20
-30
-40
-50
86
70
54
38
22
6
-10
-26
-42
-58
May 2015
Nov 2015
May 2016
Nov 2016
May 2017
Relative Humidity, In Percent
100
80
60
40
20
0
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

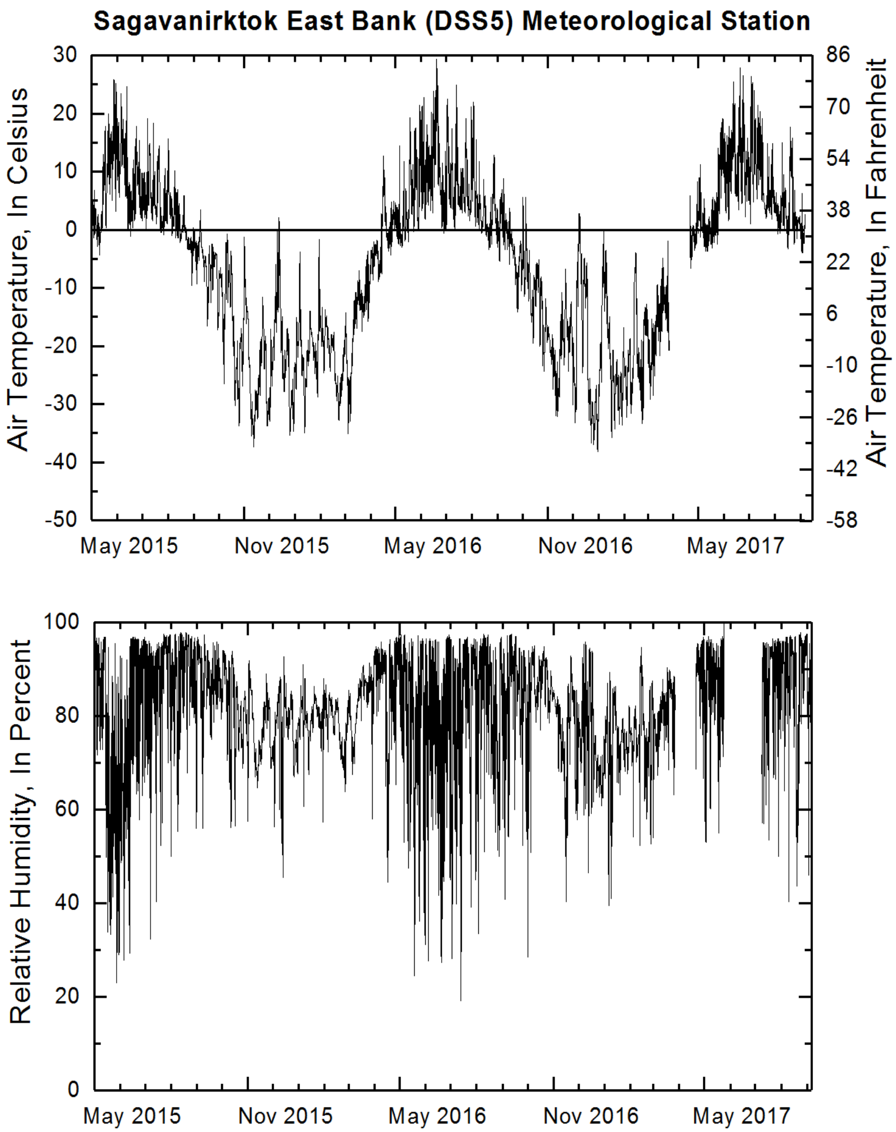

Sagavnairktok River Below Ivishak (DSS2) Meteorological Station
Air Temperature, In Celsius
Air Temperature, In Fahrenheit
30
20
10
0
-10
-20
-30
-40
-50
86
70
54
38
22
6
-10
-26
-42
-58
May 2015
Nov 2015
May 2016
Nov 2016
May 2017
Relative Humidity, In Percent
100
90
80
70
60
50
40
30
20
10
0
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

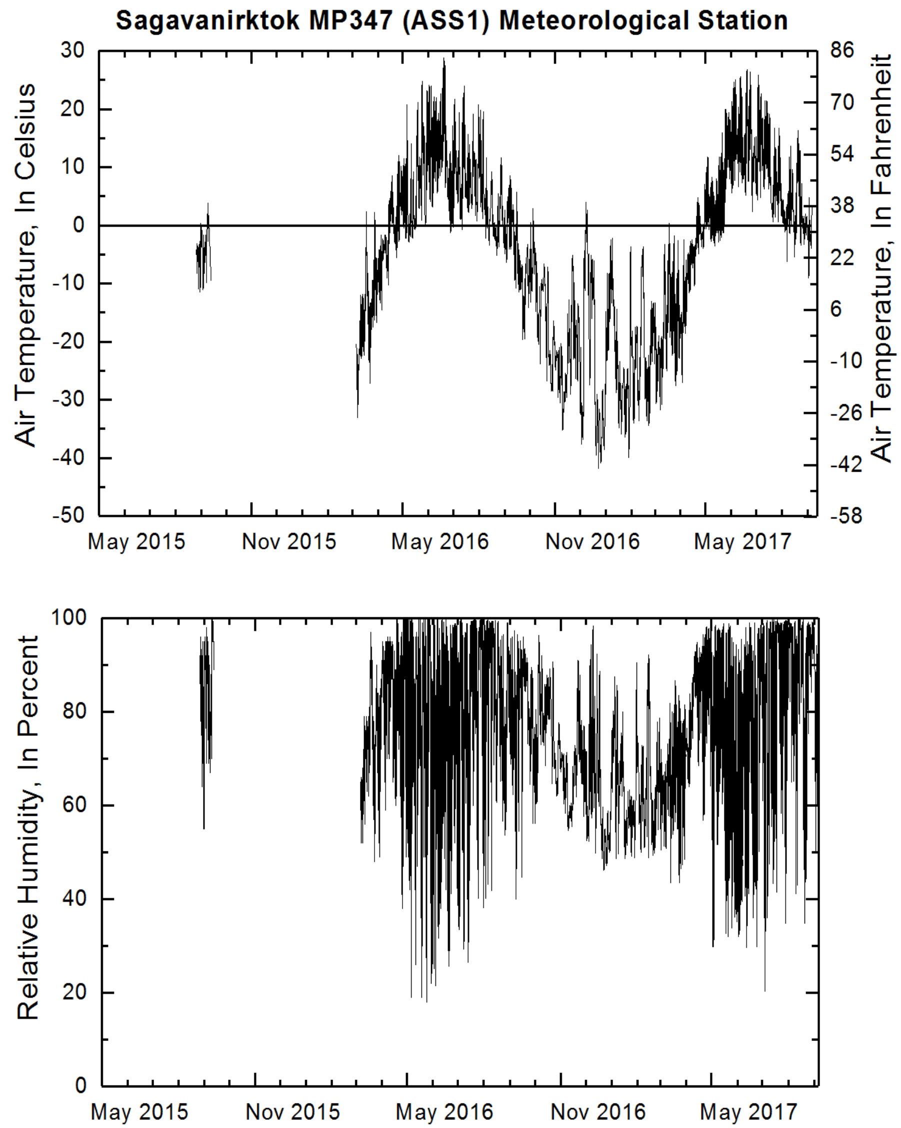
Sagavanirktok at Happy Valley (DSS3) Meteorological Station

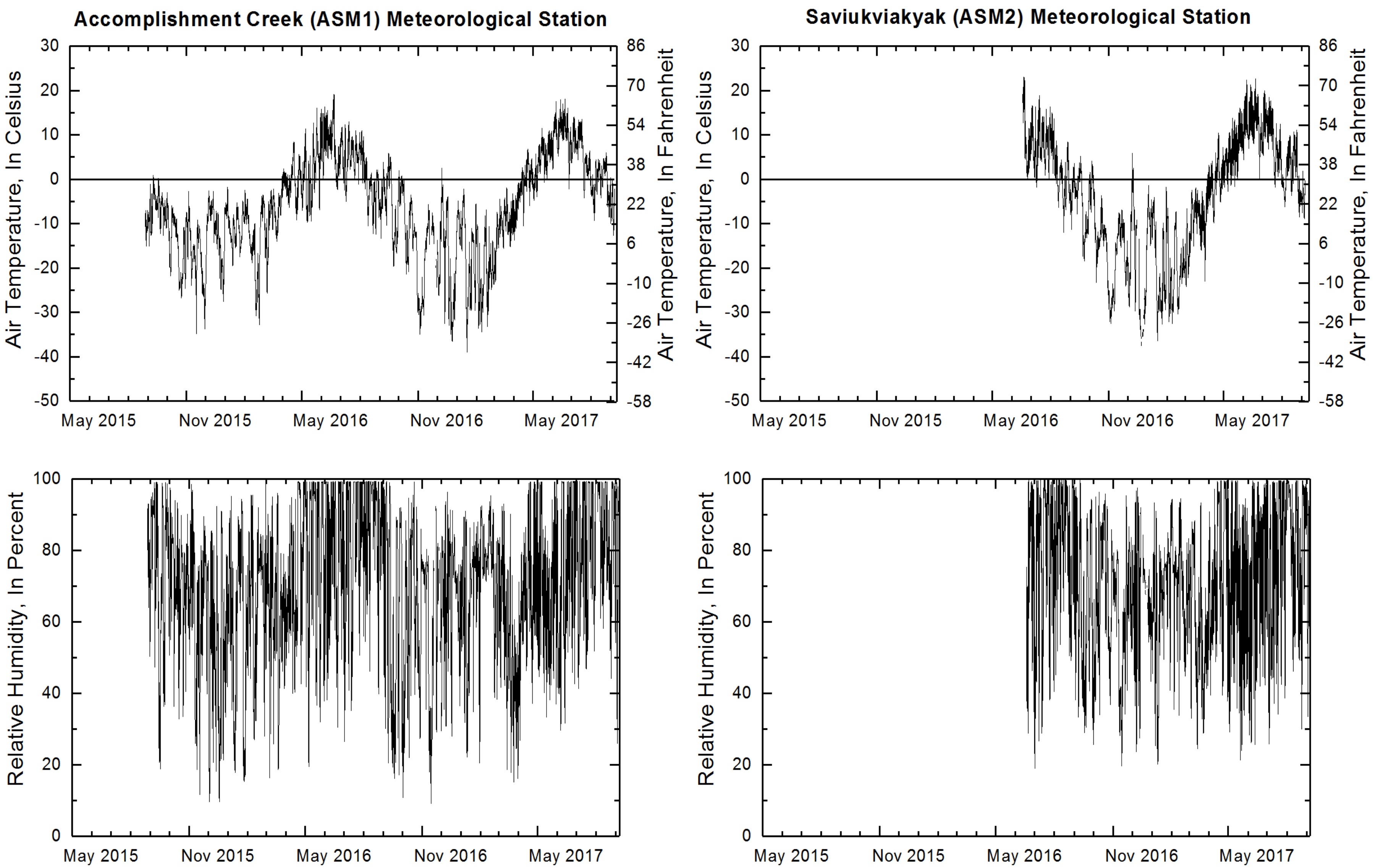


Sagavanirktok Mile 318 (DSS4) Meteorological Station

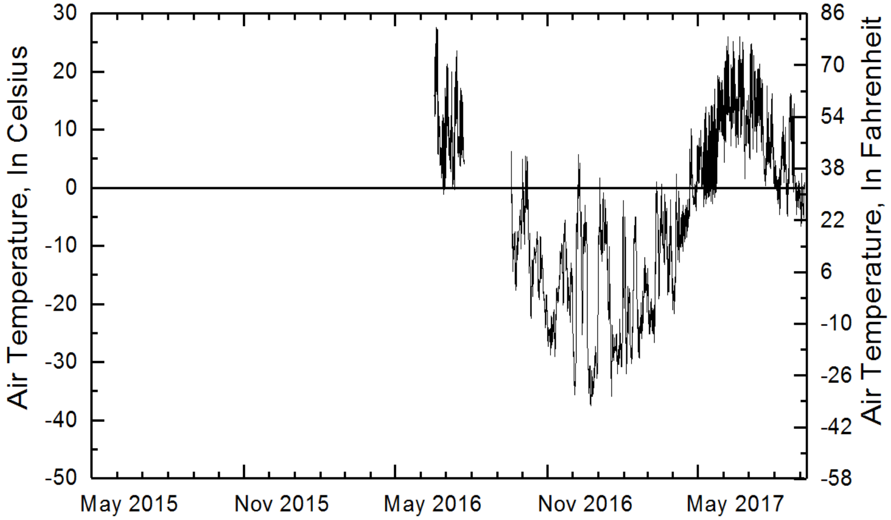


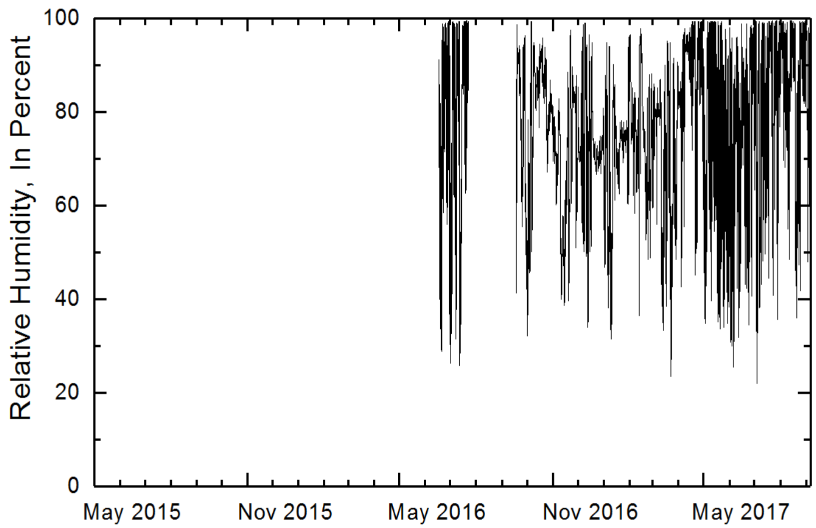

Sagavanirktok East Bank (DSS5) Meteorological Station
Air Temperature, In Celsius
Air Temperature, In Fahrenheit
Relative Humidity, In Percent
May 2015
Nov 2015
May 2016
Nov 2016
May 2017


Sagavanirktok MP347 (ASS1) Meteorological Station
Air Temperature, In Celsius
Air Temperature, In Fahrenheit
Relative Humidity, In Percent
May 2015
Nov 2015
May 2016
Nov 2016
May 2017


Accomplishment Creek (ASM1) Meteorological Station
Saviukviakyak (ASM2) Meteorological Station
Air Temperature, In Celsius
Air Temperature, In Fahrenheit
Relative Humidity, In Percent
30
20
10
0
-10
-20
-30
-40
-50
86
70
54
38
22
6
-10
-26
-42
-58
100
80
60
40
20
0
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

Ivishak (ASM3) Meteorological Station

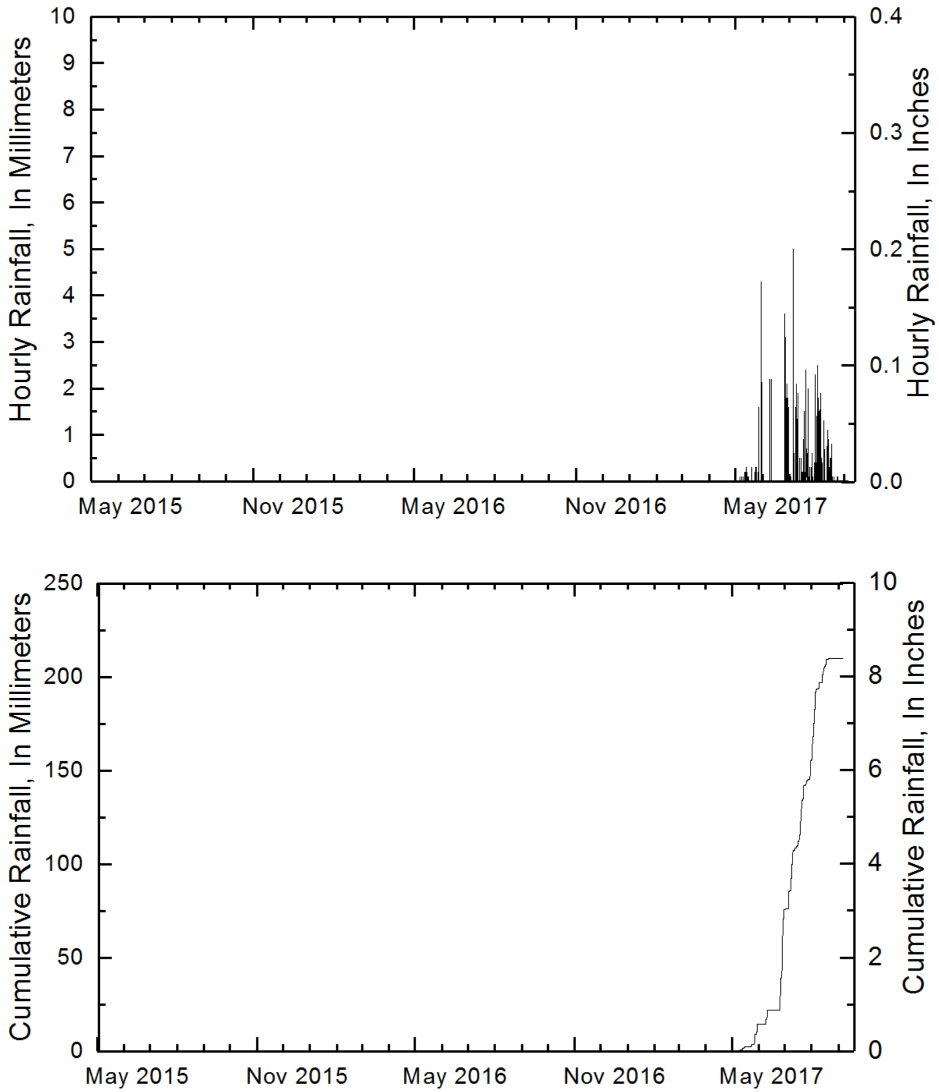




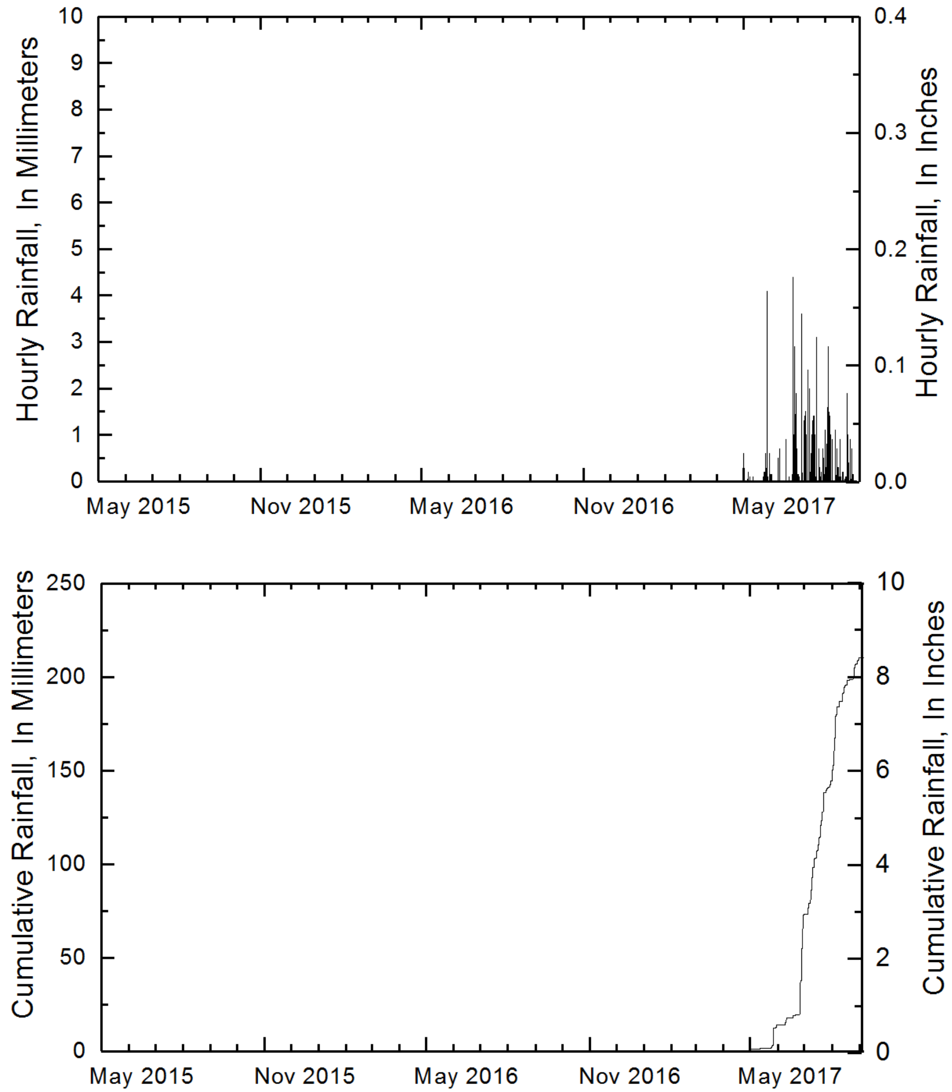
APPENDIX B

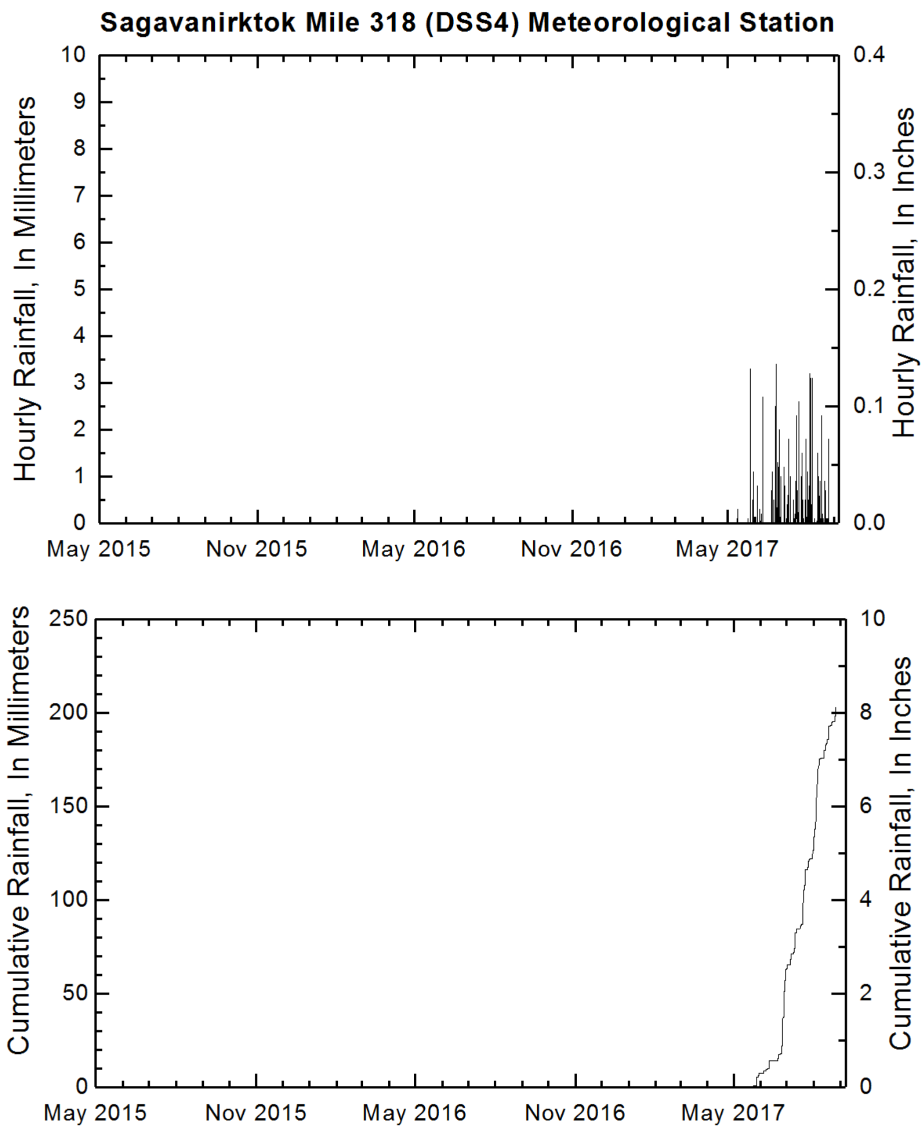
Precipitation

Sag-Ivishak (DBM4) Meteorological Station

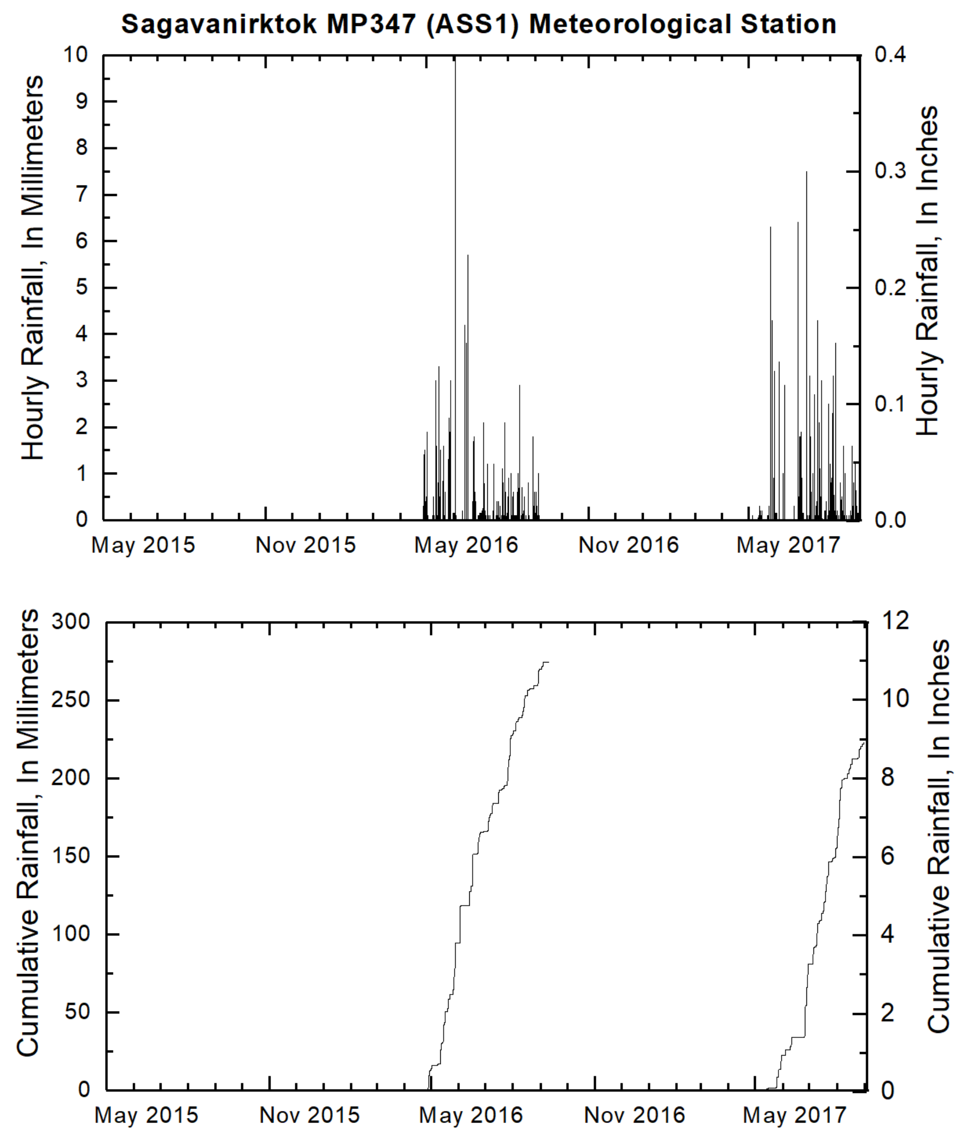


Echooka (DSM1) Meteorological Station

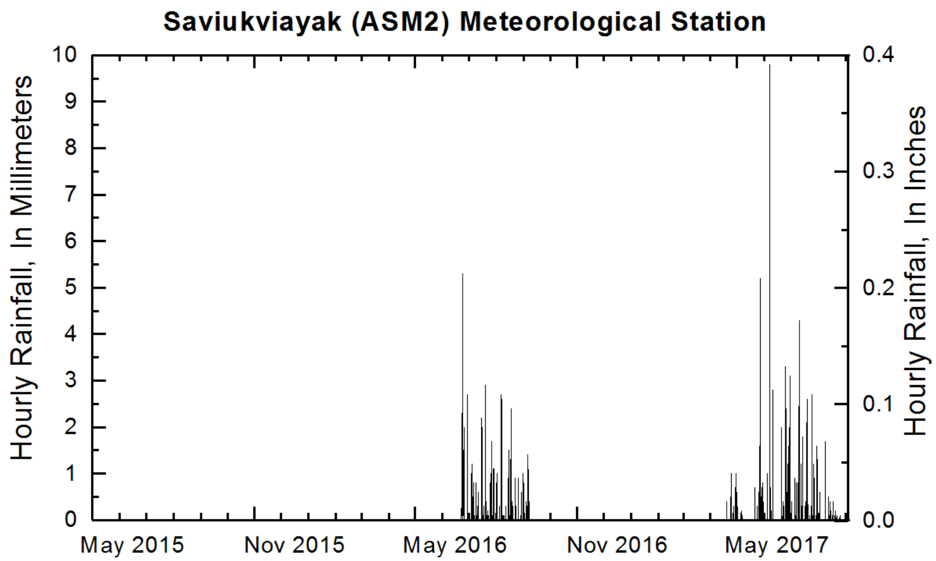


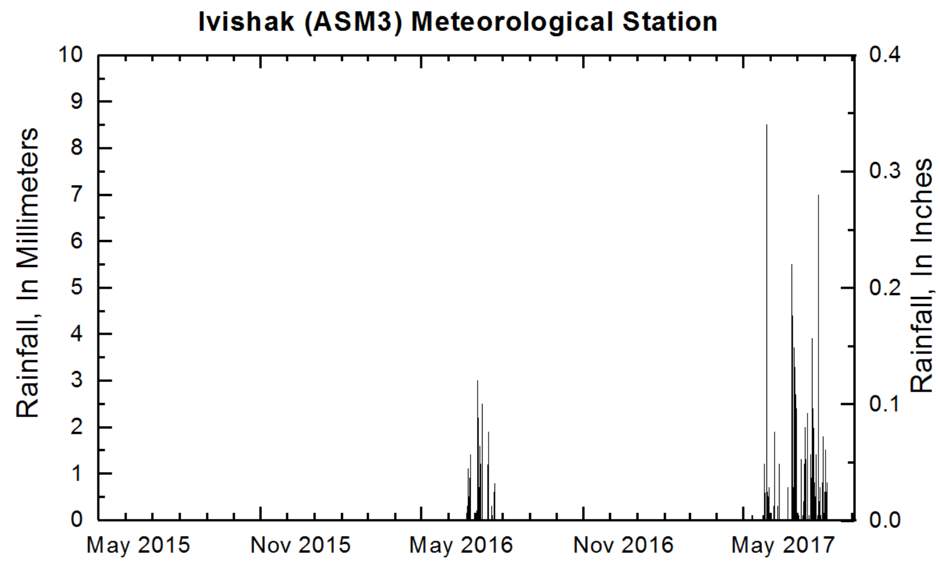


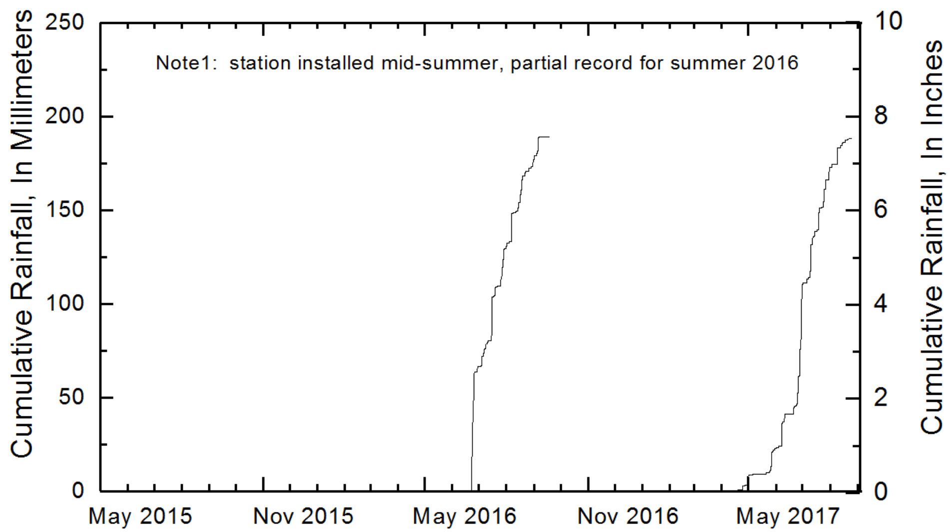
Sagavanirktok Mile 318 (DSS4) Meteorological Station
Hourly Rainfall, In Millimeters
Hourly Rainfall, In Inches
Cumulative Rainfall, In Millimeters
Cumulative Rainfall, In Inches
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

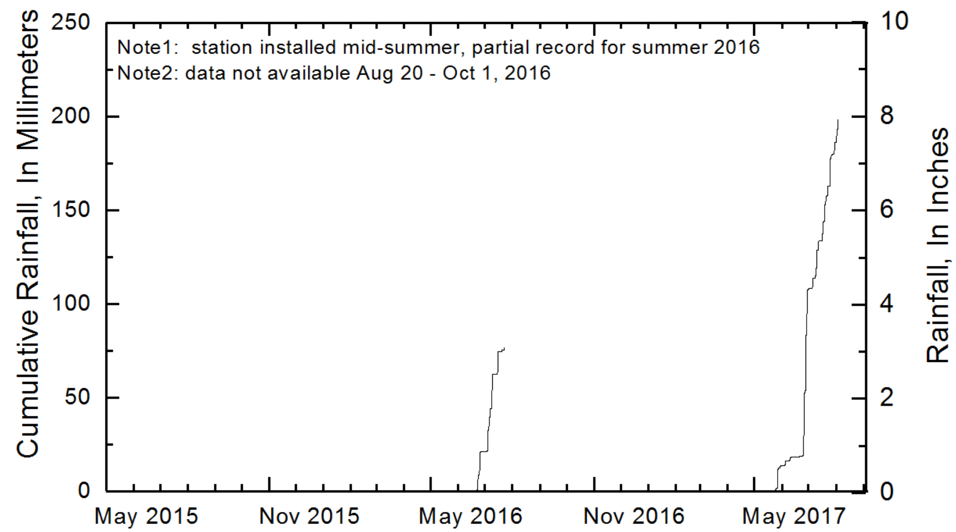


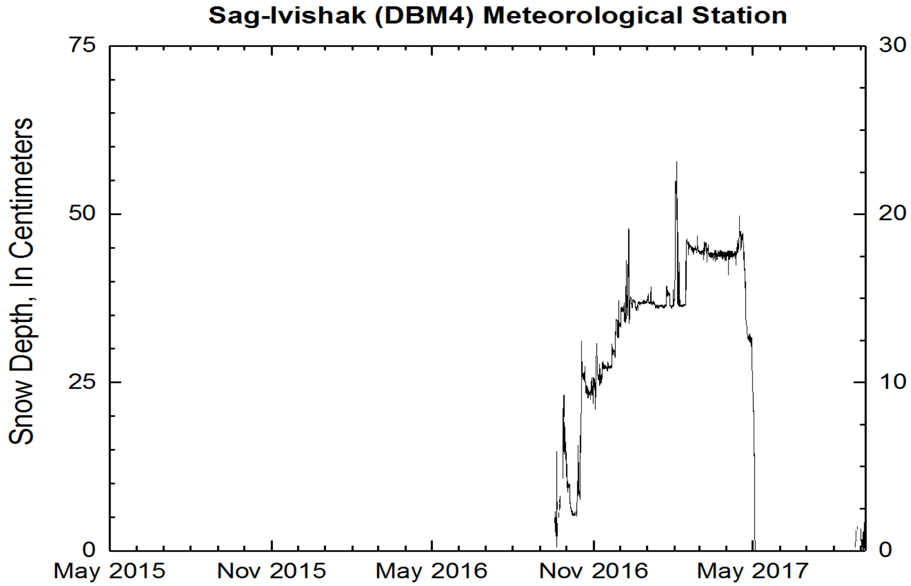
Sagavanirktok MP347 (ASS1) Meteorological Station
Hourly Rainfall, In Millimeters
Hourly Rainfall, In Inches
Cumulative Rainfall, In Millimeters
Cumulative Rainfall, In Inches
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

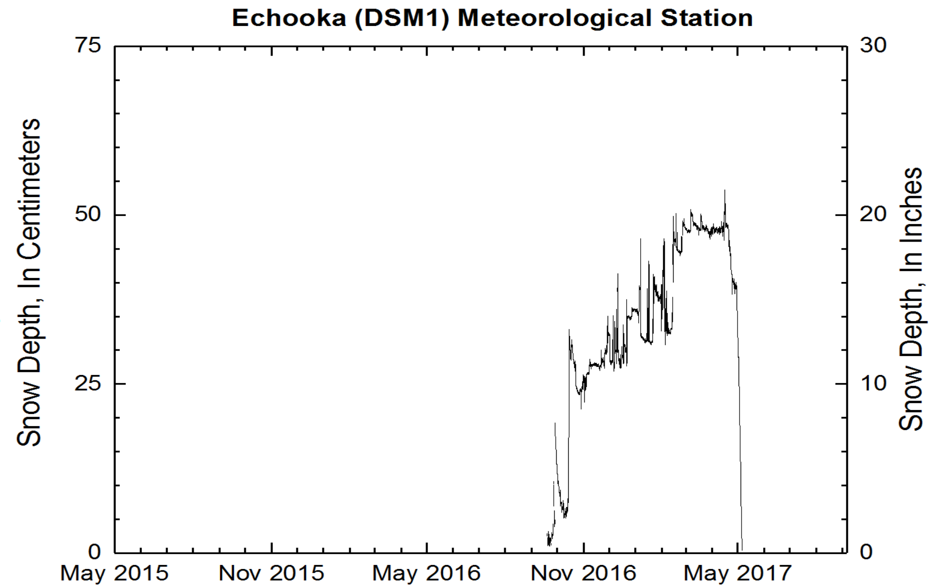

Saviukviayak (ASM2) Meteorological Station
Hourly Rainfall, In Millimeters
Hourly Rainfall, In Inches
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

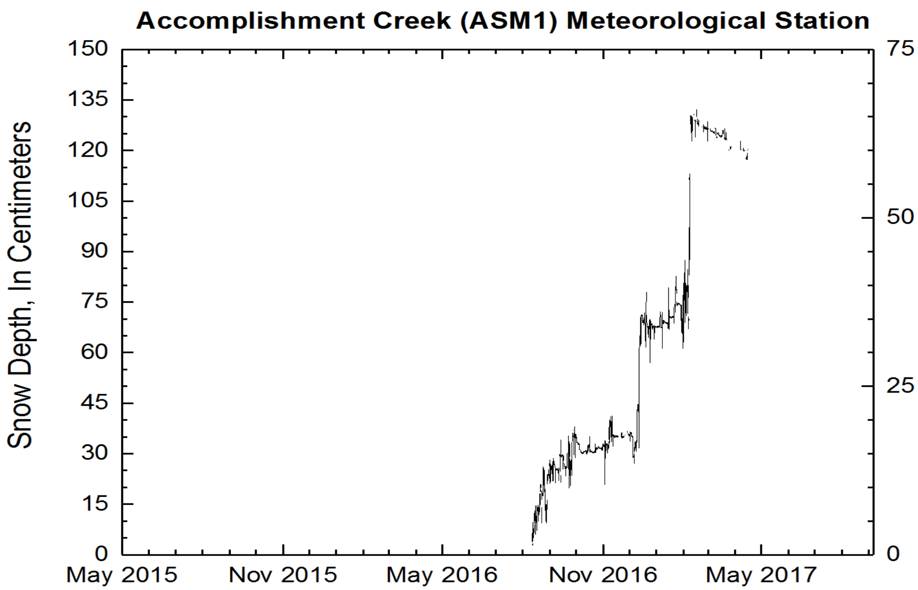

Ivishak (ASM3) Meteorological Station
Rainfall, In Millimeters
Rainfall, In Inches
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

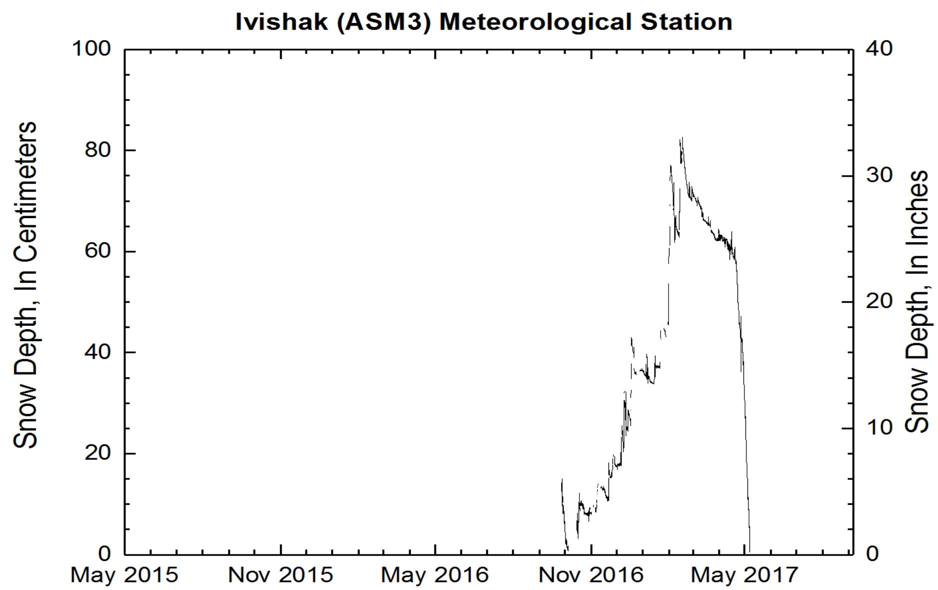

Note1: station installed mid-summer, partial record for summer 2016
Cumulative Rainfall, In Millimeters
Cumulative Rainfall, In Inches
May 2015
Nov 2015
May 2016
Nov 2016
May 2017


Note1: station installed mid-summer, partial record for summer 2016
Note2: data not available Aug 20 - Oct 1, 2016
Cumulative Rainfall, In Millimeters
Rainfall, In Inches
May 2015
Nov 2015
May 2016
Nov 2016
May 2017


Sag-Ivishak (DBM4) Meteorological Station
Snow Depth, In Centimeters
Snow Depth, In Inches
0
25
50
75
0
10
20
30
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

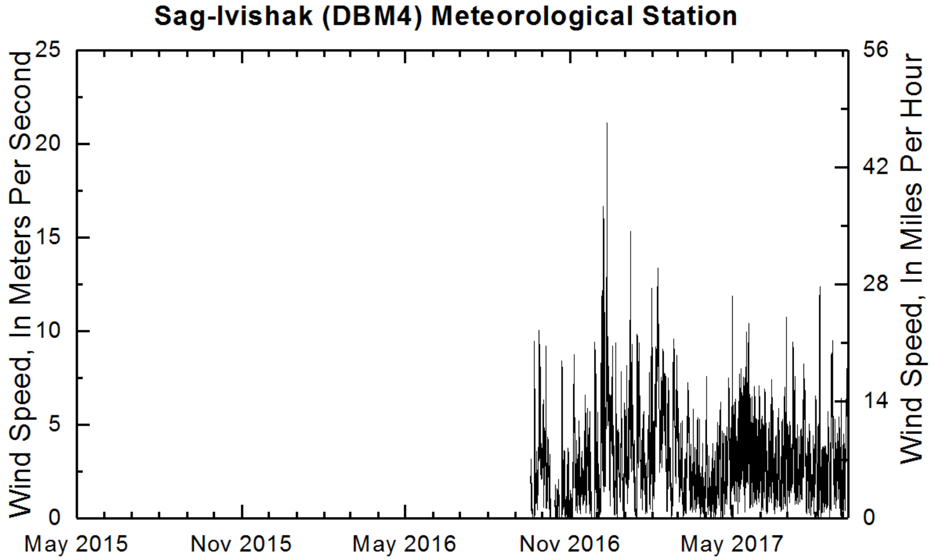

Echooka (DSM1) Meteorological Station
Snow Depth, In Centimeters
Snow Depth, In Inches
0
25
50
75
0
10
20
30
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

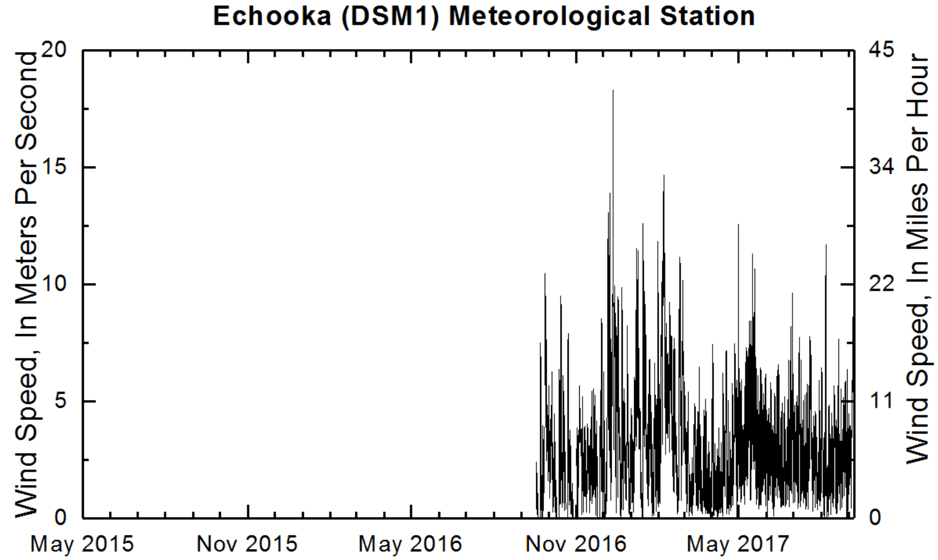

Accomplishment Creek (ASM1) Meteorological Station
Snow Depth, In Centimeters
Snow Depth, In Inches
0
15
30
45
60
75
90
105
120
135
150
0
25
50
75
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

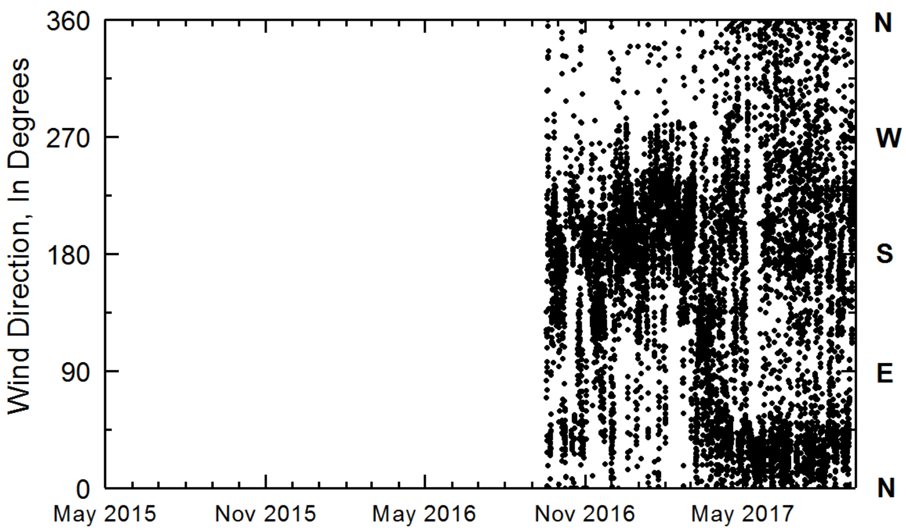

Ivishak (ASM3) Meteorological Station
Snow Depth, In Centimeters
Snow Depth, In Inches
0
20
40
60
80
100
0
10
20
30
40
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

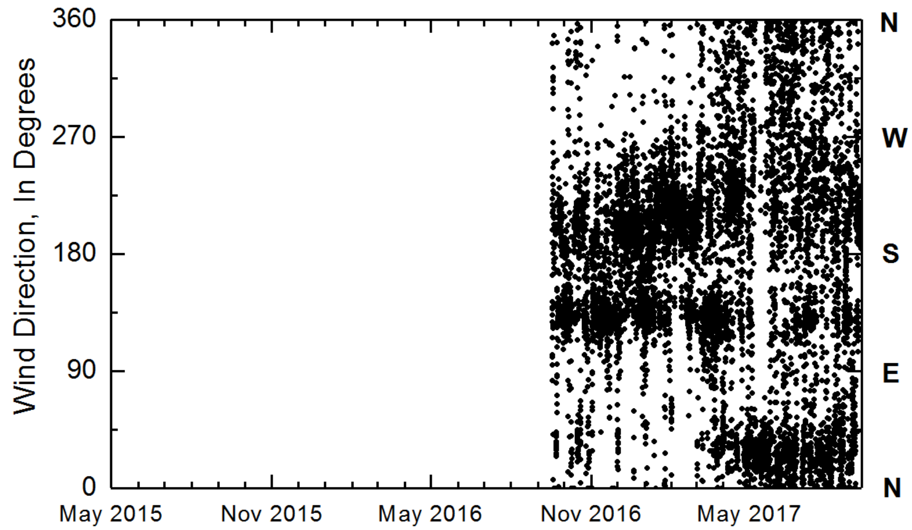
APPENDIX C

Wind Speed and Direction

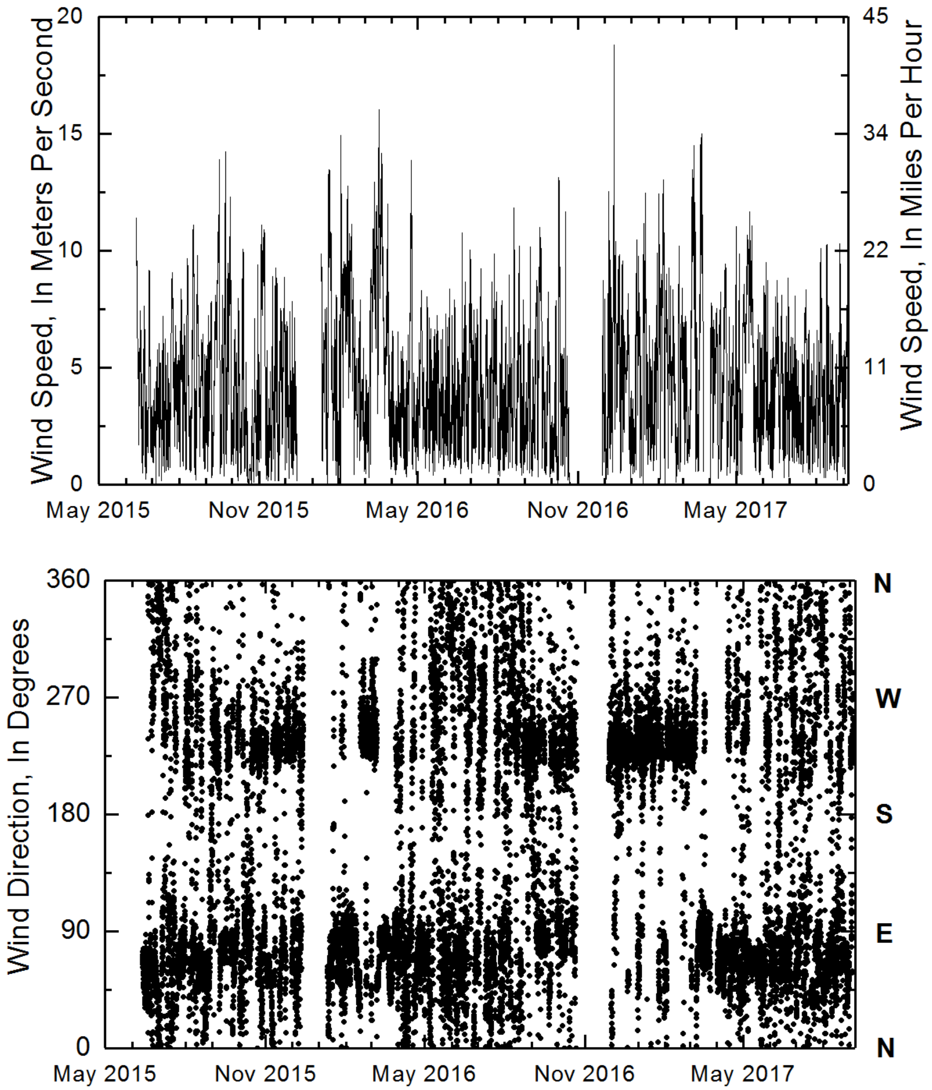

Sag-Ivishak (DBM4) Meteorological Station
Wind Speed, In Meters Per Second
Wind Speed, In Miles Per Hour
0
5
10
15
20
25
0
14
28
42
56
May 2015
Nov 2015
May 2016
Nov 2016
May 2017


Echooka (DSM1) Meteorological Station
Wind Speed, In Meters Per Second
Wind Speed, In Miles Per Hour
0
5
10
15
20
0
11
22
34
45
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

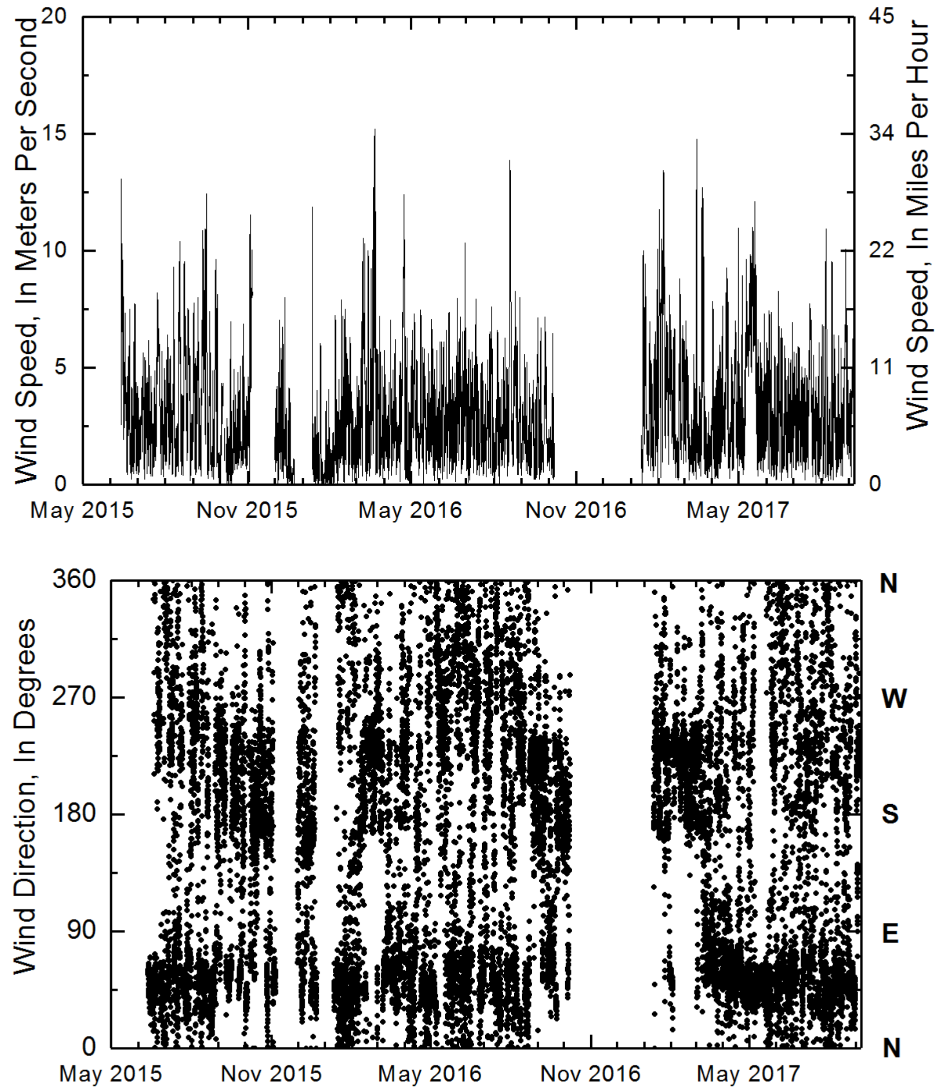

Wind Direction, In Degrees
0
90
180
270
360
N
E
S
W
N
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

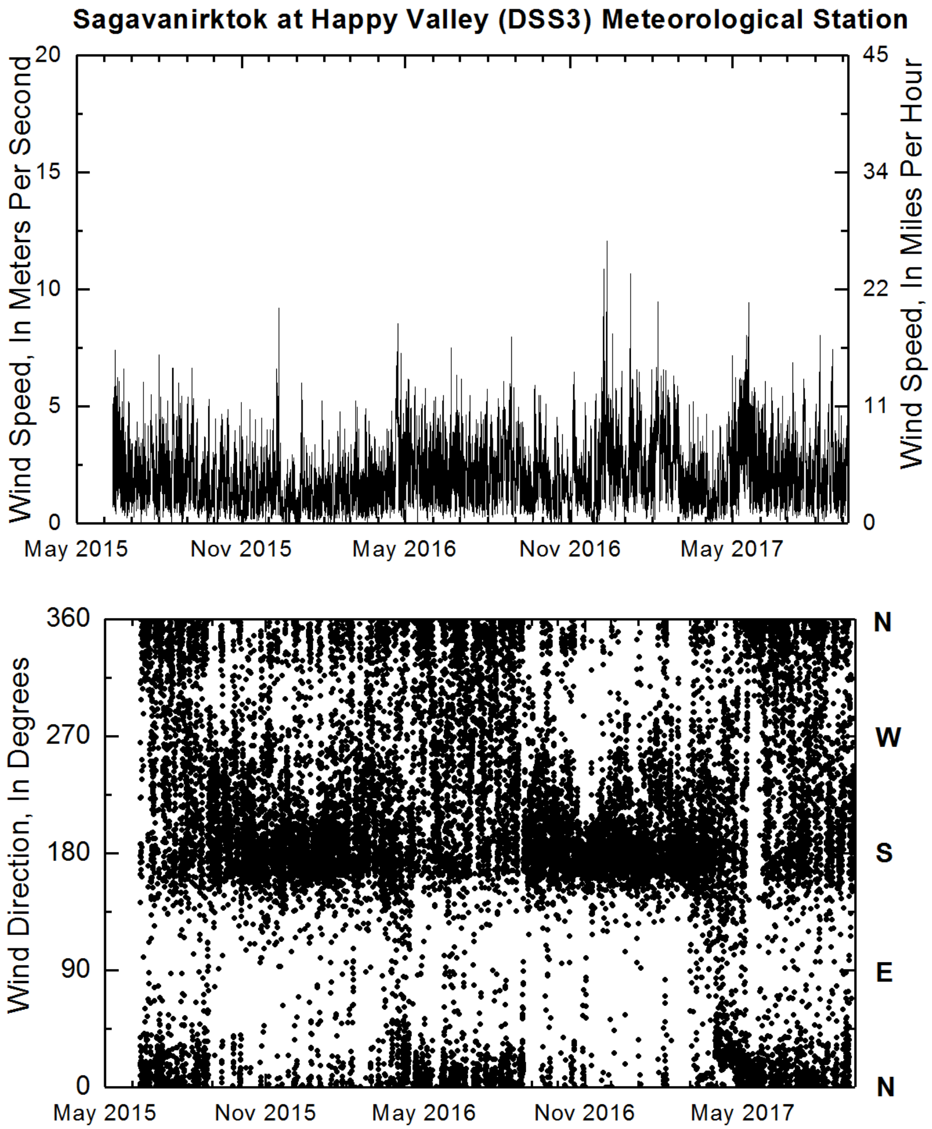

Wind Direction, In Degrees
0
90
180
270
360
N
E
S
W
N
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

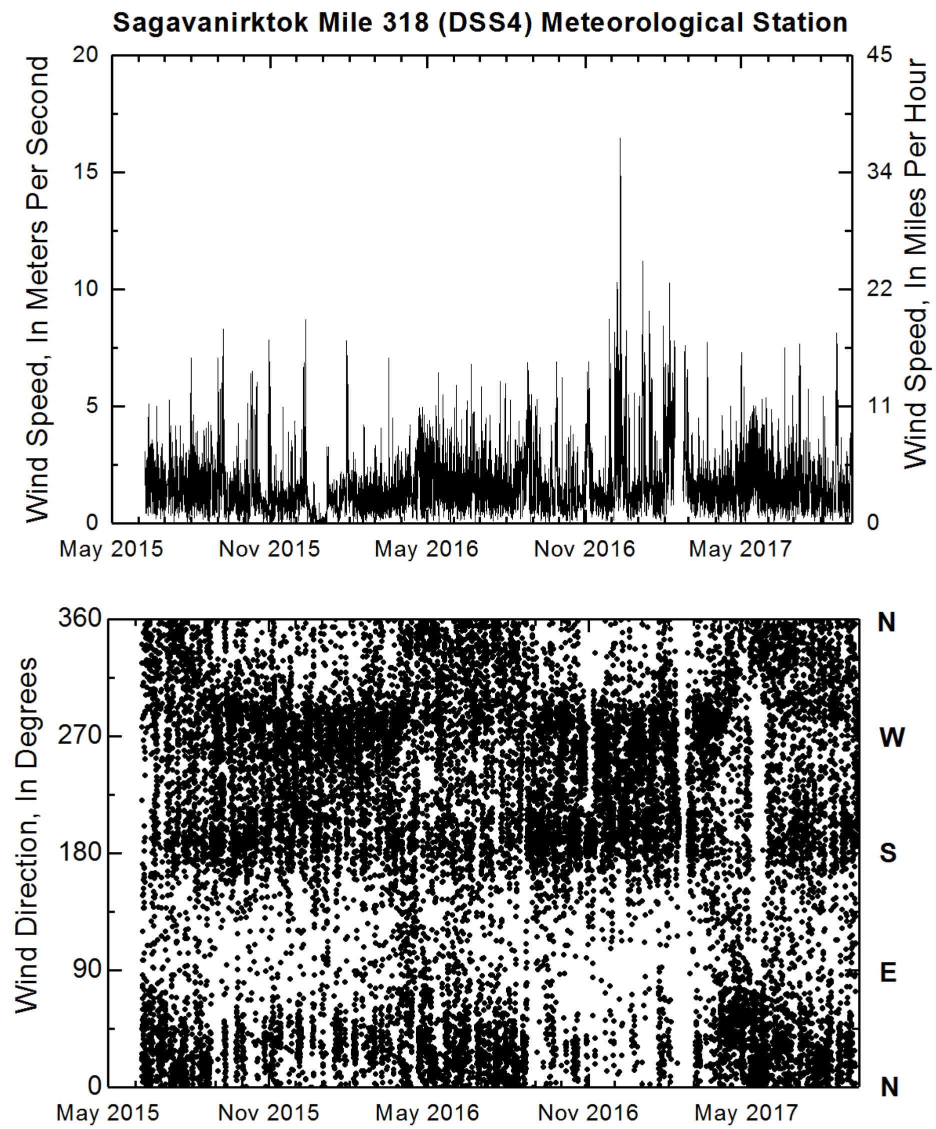
Sagavanirktok River MP 405 (DSS1) Meteorological Station

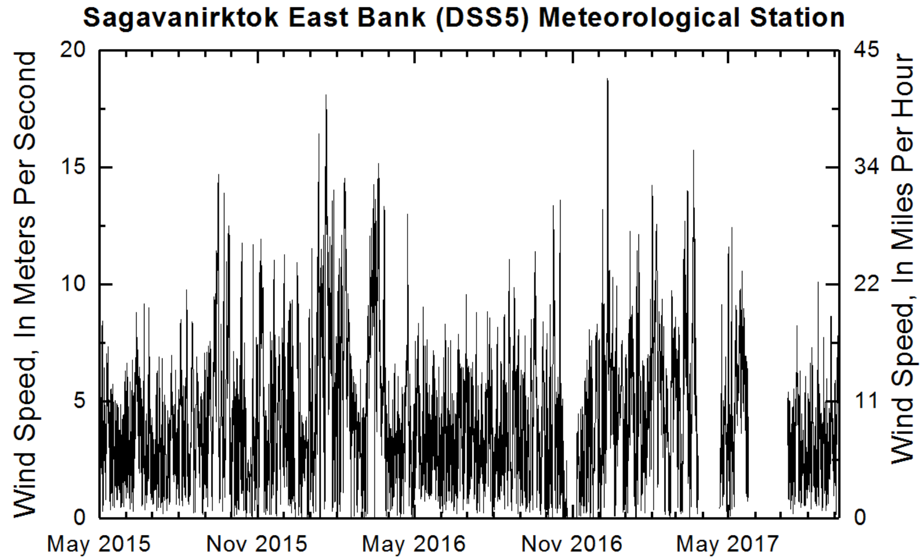


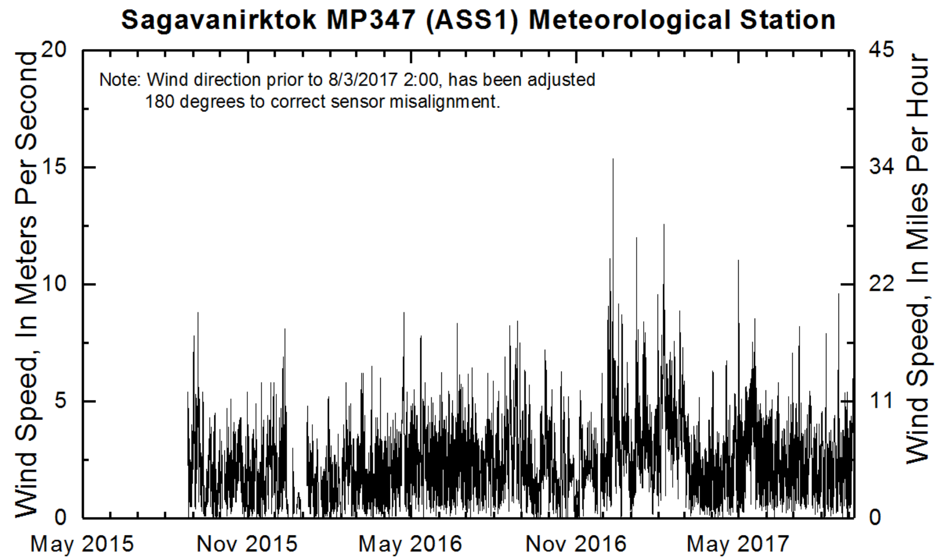
Sagavnairktok River Below Ivishak (DSS2) Meteorological Station

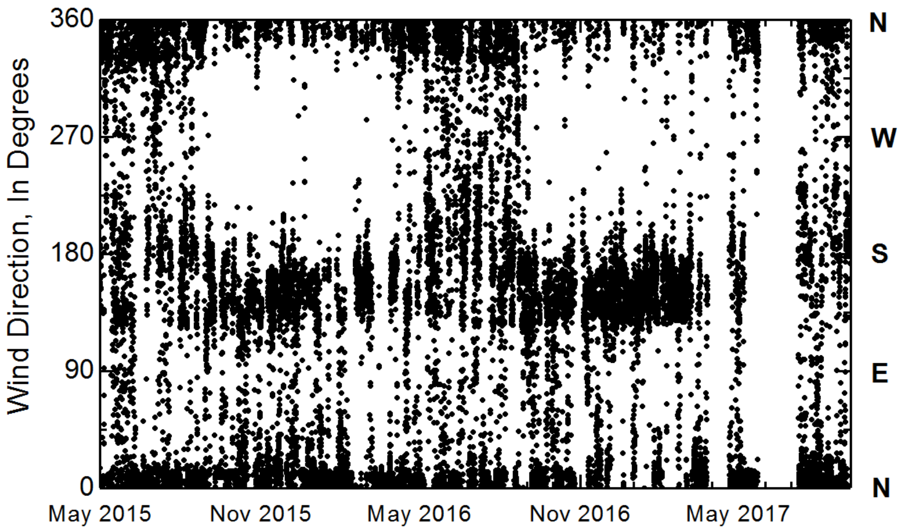


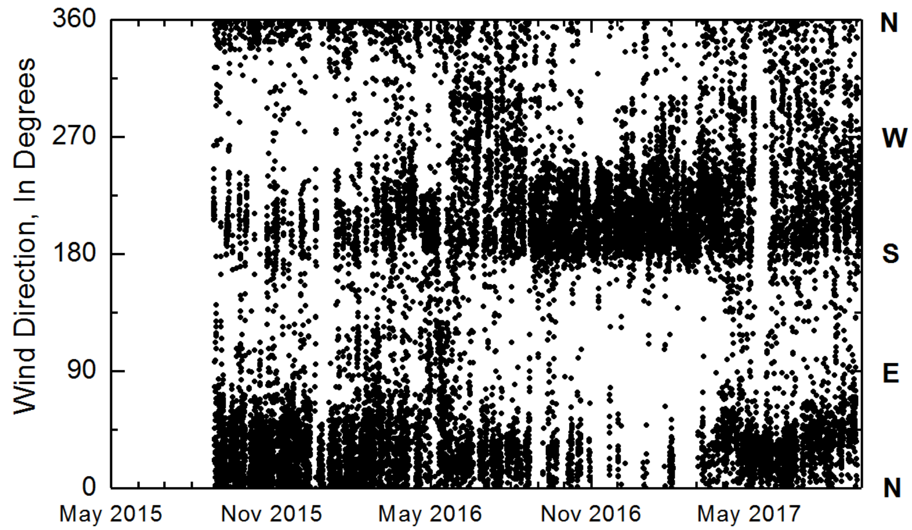

Sagavanirktok at Happy Valley (DSS3) Meteorological Station
Wind Speed, In Meters Per Second
Wind Speed, In Miles Per Hour
0
5
10
15
20
0
11
22
34
45
May 2015
Nov 2015
May 2016
Nov 2016
May 2017
Wind Direction, In Degrees
0
90
180
270
360
N
E
S
W
N


Sagavanirktok Mile 318 (DSS4) Meteorological Station
Wind Speed, In Meters Per Second
Wind Speed, In Miles Per Hour
0
5
10
15
20
0
11
22
34
45
May 2015
Nov 2015
May 2016
Nov 2016
May 2017
Wind Direction, In Degrees
0
90
180
270
360
N
E
S
W
N

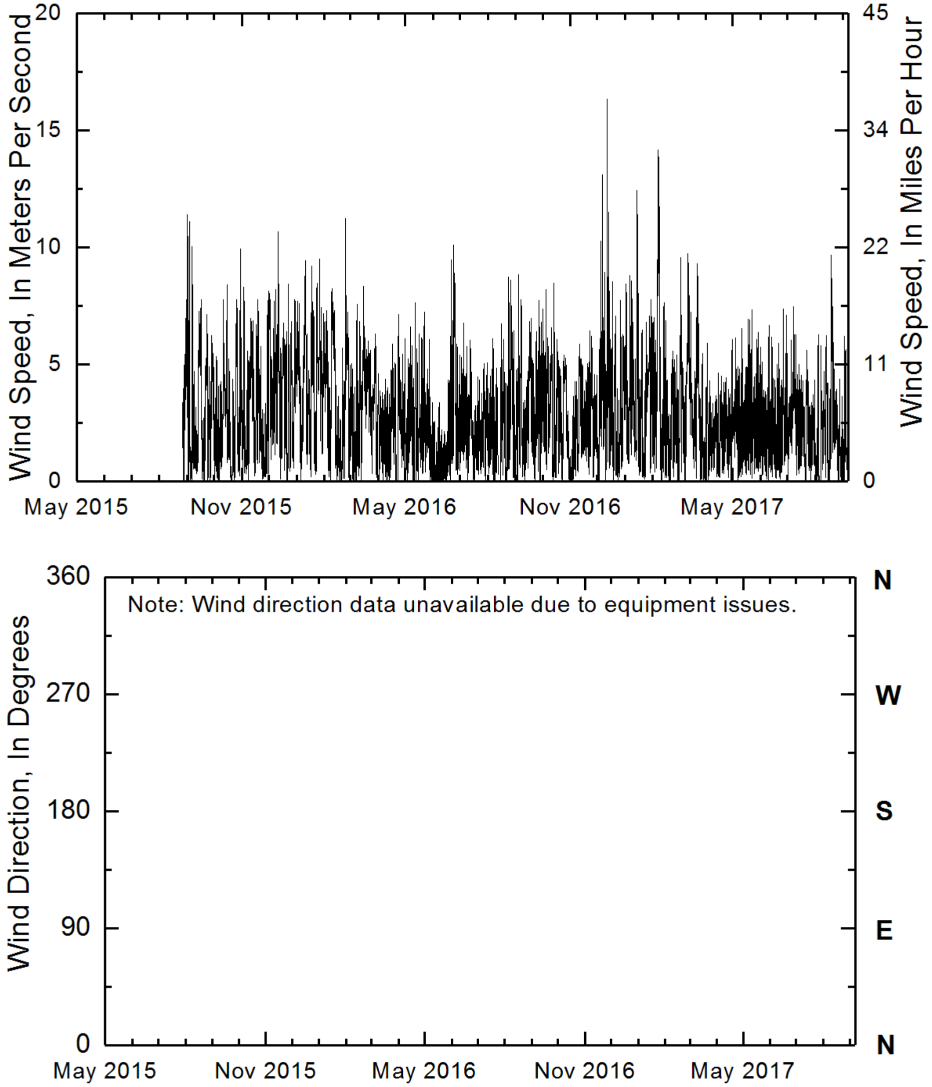

Sagavanirktok East Bank (DSS5) Meteorological Station
Wind Speed, In Meters Per Second
Wind Speed, In Miles Per Hour
20
15
10
5
0
45
34
22
11
0
May 2015
Nov 2015
May 2016
Nov 2016
May 2017


Sagavanirktok MP347 (ASS1) Meteorological Station
Note: Wind direction prior to 8/3/2017 2:00, has been adjusted
180 degrees to correct sensor misalignment.
Wind Speed, In Meters Per Second
Wind Speed, In Miles Per Hour
20
15
10
5
0
45
34
22
11
0
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

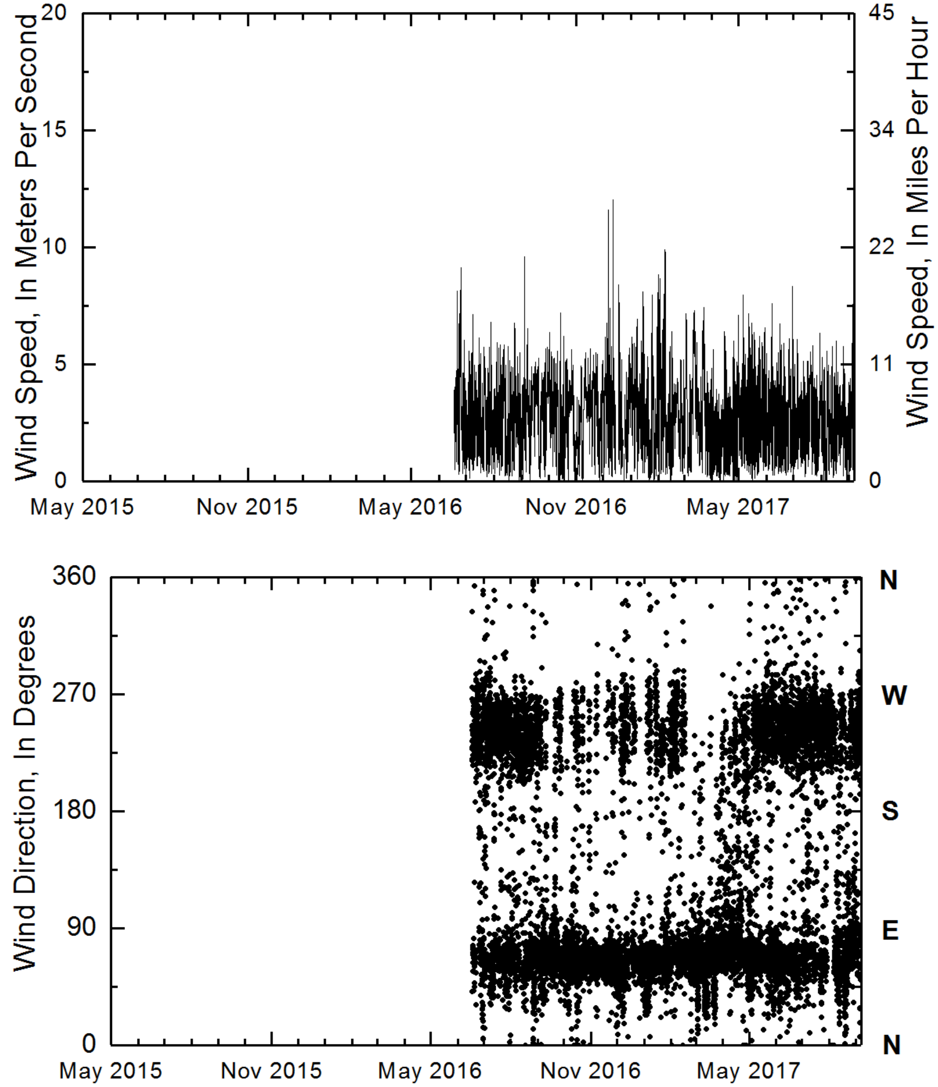

Wind Direction, In Degrees
360
270
180
90
0
N
W
S
E
N
May 2015
Nov 2015
May 2016
Nov 2016
May 2017


Wind Direction, In Degrees
360
270
180
90
0
N
W
S
E
N
May 2015
Nov 2015
May 2016
Nov 2016
May 2017

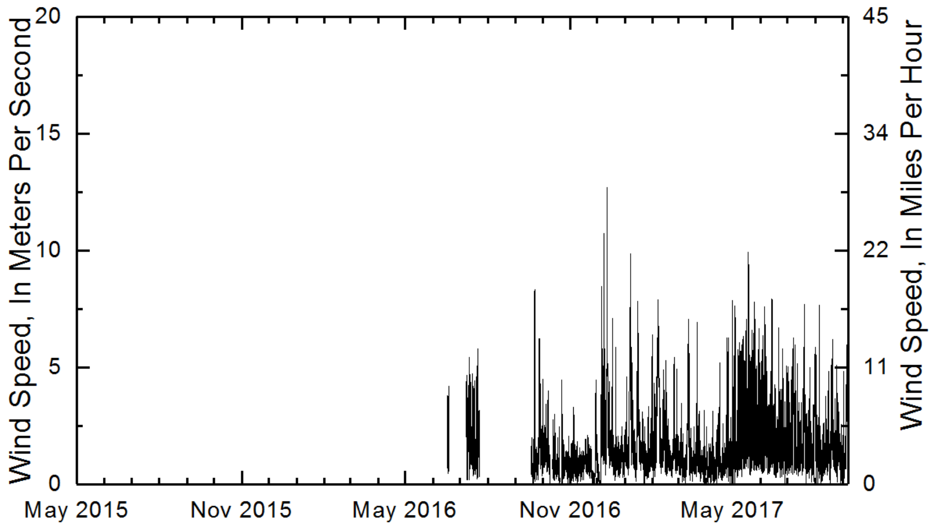
Accomplishment Creek (ASM1) Meteorological Station

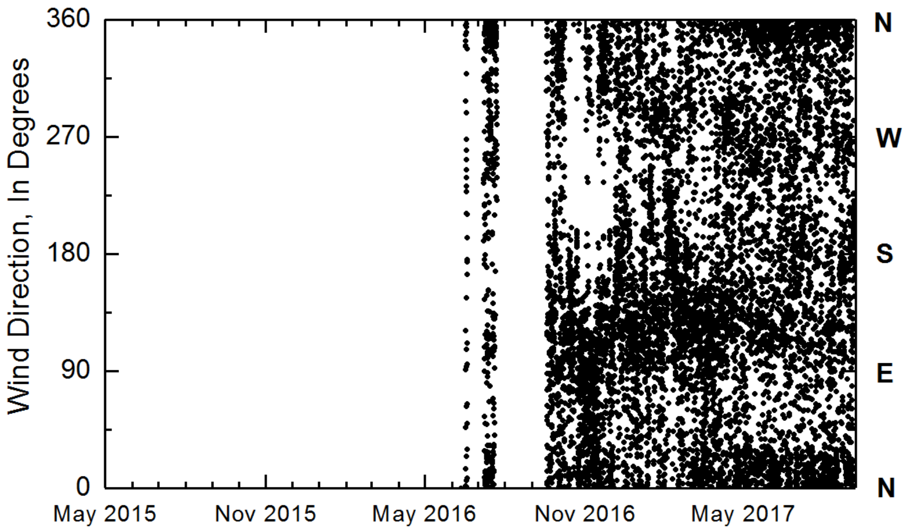


Saviukviayak (ASM2) Meteorological Station



Ivishak (ASM3) Meteorological Station

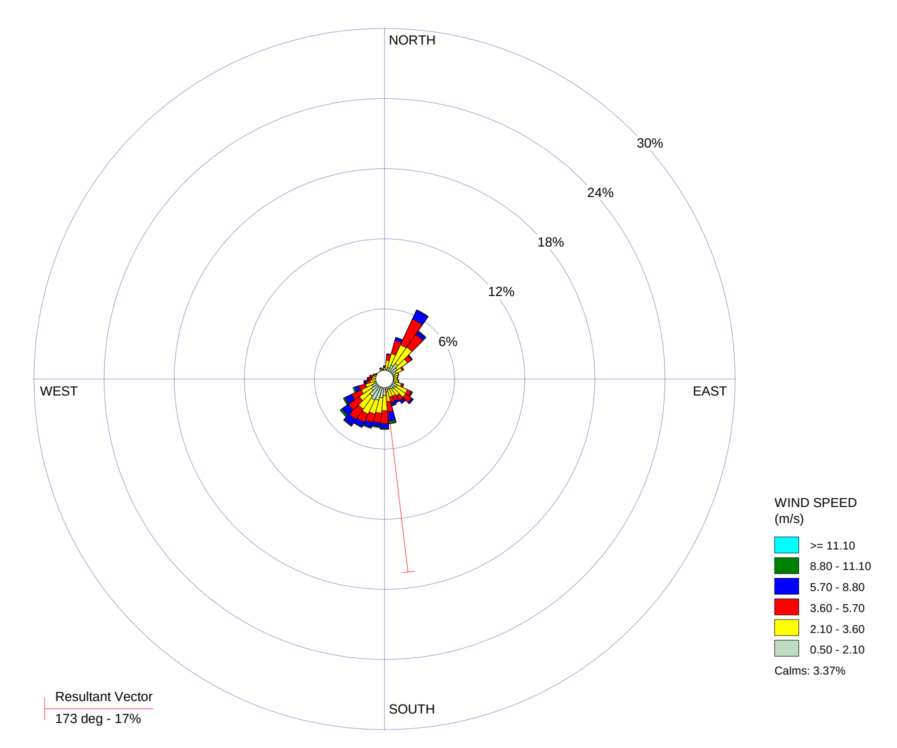




WIND ROSE PLOT:
DBM4 Sag-Ivishak Period of Record

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 44244
Missing Hours: 2663
Data Availability: 93.98%



DATA PERIOD:
Start Date: 7/26/2006 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
41581 hrs.	**3.37%**

AVG. WIND SPEED:
2.87 m/s

COMPANY NAME:
University of Alaska
INE/WERC

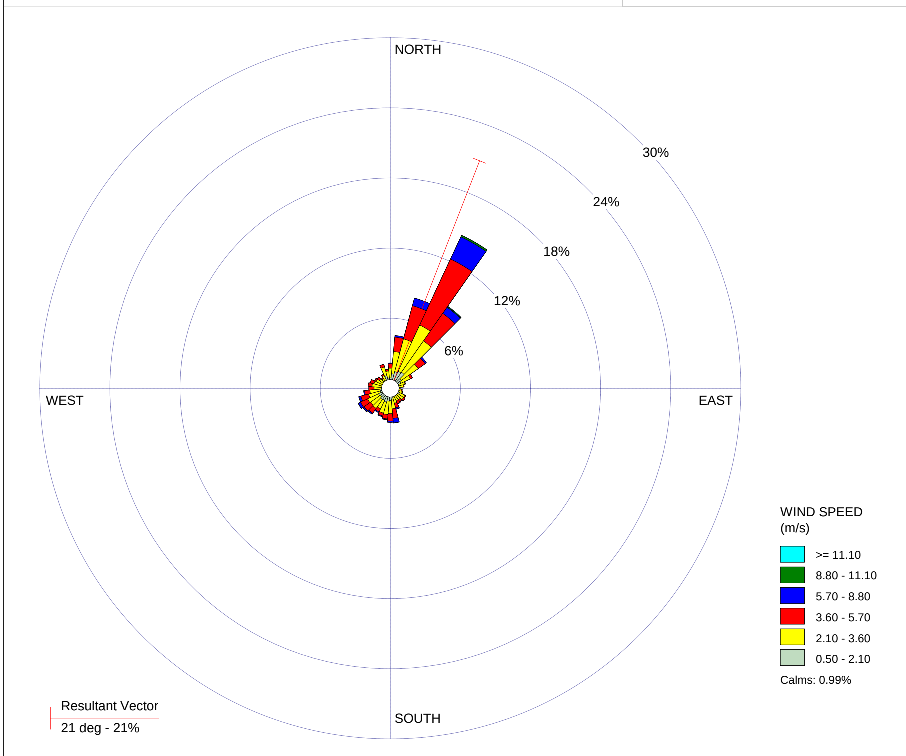
DATE:
10/16/2017

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DBM4 Sag-Ivishak Summer

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 15572
Missing Hours: 43
Data Availability: 99.72%



DATA PERIOD:
Start Date: 7/26/2006 - 00:00
End Date: 9/15/2017 - 23:00

TOTAL COUNT:	CALM WINDS:
15529 hrs.	**0.99%**

AVG. WIND SPEED:
2.89 m/s

COMPANY NAME:
University of Alaska
INE/WERC

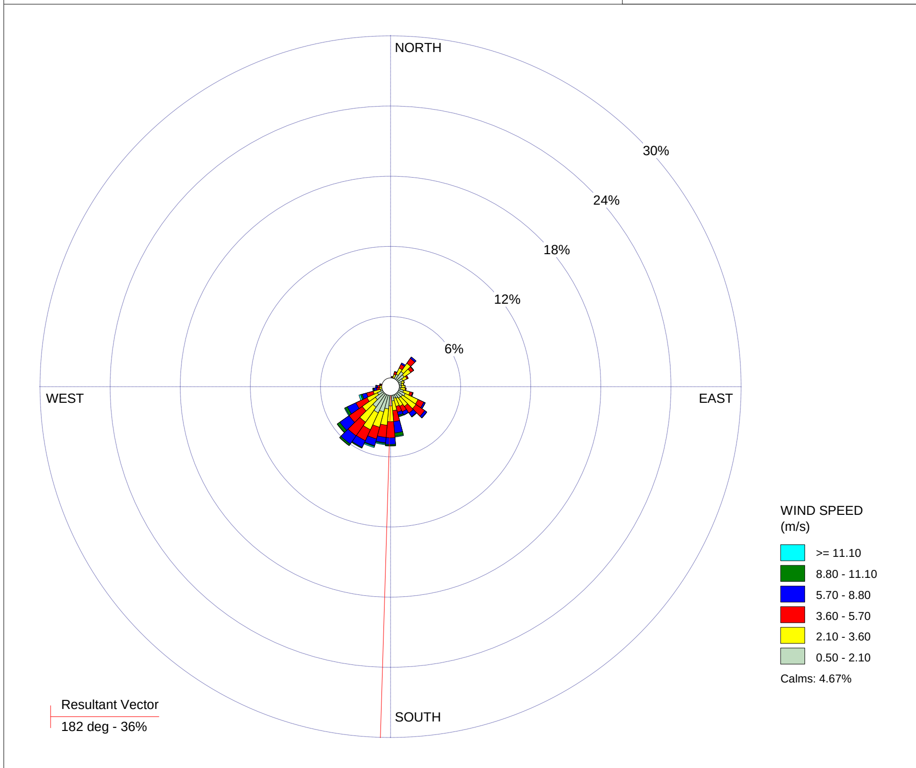
DATE:
10/16/2017

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DBM4 Sag-Ivishak Winter

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 28672
Missing Hours: 2620
Data Availability: 90.86%



DATA PERIOD:
Start Date: 9/16/2006 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
26052 hrs.	**4.67%**

AVG. WIND SPEED:
2.87 m/s

COMPANY NAME:
University of Alaska
INE/WERC

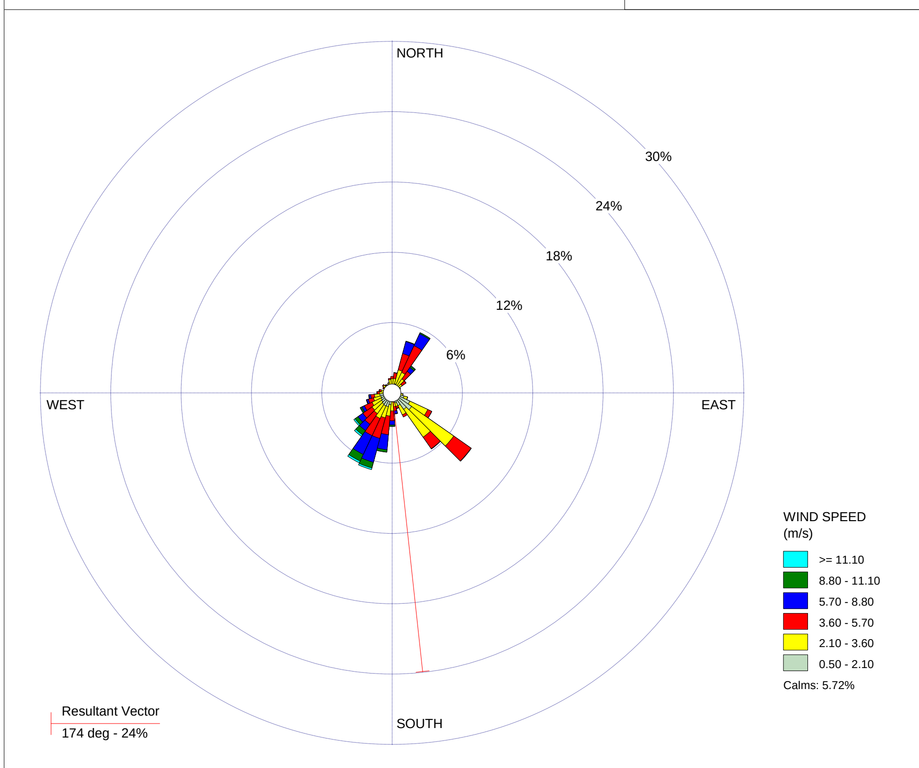
DATE:
10/16/2017

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSM1_Echooka_Period_of_Record

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 8502
Missing Hours: 178
Data Availability: 97.91%



DATA PERIOD:
Start Date: 10/11/2016 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
8324 hrs.	**5.72%**

AVG. WIND SPEED:
3.20 m/s

COMPANY NAME:
University of Alaska
INE/WERC

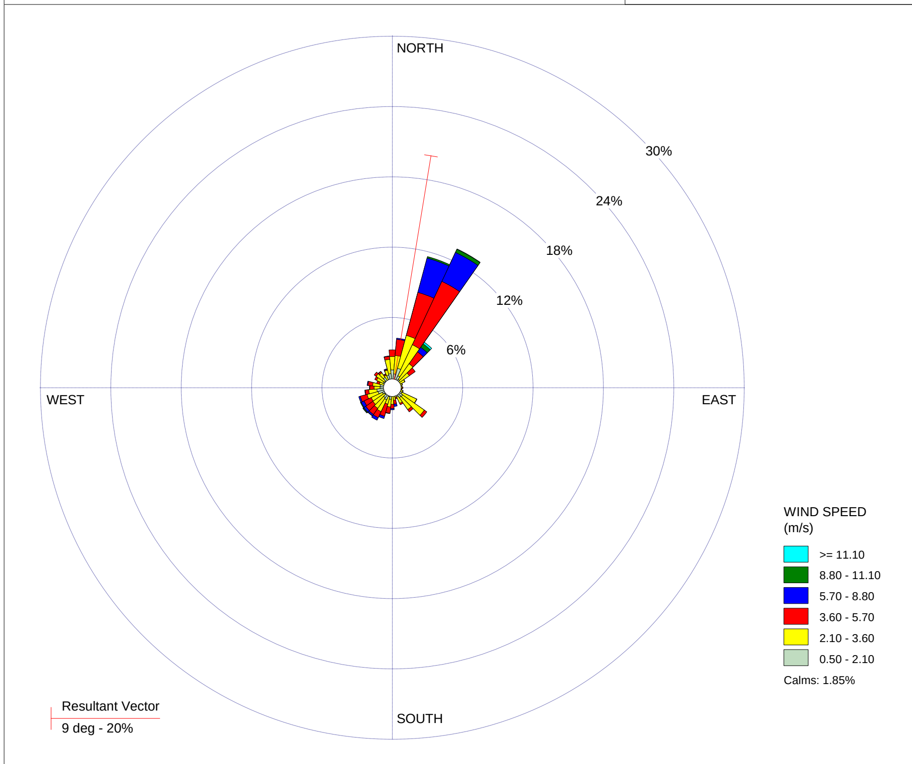
DATE:
10/3/2017

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSM1_Echooka_Summer

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 2976
Missing Hours: 0
Data Availability: 100%



DATA PERIOD:
Start Date: 5/15/2017 - 00:00
End Date: 9/15/2017 - 23:00

TOTAL COUNT:	CALM WINDS:
2976 hrs.	**1.85%**

AVG. WIND SPEED:
3.04 m/s

COMPANY NAME:
University of Alaska
INE/WERC

DATE:
10/3/2017

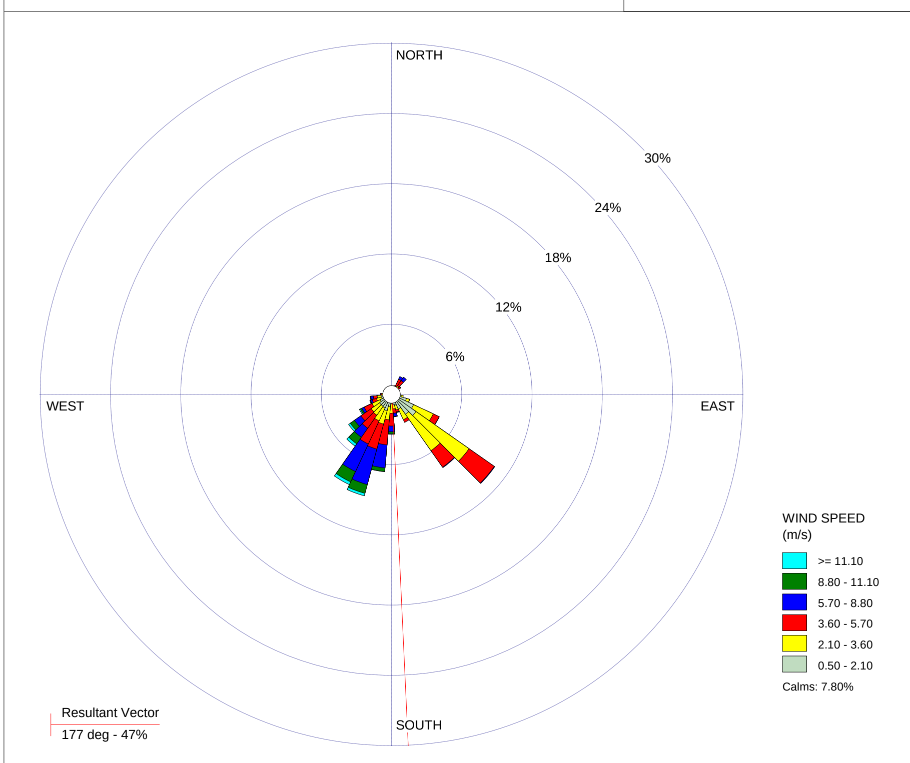
werc Water and Environmental Research Center

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSM1_Echooka_Winter

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 5526
Missing Hours: 178
Data Availability: 96.78%



DATA PERIOD:
Start Date: 10/11/2016 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
5348 hrs.	**7.80%**

AVG. WIND SPEED:
3.30 m/s

COMPANY NAME:
University of Alaska
INE/WERC

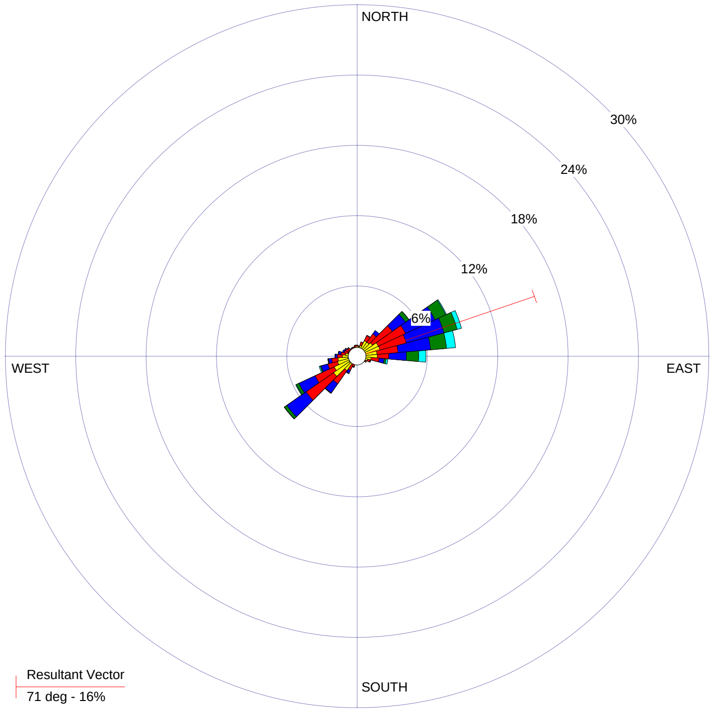
DATE:
10/3/2017

werc Water and Environmental Research Center

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSS1 Sagavanirktok River MP 405 Period of Record

DISPLAY:
Wind Speed
Direction (blowing from)



WIND SPEED (m/s)
- >= 11.10
- 8.80 - 11.10
- 5.70 - 8.80
- 3.60 - 5.70
- 2.10 - 3.60
- 0.50 - 2.10

Calms: 1.23%

Resultant Vector
71 deg - 16%

COMMENTS:
Total Hours: 19597
Missing Hours: 1773
Data Availability: 90.95%

DATA PERIOD:
Start Date: 7/7/2015 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
17824 hrs.	**1.23%**

AVG. WIND SPEED:
4.49 m/s

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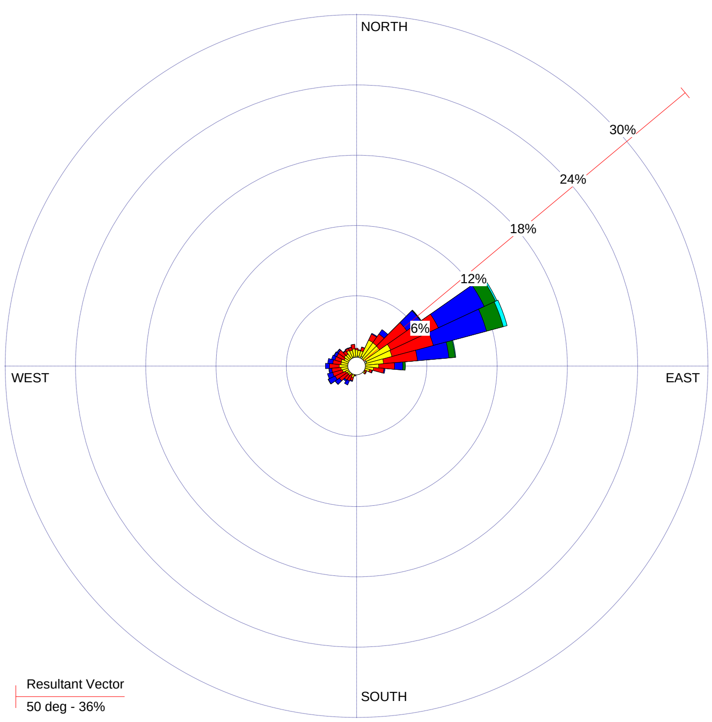
DATE:
10/30/2017

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSS1 Sagavanirktok River MP 405 Summer

DISPLAY:
Wind Speed
Direction (blowing from)



WIND SPEED (m/s)
- >= 11.10
- 8.80 - 11.10
- 5.70 - 8.80
- 3.60 - 5.70
- 2.10 - 3.60
- 0.50 - 2.10

Calms: 0.38%

Resultant Vector
50 deg - 36%

COMMENTS:
Total Hours: 7573
Missing Hours: 0
Data Availability: 100%

DATA PERIOD:
Start Date: 7/7/2015 - 00:00
End Date: 9/14/2017 - 23:00

TOTAL COUNT:	CALM WINDS:
7573 hrs.	**0.38%**

AVG. WIND SPEED:
4.04 m/s

COMPANY NAME:
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10/30/2017

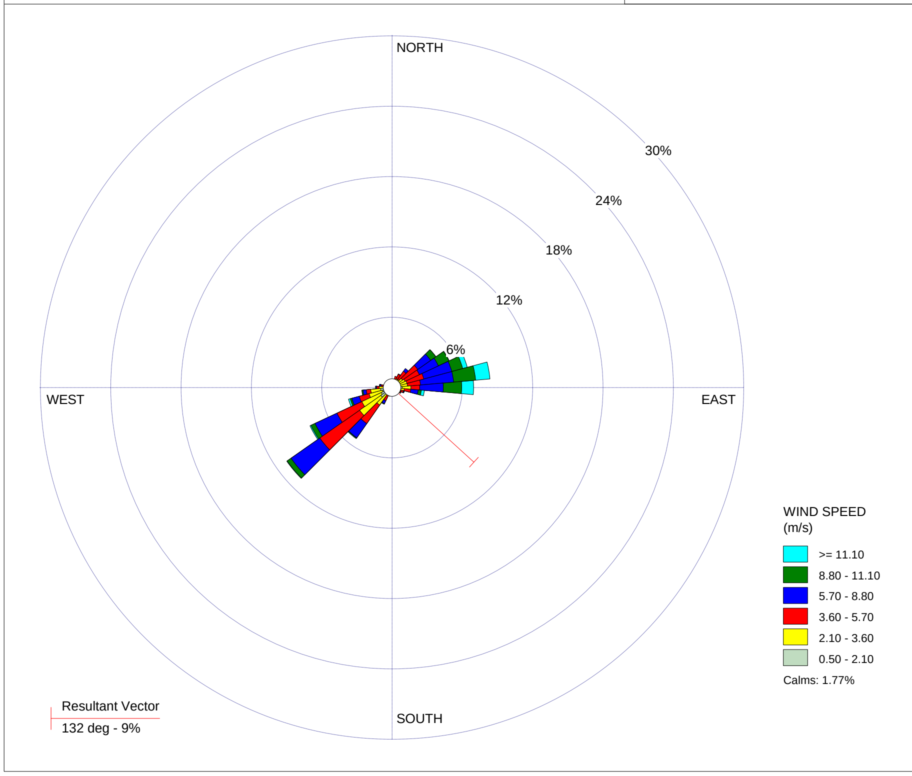
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

DSS1 Sagavanirktok River MP 405 Winter

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Total Hours: 12024
Missing Hours: 1773
Data Availability: 85.25%

DATA PERIOD:

Start Date: 9/15/2015 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
10251 hrs.	**1.77%**

AVG. WIND SPEED:

4.81 m/s

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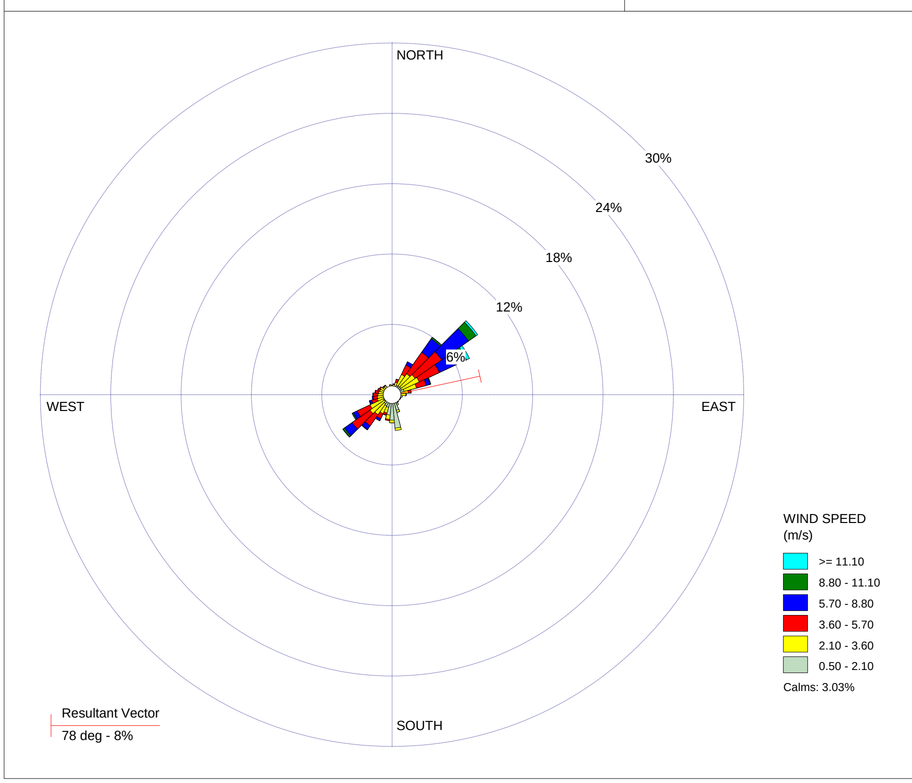
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

DSS2 Sagavanirktok River Below Ivishak Period of Record

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Total Hours: 19606
Missing Hours: 3466
Data Availability: 82.32%

DATA PERIOD:

Start Date: 7/7/2015 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
16140 hrs.	**3.03%**

AVG. WIND SPEED:

3.12 m/s

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DATE:

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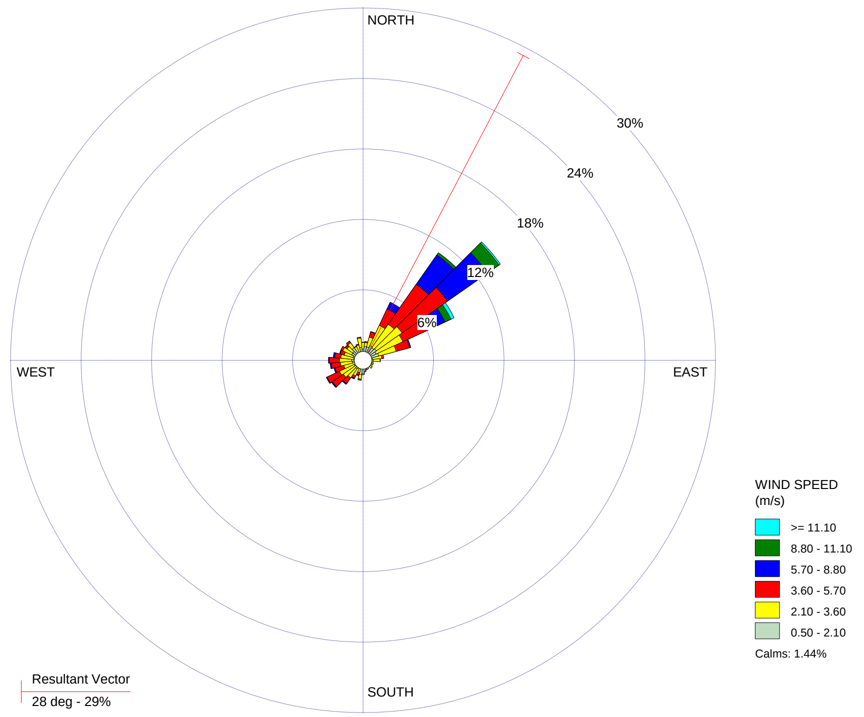
WIND ROSE PLOT:
DSS2 Sagavanirktok below Ivishak Summer

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 7581
Missing Hours: 1
Data Availability: 99.99%



DATA PERIOD:
Start Date: 7/7/2015 - 00:00
End Date: 9/14/2017 - 23:00

TOTAL COUNT:	CALM WINDS:
7580 hrs.	**1.44%**

AVG. WIND SPEED:
3.21 m/s

COMPANY NAME:
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10/30/2017

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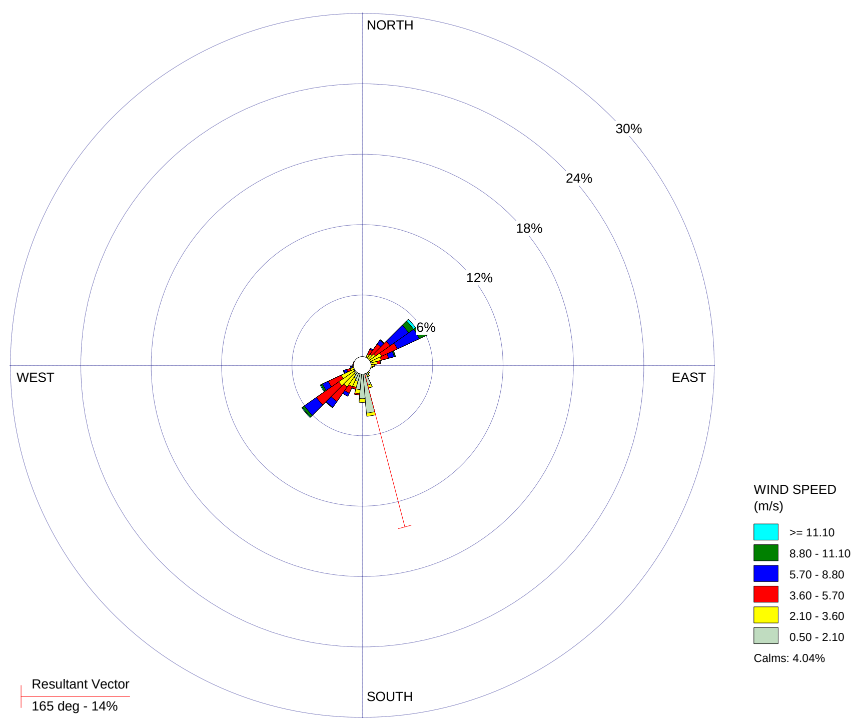
WIND ROSE PLOT:
DSS2 Sagavanirktok below Ivishak Winter

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 12025
Missing Hours: 3465
Data Availability: 71.19%



DATA PERIOD:
Start Date: 9/15/2015 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
8560 hrs.	**4.04%**

AVG. WIND SPEED:
3.03 m/s

COMPANY NAME:
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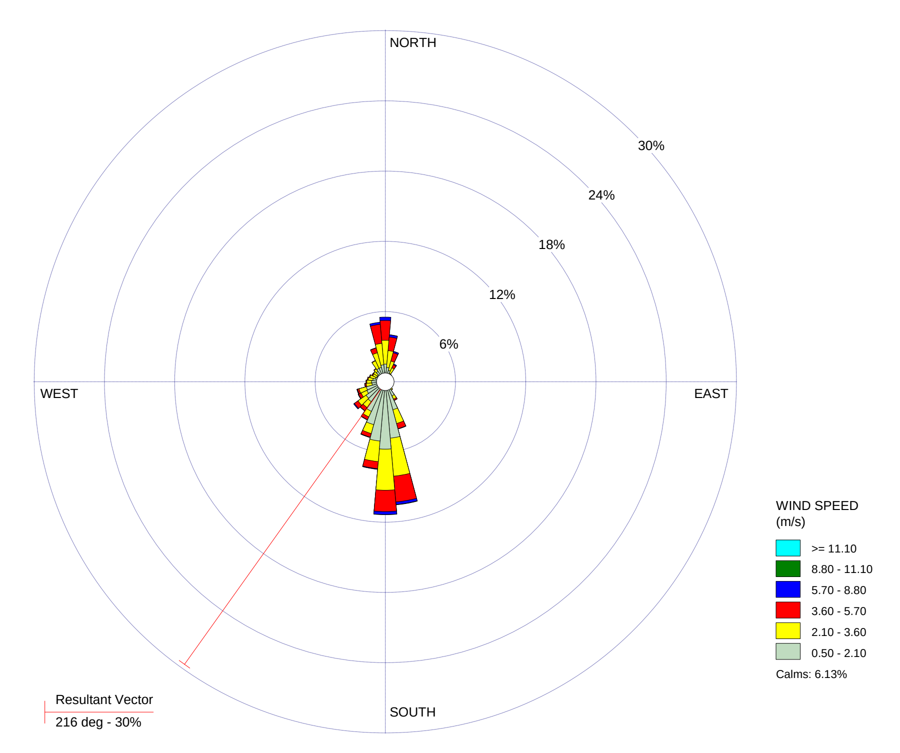
DATE:
10/30/2017

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSS3 Sagavanirktok at Happy Valley Period of Record

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:
Total Hours: 19665
Missing Hours: 1
Data Availability: 99.99%

DATA PERIOD:
Start Date: 7/4/2015 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
19664 hrs.	**6.13%**

AVG. WIND SPEED:
2.06 m/s

COMPANY NAME:
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DATE:
10/30/2017

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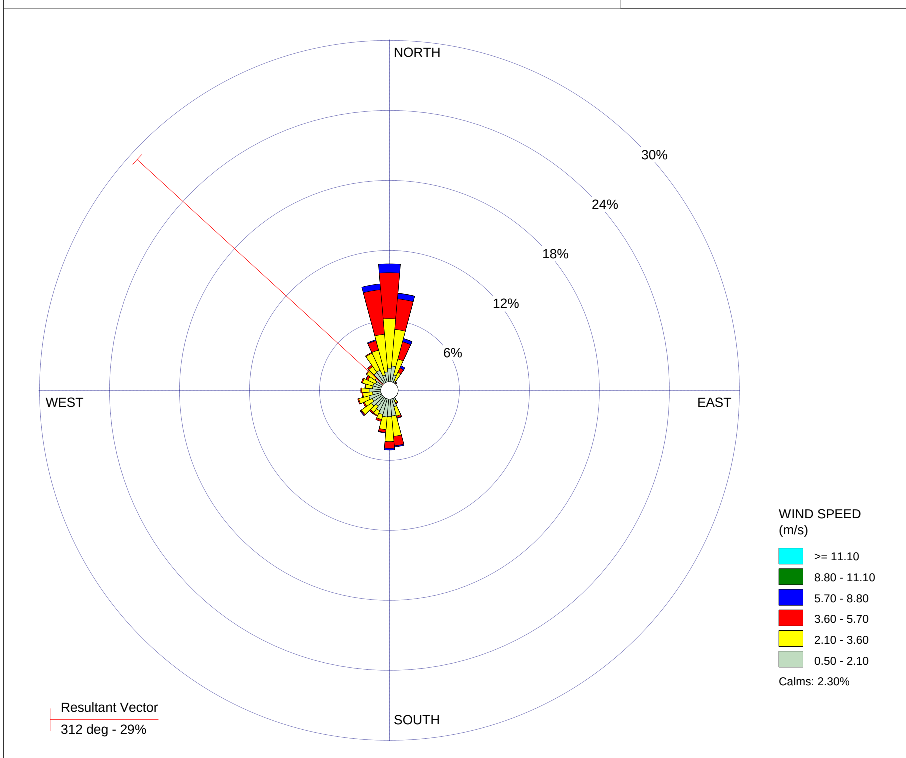
WIND ROSE PLOT:
DSS3 Sagavanirktok at Happy Valley Summer

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:
Total Hours: 7640
Missing Hours: 0
Data Availability: 100%

DATA PERIOD:
Start Date: 7/4/2015 - 00:00
End Date: 9/14/2017 - 23:00

TOTAL COUNT:	CALM WINDS:
7640 hrs.	**2.30%**

AVG. WIND SPEED:
2.38 m/s

COMPANY NAME:
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DATE:
10/30/2017

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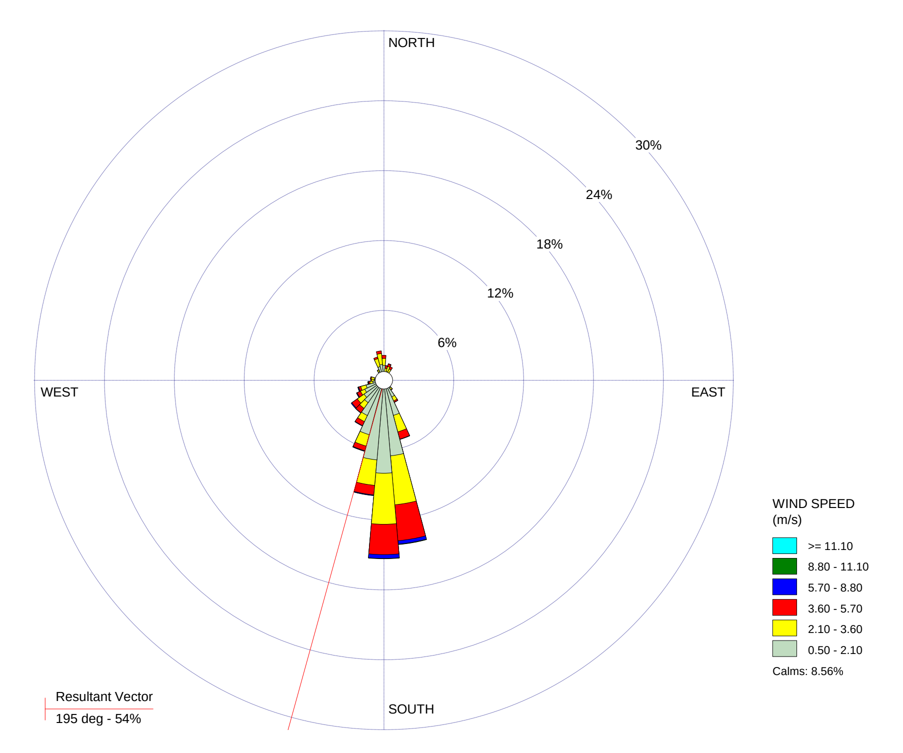
WIND ROSE PLOT:
DSS3 Sagavanirktok at Happy Valley Winter

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 12025
Missing Hours: 1
Data Availability: 99.99%



DATA PERIOD:
Start Date: 9/15/2015 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
12024 hrs.	**8.56%**

AVG. WIND SPEED:
1.85 m/s

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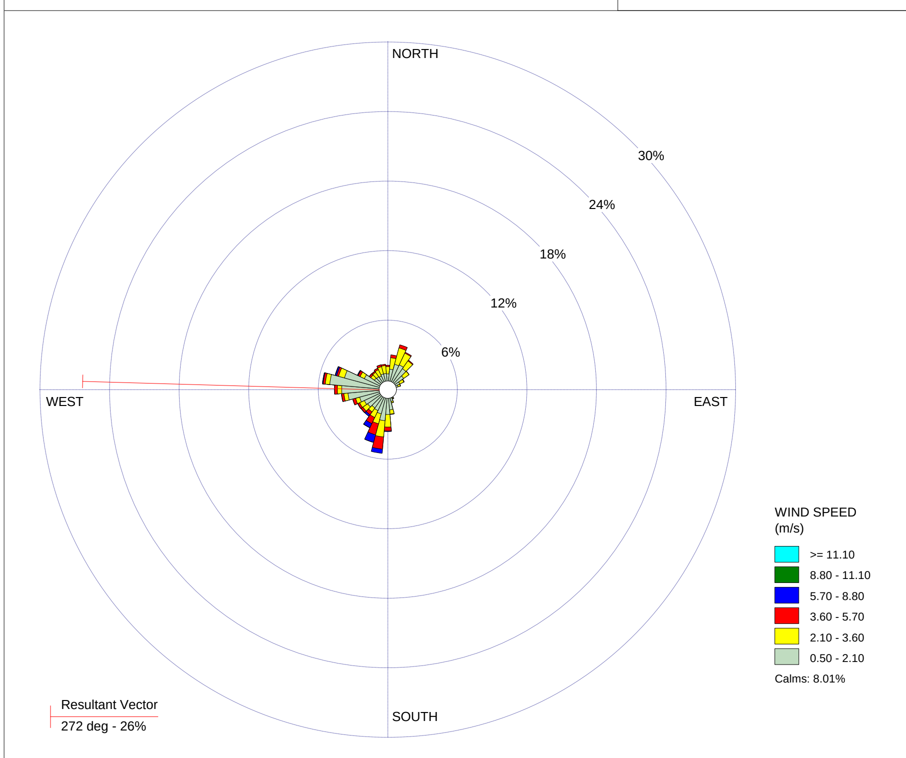
DATE:
10/30/2017

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSS4 Sagavanirktok River MP 318 Period of Record

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 19699
Missing Hours: 280
Data Availability: 98.58%



DATA PERIOD:
Start Date: 7/3/2015 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
19419 hrs.	**8.01%**

AVG. WIND SPEED:
1.68 m/s

COMPANY NAME:
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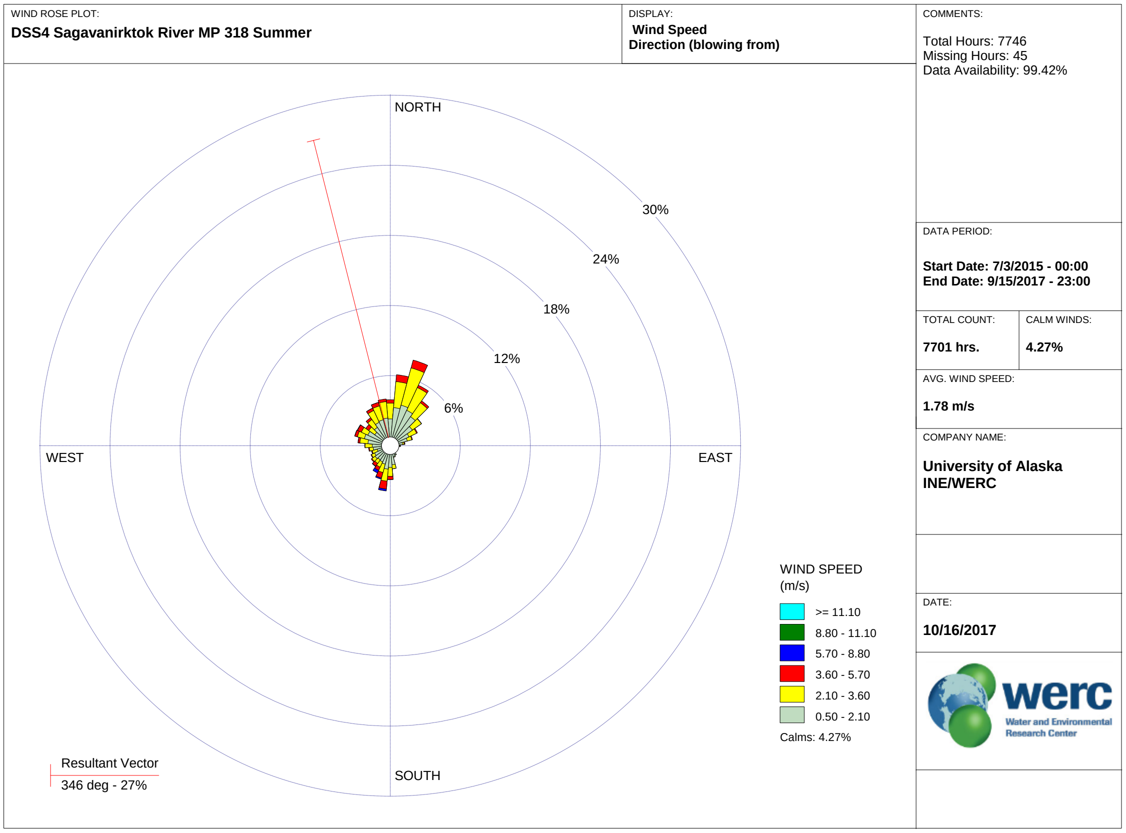
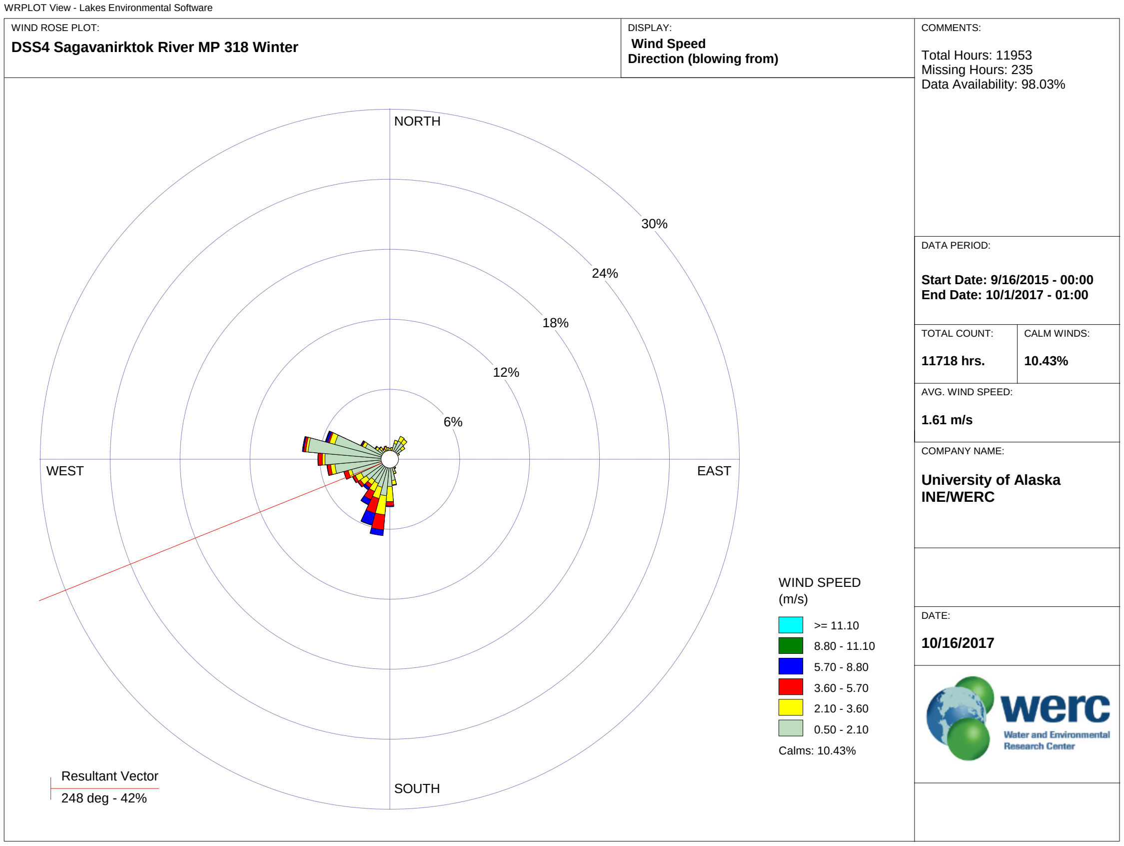
DATE:
10/16/2017

WRPLOT View - Lakes Environmental Software



WRPLOT View - Lakes Environmental Software

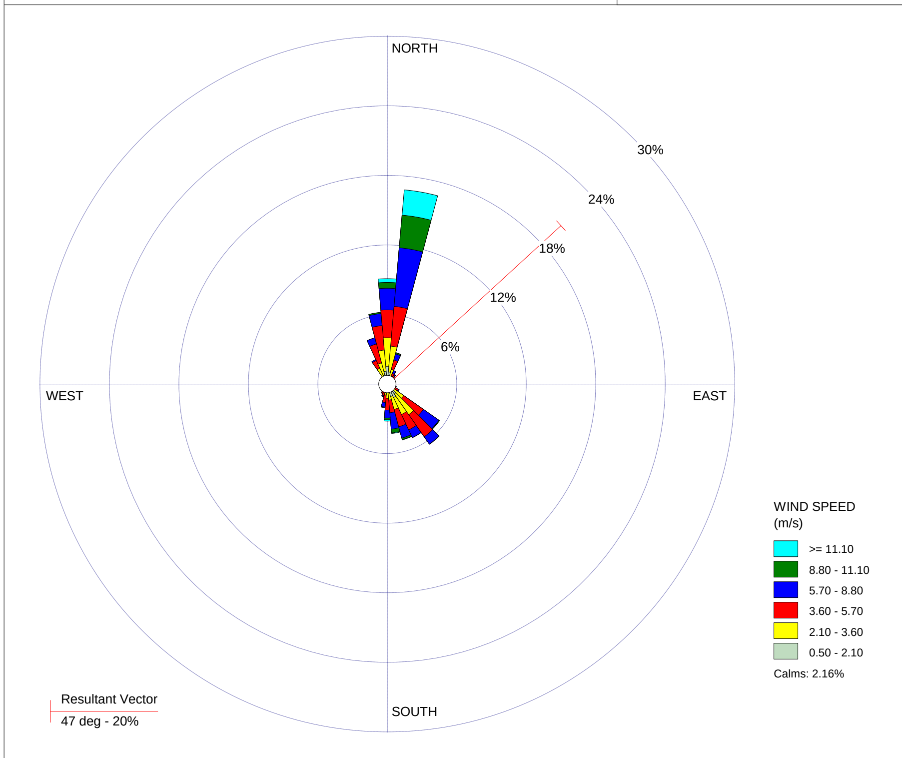


WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSS5 Sagavanirktok East Bank Period of Record

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 20629
Missing Hours: 1969
Data Availability: 90.46%



DATA PERIOD:
Start Date: 5/25/2015 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:
18660 hrs.

CALM WINDS:
2.16%

AVG. WIND SPEED:
4.29 m/s

COMPANY NAME:
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DATE:
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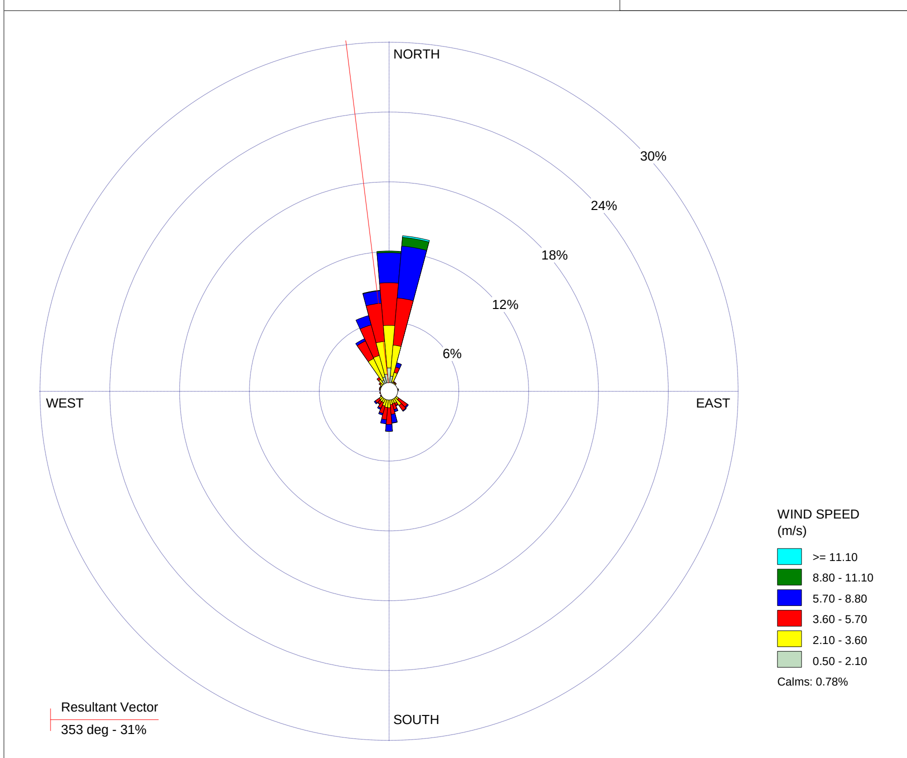
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
DSS5 Sagavanirktok East Bank Summer

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 8676
Missing Hours: 1108
Data Availability: 87.23%



DATA PERIOD:
Start Date: 5/25/2015 - 00:00
End Date: 9/15/2017 - 23:00

TOTAL COUNT:
7568 hrs.

CALM WINDS:
0.78%

AVG. WIND SPEED:
3.55 m/s

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DATE:
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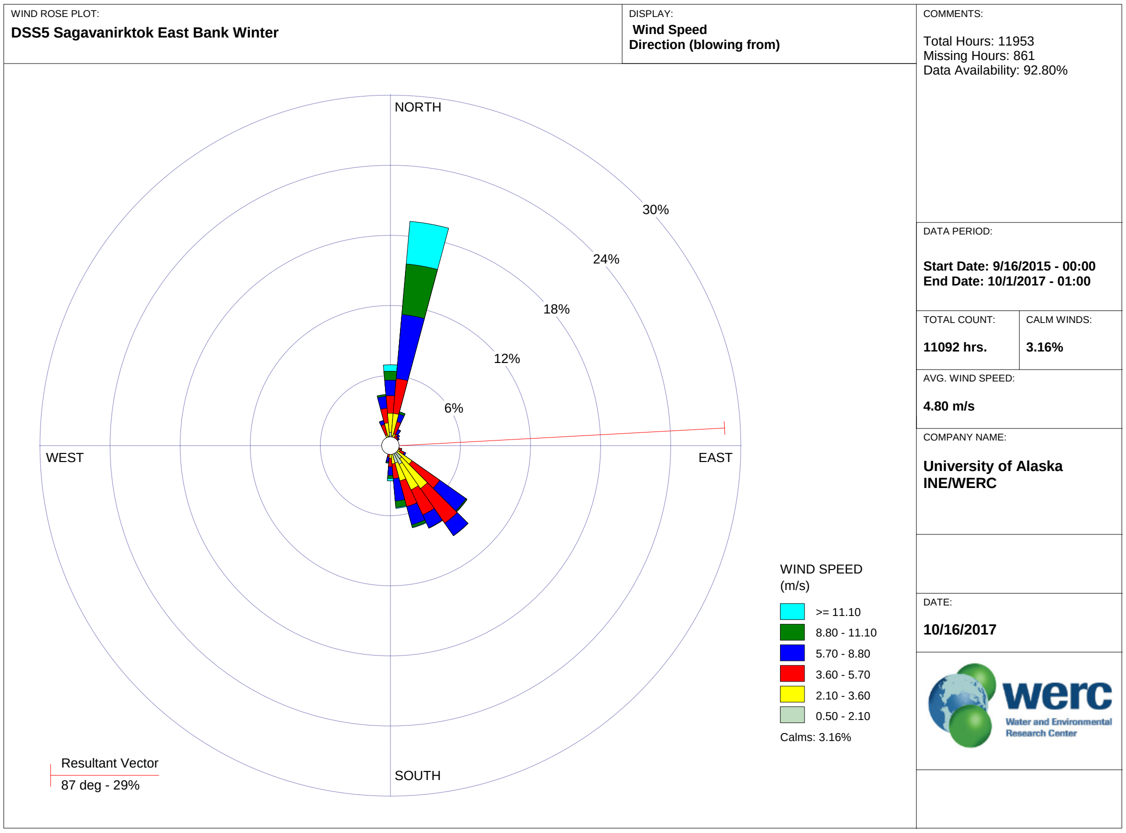
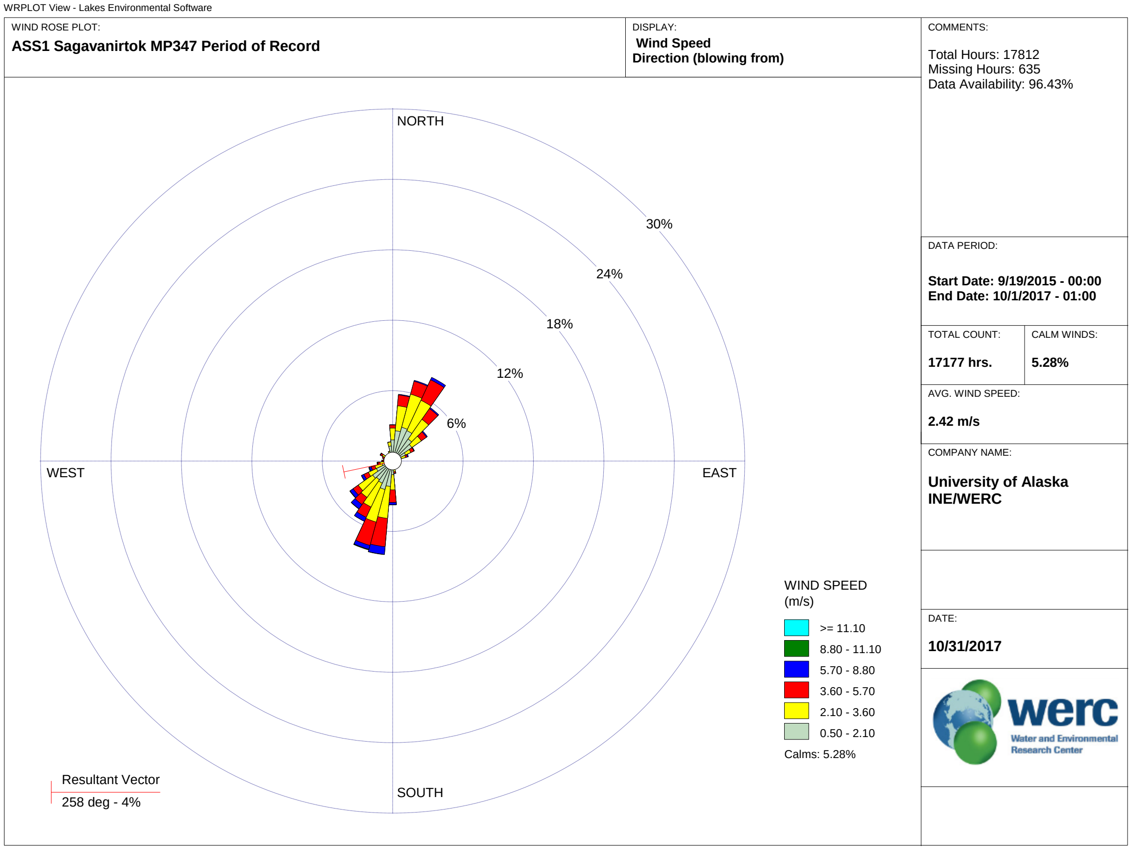
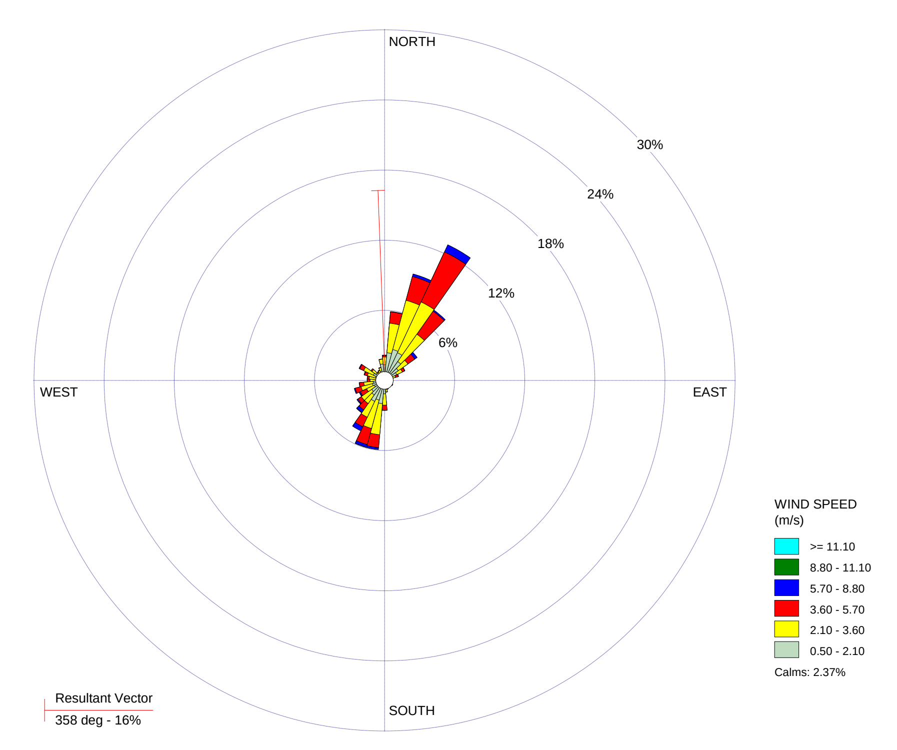


WRPLOT View - Lakes Environmental Software



WRPLOT View - Lakes Environmental Software

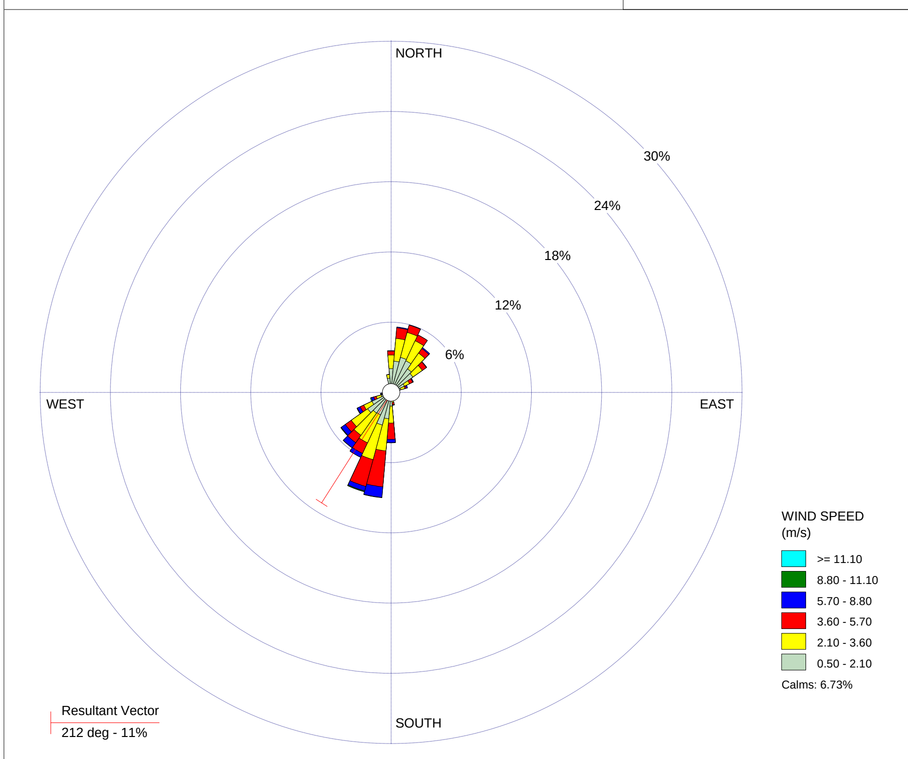
WIND ROSE PLOT:	DISPLAY:	COMMENTS:
ASS1 Sagavanirtok MP347 Summer	**Wind Speed** **Direction (blowing from)**	Total Hours: 5902 Missing Hours: 12 Data Availability: 99.80%



DATA PERIOD:	**Start Date: 5/15/2016 - 00:00** **End Date: 9/14/2017 - 23:00**
TOTAL COUNT:	**5890 hrs.**
CALM WINDS:	**2.37%**
AVG. WIND SPEED:	**2.56 m/s**
COMPANY NAME:	**University of Alaska INE/WERC**
DATE:	**10/31/2017**

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:	DISPLAY:	COMMENTS:
ASS1 Sagavanirtok MP347 Winter	**Wind Speed** **Direction (blowing from)**	Total Hours: 11910 Missing Hours: 623 Data Availability: 94.77%



DATA PERIOD:	**Start Date: 9/19/2015 - 00:00** **End Date: 10/1/2017 - 01:00**
TOTAL COUNT:	**11287 hrs.**
CALM WINDS:	**6.73%**
AVG. WIND SPEED:	**2.35 m/s**
COMPANY NAME:	**University of Alaska INE/WERC**
DATE:	**10/31/2017**

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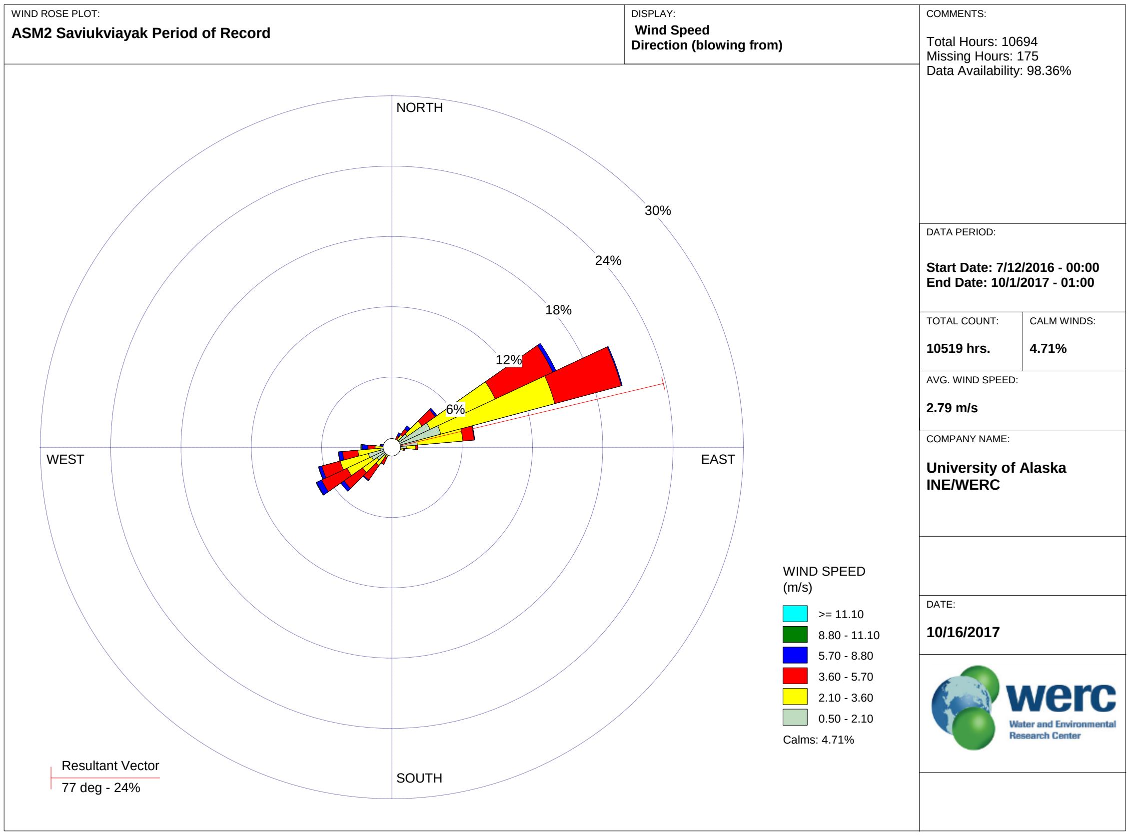
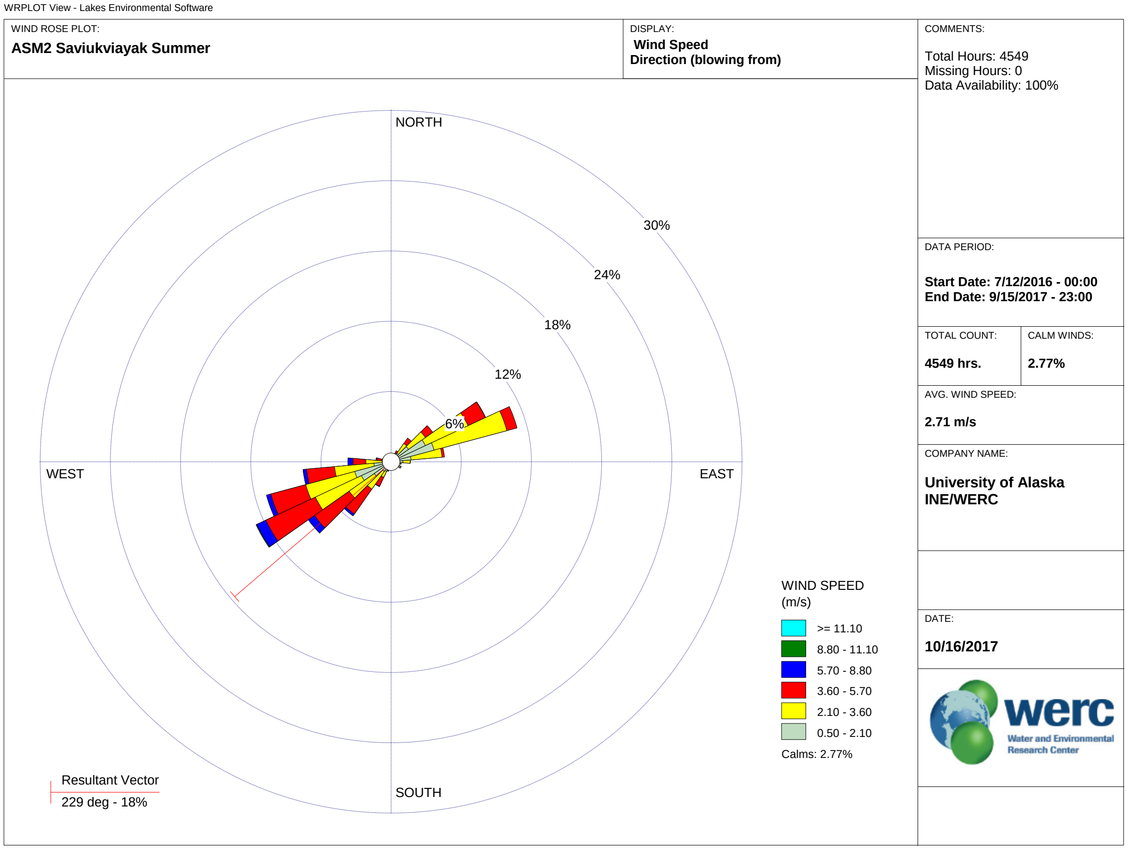


WRPLOT View - Lakes Environmental Software

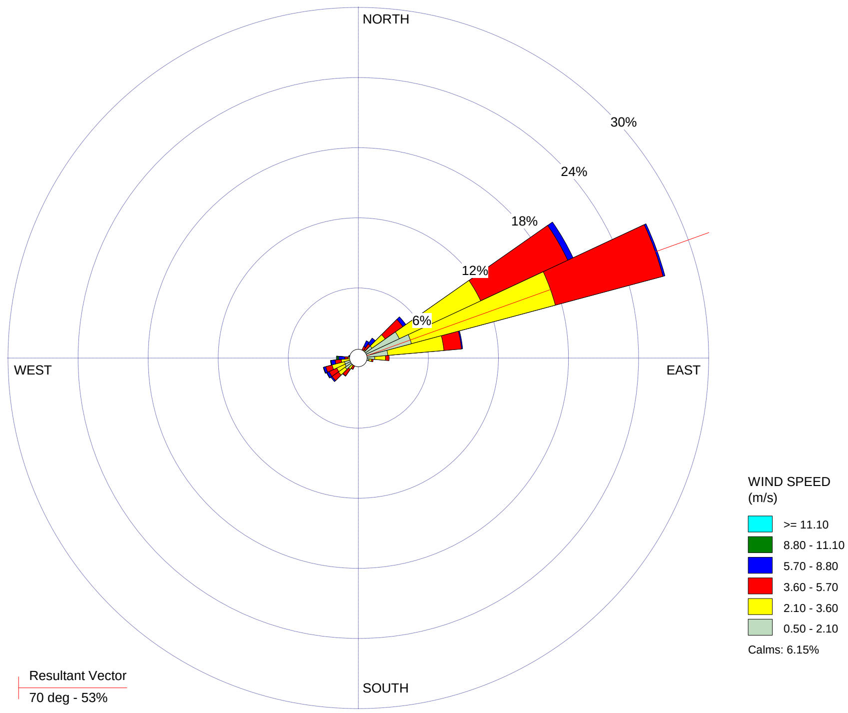


WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
ASM2 Saviukviayak Winter

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 6145
Missing Hours: 175
Data Availability: 97.15%



DATA PERIOD:
Start Date: 9/16/2016 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
5970 hrs.	**6.15%**

AVG. WIND SPEED:
2.84 m/s

COMPANY NAME:
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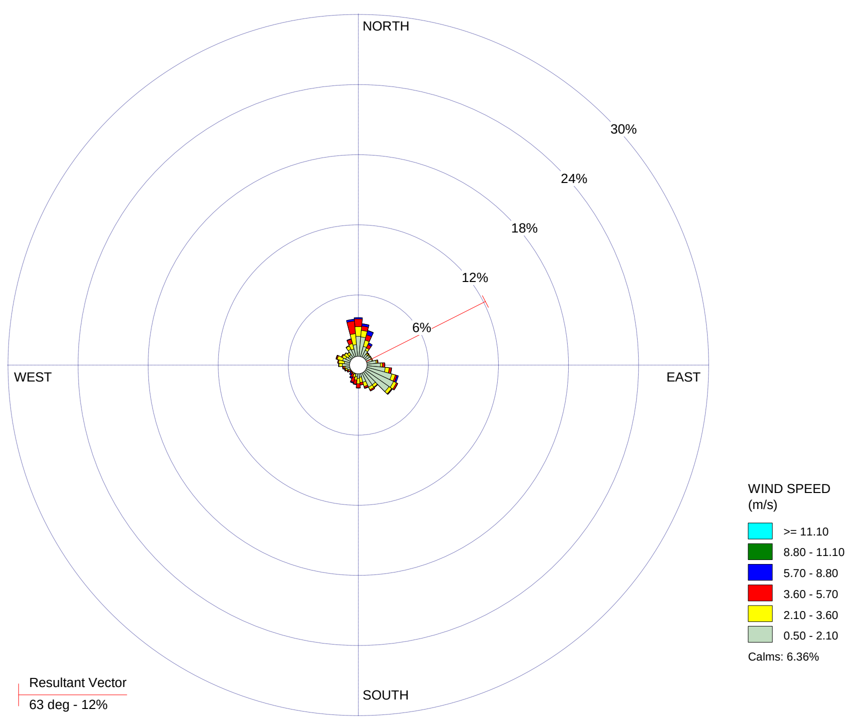
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
ASM3 Ivishak Period of Record

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 10838
Missing Hours: 2062
Data Availability: 80.97%



DATA PERIOD:
Start Date: 7/6/2016 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:	CALM WINDS:
8776 hrs.	**6.36%**

AVG. WIND SPEED:
1.69 m/s

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DATE:
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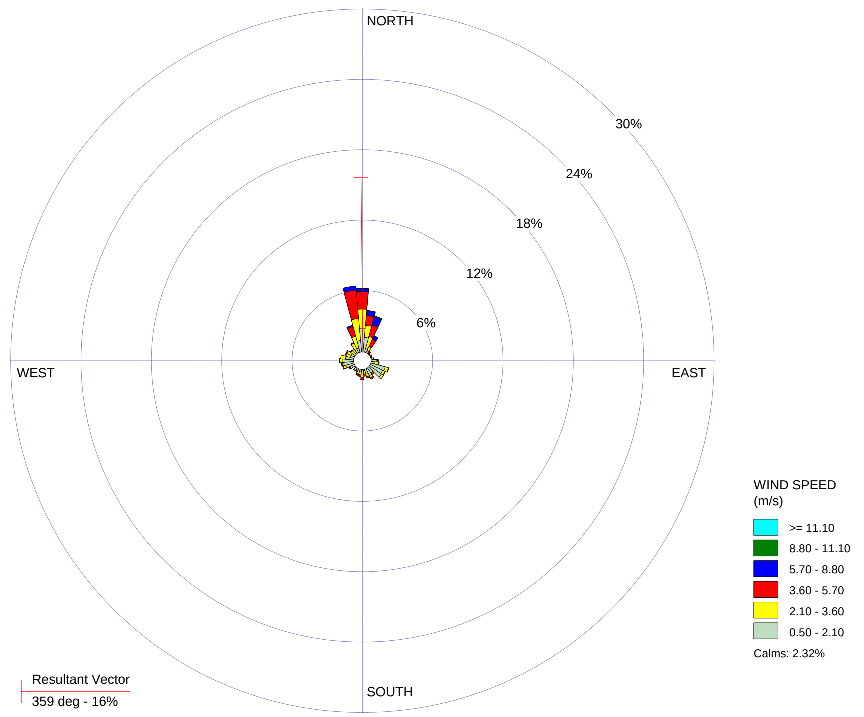
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:
ASM3 Ivishak Summer

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 4693
Missing Hours: 1310
Data Availability: 72.09%



DATA PERIOD:
Start Date: 7/6/2016 - 00:00
End Date: 9/15/2017 - 23:00

TOTAL COUNT:
3383 hrs.

CALM WINDS:
2.32%

AVG. WIND SPEED:
2.06 m/s

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DATE:
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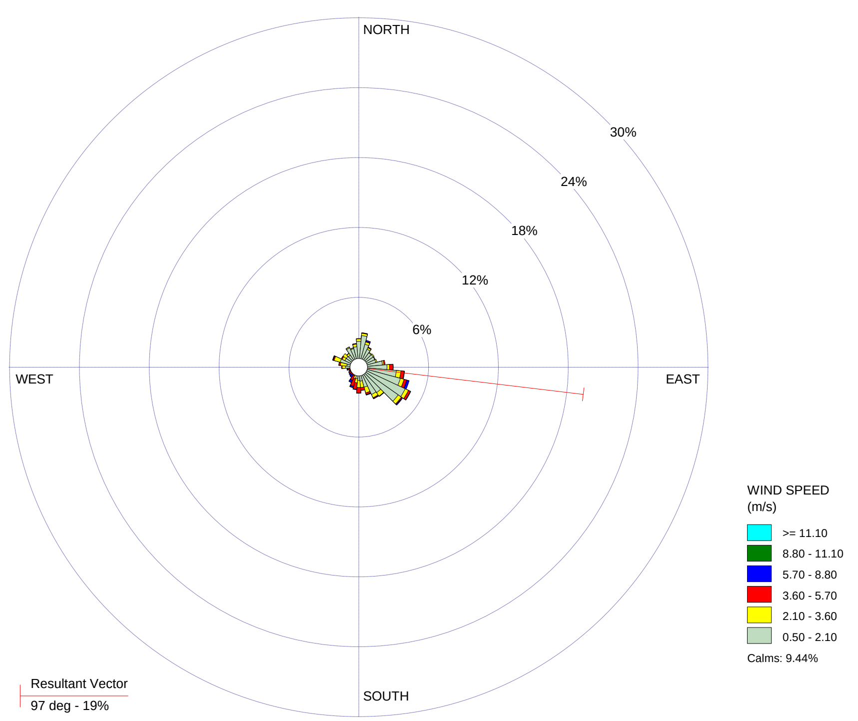
WIND ROSE PLOT:
ASM3 Ivishak Winter

DISPLAY:
Wind Speed
Direction (blowing from)

COMMENTS:
Total Hours: 6145
Missing Hours: 675
Data Availability: 87.76%



DATA PERIOD:
Start Date: 9/16/2016 - 00:00
End Date: 10/1/2017 - 01:00

TOTAL COUNT:
5393 hrs.

CALM WINDS:
9.44%

AVG. WIND SPEED:
1.46 m/s

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APPENDIX D

Stage and Discharge Measurement Tables

Table D1. Water level elevations at the Sagavanirktok River DSS4 station. Water level elevation data from 2016 published in Toniolo et al (2016a) were adjusted by 4 cm due to a shifting benchmark.

Date/Time (AST)	Elevation (m, NAVD 88, GEOID12A)	Notes
7/3/2015 15:33	369.45	
7/28/2015 12:02	369.19	
9/12/2015 16:22	369.21	
5/12/2016 0:00	370.55	Ice
5/13/2016 8:41	370.42	Ice
5/15/2016 13:03	370.24	Ice
5/16/2016 15:02	370.13	Ice
5/17/2016 8:20	370.16	Ice
5/18/2016 14:40	369.95	Ice
5/19/2016 8:45	370.02	Ice
5/21/2016 13:30	369.85	Ice
5/21/2016 13:30	369.85	Ice
5/22/2016 11:45	369.89	Ice
5/23/2016 17:20	369.88	
5/28/2016 17:15	369.36	
6/24/2016 13:45	369.90	
7/3/2016 15:00	369.68	
8/4/2016 12:00	369.36	
8/30/2016 13:30	369.36	
5/16/2017 14:30	371.50	
5/17/2017 14:40	371.60	
5/18/2017 9:10	371.56	
5/18/2017 13:35	371.56	
5/19/2017 15:00	371.54	
5/20/2017 12:35	371.37	
5/21/2017 13:45	371.28	
5/22/2017 9:00	371.24	
5/23/2017 15:00	371.27	
5/24/2017 9:00	371.34	
5/24/2017 14:15	371.35	
5/25/2017 12:30	371.25	
5/26/2017 9:00	371.10	
5/27/2017 13:00	370.91	
5/28/2017 9:15	370.84	
5/29/2017 13:30	370.70	
5/30/2017 9:15	370.69	
5/31/2017 9:40	370.67	
7/6/2017 12:56	369.40	
8/3/2017 9:12	369.59	
9/4/2017 13:54	369.49	

Table D2. ADCP discharge measurements on the Sagavanirktok River at MP318 (DSS4) for the period of record. Some of the measurements were made at the USGS station, located 4 miles downstream of the station.

Date	Msmt. No.	Discharge (m^3/s)	Discharge (ft^3/s)	Coefficient of Variation (%)	Msmt. Rating	Reference	Notes
7/3/2015 15:33	1	94	3320	8	good		
7/28/2015 12:02	2	52	1835	5	good		
9/12/2015 16:22	3	58	2050	10	good		
5/12/2016 14:00	4	89	3145	8	good		
5/13/2016 12:00	5	195	6870	1	good	BT	Ice, Measurement made 1 mile downstream DSS4
5/16/2016 14:33	6	77	2702	1	good	WAAS/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/17/2016 9:25	7	49	1737	2	good	WAAS/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/18/2016 14:54	8	58	2031	3	good	WAAS/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/19/2016 9:04	9	66	2331	1	good	BT	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/21/2016 13:40	10	96	3376	2	good	WAAS/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/22/2016 12:00	11	120	4227	2	good	WAAS/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/23/2016 15:22	12	135	4775	2	good	WAAS/VTG	Measurement at USGS station, 4 miles downstream DSS4
6/24/2016 13:45	13	254	8970		good		
8/4/2016 12:00	14	96	3390		good		
8/30/2016 13:30	15	91	3215		good		
5/17/2017 14:16	16	69.4	2451	6	poor	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/18/2017 12:55	17	155	5474	2	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/19/2017 15:10	18	152	5368	5	poor	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/20/2017 11:38	19	112	3955	9	poor	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/21/2017 13:31	20	88.4	3122	2	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4

Date	Msmt. No.	Discharge (m^3/s)	Discharge (ft^3/s)	Coefficient of Variation (%)	Msmt. Rating	Reference	Notes
5/22/2017 11:15	21	92	3249	3	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/23/2017 14:56	22	135	4767	4	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/24/2017 11:47	23	172	6074	3	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/24/2017 16:48	24	191	6745	2	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/25/2017 12:41	25	211	7451	2	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/26/2017 11:12	26	168	5933	2	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/27/2017 14:20	27	122	4308	2	fair	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/28/2017 12:16	28	113	3991	1	good	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/29/2017 13:51	29	113	3991	1	good	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/30/2017 11:07	30	134	4732	1	good	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
5/31/2017 9:37	31	163	5756	2	good	BT/VTG	Ice, Measurement at USGS station, 4 miles downstream DSS4
7/6/2017 14:44	32	116	4097	2	good	BT/VTG	
8/3/2017 10:51	33	166	5862	0	good	BT/VTG	Measurement at USGS station, 4 miles downstream DSS4
9/4/2017 9:20	34	138	4873	1	good	BT/VTG	

Table D3. Water level elevations at the Sagavanirktok River DSS3 station.

Date/Time (AST)	Elevation (m, NAVD 88, GEOID12A)	Notes
7/4/2015 14:43	288.57	
7/28/2015 13:41	288.31	
9/11/2015 16:13	288.42	
9/12/2015 10:50	288.39	
5/12/2016 1:55	289.55	Ice
5/15/2016 9:30	289.36	Ice
5/16/2016 13:15	288.84	Ice
5/17/2016 10:45	288.51	Ice
5/18/2016 11:30	288.46	Ice
5/19/2016 11:00	288.63	Ice
5/20/2016 11:00	288.77	Ice
5/21/2016 11:45	288.84	Ice
5/22/2016 14:45	288.92	Ice
5/23/2016 15:15	288.99	
6/26/2016 15:00	289.20	
7/4/2016 12:00	288.95	
8/3/2016 12:30	288.79	
9/3/2016 13:00	288.77	
5/16/2017 13:15	289.14	
5/17/2017 10:00	288.97	
5/18/2017 13:00	289.34	
5/20/2017 12:00	289.35	
5/21/2017 10:40	289.27	
5/22/2017 15:00	289.16	
5/23/2017 11:45	289.16	
5/24/2017 13:15	289.32	
5/25/2017 10:15	289.43	
5/26/2017 13:00	289.27	
5/27/2017 11:00	289.12	
5/28/2017 12:00	289.07	
5/29/2017 11:45	289.10	
5/30/2017 11:00	289.13	
7/7/2017 10:32	288.78	
8/4/2017 14:22	289.17	
9/5/2017 13:09	289.09	

Table D4. ADCP discharge measurements on the Sagavanirktok River at Happy Valley (DSS3) during breakup 2016.

Date	Msmt. No.	Discharge (m^3/s)	Discharge (ft^3/s)	Coefficient of Variation (%)	Msmt. Rating	Referenc e	Notes
7/4/2015 13:38	1	90	3178	2	good	RTK/VTG	
7/28/2015 14:40	2	53	1872	4	good	RTK/VTG	
9/11/2015 9:34	3	76	2684	4	fair	RTK/VTG	
5/15/2016 10:52	4	248	8760	5, 2 and 2	poor	RTK/VTG	Ice. Measured in 3 different channels
5/16/2016 11:00	5	126	4460	4 and 1	good	BT/VTG	Ice. Measured in 2 different channels
5/18/2016 12:30	6	86	3040	3 and 1	good	BT/VTG	Ice. Measured in 2 different channels
5/19/2016 11:30	7	118	4160	1 and 2	good	BT/VTG	Ice. Measured in 2 different channels
5/20/2016 10:00	8	145	5125	2 and 1	good	BT	Ice. Measured in 2 different channels
5/21/2016 11:30	9	175	7470	2 and 1	good	BT/VTG	Ice. Measured in 2 different channels
5/22/2016 14:15	10	198	7000	1 and 1	good	BT/VTG	Ice. Measured in 2 different channels
5/23/2016 13:00	11	216	7610	0 and 2	good	BT/VTG	Ice. Measured in 2 different channels
6/26/2016 15:00	12	244	8617				
8/3/2016 12:30	13	113	3991				
9/3/2016 13:00	14	119	4202				
5/22/2017 14:02	15	112	3814	3	fair	BT/VTG	3 channels, measured main channel, 4 cms estimated
5/23/2017 11:34	16	116	3,955	2	fair	BT/VTG	3 channels, measured main channel, 4 cms estimated
5/26/2017 13:03	17	256	8899	1	fair	BT/VTG	3 channels, measured only main channel, 3 cms estimated
5/27/2017 12:28	18	221	7663	1	fair	BT/VTG	3 channels, measured only main channel, 3 cms estimated
5/28/2017 14:24	19	212	7381	1	fair	BT/VTG	3 channels, measured only main channel, 3 cms estimated
5/29/2017 12:15	20	225	7840	1	fair	BT/VTG	3 channels, measured only main channel, 3 cms estimated
5/30/2017 13:03	21	223	7769	1	fair	BT/VTG	3 channels, measured only main channel, 3 cms estimated
7/7/2017 14:00	22	106	3743	2	good	BT/VTG	

Date	Msmt. No.	Discharge (m^3/s)	Discharge (ft^3/s)	Coefficient of Variation (%)	Msmt. Rating	Referenc e	Notes
8/4/2017 10:56	23	206	7275	1	good	BT/VTG	
9/5/2017 9:30	24	191	6745	1	good	BT	

Note: Msmt. = measurement, e = estimated

Table D5. Water level elevations at the Sagavanirktok River DSS2 station. Water level measurements from 2016 reported in Toniolo et al. (2016a) have been modified.

Date/Time (AST)	Elevation (m, NAVD 88, GEOID12A)	Notes
7/5/2015 15:10	134.95	
7/6/2015 13:42	134.93	
7/29/2015 10:49	134.73	
9/8/2015 09:20	134.97	
9/9/2015 17:18	134.95	
9/13/2015 16:45	134.90	
5/13/2016 15:00	137.02	Ice
5/14/2016 11:45	137.03	Ice
5/17/2016 14:00	136.05	Ice
5/20/2016 13:15	136.11	Ice
5/23/2016 12:45	136.30	
6/25/2016 12:00	135.53	
8/2/2016 15:00	135.04	
8/31/2016 15:30	135.14	
5/27/2017 12:40	136.21	Ice
5/28/2017 10:20	136.20	Ice
7/9/2017 09:50	135.01	
8/6/2017 12:45	135.47	
9/7/2017 10:50	135.49	

Table D6. ADCP discharge measurements on the Sagavanirktok River below the Ivishak River (DSS2) for the period of record.

Date	Msmt. No.	Discharge (m^3/s)	Discharge (ft^3/s)	Coefficient of Variation (%)	Msmt. Rating	Reference	Notes
7/6/2015 12:34	1	161	5686	2	good	RTK/VTG	
7/29/2015 12:04	2	101	3567	1	good	RTK/VTG	
9/13/2015 12:27	3	152	5368	6	fair	RTK/VTG	
5/14/2016 13:00	4	850	30018	3, 3, 3, 4, and 4	fair	BT/VTG	Measurement in 5 different channels
6/25/2016 12:00	5	482	17021		fair		
8/2/2016 15:00	6	176			fair		
8/31/2016 15:00	7	227			fair		
5/27/2017 12:40	8	553	19529	3, 3, 2, and N/A	fair	BT/VTG	Measured in 4 channels
5/28/2017 10:20	9	674	23802	2, 3, 3, and N/A	fair	BT/VTG	Measured in 4 channels
7/9/2017 9:50	10	178	6286	1	good	BT/VTG	
8/6/2017 12:45	11	313	11054	2	good	BT/VTG	
9/7/2017 10:50	12	393	13879	2,3, and 4	good	BT/VTG	Measured in 3 channels

Table D7. Water level elevations at the Sagavanirktok River East Bank station.

Date/Time (AST)	Elevation (m, NAVD 88, GEOID12A)	Notes
5/16/2015 10:56	59.09	Ice
5/17/2015 15:12	59.40	Ice
5/18/2015 10:20	59.48	Ice
5/18/2015 12:23	59.35	Ice
5/18/2015 16:38	59.25	Ice
5/19/2015 14:12	59.26	Ice
5/20/2015 13:44	59.00	Ice
5/21/2015 13:35	58.75	Ice
5/22/2015 13:30	58.66	Ice
5/22/2015 14:07	58.69	Ice
5/23/2015 10:58	58.50	Ice
5/23/2015 11:49	58.31	Ice
5/24/2015 15:12	57.96	Ice
5/26/2015 13:19	57.79	
5/27/2015 16:38	57.47	
5/28/2015 11:35	57.35	
5/29/2015 15:41	57.30	
5/30/2015 15:52	57.57	
5/31/2015 14:32	57.21	
6/1/2015 10:31	56.98	
6/2/2015 11:59	56.79	
5/11/2016 13:45	58.35	Ice
5/13/2016 15:27	58.35	Ice
5/14/2016 15:52	58.24	Ice
5/15/2016 15:45	58.15	Ice
5/16/2016 12:45	58.06	Ice
5/19/2016 14:34	57.92	Ice
5/20/2016 13:57	57.96	Ice
5/21/2016 12:30	57.94	Ice
5/24/2016 16:58	57.91	Ice
5/26/2016 12:36	57.91	Ice
5/27/2016 15:17	57.90	Ice
5/28/2016 9:30	57.81	Ice
5/20/2017 10:40	58.48	Ice
5/21/2017 14:30	58.42	Ice
5/24/2017 10:00	58.21	Ice
5/26/2017 22:20	58.09	Ice
5/27/2017 15:05	57.99	Ice
5/28/2017 12:50	57.74	Ice
5/30/2017 13:50	57.78	Ice
5/31/2017 14:49	57.75	Ice

Table D8. ADCP discharge measurements on the Sagavanirktok River East Bank Station at Franklin Bluffs.

Date	Msmt. No.	Discharge (m^3/s)	Discharge (ft^3/s)	Coefficient of Variation (%)	Msmt. Rating	Reference	Notes
5/18/2015 14:50	1	1240	43790	N/A, only 1 transect	poor	VTG	One R to L transect only
5/20/2015 12:50	2	1560	55090	4	fair	RTK/VTG	
5/22/2015 12:30	3	1290	45450	5	fair	RTK/VTG	
5/23/2015 10:00	4	1000e	35310e	N/A, estimated	poor	WAAS and RTK/VTG	Estimated based on measured velocity, estimated width, estimated depth
5/24/2015 13:15	5	675	23835	10	poor	WAAS and RTK/VTG	L to R transects only
5/27/2015 15:00	6	415	14655	2 (west) and 4 (east)	fair	RTK/VTG	L to R transects only
5/28/2015 10:15	7	450	15890	15 (west) and 6 (east)	poor	WAAS and RTK/VTG and BT	R to L transects only for west channel; no moving bed test
5/30/2015 14:00	8	1110	39200	6 (west) and 3 (east)	poor	WAAS and RTK/VTG	Directional bias suspected; R to L transects only; and beam 3 misalignment
5/15/2016 15:45	9	545e	19245e	7	poor	WAAS/VTG	Measurement made at MP380. Side channel estimated at 50 cm, (included in total discharge)
5/19/2016 14:34	10	311	10980	5	fair	WAAS/VTG	
5/20/2016 13:57	11	412	14550	5	fair	BT	
5/21/2016 12:30	12	465	16421	4	good	WAAS/VTG	
5/24/2016 16:58	13	435	15362	3	good	WAAS/VTG	
5/26/2016 12:36	14	378	13349	2	good	WAAS/VTG	
5/27/2016 15:17	15	332	11725	2	good	BT	
5/28/2016 9:30	16	198	6992	4	good	WAAS/VTG	
5/20/2017 9:50	17	291	10,277	1	good	BT/VTG	Ice. Measured at MP389
5/21/2017 13:40	18	241	8,510	1	good	BT/VTG	Ice. Measured at MP389
5/24/2017 8:45	19	257	9,075	1 and 6	fair	BT/VTG	Measured in 2 channels, Measured at MP389
5/26/2017 20:25	20	702	24,791	7 and 1	poor	BT/VTG	Measured in 2 channels, Measured at MP387
5/27/2017 14:25	21	606	21,400	3, 2, and 2	fair	BT	Measured in 3 channels, Measured at MP387
5/28/2017 12:10	22	645	22,777	4, N/A, 2, N/A, and 3	fair	BT/VTG	Measured in 5 channels, Measured at MP387

Date	Msmt. No.	Discharge (m^3/s)	Discharge (ft^3/s)	Coefficient of Variation (%)	Msmt. Rating	Reference	Notes
5/30/2017 14:35	23	746	26,345	1, N/A, 1, and 6	fair	BT/VTG	Measured in 4 channels, Measured at MP387
5/31/2017 15:30	24	659	23,272	1, N/A, and 0	fair	BT/VTG	Measured in 3 channels, Measured at MP387

Note: R – right; L – left; e – estimated discharge; Msmt. – measurement

Table D9. Water level elevations at the Sagavanirktok River near MP405 (DSS1) station.

Date/Time (AST)	Elevation (m, NAVD 88, GEOID12A)	Notes
7/7/2015 10:42	25.01	
7/29/2015 16:35	24.88	
9/8/2015 12:31	25.04	
9/9/2015 12:10	25.04	
6/26/2016 14:00	25.42	
6/30/2016 08:45	25.39	
8/1/2016 16:30	25.09	
9/2/2016 13:15	25.24	
5/24/2017 13:40	25.69	Ice
5/25/2017 14:48	25.77	Ice
5/27/2017 16:10	25.85	Ice
5/28/2017 13:40	25.69	Ice
5/30/2017 13:05	25.63	Ice
5/31/2017 13:40	25.63	Ice
7/8/2017 12:20	25.06	
8/5/2017 13:55	25.31	
9/6/2017 14:05	25.32	

Table D10. ADCP discharge measurements on the Sagavanirktok River near MP405 (DSS1).

Date	Msmt. No.	Discharge (m^3/s)	Discharge (ft^3/s)	Coefficient of Variation (%)	Msmt. Rating	Reference	Notes
7/7/2015 9:41	1	60	2120	8	poor	RTK/VTG	10+ mph wind, 2 ft waves
7/29/2015 15:56	2	40	1415	5	poor	RTK/VTG	
9/9/2015 9:41	3	82	2895	10	poor	RTK/VTG	
6/26/2016 14:00	4	212	7485			WAAS/VTG	
8/1/2016 16:30	5	86	3035			WAAS/VTG	
9/2/2016 13:15	6	133	4695			WAAS/VTG	
5/24/2017 13:40	7	117	4132	1	good	BT/VTG	Ice
5/26/2017 21:50	8	332	11725	2	good	BT/VTG	Ice
5/27/2017 16:10	9	336	11866	1	good	BT	Ice
5/28/2017 13:40	10	364	12855	1 and N/A	good	BT/VTG	Measured in 2 channels
5/30/2017 13:05	11	449	15856	1 and N/A	good	BT/VTG	Measured in 2 channels
5/31/2017 13:40	12	430	15185	1 and N/A	good	BT/VTG	Measured in 2 channels
7/8/2017 12:20	13	79	2790	1	good	BT/VTG	
8/5/2017 13:55	14	155	5474	1	good	BT/VTG	
9/6/2017 14:05	15	189	6675	1	good	BT/VTG	

APPENDIX E

ADCP Discharge Measurement Summary Forms

Station Number:
Station Name: Sagavanirktok River DSS4 at USGS gauge

Meas. No.: 13
Date: 06/24/2016

Party: JK/TT
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: 369.90 m

Width: 111.1 m Area: 140.2 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.82 m/s
Discharge: 254 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (19.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.26 m/s
Max. Depth: 2.74 m
Mean Depth: 1.26 m
% Meas.: 74.87
Water Temp.: None
ADCP Temp.: 12.5 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 12813 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: sag-usgs_6-24-16_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	2.00	22.0	335	28.3	193	30.7	0.453	2.28	255	113.0	148.0	06:52	06:56	0.55	1.72	0	4
001	R	4.00	22.0	232	28.8	189	33.7	1.35	2.24	255	106.4	131.3	06:56	06:59	0.65	1.94	0	3
002	L	2.00	25.0	237	28.4	193	32.3	0.303	2.28	256	115.7	148.3	07:01	07:03	0.71	1.73	0	3
003	R	2.00	25.0	366	28.9	187	33.0	0.481	2.32	252	109.4	133.3	07:04	07:08	0.40	1.89	0	2
Mean		2.50	23.5	292	28.6	190	32.4	0.647	2.28	254	111.1	140.2	**Total**	00:15	0.58	1.82	0	3
SDev		1.00	1.73	68	0.298	3.03	1.26	0.476	0.032	1.94	4.1	9.2			0.13	0.11		
SD/M		0.40	0.07	0.23	0.01	0.02	0.04	0.74	0.01	0.01	0.04	0.07			0.23	0.06		

Remarks: Q with RiverPro 254 m3/s using BT with 1% error, 243 m3/s using VTG with 3% error.

Station Number:
Station Name: Sagavanirktok River DSS4

Meas. No.: 14
Date: 08/04/2016

Party: JK/TT
Boat/Motor: Kayak
Gauge Height: 369.36 m

Width: 94.5 m
Area: 95.9 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.00 m/s
Discharge: 96.0 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.5°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.140 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 0.10 m/s
WT Error Vel.: 0.35 m/s*
BT Up Vel.: 0.30 m/s*
WT Up Vel.: 2.50 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 1.91 m/s
Max. Depth: 1.66 m
Mean Depth: 1.01 m
% Meas.: 65.88
Water Temp.: None
ADCP Temp.: 6.1 °C

ADCP:
Type/Freq.: StreamPro / 2000 kHz
Serial #: 1180 Firmware: 31.12
Bin Size: 6 cm* Blank: 3 cm
BT Mode: 10 BT Pings: 2
WT Mode: 12 WT Pings: 6

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS4

Project Name: dss4-080416-discharge_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	6.00	7.00	161	22.3	62.6	11.8	0.184	0.762	97.6	94.7	94.3	10:32	10:35	0.47	1.04	1	2
001	R	4.00	10.0	181	20.7	64.2	10.1	0.090	0.362	95.5	94.9	97.0	10:38	10:42	0.43	0.98	1	2
002	L	4.00	7.00	155	21.9	61.3	10.6	0.043	0.502	94.3	94.1	94.3	10:43	10:46	0.49	1.00	0	2
003	R	4.00	10.0	158	20.7	64.9	10.1	0.176	0.741	96.6	94.4	97.9	10:48	10:51	0.49	0.99	1	2
Mean		4.50	8.50	163	21.4	63.2	10.6	0.123	0.592	96.0	94.5	95.9	**Total**	00:19	0.47	1.00	0	2
5Dev		1.00	1.73	12	0.814	1.63	0.786	0.068	0.193	1.43	0.4	1.9			0.03	0.02		
5D/M		0.22	0.20	0.07	0.04	0.03	0.07	0.55	0.33	0.01	0.00	0.02			0.06	0.02		

Remarks: Q with StreamPro 96 m3/s using BT with 1% error, 92 m3/s using VTG with 2% error.

*value not consistent for all transects

Station Number:
Station Name: Sagavanirktok River DSS4

Meas. No.: 15
Date: 08/30/2016

Party: JH/JK	Width: 85.2 m	Processed by: DV
Boat/Motor: Kayak	Area: 89.5 m2	Mean Velocity: 1.02 m/s
Gauge Height: 369.36 m	G.H.Change: 0.000 m	Discharge: 91.4 m3/s

Area Method: Mean Flow	ADCP Depth: 0.170 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.5°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.30 m/s	Type/Freq.: StreamPro / 2000 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.75 m	Serial #: 1180	Firmware: 31.12
BT Error Vel.: 0.10 m/s	Mean Depth: 1.05 m	Bin Size: 10 cm	Blank: 3 cm
WT Error Vel.: 0.38 m/s	% Meas.: 61.66	BT Mode: 10	BT Pings: 2
BT Up Vel.: 0.30 m/s*	Water Temp.: None	WT Mode: 12	WT Pings: 6
WT Up Vel.: 2.00 m/s	ADCP Temp.: 7.5 °C		
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: DSS4

Project Name: dss4 20160830q91cms.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	4.00	5.00	282	22.6	53.2	12.3	0.159	0.407	88.7	88.0	89.1	09:30	09:36	0.40	1.00	9	4
001	R	5.00	5.00	190	22.9	56.8	12.3	0.299	0.438	92.7	81.8	84.1	09:42	09:45	0.44	1.10	6	4
002	L	3.00	8.00	184	20.7	56.9	11.7	0.169	0.836	90.3	85.6	93.9	09:49	09:52	0.47	0.96	11	2
003	R	3.00	8.00	186	22.2	58.7	12.2	0.192	0.754	94.0	85.2	90.9	09:57	10:01	0.42	1.03	3	3
Mean		3.75	6.50	210	22.1	56.4	12.1	0.205	0.609	91.4	85.2	89.5	**Total**	00:30	0.43	1.02	7	3
5Dev		0.96	1.73	48	0.977	2.27	0.264	0.064	0.218	2.38	2.6	4.1			0.03	0.06		
5D/M		0.26	0.27	0.23	0.04	0.04	0.02	0.31	0.36	0.03	0.03	0.05			0.07	0.06		

Remarks: Q with StreamPro 91 m3/s using BT with 3% error, 70 m3/s using VTG with 20% error.

*value not consistent for all transects

Station Number: 15908000
Station Name: Sagavanirktok River DSS4 at USGS gauge

Meas. No.: 16
Date: 05/17/2017

Party: DB/JH	Width: 113.5 m	Processed by: DV
Boat/Motor: 12' cataraft w 10 hp prop	Area: 130.6 m2	Mean Velocity: 0.531 m/s
Gauge Height: 371.60 m	G.H.Change: 0.000 m	Discharge: 69.4 m3/s

Area Method: Mean Flow	ADCP Depth: 0.076 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.53 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.56 m	Serial #: 1129	Firmware: 56.03
BT Error Vel.: 1.00 m/s	Mean Depth: 1.15 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 73.67	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: 0.3 °C	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.5 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: USGS gauge

Project Name: sag_usgs_20170517q69.4cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
001	L	0.91	1.83	297	11.5	51.4	5.73	0.035	0.040	68.7	111.7	130.7	14:10	14:13	0.72	0.53	6	1
002	*R*	*1.22*	*1.83*	*298*	*10.8*	*47.3*	*5.83*	*0.027*	*0.034*	*64.0*	*115.4*	*129.6*	*14:13*	*14:16*	*0.65*	*0.49*	*3*	*1*
003	L	*1.22*	*2.44*	*297*	*11.5*	*49.1*	*6.94*	*0.030*	*0.030*	*67.5*	*112.1*	*129.1*	*14:16*	*14:19*	*0.71*	*0.52*	*6*	*2*
004	*R*	*1.22*	*2.44*	*327*	*12.1*	*55.0*	*6.69*	*0.067*	*0.022*	*73.9*	*115.5*	*130.7*	*14:19*	*14:23*	*0.61*	*0.56*	*3*	*1*
005	*L*	*1.22*	*2.44*	*324*	*12.3*	*53.0*	*7.54*	*0.042*	*0.050*	*72.9*	*112.6*	*133.1*	*14:23*	*14:26*	*0.68*	*0.55*	*7*	*1*
Mean		1.16	2.19	308	11.7	51.1	6.55	0.040	0.035	69.4	113.5	130.6	**Total**	00:16	0.67	0.53	5	1
5Dev		0.14	0.33	15	0.592	3.04	0.764	0.016	0.011	4.04	1.8	1.5			0.05	0.03		
5D/M		0.12	0.15	0.05	0.05	0.06	0.12	0.40	0.30	0.06	0.02	0.01			0.07	0.05		

Remarks: Q with RiverPro 69.4 m3/s using BT with 6% error, 67 m3/s using VTG with 7% error.

Discharge for transects in *italics* have a total Q more than 5% from the mean

Station Number: 15908000 | Meas. No.: 17
Station Name: Sagavanirktok River DSS4 at USGS gauge | Date: 05/18/2017

Party: DB/JH	Width: 111.9 m	Processed by: DV
Boat/Motor: 12' cataraft w 10 hp prop	Area: 231.3 m2	Mean Velocity: 0.671 m/s
Gauge Height: 371.56 m	G.H.Change: 0.000 m	Discharge: 155 m3/s

Area Method: Mean Flow	ADCP Depth: 0.076 m*	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.1°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.21 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 4.37 m	Serial #: 1129	Firmware: 56.03
BT Error Vel.: 1.00 m/s*	Mean Depth: 2.07 m	Bin Size: 50 cm	Blank: 50 cm
WT Error Vel.: 10.00 m/s*	% Meas.: 76.53	BT Mode: 0	BT Pings: 1
BT Up Vel.: 10.00 m/s*	Water Temp.: 0.3 °C	WT Mode: 1	WT Pings: 1
WT Up Vel.: 10.00 m/s*	ADCP Temp.: 0.3 °C	WV : 170	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: sag_usgs_20170518_q155cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
001	R	3.05	2.44	318	18.0	121	19.4	-0.127	0.114	159	113.5	237.0	12:47	12:51	0.61	0.67	2	1
002	L	3.05	2.44	305	16.9	116	17.6	-0.133	0.052	151	112.8	236.4	12:51	12:55	0.65	0.64	5	0
003	R	3.05	2.44	344	17.6	118	19.1	-0.145	0.071	154	111.4	229.6	12:55	12:59	0.58	0.67	4	0
004	L	3.05	2.44	297	16.8	117	18.6	-0.182	0.065	152	111.5	230.6	12:59	13:03	0.66	0.66	3	0
005	R	3.05	2.44	318	18.0	121	18.8	0.070	0.041	158	111.6	225.5	13:03	13:07	0.60	0.70	9	1
006	L	3.05	2.44	258	17.1	120	20.9	-0.136	0.030	158	110.6	228.5	13:07	13:10	0.76	0.69	3	1
Mean		3.05	2.44	306	17.4	119	19.1	-0.109	0.062	155	111.9	231.3	**Total**	00:22	0.64	0.67	5	1
5Dev		0.00	0.00	29	0.561	2.13	1.08	0.090	0.030	3.38	1.0	4.5			0.06	0.02		
5D/M		0.00	0.00	0.09	0.03	0.02	0.06	0.82	0.47	0.02	0.01	0.02			0.10	0.03		

Remarks: Q with RiverPro 155 m3/s using BT with 2% error, 154 m3/s using VTG with 3% error.

*value not consistent for all transects

Station Number: 15908000 — Meas. No.: 18

Station Name: Sagavanirktok River DSS4 at USGS gauge — Date: 05/19/2017

Party: DB/JH	Width: 114.4 m	Processed by: DV
Boat/Motor: 12' cataraft w 10 hp prop	Area: 219.0 m2	Mean Velocity: 0.693 m/s
Gauge Height: 371.54 m	G.H.Change: 0.000 m	Discharge: 152 m3/s

Area Method: Mean Flow	ADCP Depth: 0.076 m*	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.88 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 3.78 m	Serial #: 1129	Firmware: 56.03
BT Error Vel.: 1.00 m/s*	Mean Depth: 1.91 m	Bin Size: 50 cm	Blank: 50 cm
WT Error Vel.: 10.00 m/s*	% Meas.: 75.82	BT Mode: 0	BT Pings: 1
BT Up Vel.: 10.00 m/s*	Water Temp.: 0.3 °C	WT Mode: 1	WT Pings: 1
WT Up Vel.: 10.00 m/s*	ADCP Temp.: 0.3 °C	WV : 170	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES   Evaluation: YES

Meas. Location: USGS gauge

Project Name: sag_usgs_20170519_q152cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	3.05	2.13	282	17.9	115	19.2	0.077	0.031	152	114.9	224.7	14:56	14:59	0.73	0.68	2	1
001	*R*	*3.05*	*2.13*	*289*	*18.0*	*108*	*17.0*	*-0.114*	*0.060*	*142*	*114.0*	*217.0*	*14:59*	*15:03*	*0.69*	*0.66*	*5*	*1*
002	*L*	*3.05*	*2.13*	*301*	*17.4*	*105*	*17.1*	*-0.049*	*0.062*	*140*	*113.6*	*218.4*	*15:03*	*15:06*	*0.69*	*0.64*	*1*	*0*
003	R	3.05	2.13	304	18.7	120	19.8	-0.081	0.023	158	114.5	218.6	15:07	15:10	0.67	0.72	2	0
004	*L*	*3.05*	*2.13*	*284*	*18.7*	*123*	*19.0*	*-0.115*	*0.019*	*160*	*115.6*	*221.7*	*15:10*	*15:14*	*0.71*	*0.72*	*1*	*0*
005	R	3.05	2.13	321	18.8	114	19.0	-0.013	0.021	152	114.7	214.8	15:14	15:17	0.62	0.71	2	0
006	L	3.05	2.13	298	18.1	121	19.5	-0.185	0.013	158	116.6	223.5	15:18	15:21	0.70	0.71	1	1
007	R	3.05	2.13	316	17.7	115	18.1	-0.090	0.034	151	111.7	213.2	15:21	15:25	0.63	0.71	1	0
Mean		3.05	2.13	299	18.2	115	18.6	-0.071	0.033	152	114.4	219.0	**Total**	00:28	0.68	0.69	2	0
SDev		0.00	0.00	14	0.525	6.10	1.08	0.078	0.019	7.38	1.4	4.1			0.04	0.03		
SD/M		0.00	0.00	0.05	0.03	0.05	0.06	1.10	0.56	0.05	0.01	0.02			0.06	0.04		

Remarks: Q with RiverPro 152 m3/s using BT with 5% error, 144 m3/s using VTG with 6% error.

Discharge for transects in *italics* have a total Q more than 5% from the mean

*value not consistent for all transects

Station Number: 15908000 | Meas. No.: 19
Station Name: Sagavanirktok River DSS4 at USGS gauge | Date: 05/20/2017

Party: DB/JH	Width: 112.7 m	Processed by: DV
Boat/Motor: 12' cataraft w 10 hp prop	Area: 187.9 m2	Mean Velocity: 0.596 m/s
Gauge Height: 371.38 m	G.H.Change: 0.000 m	Discharge: 112 m3/s

Area Method: Mean Flow	ADCP Depth: 0.076 m*	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.36 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 3.45 m	Serial #: 1129	Firmware: 56.03
BT Error Vel.: 1.00 m/s*	Mean Depth: 1.67 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s*	% Meas.: 74.11	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s*	Water Temp.: 0.3 °C	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s*	ADCP Temp.: 0.1 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES | Project Name: Sag_USGS_20170520_0.mmt
Performed Moving Bed Test: YES | Software: 2.17
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: USGS gauge

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	*L*	1.52	1.83	324	15.4	76.8	12.2	0.016	0.057	105	110.3	187.4	11:27	11:30	0.67	0.56	5	1
001	R	1.52	1.83	335	15.5	85.0	13.1	-0.048	0.060	114	112.9	187.8	11:30	11:34	0.61	0.60	2	0
002	*L*	1.52	2.13	345	16.7	90.0	13.0	-0.014	0.028	120	114.4	194.7	11:34	11:38	0.59	0.61	1	0
003	R	1.52	2.13	335	16.0	86.5	13.1	-0.014	0.041	116	111.8	187.0	11:38	11:42	0.58	0.62	1	0
004	*L*	1.52	2.13	318	18.2	97.8	15.5	-0.022	0.063	132	115.8	193.4	11:42	11:46	0.67	0.68	1	0
005	R	1.52	2.13	315	15.9	79.4	13.0	-0.034	0.070	108	111.3	184.8	11:46	11:49	0.64	0.59	1	0
006	*L*	1.52	2.13	322	15.0	73.4	12.8	-0.028	0.033	101	112.2	183.4	11:49	11:53	0.65	0.55	2	0
007	*R*	1.52	2.13	284	14.8	75.3	11.5	-0.083	0.029	102	112.5	184.6	11:53	11:56	0.69	0.55	1	0
Mean		1.52	2.06	322	16.0	83.0	13.0	-0.028	0.048	112	112.7	187.9	**Total**	00:29	0.64	0.60	2	0
5Dev		0.00	0.14	18	1.10	8.35	1.14	0.029	0.017	10.4	1.7	4.1			0.04	0.04		
5D/M		0.00	0.07	0.06	0.07	0.10	0.09	1.02	0.35	0.09	0.02	0.02			0.06	0.07		

Remarks: Q with RiverPro 112 m3/s using BT with 9% error, 109 m3/s using VTG with 12% error.

Discharge for transects in *italics* have a total Q more than 5% from the mean

*value not consistent for all transects

Station Number: 15908000 — Meas. No.: 20

Station Name: Sagavanirktok River DSS4 at USGS gauge — Date: 05/21/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 371.28 m

Width: 112.9 m
Area: 145.1 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.609 m/s
Discharge: 88.4 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.1°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s — Rating No.: 1
Adj.Mean Vel: 0.00 m/s — Qm Rating: U
Rated Area: 0.000 m2 — Diff.: 0.000%
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s*
WT Error Vel.: 10.00 m/s*
BT Up Vel.: 10.00 m/s*
WT Up Vel.: 10.00 m/s*
Use Weighted Mean Depth: YES

Max. Vel.: 3.24 m/s
Max. Depth: 3.02 m
Mean Depth: 1.29 m
% Meas.: 69.62
Water Temp.: 1.0 °C
ADCP Temp.: 0.3 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 — Firmware: 56.03
Bin Size: 2 cm — Blank: 10 cm
BT Mode: Auto — BT Pings: Dyn
WT Mode: Auto — WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170521_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	2.13	4.57	340	15.9	62.1	11.4	0.030	0.119	89.6	111.4	141.3	13:10	13:13	0.60	0.63	1	0
001	R	1.83	4.57	325	16.1	62.4	11.1	0.014	0.046	89.7	113.4	147.0	13:14	13:17	0.56	0.61	0	0
002	L	1.83	4.57	342	16.2	61.2	10.6	0.025	0.057	88.1	112.4	141.5	13:17	13:21	0.57	0.62	1	0
003	R	1.83	4.57	344	15.7	61.2	9.98	0.009	0.087	87.0	112.2	146.7	13:21	13:25	0.55	0.59	1	0
004	L	1.83	4.57	380	15.9	58.6	10.4	0.014	0.089	85.0	112.6	140.6	13:25	13:29	0.51	0.60	1	0
005	R	1.83	4.57	336	16.0	63.1	10.5	0.011	0.077	89.6	114.0	148.6	13:29	13:32	0.56	0.60	1	0
006	L	1.83	4.57	359	16.4	60.3	10.3	0.016	0.061	87.0	112.3	144.1	13:32	13:36	0.54	0.60	1	0
007	R	1.83	4.57	342	16.1	63.4	11.6	0.008	0.067	91.1	114.6	150.8	13:36	13:40	0.53	0.60	0	0
Mean		1.87	4.57	346	16.0	61.5	10.7	0.016	0.075	88.4	112.9	145.1	**Total**	00:29	0.55	0.61	1	0
5Dev		0.11	0.00	17	0.206	1.58	0.571	0.008	0.023	2.00	1.1	3.8			0.03	0.01		
5D/M		0.06	0.00	0.05	0.01	0.03	0.05	0.49	0.31	0.02	0.01	0.03			0.05	0.02		

Remarks: Q with RiverPro 88.4 m3/s using BT with 2% error, 87 m3/s using VTG with 2% error.

*value not consistent for all transects

Station Number: 15908000 | Meas. No.: 21
Station Name: Sagavanirktok River DSS4 at USGS gauge | Date: 05/22/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 371.24 m

Width: 114.0 m
Area: 152.8 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.603 m/s
Discharge: 92.1 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s | Rating No.: 1
Adj.Mean Vel: 0.00 m/s | Qm Rating: U
Rated Area: 0.000 m2 | Diff.: 0.000%
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s*
WT Error Vel.: 10.00 m/s*
BT Up Vel.: 10.00 m/s*
WT Up Vel.: 10.00 m/s*
Use Weighted Mean Depth: YES

Max. Vel.: 2.82 m/s
Max. Depth: 3.08 m
Mean Depth: 1.34 m
% Meas.: 70.82
Water Temp.: 0.3 °C
ADCP Temp.: 0.3 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 | Firmware: 56.03
Bin Size: 2 cm | Blank: 10 cm
BT Mode: Auto | BT Pings: Dyn
WT Mode: Auto | WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170522_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.83	4.57	365	15.5	67.2	11.2	0.017	0.076	94.0	114.2	156.3	11:01	11:05	0.53	0.60	1	0
001	R	1.83	4.57	353	15.5	63.6	10.6	0.011	0.147	89.8	113.1	150.0	11:05	11:09	0.53	0.60	1	0
002	L	1.83	4.57	345	15.3	62.9	10.7	0.016	0.048	89.0	113.0	147.8	11:09	11:13	0.54	0.60	1	0
003	R	1.83	4.57	351	16.1	65.8	11.1	0.016	0.068	93.1	114.8	151.6	11:13	11:17	0.52	0.61	0	0
004	L	1.83	4.57	340	15.7	64.9	11.0	0.014	0.182	91.8	114.7	156.1	11:17	11:20	0.56	0.59	1	0
005	R	1.83	4.57	340	15.3	63.5	10.4	0.012	0.134	89.4	114.4	154.2	11:21	11:24	0.54	0.58	0	0
006	L	1.83	4.57	363	16.6	67.3	11.5	0.015	0.053	95.4	113.8	153.9	11:25	11:28	0.53	0.62	1	0
007	R	1.83	4.57	360	16.5	66.6	11.1	0.008	0.136	94.3	114.2	152.3	11:28	11:32	0.51	0.62	1	0
Mean		1.83	4.57	352	15.8	65.2	10.9	0.014	0.106	92.1	114.0	152.8	**Total**	00:31	0.53	0.60	1	0
5Dev		0.00	0.00	10	0.498	1.73	0.374	0.003	0.050	2.46	0.7	2.9			0.01	0.01		
5D/M		0.00	0.00	0.03	0.03	0.03	0.03	0.23	0.48	0.03	0.01	0.02			0.03	0.02		

Remarks: Q with RiverPro 92 m3/s using BT with 3% error, 91.4 m3/s using VTG with 3% error.

*value not consistent for all transects

Station Number: 15908000 Meas. No.: 22
Station Name: Sagavanirktok River DSS4 at USGS gauge Date: 05/23/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 371.27 m

Width: 111.5 m
Area: 174.0 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.774 m/s
Discharge: 135 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 4.31

ADCP Depth: 0.076 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s Rating No.: 1
Adj.Mean Vel: 0.00 m/s Qm Rating: U
Rated Area: 0.000 m2 Diff.: 0.000%
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s*
WT Error Vel.: 10.00 m/s*
BT Up Vel.: 10.00 m/s*
WT Up Vel.: 10.00 m/s*
Use Weighted Mean Depth: YES

Max. Vel.: 3.10 m/s
Max. Depth: 3.21 m
Mean Depth: 1.56 m
% Meas.: 72.76
Water Temp.: 0.3 °C
ADCP Temp.: 0.3 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170523_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.22	1.83	306	18.8	96.4	17.1	0.021	0.071	132	110.9	175.4	14:45	14:48	0.61	0.76	1	0
001	R	1.22	1.83	310	19.9	97.9	17.2	0.024	0.070	135	111.1	172.5	14:48	14:52	0.57	0.78	1	0
002	L	1.22	1.83	309	19.7	97.7	17.8	0.029	0.066	135	111.9	172.5	14:52	14:56	0.56	0.78	1	0
003	R	1.22	1.83	321	20.2	97.5	17.8	0.005	0.083	136	110.3	168.4	14:56	14:59	0.56	0.81	1	1
004	L	1.22	1.83	308	19.9	101	18.0	0.033	0.043	139	112.1	176.4	14:59	15:03	0.57	0.79	0	0
005	*R*	*1.22*	*1.83*	*321*	*17.6*	*91.5*	*15.5*	*0.015*	*0.043*	*125*	*113.6*	*176.2*	*15:03*	*15:06*	*0.55*	*0.71*	*1*	*0*
006	L	*1.22*	*1.83*	*319*	*19.3*	*103*	*17.4*	*0.011*	*0.055*	*140*	*111.0*	*176.4*	*15:07*	*15:10*	*0.55*	*0.79*	*1*	*0*
Mean		1.22	1.83	313	19.3	98.0	17.3	0.020	0.062	135	111.5	174.0	**Total**	00:25	0.57	0.77	1	0
SDev		0.00	0.00	7	0.889	3.75	0.840	0.010	0.015	5.12	1.1	3.0			0.02	0.03		
SD/M		0.00	0.00	0.02	0.05	0.04	0.05	0.51	0.25	0.04	0.01	0.02			0.04	0.04		

Remarks: Q with RiverPro 135 m3/s using BT with 4% error, 133 m3/s using VTG with 4% error.

Discharge for transects in *italics* have a total Q more than 5% from the mean

*value not consistent for all transects

Station Number: 15908000 | Meas. No.: 23

Station Name: Sagavanirktok River DSS4 at USGS gauge | Date: 05/24/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 371.34 m

Width: 111.9 m
Area: 190.9 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.900 m/s
Discharge: 172 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 3.18

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s | Rating No.: 1
Adj.Mean Vel: 0.00 m/s | Qm Rating: U
Rated Area: 0.000 m2 | Diff.: 0.000%
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.71 m/s
Max. Depth: 3.34 m
Mean Depth: 1.71 m
% Meas.: 74.46
Water Temp.: 0.3 °C
ADCP Temp.: 0.5 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 | Firmware: 56.03
Bin Size: 2 cm | Blank: 10 cm
BT Mode: Auto | BT Pings: Dyn
WT Mode: Auto | WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170524_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.22	1.52	265	21.2	130	22.8	0.018	0.116	174	112.8	196.5	11:33	11:36	0.70	0.89	1	0
001	R	0.91	1.52	257	20.7	124	21.2	0.005	0.103	166	110.3	190.0	11:37	11:40	0.69	0.88	1	0
002	L	0.91	1.52	292	20.4	125	21.3	-0.004	0.093	167	111.5	187.4	11:40	11:43	0.62	0.89	0	0
003	R	1.22	1.52	311	21.6	128	22.7	0.013	0.092	173	110.9	188.4	11:43	11:46	0.58	0.92	0	0
004	L	1.22	1.52	297	21.0	127	23.3	-0.024	0.074	171	113.0	196.5	11:47	11:50	0.62	0.87	1	0
005	R	1.22	1.52	253	21.5	124	21.2	-0.007	0.068	167	113.4	188.6	11:50	11:53	0.68	0.88	0	0
006	L	1.22	1.52	312	21.5	132	24.0	0.026	0.084	177	113.5	196.2	11:53	11:57	0.61	0.90	1	0
007	R	1.22	1.52	274	22.2	132	23.3	0.026	0.096	178	110.1	183.3	11:57	12:00	0.65	0.97	0	0
Mean		1.14	1.52	282	21.3	128	22.5	0.007	0.091	172	111.9	190.9	**Total**	00:26	0.64	0.90	0	0
5Dev		0.14	0.00	24	0.563	3.21	1.13	0.018	0.015	4.63	1.4	5.0			0.04	0.03		
5D/M		0.12	0.00	0.08	0.03	0.03	0.05	2.65	0.17	0.03	0.01	0.03			0.07	0.04		

Remarks: Q with RiverPro 172 m3/s using BT with 3% error, 169 m3/s using VTG with 5% error.

Station Number: 15908000
Station Name: Sagavanirktok River DSS4 at USGS gauge

Meas. No.: 24
Date: 05/24/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 371.35 m

Width: 104.7 m
Area: 222.0 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.860 m/s
Discharge: 191 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 5.30

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.24 m/s
Max. Depth: 3.48 m
Mean Depth: 2.12 m
% Meas.: 79.31
Water Temp.: 1.1 °C
ADCP Temp.: 0.5 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170524_mmt2
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	1.52	2.44	210	16.9	153	22.7	0.070	0.085	193	106.6	224.2	16:40	16:42	0.79	0.86	2	0
001	L	1.52	1.83	225	16.9	153	22.5	0.056	0.035	192	103.0	217.4	16:42	16:45	0.74	0.88	0	0
002	R	1.52	1.83	224	16.9	154	23.3	0.124	0.041	194	103.7	219.2	16:45	16:48	0.74	0.89	1	0
003	L	1.52	2.44	237	16.6	151	22.6	0.114	0.052	191	104.8	224.1	16:48	16:51	0.69	0.85	2	0
004	R	1.52	2.44	217	16.2	144	21.4	0.084	0.107	182	104.2	220.3	16:51	16:53	0.78	0.83	0	0
005	L	1.52	1.83	243	16.9	153	22.1	0.139	0.075	192	101.8	217.4	16:53	16:56	0.68	0.88	1	0
006	R	1.52	1.83	234	16.7	151	23.3	0.075	0.051	191	106.1	224.7	16:56	16:59	0.73	0.85	1	0
007	L	1.52	1.83	237	16.8	153	23.3	0.075	0.062	193	107.3	229.1	16:59	17:02	0.71	0.84	3	0
Mean		1.52	2.06	228	16.7	151	22.6	0.092	0.064	191	104.7	222.0	**Total**	00:22	0.73	0.86	1	0
5Dev		0.00	0.32	11	0.262	3.00	0.670	0.030	0.024	3.75	1.9	4.1			0.04	0.02		
5D/M		0.00	0.15	0.05	0.02	0.02	0.03	0.32	0.38	0.02	0.02	0.02			0.05	0.03		

Remarks: Q with RiverPro 191 m3/s using BT with 2% error, 187 m3/s using VTG with 5% error.

*Compass calibration and evaluation were not necessary because the instrument’s compass was previously calibrated and evaluated at this location (the instrument was in place).

Station Number: 15908000 Meas. No.: 25
Station Name: Sagavanirktok River DSS4 at USGS gauge Date: 05/25/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 371.25 m

Width: 122.6 m
Area: 243.8 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.864 m/s
Discharge: 211 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 3.60

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s*
WT Error Vel.: 10.00 m/s*
BT Up Vel.: 10.00 m/s*
WT Up Vel.: 10.00 m/s*
Use Weighted Mean Depth: YES

Max. Vel.: 2.58 m/s
Max. Depth: 3.66 m
Mean Depth: 1.99 m
% Meas.: 79.69
Water Temp.: 0.3 °C
ADCP Temp.: 0.2 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170525_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	4.57	0.91	233	17.4	173	26.2	0.104	-0.007	216	123.0	246.2	12:29	12:32	0.78	0.88	0	0
001	R	4.57	0.91	272	16.9	166	25.3	0.049	0.002	208	122.5	243.6	12:32	12:35	0.69	0.85	0	0
002	L	4.57	0.91	241	17.6	174	26.3	0.093	0.015	218	122.3	244.6	12:35	12:38	0.76	0.89	1	0
003	R	4.57	0.91	279	17.0	168	25.3	0.070	0.010	210	122.7	243.3	12:38	12:41	0.65	0.86	0	0
004	L	4.57	0.91	251	16.5	163	24.8	0.069	0.017	205	122.9	244.8	12:41	12:44	0.73	0.84	0	0
005	R	4.57	0.91	288	16.7	164	26.0	0.034	0.025	207	122.3	243.1	12:44	12:47	0.65	0.85	0	0
006	L	4.57	0.91	228	16.6	165	25.3	0.092	0.003	207	122.5	243.1	12:47	12:50	0.79	0.85	1	0
007	R	4.57	0.91	284	17.4	169	26.3	0.027	0.004	213	123.0	241.8	12:50	12:53	0.65	0.88	0	0
Mean		4.57	0.91	259	17.0	168	25.7	0.067	0.009	211	122.6	243.8	**Total**	00:23	0.71	0.86	0	0
5Dev		0.00	0.00	24	0.414	3.96	0.589	0.029	0.010	4.83	0.3	1.4			0.06	0.02		
5D/M		0.00	0.00	0.09	0.02	0.02	0.02	0.42	1.18	0.02	0.00	0.01			0.09	0.02		

Remarks: Q with RiverPro 211 m3/s using BT with 2% error, 206 m3/s using VTG with 2% error.

*value not consistent for all transects

Station Number: 15908000 | Meas. No.: 26
Station Name: Sagavanirktok River DSS4 at USGS gauge | Date: 05/26/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 371.10 m

Width: 119.0 m
Area: 192.0 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.874 m/s
Discharge: 168 m3/s

Area Method: Mean Flow*
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s*
WT Error Vel.: 10.00 m/s*
BT Up Vel.: 10.00 m/s*
WT Up Vel.: 10.00 m/s*
Use Weighted Mean Depth: YES

Max. Vel.: 2.49 m/s
Max. Depth: 3.19 m
Mean Depth: 1.61 m
% Meas.: 78.69
Water Temp.: 0.3 °C
ADCP Temp.: 0.6 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 | Firmware: 56.03
Bin Size: 2 cm | Blank: 10 cm
BT Mode: Auto | BT Pings: Dyn
WT Mode: Auto | WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170526_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	0.91	2.44	273	15.8	132	19.8	0.042	0.028	167	120.4	197.3	11:02	11:05	0.69	0.85	4	0
001	R	1.22	2.44	240	15.8	131	19.4	0.107	0.033	167	118.9	192.2	11:06	11:08	0.80	0.87	0	0
002	L	1.22	2.13	250	16.1	133	19.8	0.085	0.010	169	119.3	193.5	11:09	11:11	0.75	0.87	0	0
003	R	1.22	2.13	223	16.3	133	19.8	0.077	0.011	170	118.7	190.4	11:11	11:14	0.83	0.89	0	0
004	L	1.22	2.13	242	16.3	133	20.3	0.093	-0.003	169	119.4	192.4	11:14	11:17	0.76	0.88	0	0
005	R	1.22	2.13	236	16.5	136	19.3	0.079	0.014	172	119.0	190.4	11:17	11:19	0.79	0.90	0	0
006	L	1.22	2.13	245	15.3	127	18.6	0.104	0.010	161	118.4	191.2	11:19	11:22	0.77	0.84	0	0
007	R	1.22	2.13	231	16.4	132	19.9	0.108	0.007	169	118.2	188.2	11:22	11:25	0.78	0.90	2	0
Mean		1.18	2.21	242	16.1	132	19.6	0.087	0.014	168	119.0	192.0	**Total**	00:22	0.77	0.87	1	0
5Dev		0.11	0.14	15	0.393	2.51	0.516	0.022	0.012	3.21	0.7	2.7			0.04	0.02		
5D/M		0.09	0.06	0.06	0.02	0.02	0.03	0.25	0.84	0.02	0.01	0.01			0.05	0.03		

Remarks: Q with RiverPro 168 m3/s using BT with 2% error, 171 m3/s using VTG with 2% error.

*value not consistent for all transects

Station Number: 15908000 Meas. No.: 27

Station Name: Sagavanirktok River DSS4 at USGS gauge Date: 05/27/2017

Party: DB/JH	Width: 101.4 m	Processed by: DV
Boat/Motor: 12' cataraft w 10 hp prop	Area: 123.7 m2	Mean Velocity: 0.990 m/s
Gauge Height: 370.91 m	G.H.Change: 0.000 m	Discharge: 122 m3/s

Area Method: Mean Flow	ADCP Depth: 0.076 m*	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.61 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.60 m	Serial #: 1129	Firmware: 56.03
BT Error Vel.: 1.00 m/s*	Mean Depth: 1.22 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s*	% Meas.: 75.40	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s*	Water Temp.: 0.4 °C	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s*	ADCP Temp.: 0.9 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: USGS gauge

Project Name: Sag_USGS_20170527_0.mmt

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.52	12.2	280	14.9	94.1	15.2	0.099	-0.061	124	102.0	127.7	14:11	14:13	0.54	0.97	4	3
001	R	1.83	12.2	233	14.6	90.1	15.6	0.069	-0.044	120	101.5	124.6	14:14	14:16	0.62	0.97	0	2
002	L	1.83	12.2	272	14.5	90.8	14.3	0.069	-0.016	120	102.0	125.3	14:17	14:19	0.55	0.95	0	3
003	R	1.83	12.2	238	14.9	91.5	14.7	0.067	-0.021	121	101.0	121.5	14:20	14:22	0.60	1.00	0	2
004	L	1.83	12.2	258	15.4	94.7	15.6	0.070	-0.076	126	101.8	125.1	14:22	14:25	0.56	1.00	0	2
005	R	2.13	12.2	235	15.2	92.5	15.4	0.083	-0.044	123	99.8	120.9	14:25	14:27	0.61	1.02	1	1
006	L	2.13	12.2	268	15.0	91.3	14.9	0.056	-0.027	121	101.5	122.2	14:28	14:30	0.55	0.99	1	2
007	R	1.52	12.2	238	15.3	93.3	15.4	0.050	-0.069	124	101.3	122.1	14:30	14:33	0.59	1.01	0	1
Mean		1.83	12.2	252	15.0	92.3	15.1	0.070	-0.045	122	101.4	123.7	**Total**	00:22	0.58	0.99	1	2
5Dev		0.23	0.00	19	0.331	1.62	0.480	0.015	0.022	2.13	0.7	2.4			0.03	0.02		
5D/M		0.13	0.00	0.08	0.02	0.02	0.03	0.22	0.50	0.02	0.01	0.02			0.05	0.02		

Remarks: Q with RiverPro 122 m3/s using BT with 2% error, 122 m3/s using VTG with 2% error.

*value not consistent for all transects

Station Number: 15908000 Meas. No.: 28
Station Name: Sagavanirktok River DSS4 at USGS gauge Date: 05/28/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 370.84 m

Width: 90.2 m
Area: 112.3 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.00 m/s
Discharge: 113 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 2.45

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s Rating No.: 1
Adj.Mean Vel: 0.00 m/s Qm Rating: U
Rated Area: 0.000 m2 Diff.: 0.000%
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s*
WT Error Vel.: 10.00 m/s*
BT Up Vel.: 10.00 m/s*
WT Up Vel.: 10.00 m/s*
Use Weighted Mean Depth: YES

Max. Vel.: 2.50 m/s
Max. Depth: 2.11 m
Mean Depth: 1.24 m
% Meas.: 74.89
Water Temp.: 0.9 °C
ADCP Temp.: 1.1 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170528_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.83	8.23	224	14.6	84.8	14.0	0.101	-0.062	113	90.2	111.3	12:06	12:09	0.60	1.02	1	1
001	R	1.83	8.23	195	14.5	85.0	13.7	0.092	-0.057	113	90.5	112.4	12:09	12:11	0.66	1.01	2	0
002	L	1.83	9.14	213	14.5	84.4	13.7	0.086	-0.109	113	91.2	112.7	12:11	12:13	0.62	1.00	0	0
003	R	1.52	9.14	219	14.2	83.2	13.8	0.066	-0.145	111	90.6	112.2	12:14	12:16	0.58	0.99	0	0
004	L	1.52	8.23	206	14.5	85.2	14.0	0.064	-0.053	114	89.9	112.3	12:16	12:18	0.63	1.01	0	1
005	R	1.52	8.23	221	14.6	85.4	13.7	0.073	-0.061	114	90.1	112.8	12:18	12:21	0.58	1.01	0	1
006	L	1.52	8.23	209	14.3	82.6	13.4	0.082	-0.080	110	90.2	113.1	12:21	12:23	0.63	0.97	1	2
007	R	1.52	8.23	213	14.6	84.0	14.2	0.071	-0.111	113	89.3	111.5	12:23	12:26	0.60	1.01	1	0
Mean		1.64	8.46	212	14.5	84.3	13.8	0.079	-0.085	113	90.2	112.3	**Total**	00:19	0.61	1.00	1	1
5Dev		0.16	0.42	9	0.151	1.02	0.264	0.013	0.033	1.30	0.5	0.6			0.03	0.01		
5D/M		0.10	0.05	0.04	0.01	0.01	0.02	0.17	0.39	0.01	0.01	0.01			0.04	0.01		

Remarks: Q with RiverPro 113 m3/s using BT with 1% error, 110 m3/s using VTG with 2% error.

*value not consistent for all transects

Station Number: 15908000 Meas. No.: 29
Station Name: Sagavanirktok River DSS4 at USGS gauge Date: 05/29/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 370.70 m

Width: 88.8 m
Area: 98.2 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.15 m/s
Discharge: 113 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s*
WT Error Vel.: 10.00 m/s*
BT Up Vel.: 10.00 m/s*
WT Up Vel.: 10.00 m/s*
Use Weighted Mean Depth: YES

Max. Vel.: 2.78 m/s
Max. Depth: 2.36 m
Mean Depth: 1.11 m
% Meas.: 73.05
Water Temp.: 1.3 °C
ADCP Temp.: 0.8 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170529_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	2.44	11.0	268	15.8	82.6	15.3	0.165	-0.094	114	90.5	98.9	13:43	13:46	0.50	1.15	0	4
001	R	2.44	11.0	216	15.9	83.5	14.8	0.168	-0.078	114	90.6	98.8	13:46	13:48	0.60	1.16	0	1
002	L	2.44	9.14	239	15.7	81.7	15.1	0.185	-0.035	113	88.3	98.1	13:48	13:51	0.54	1.15	0	3
003	R	2.44	9.14	194	15.6	82.8	14.2	0.184	-0.049	113	88.6	98.5	13:51	13:53	0.66	1.15	0	1
004	L	2.44	9.14	234	15.8	82.9	15.0	0.180	-0.057	114	88.7	98.4	13:53	13:55	0.57	1.16	2	4
005	R	2.44	9.14	208	15.3	82.7	14.6	0.155	-0.058	113	87.8	97.6	13:56	13:58	0.61	1.16	1	2
006	L	2.44	9.14	246	15.3	80.4	14.5	0.131	-0.066	110	88.2	97.9	13:58	14:00	0.53	1.13	1	3
007	R	2.44	9.14	195	15.2	81.5	13.9	0.171	-0.094	111	87.9	97.8	14:00	14:03	0.65	1.13	1	1
Mean		2.44	9.60	225	15.6	82.3	14.7	0.167	-0.066	113	88.8	98.2	**Total**	00:19	0.58	1.15	1	2
5Dev		0.00	0.85	26	0.287	0.980	0.455	0.018	0.021	1.46	1.1	0.5			0.06	0.01		
5D/M		0.00	0.09	0.12	0.02	0.01	0.03	0.11	0.32	0.01	0.01	0.00			0.10	0.01		

Remarks: Q with RiverPro 113 m3/s using BT with 1% error, 112 m3/s using VTG with 2% error.

*value not consistent for all transects

Station Number: 15908000 Meas. No.: 30
Station Name: Sagavanirktok River DSS4 at USGS gauge Date: 05/30/2017

Party: DB/JH	Width: 93.5 m	Processed by: DV
Boat/Motor: 12' cataraft w 10 hp prop	Area: 104.6 m2	Mean Velocity: 1.28 m/s
Gauge Height: 370.69 m	G.H.Change: 0.000 m	Discharge: 134 m3/s

Area Method: Mean Flow	ADCP Depth: 0.076 m*	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.94 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.45 m	Serial #: 1129	Firmware: 56.03
BT Error Vel.: 1.00 m/s*	Mean Depth: 1.12 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s*	% Meas.: 73.38	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s*	Water Temp.: 0.6 °C	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s*	ADCP Temp.: 0.4 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170530_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	4.57	9.14	254	18.0	98.3	17.7	0.326	-0.073	134	93.2	104.8	10:58	11:00	0.53	1.28	0	4
001	R	4.57	9.14	214	18.0	98.1	16.9	0.346	-0.121	133	93.6	105.1	11:00	11:03	0.63	1.27	0	0
002	L	4.57	9.14	212	18.0	99.0	17.6	0.364	-0.031	135	94.1	104.8	11:03	11:05	0.62	1.29	0	2
003	R	4.57	9.14	201	17.9	96.3	17.1	0.291	-0.003	132	94.1	104.2	11:05	11:07	0.67	1.26	0	1
004	L	4.57	9.14	221	17.9	98.3	17.0	0.343	-0.048	134	92.7	104.1	11:07	11:10	0.60	1.28	0	3
005	R	4.57	9.14	197	18.1	98.6	17.6	0.347	-0.049	135	92.9	103.9	11:10	11:12	0.66	1.29	0	3
006	L	4.57	9.14	227	18.4	100	17.4	0.395	-0.048	136	94.1	105.5	11:12	11:14	0.59	1.29	0	3
007	R	4.57	9.14	216	18.1	97.5	17.4	0.404	-0.083	133	93.2	104.4	11:14	11:17	0.60	1.28	0	2
Mean		4.57	9.14	217	18.0	98.3	17.3	0.352	-0.057	134	93.5	104.6	**Total**	00:19	0.61	1.28	0	2
5Dev		0.00	0.00	18	0.149	1.15	0.293	0.036	0.036	1.43	0.6	0.5			0.04	0.01		
5D/M		0.00	0.00	0.08	0.01	0.01	0.02	0.10	0.62	0.01	0.01	0.01			0.07	0.01		

Remarks: Q with RiverPro 134 m3/s using BT with 1% error, 132 m3/s using VTG with 2% error.

*value not consistent for all transects

Station Number: 15908000
Station Name: Sagavanirktok River DSS4 at USGS gauge

Meas. No.: 31
Date: 05/31/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 370.67 m

Width: 95.4 m
Area: 111.0 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.47 m/s
Discharge: 163 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m*
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s*
WT Error Vel.: 10.00 m/s*
BT Up Vel.: 10.00 m/s*
WT Up Vel.: 10.00 m/s*
Use Weighted Mean Depth: YES

Max. Vel.: 3.99 m/s
Max. Depth: 2.53 m
Mean Depth: 1.16 m
% Meas.: 73.55
Water Temp.: 0.4 °C
ADCP Temp.: 0.8 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129
Firmware: 56.03
Bin Size: 2 cm
Blank: 10 cm
BT Mode: Auto
BT Pings: Dyn
WT Mode: Auto
WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: USGS gauge

Project Name: Sag_USGS_20170531_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	4.57	9.14	207	21.3	121	21.0	0.676	-0.027	164	95.2	111.1	09:30	09:32	0.65	1.48	0	1
001	R	4.57	9.14	203	21.8	122	21.0	0.569	-0.079	166	93.9	109.5	09:32	09:35	0.64	1.51	0	1
002	L	4.57	9.14	204	21.8	122	21.9	0.564	-0.040	166	95.8	111.9	09:35	09:37	0.66	1.49	0	0
003	R	4.57	9.14	203	20.9	118	20.9	0.522	-0.054	160	94.8	109.1	09:37	09:39	0.68	1.47	0	0
004	L	4.57	9.14	208	20.8	118	21.2	0.553	-0.064	160	96.8	112.7	09:39	09:42	0.64	1.42	0	0
005	R	4.57	9.14	207	21.4	120	21.8	0.515	-0.026	164	95.7	110.7	09:42	09:44	0.65	1.48	0	0
006	L	4.57	9.14	220	22.2	124	22.0	0.566	-0.021	168	95.5	111.4	09:44	09:46	0.60	1.51	0	1
007	R	4.57	9.14	210	20.8	116	20.4	0.591	-0.052	158	95.7	111.2	09:46	09:49	0.63	1.42	0	1
Mean		4.57	9.14	207	21.4	120	21.3	0.570	-0.045	163	95.4	111.0	**Total**	00:18	0.64	1.47	0	1
SDev		0.00	0.00	6	0.527	2.71	0.565	0.050	0.020	3.65	0.9	1.2			0.02	0.04		
SD/M		0.00	0.00	0.03	0.02	0.02	0.03	0.09	0.45	0.02	0.01	0.01			0.03	0.02		

Remarks: Q with RiverPro 163 m3/s using BT with 2% error, 164 m3/s using VTG with 3% error.

*value not consistent for all transects

Station Number: 15908000 Meas. No.: 32

Station Name: Sagavanirktok River DSS4 at USGS gauge Date: 08/03/2017

Party: JB/JK
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: 369.59 m

Width: 89.9 m
Area: 106.7 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.56 m/s
Discharge: 166 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (17.5°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.11 m/s
Max. Depth: 2.29 m
Mean Depth: 1.19 m
% Meas.: 73.48
Water Temp.: None
ADCP Temp.: 10.6 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: USGS gauge

Project Name: sag_08032017_usgs_q161cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	2.00	6.00	255	23.1	121	21.3	0.239	0.137	166	90.3	104.6	10:40	10:43	0.58	1.59	2	1
001	L	2.00	6.00	246	22.0	122	21.6	0.149	0.185	166	89.9	108.5	10:45	10:48	0.57	1.53	1	1
002	R	2.00	6.00	231	22.7	122	21.3	0.309	0.104	166	88.0	103.7	10:48	10:51	0.58	1.61	1	0
003	L	2.00	6.00	269	21.9	124	21.1	0.121	0.159	167	91.1	110.2	10:51	10:54	0.53	1.51	2	0
Mean		2.00	6.00	250	22.4	122	21.3	0.205	0.146	166	89.9	106.7	**Total**	00:13	0.57	1.56	2	0
5Dev		0.00	0.00	16	0.569	1.01	0.214	0.086	0.034	0.526	1.3	3.1			0.02	0.04		
5D/M		0.00	0.00	0.06	0.03	0.01	0.01	0.42	0.23	0.00	0.01	0.03			0.04	0.03		

Remarks: Q with RiverPro 166 m3/s using BT with 0% error, 159 m3/s using VTG with 3% error.

Station Number:
Station Name: Sagavanirktok River DSS4

Meas. No.: 33
Date: 07/06/2017

Party: JK/JH
Boat/Motor: Kayak
Gauge Height: 369.40 m

Width: 79.5 m
Area: 97.4 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.19 m/s
Discharge: 116 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (17.6°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.00 m/s
Max. Depth: 1.83 m
Mean Depth: 1.23 m
% Meas.: 74.05
Water Temp.: None
ADCP Temp.: 12.1 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS4

Project Name: dss4_7062017q112cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	5.00	5.00	433	14.3	87.0	16.0	0.098	0.770	118	73.6	101.2	02:26	02:31	0.38	1.17	1	1
001	R	5.00	5.00	483	16.5	84.6	12.8	0.165	0.248	114	86.5	95.2	02:36	02:42	0.36	1.20	0	1
002	L	5.00	5.00	275	14.5	85.4	13.9	0.042	0.692	115	74.6	95.9	02:44	02:47	0.55	1.19	1	1
003	R	5.00	5.00	400	16.3	86.9	13.2	0.185	0.674	117	83.2	97.4	02:50	02:54	0.40	1.21	3	1
Mean		5.00	5.00	397	15.4	86.0	14.0	0.123	0.596	116	79.5	97.4	**Total**	00:28	0.42	1.19	1	1
SDev		0.00	0.00	89	1.16	1.17	1.41	0.065	0.236	1.96	6.4	2.7			0.09	0.02		
SD/M		0.00	0.00	0.22	0.07	0.01	0.10	0.53	0.40	0.02	0.08	0.03			0.20	0.01		

Remarks: Q with RiverPro 116 m3/s using BT with 2% error, 113 m3/s using VTG with 2% error.

Station Number:

Station Name: Sagavanirktok River DSS4

Meas. No.: 34

Date: 09/04/2017

Party: JK/KP
Boat/Motor: Kayak
Gauge Height: 369.49 m

Width: 79.4 m
Area: 107.9 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.29 m/s
Discharge: 138 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: On Site (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 0.10 m/s*
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.97 m/s
Max. Depth: 2.15 m
Mean Depth: 1.36 m
% Meas.: 74.91
Water Temp.: None
ADCP Temp.: 4.2 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz*
Serial #: 1243 Firmware: 56.04*
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS4

Project Name: DSS4_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
001	R	5.00	1.00	272	16.9	103	17.7	0.025	0.022	137	82.9	113.4	09:39	09:42	0.48	1.21	1	1
002	L	5.00	1.00	282	17.2	103	17.4	-0.028	0.015	138	81.0	111.5	09:35	09:38	0.48	1.23	2	2
000	L	1.00	5.00	343	17.2	104	17.1	-0.006	0.137	138	70.7	93.8	09:06	09:10	0.41	1.47	1	1
001	R	1.00	5.00	301	17.1	104	17.5	-0.003	0.113	139	83.0	112.9	09:11	09:15	0.44	1.23	1	1
Mean		3.00	3.00	299	17.1	103	17.4	-0.003	0.072	138	79.4	107.9	**Total**	22:22	0.45	1.29	1	1
5Dev		2.31	2.31	31	0.151	0.745	0.258	0.022	0.062	0.774	5.9	9.4			0.04	0.12		
5D/M		0.77	0.77	0.11	0.01	0.01	0.01	7.25	0.87	0.01	0.07	0.09			0.08	0.10		

Remarks: Q with RiverPro 138 m3/s using BT with 1% error, 128 m3/s using VTG with 7% error.

*value not consistent for all transects

Station Number:
Station Name: Sagavanirktok River DSS3

Meas. No.: 12
Date: 06/26/2016

Party: JK/TT
Boat/Motor: 10' raft with 15 hp prop
Gauge Height: 289.20 m

Width: 147.5 m Area: 141.6 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.91 m/s
Discharge: 270 m3/s

Area Method: Mean Flow Nav.
Method: Bottom Track
MagVar Method: None (19.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 10.59

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.89 m/s
Max. Depth: 1.49 m
Mean Depth: 0.960 m
% Meas.: 65.01
Water Temp.: None
ADCP Temp.: 13.5 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 12813 Firmware: 56.03
Bin Size: 6 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS3

Project Name: dss3-hv-6-26-16_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	3.00	4.00	473	52.8	175	35.1	1.20	0.585	265	148.8	145.7	09:37	09:41	0.54	1.81	0	3
001	R	3.00	4.00	399	57.5	177	38.8	1.06	0.635	275	147.7	143.2	09:43	09:47	0.69	1.92	0	5
002	L	4.00	3.00	406	54.3	176	38.1	1.86	0.292	270	145.9	139.6	09:49	09:53	0.65	1.93	0	3
003	R	2.00	3.00	414	56.6	175	38.6	0.410	0.312	271	147.4	137.7	09:53	09:58	0.66	1.97	0	4
Mean		3.00	3.50	423	55.3	176	37.6	1.13	0.456	270	147.5	141.6	**Total**	00:21	0.64	1.91	0	4
5Dev		0.82	0.58	34	2.14	1.24	1.74	0.596	0.179	4.47	1.2	3.6			0.06	0.07		
5D/M		0.27	0.16	0.08	0.04	0.01	0.05	0.53	0.39	0.02	0.01	0.03			0.10	0.03		

Remarks: Q with RiverPro 270 m3/s using BT with 2% error, 234 m3/s using VTG with 1% error.

Station Number:
Station Name: Sagavanirktok River DSS3

Meas. No.: 13
Date: 08/03/2016

Party: JK/TT
Boat/Motor: Kayak
Gauge Height: 288.79 m

Width: 94.0 m
Area: 88.7 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.28 m/s
Discharge: 114 m3/s

Area Method: Mean Flow
Nav. Method: DGPS
MagVar Method: None (18.5°)
Depth: Composite (BT)

ADCP Depth: 0.140 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 0.10 m/s
WT Error Vel.: 0.35 m/s
BT Up Vel.: 0.30 m/s*
WT Up Vel.: 2.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.04 m/s
Max. Depth: 1.87 m
Mean Depth: 0.945 m
% Meas.: 67.25
Water Temp.: None
ADCP Temp.: 6.9 °C

ADCP:
Type/Freq.: StreamPro / 2000 kHz
Serial #: 1180
Firmware: 31.12
Bin Size: 6 cm
Blank: 3 cm
BT Mode: 10
BT Pings: 2
WT Mode: 12
WT Pings: 6

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS3

Project Name: dss3-080316-discharge_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
001	R	2.00	20.0	151	24.3	73.1	13.4	0.596	1.21	113	94.1	81.8	10:08	10:11	0.56	1.38	14	5
002	L	3.00	20.0	126	22.5	76.2	12.3	0.298	1.77	113	97.0	92.1	10:14	10:16	0.63	1.23	0	3
003	R	2.00	20.0	136	21.6	78.7	12.2	0.360	1.39	114	91.1	90.4	10:17	10:20	0.54	1.26	1	4
004	L	2.00	20.0	138	22.6	77.4	12.4	0.132	1.65	114	93.6	90.6	10:22	10:25	0.56	1.26	0	6
Mean		2.25	20.0	137	22.7	76.3	12.6	0.347	1.50	114	94.0	88.7	**Total**	00:17	0.57	1.28	4	5
5Dev		0.50	0.00	10	1.16	2.40	0.552	0.192	0.252	0.799	2.4	4.7			0.04	0.07		
5D/M		0.22	0.00	0.08	0.05	0.03	0.04	0.55	0.17	0.01	0.03	0.05			0.07	0.05		

Remarks: Q with StreamPro 112 m3/s using BT with 15% error, 114 m3/s using VTG with 3% error.

*value not consistent for all transects

Station Number: Meas. No.: 14

Station Name: Sagavanirktok River DSS3 Date: 09/03/2016

Party: JH/JK	Width: 94.3 m	Processed by: DV
Boat/Motor: Kayak	Area: 93.4 m2	Mean Velocity: 1.29 m/s
Gauge Height: 288.77 m	G.H.Change: 0.000 m	Discharge: 120 m3/s

Area Method: Mean Flow	ADCP Depth: 0.170 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.5°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.49 m/s	Type/Freq.: StreamPro / 2000 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.60 m	Serial #: 1180	Firmware: 31.12
BT Error Vel.: 0.10 m/s	Mean Depth: 0.990 m	Bin Size: 10 cm*	Blank: 3 cm
WT Error Vel.: 0.30 m/s	% Meas.: 61.89	BT Mode: 10	BT Pings: 2
BT Up Vel.: 0.30 m/s*	Water Temp.: None	WT Mode: 12	WT Pings: 6
WT Up Vel.: 3.00 m/s	ADCP Temp.: 6.8 °C		
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: NO

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS3

Project Name: dss3 20160903q120cms.mmt

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
001	L	3.00	40.0	145	21.5	72.7	14.5	0.408	8.41	118	90.9	90.8	09:57	10:00	0.54	1.29	0	6
002	*R*	*3.00*	*35.0*	*116*	*24.6*	*82.1*	*14.9*	*0.671*	*5.17*	*127*	*98.5*	*103.7*	*10:06*	*10:09*	*0.58*	*1.23*	*2*	*3*
003	L	3.00	40.0	120	21.5	72.4	14.8	0.404	8.35	117	91.9	87.6	10:14	10:17	0.44	1.34	7	3
004	R	3.00	40.0	85	19.8	74.1	14.2	0.677	8.73	118	89.6	91.6	10:17	10:19	0.54	1.28	0	3
005	L	3.00	40.0	99	22.8	70.7	15.9	0.502	8.33	118	94.6	88.2	10:21	10:23	0.57	1.34	6	4
006	R	3.00	40.0	104	22.2	75.7	15.8	0.650	8.54	123	95.7	95.3	10:24	10:26	0.52	1.29	1	4
007	L	3.00	40.0	102	23.1	70.7	15.7	0.516	7.64	118	95.7	90.3	10:29	10:31	0.55	1.30	2	3
008	R	3.00	40.0	95	22.2	75.6	14.9	0.982	7.51	121	97.9	100.1	10:31	10:33	0.60	1.21	0	3
Mean		3.00	39.4	108	22.2	74.3	15.1	0.601	7.83	120	94.3	93.4	**Total**	00:36	0.54	1.29	2	4
SDev		0.00	1.77	19	1.38	3.70	0.615	0.189	1.16	3.61	3.2	5.8			0.05	0.05		
SD/M		0.00	0.04	0.17	0.06	0.05	0.04	0.32	0.15	0.03	0.03	0.06			0.09	0.04		

Remarks: Q with StreamPro 120 m3/s using BT with 3% error, 112 m3/s using VTG with 5% error.

Discharge for transects in *italics* have a total Q more than 5% from the mean

*value not consistent for all transects

Station Number: Meas. No.: 15

Station Name: Sagavanirktok River DSS3 Channel 3 Date: 05/22/2017

Party: DB/JH	Width: 97.8 m	Processed by: DV
Boat/Motor: 12' cataraft w 10 hp prop	Area: 103.8 m2	Mean Velocity: 1.04 m/s
Gauge Height: 289.16. m	G.H.Change: 0.000 m	Discharge: 108 m3/s

Area Method: Mean Flow	ADCP Depth: 0.076 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.1°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 1.54		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 4.49 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.71 m	Serial #: 1129	Firmware: 56.03
BT Error Vel.: 1.00 m/s	Mean Depth: 1.06 m	Bin Size: 50 cm	Blank: 50 cm
WT Error Vel.: 10.00 m/s	% Meas.: 70.71	BT Mode: 0	BT Pings: 1
BT Up Vel.: 10.00 m/s	Water Temp.: 0.5 °C	WT Mode: 1	WT Pings: 1
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.4 °C	WV : 170	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS3 Channel 3

Project Name: dss3_c3_20170522_q108cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.22	4.57	220	18.1	74.0	12.3	0.119	0.250	105	96.1	102.3	13:51	13:53	0.67	1.02	3	1
001	*R*	*1.22*	*4.57*	*238*	*19.6*	*80.2*	*13.6*	*0.121*	*0.294*	*114*	*99.3*	*105.6*	*13:54*	*13:56*	*0.63*	*1.08*	*1*	*1*
002	L	1.22	4.57	238	18.9	76.4	12.9	0.080	0.292	109	98.3	104.0	13:56	13:59	0.62	1.04	1	1
003	R	1.22	4.57	240	17.9	73.0	11.9	0.125	0.242	103	97.0	102.0	13:59	14:02	0.61	1.01	1	1
004	L	1.22	4.57	250	18.3	76.4	12.5	0.070	0.165	108	98.1	104.4	14:02	14:05	0.57	1.03	0	1
005	R	1.22	4.57	252	18.1	74.4	12.3	0.049	0.135	105	97.4	102.1	14:05	14:08	0.59	1.03	2	1
006	L	1.22	4.57	253	18.6	76.4	12.8	0.064	0.221	108	98.4	104.8	14:08	14:11	0.58	1.03	1	1
007	R	1.22	4.57	242	18.9	78.7	13.2	0.181	0.222	111	98.2	105.1	14:11	14:13	0.61	1.06	0	1
Mean		1.22	4.57	241	18.5	76.2	12.7	0.101	0.228	108	97.8	103.8	**Total**	00:22	0.61	1.04	1	1
SDev		0.00	0.00	11	0.551	2.40	0.540	0.043	0.056	3.50	1.0	1.4			0.03	0.02		
SD/M		0.00	0.00	0.04	0.03	0.03	0.04	0.43	0.25	0.03	0.01	0.01			0.05	0.02		

Remarks: Q with RiverPro 108 m3/s using BT with 3% error, 107 m3/s using VTG with 3% error.

Total Q=108+4=112 m3/s (4 m3/s estimated from small channels).

Discharge for transects in *italics* have a total Q more than 5% from the mean

Station Number: Meas. No.: 16

Station Name: Sagavanirktok River DSS3 Channel 3 Date: 05/23/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 289.17 m

Width: 90.6 m
Area: 101.4 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.10 m/s
Discharge: 112 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.1°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 12.6 m/s
Max. Depth: 1.71 m
Mean Depth: 1.12 m
% Meas.: 72.00
Water Temp.: 0.3 °C
ADCP Temp.: 0.3 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 Firmware: 56.03
Bin Size: 50 cm Blank: 50 cm
BT Mode: 0 BT Pings: 1
WT Mode: 1 WT Pings: 1
WV : 170

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS3 Channel 3

Project Name: dss3_c3_20170523_q112cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.22	4.57	316	18.1	79.9	13.0	0.073	0.201	111	92.9	103.8	11:20	11:23	0.55	1.07	12	2
001	R	1.22	4.57	272	18.3	81.5	12.9	0.092	0.160	113	92.6	100.8	11:24	11:27	0.57	1.12	0	1
002	L	1.22	3.05	277	17.7	79.5	12.7	0.063	0.032	110	90.2	101.1	11:27	11:30	0.55	1.09	2	0
003	R	1.22	3.05	296	18.2	80.3	13.3	0.109	-0.083	112	90.3	99.6	11:30	11:34	0.53	1.12	3	1
004	L	1.22	3.05	298	17.9	79.8	12.7	0.085	0.152	111	90.8	102.4	11:34	11:37	0.53	1.08	2	1
005	R	1.22	3.05	282	18.3	80.8	13.5	0.081	0.092	113	91.0	101.8	11:37	11:40	0.55	1.11	0	0
006	L	1.22	2.44	334	17.6	78.2	12.3	0.075	-0.046	108	87.1	99.3	11:40	11:44	0.50	1.09	8	0
007	R	1.22	2.44	284	18.4	83.1	13.9	0.074	0.051	115	89.5	102.1	11:44	11:48	0.56	1.13	1	0
Mean		1.22	3.28	294	18.1	80.4	13.0	0.081	0.070	112	90.6	101.4	**Total**	00:27	0.54	1.10	3	1
5Dev		0.00	0.84	21	0.303	1.45	0.484	0.014	0.101	2.18	1.8	1.5			0.02	0.02		
5D/M		0.00	0.26	0.07	0.02	0.02	0.04	0.17	1.44	0.02	0.02	0.01			0.04	0.02		

Remarks: Q with RiverPro 112 m3/s using BT with 2% error, 114 m3/s using VTG with 2% error.

Total Q=112+4=116 m3/s (4 m3/s estimated from small channels).

Station Number: | Meas. No.: 17

Station Name: Sagavanirktok River DSS3 Channel 3 | Date: 05/26/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 289.27 m

Width: 99.5 m
Area: 129.8 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.94 m/s
Discharge: 252 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (17.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.81 m/s
Max. Depth: 2.03 m
Mean Depth: 1.30 m
% Meas.: 71.88
Water Temp.: 0.3 °C
ADCP Temp.: 0.5 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 | Firmware: 56.03
Bin Size: 6 cm | Blank: 10 cm
BT Mode: Auto | BT Pings: Dyn
WT Mode: Auto | WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: DSS3 Channel 3

Project Name: DSS3_C3_20170526_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.22	1.22	238	37.5	180	33.3	0.246	0.078	251	101.0	132.5	12:49	12:52	0.63	1.90	0	0
003	L	1.22	1.83	221	37.0	181	33.4	0.186	0.125	252	99.1	132.1	12:56	12:58	0.68	1.91	0	0
004	R	1.83	1.83	222	36.9	182	33.6	0.358	0.180	253	98.1	127.7	12:58	13:01	0.68	1.99	0	0
005	R	1.83	1.83	204	36.6	178	32.2	0.363	0.172	248	97.8	127.3	13:02	13:05	0.74	1.95	1	0
006	L	1.83	1.83	207	37.8	183	33.0	0.289	0.203	254	101.4	132.0	13:06	13:09	0.70	1.93	0	0
007	R	1.83	1.83	266	37.6	180	34.0	0.370	0.216	252	99.1	126.7	13:09	13:12	0.59	1.99	0	0
008	L	1.83	1.83	232	36.8	182	33.7	0.321	0.143	253	100.0	131.1	13:12	13:15	0.65	1.93	1	0
009	R	1.83	1.83	219	37.4	180	31.9	0.195	0.189	250	99.8	129.1	13:15	13:18	0.69	1.94	0	0
Mean		1.68	1.75	226	37.2	181	33.1	0.291	0.163	252	99.5	129.8	**Total**	00:29	0.67	1.94	0	0
5Dev		0.28	0.22	20	0.437	1.51	0.741	0.075	0.046	2.10	1.3	2.4			0.05	0.03		
5D/M		0.17	0.12	0.09	0.01	0.01	0.02	0.26	0.28	0.01	0.01	0.02			0.07	0.02		

Remarks: Q with RiverPro 252 m3/s using BT with 1% error, 247 m3/s using VTG with 2% error.

Station Number: Meas. No.: 18

Station Name: Sagavanirktok River DSS3 Channel 3 Date: 05/27/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 289.12 m

Width: 93.9 m
Area: 119.7 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.81 m/s
Discharge: 217 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.1°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s Rating No.: 1
Adj.Mean Vel: 0.00 m/s Qm Rating: U
Rated Area: 0.000 m2 Diff.: 0.000%
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.76 m/s
Max. Depth: 2.24 m
Mean Depth: 1.28 m
% Meas.: 71.80
Water Temp.: 0.4 °C
ADCP Temp.: 0.9 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS3 Channel 3

Project Name: DSS3_C3_20170527_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.22	0.91	217	31.8	155	27.8	0.112	0.011	215	94.0	120.8	12:17	12:20	0.66	1.78	0	0
001	R	1.22	0.91	238	32.6	153	27.8	0.087	0.030	214	92.2	116.7	12:20	12:23	0.61	1.83	0	0
002	L	1.22	0.91	243	32.1	155	28.4	0.094	0.013	216	95.6	122.7	12:23	12:26	0.60	1.76	0	0
003	R	1.22	0.91	207	33.2	155	28.7	0.060	0.009	217	92.6	115.7	12:26	12:28	0.73	1.88	0	0
004	L	1.22	0.91	218	31.6	157	28.7	0.074	0.026	217	95.0	122.8	12:28	12:31	0.65	1.77	0	0
005	R	1.22	0.91	238	34.2	158	29.8	0.093	0.014	222	93.5	116.7	12:31	12:33	0.61	1.90	0	0
006	L	1.22	0.91	236	31.9	160	28.6	0.086	0.022	220	95.0	124.0	12:34	12:36	0.60	1.78	0	0
007	R	1.22	0.91	230	32.7	154	29.0	0.059	0.019	216	93.2	118.5	12:36	12:39	0.61	1.82	0	0
Mean		1.22	0.91	228	32.5	156	28.6	0.083	0.018	217	93.9	119.7	**Total**	00:21	0.63	1.81	0	0
5Dev		0.00	0.00	13	0.872	2.09	0.658	0.018	0.008	2.67	1.2	3.2			0.04	0.05		
5D/M		0.00	0.00	0.06	0.03	0.01	0.02	0.22	0.42	0.01	0.01	0.03			0.07	0.03		

Remarks: Q with RiverPro 217 m3/s using BT with 1% error, 211 m3/s using VTG with 1% error.

Station Number: Meas. No.: 19

Station Name: Sagavanirktok River DSS3 Channel 3 Date: 05/28/2017

Party: DB/JH
Boat/Motor: 12' cataraft w 10 hp prop
Gauge Height: 289.07 m

Width: 98.4 m
Area: 118.5 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.76 m/s
Discharge: 209 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (17.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.076 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 4.18 m/s
Max. Depth: 1.86 m
Mean Depth: 1.20 m
% Meas.: 71.17
Water Temp.: 0.4 °C
ADCP Temp.: 1.0 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1129 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS3 Channel 3

Project Name: DSS3_C3_20170528_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	1.83	1.83	216	32.5	146	26.2	0.250	0.127	205	95.8	117.5	14:14	14:16	0.71	1.75	0	0
001	L	1.83	3.05	209	34.5	147	25.5	0.257	0.389	208	104.3	119.9	14:16	14:19	0.75	1.73	1	0
002	R	1.52	3.05	257	35.1	151	25.7	0.161	0.365	212	104.3	120.0	14:19	14:22	0.61	1.76	1	0
003	L	1.52	2.44	195	33.3	148	26.8	0.181	0.080	208	97.5	118.4	14:22	14:24	0.77	1.76	0	0
004	R	1.52	2.44	220	32.8	147	26.2	0.130	0.151	206	96.7	116.6	14:24	14:27	0.67	1.77	0	0
005	L	1.52	1.22	206	32.3	149	27.0	0.160	0.056	208	96.5	119.6	14:27	14:29	0.70	1.74	0	0
006	R	1.22	1.22	229	33.9	151	26.9	0.096	0.045	212	96.1	117.5	14:29	14:32	0.67	1.80	0	0
007	L	1.22	0.91	214	33.7	151	26.6	0.100	0.014	212	96.1	118.4	14:32	14:34	0.70	1.79	0	0
Mean		1.52	2.02	218	33.5	149	26.4	0.167	0.153	209	98.4	118.5	**Total**	00:20	0.70	1.76	0	0
5Dev		0.23	0.85	19	0.963	2.07	0.574	0.061	0.145	2.67	3.7	1.2			0.05	0.02		
5D/M		0.15	0.42	0.09	0.03	0.01	0.02	0.37	0.94	0.01	0.04	0.01			0.07	0.01		

Remarks: Q with RiverPro 209 m3/s using BT with 1% error, 207 m3/s using VTG with 1% error.

Station Number:
Station Name: Sagavanirktok River DSS3 Channel 3

Meas. No.: 20
Date: 05/29/2017

Party: DB/JH	Width: 99.9 m	Processed by: DV
Boat/Motor: 12' cataraft w 10 hp prop	Area: 121.7 m2	Mean Velocity: 1.82 m/s
Gauge Height: 289.10 m	G.H.Change: 0.000 m	Discharge: 222 m3/s

Area Method: Mean Flow	ADCP Depth: 0.076 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (20.5°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.78 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.87 m	Serial #: 1129	Firmware: 56.03
BT Error Vel.: 1.00 m/s	Mean Depth: 1.22 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 71.50	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: 0.3 °C	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.7 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS3 Channel 3

Project Name: DSS3_C3_20170529_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	1.22	2.44	224	33.9	158	27.0	0.116	0.069	219	96.8	119.6	12:04	12:07	0.69	1.83	0	0
001	L	1.22	2.44	241	36.7	158	28.0	0.126	0.211	223	103.3	120.1	12:07	12:09	0.79	1.85	0	0
002	R	1.52	2.44	210	34.8	163	27.7	0.181	0.224	226	98.8	123.2	12:10	12:12	0.77	1.83	2	0
003	L	1.52	2.13	213	35.7	159	26.6	0.267	0.131	222	99.8	122.1	12:12	12:15	0.71	1.81	0	0
004	R	1.52	2.13	208	34.6	158	26.8	0.134	0.099	220	99.6	121.8	12:16	12:18	0.75	1.80	0	0
005	L	1.52	2.13	226	35.8	158	29.8	0.181	0.106	224	98.9	120.4	12:18	12:21	0.69	1.86	0	0
006	R	1.52	2.13	212	34.6	158	28.8	0.190	0.125	222	99.8	122.3	12:21	12:23	0.74	1.81	0	0
007	L	1.52	2.13	214	35.6	159	27.5	0.172	0.169	223	101.9	124.0	12:23	12:26	0.73	1.80	0	0
Mean		1.45	2.25	218	35.2	159	27.8	0.171	0.142	222	99.9	121.7	**Total**	00:21	0.73	1.82	0	0
SDev		0.14	0.16	11	0.905	1.75	1.07	0.048	0.055	2.17	2.0	1.6			0.03	0.02		
SD/M		0.10	0.07	0.05	0.03	0.01	0.04	0.28	0.39	0.01	0.02	0.01			0.05	0.01		

Remarks: Q with RiverPro 222 m3/s using BT with 1% error, 220 m3/s using VTG with 2% error.

Station Number:

Station Name: Sagavanirktok River DSS3 Channel 3

Meas. No.: 21

Date: 05/30/2017

Party: DB/JH

Boat/Motor: 12' cataraft w 10 hp prop

Gauge Height: 289.13 m

Width: 99.3 m

Area: 121.5 m2

G.H.Change: 0.000 m

Processed by: DV

Mean Velocity: 1.81 m/s

Discharge: 220 m3/s

Area Method: Mean Flow

Nav. Method: Bottom Track

MagVar Method: None (16.5°)

Depth: Composite (BT)

Discharge Method: None

% Correction: 0.00

ADCP Depth: 0.076 m

Shore Ens.:10

Bottom Est: Power (0.1667)

Top Est: Power (0.1667)

Index Vel.: 0.00 m/s

Adj.Mean Vel: 0.00 m/s

Rated Area: 0.000 m2

Control1: Unspecified

Control2: Unspecified

Control3: Unspecified

Rating No.: 1

Qm Rating: U

Diff.: 0.000%

Screening Thresholds:

BT 3-Beam Solution: YES

WT 3-Beam Solution: YES

BT Error Vel.: 1.00 m/s

WT Error Vel.: 10.00 m/s

BT Up Vel.: 10.00 m/s

WT Up Vel.: 10.00 m/s

Use Weighted Mean Depth: YES

Max. Vel.: 4.01 m/s

Max. Depth: 1.76 m

Mean Depth: 1.22 m

% Meas.: 71.60

Water Temp.: 0.3 °C

ADCP Temp.: 0.4 °C

ADCP:

Type/Freq.: RiverPro/RioPro / 1200 kHz

Serial #: 1129

Firmware: 56.03

Bin Size: 2 cm

Blank: 10 cm

BT Mode: Auto

BT Pings: Dyn

WT Mode: Auto

WT Pings: Dyn

WZ : 5

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES   Evaluation: YES

Meas. Location: DSS3 Channel 3

Project Name: DSS3_C3_20170530_0.mmt

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	1.22	1.52	210	35.2	160	26.5	0.134	0.037	222	95.7	119.3	12:53	12:55	0.75	1.86	0	0
001	L	1.22	2.13	233	35.3	155	26.4	0.102	0.121	217	99.6	121.2	12:55	12:58	0.66	1.79	0	0
002	R	1.22	2.13	220	35.5	160	27.4	0.150	0.106	223	99.0	120.7	12:58	13:00	0.70	1.85	0	0
003	L	1.22	2.13	220	34.8	156	26.3	0.130	0.148	217	99.6	121.8	13:00	13:03	0.68	1.79	0	0
004	R	1.22	2.13	234	34.1	155	26.4	0.163	0.104	215	99.0	121.1	13:03	13:06	0.68	1.78	0	0
005	L	1.22	2.13	211	35.9	160	27.9	0.165	0.128	224	100.9	123.5	13:06	13:08	0.71	1.81	0	0
006	R	1.22	2.13	224	35.2	157	27.8	0.152	0.107	220	100.0	121.4	13:08	13:11	0.71	1.81	1	0
007	L	1.22	2.13	227	35.3	157	27.7	0.178	0.144	220	100.5	123.2	13:11	13:13	0.68	1.79	0	0
Mean		1.22	2.06	222	35.2	157	27.0	0.147	0.112	220	99.3	121.5	**Total**	00:20	0.70	1.81	0	0
5Dev		0.00	0.22	9	0.525	2.19	0.703	0.024	0.035	3.02	1.6	1.3			0.03	0.03		
5D/M		0.00	0.10	0.04	0.01	0.01	0.03	0.16	0.31	0.01	0.02	0.01			0.04	0.02		

Remarks: Q with RiverPro 220 m3/s using BT with 1% error, 219 m3/s using VTG with 1% error.

Station Number: Meas. No.: 22

Station Name: Sagavanirktok River DSS3 Date: 07/07/2017

Party: JK/JH	Width: 105.1 m	Processed by: DV
Boat/Motor: Kayak	Area: 92.8 m2	Mean Velocity: 1.16 m/s
Gauge Height: 288.78 m	G.H.Change: 0.000 m	Discharge: 106 m3/s

Area Method: Avg. Course	ADCP Depth: 0.060 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (17.6°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.41 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.70 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.932 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 68.20	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 13.6 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: NO

Performed Compass Calibration: YES   Evaluation: YES

Meas. Location: DSS3

Project Name: dss3_7072017q101cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.00	10.0	569	29.5	59.9	14.9	0.042	0.823	105	177.5	114.5	01:45	01:51	0.55	0.92	6	1
001	R	1.00	15.0	232	17.0	77.1	13.2	0.053	0.525	108	95.4	97.5	01:53	01:56	0.59	1.11	0	0
002	L	1.00	10.0	189	16.8	74.0	13.3	0.018	0.684	105	80.7	81.6	02:00	02:02	0.65	1.28	0	0
003	R	1.00	15.0	272	16.4	77.7	13.3	0.041	1.01	109	85.7	88.5	02:04	02:07	0.47	1.23	0	0
005	L	2.00	15.0	212	16.9	74.0	13.8	0.110	0.908	106	86.2	82.0	02:18	02:20	0.60	1.29	2	1
Mean		1.20	13.0	294	19.3	72.6	13.7	0.053	0.791	106	105.1	92.8	**Total**	00:35	0.57	1.16	2	1
5Dev		0.45	2.74	156	5.71	7.26	0.699	0.034	0.191	1.68	40.8	13.7			0.07	0.16		
5D/M		0.37	0.21	0.53	0.30	0.10	0.05	0.65	0.24	0.02	0.39	0.15			0.12	0.13		

Remarks: Q with RiverPro 106 m3/s using BT with 2% error, 100 m3/s using VTG with 3% error.

Station Number: Meas. No.: 23
Station Name: Sagavanirktok River DSS3 Date: 08/04/2017

Party: JB/JK
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: 289.18 m

Width: 154.2 m
Area: 165.0 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.26 m/s
Discharge: 206 m3/s

Area Method: Avg. Course
Nav. Method: Bottom Track
MagVar Method: None (17.6°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.72 m/s
Max. Depth: 1.80 m
Mean Depth: 1.07 m
% Meas.: 69.25
Water Temp.: None
ADCP Temp.: 10.9 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 6 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS3

Project Name: sag_08042017_dss3_214cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	2.00	5.00	238	32.5	144	25.9	1.03	0.045	203	163.3	191.3	10:46	10:49	1.01	1.06	0	0
001	L	2.00	5.00	318	36.5	141	29.6	0.482	0.073	207	150.1	150.3	10:49	10:53	0.79	1.38	0	0
002	R	2.00	5.00	283	34.1	147	26.7	0.790	0.033	209	153.3	168.8	10:53	10:56	0.82	1.24	0	0
003	L	2.00	5.00	336	37.0	140	28.2	0.340	0.524	206	150.2	149.5	10:57	11:01	0.66	1.38	0	0
Mean		2.00	5.00	293	35.0	143	27.6	0.662	0.169	206	154.2	165.0	**Total**	00:14	0.82	1.26	0	0
SDev		0.00	0.00	43	2.12	3.56	1.66	0.312	0.237	2.48	6.3	19.7			0.14	0.15		
SD/M		0.00	0.00	0.15	0.06	0.02	0.06	0.47	1.41	0.01	0.04	0.12			0.18	0.12		

Remarks: Q with RiverPro 206 m3/s using BT with 1% error, 205 m3/s using VTG with 2% error.

Station Number:

Station Name: Sagavanirktok River DSS3

Meas. No.: 24

Date: 09/05/2017

Party: JK/KP
Boat/Motor: Kayak
Gauge Height: 289.09 m

Width: 129.6 m
Area: 120.5 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.59 m/s
Discharge: 191 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: On Site (18.0°)
Depth: Composite (BT)
Discharge Method: Proportional
% Correction: 1.33

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:

BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 6.86 m/s
Max. Depth: 1.42 m
Mean Depth: 0.930 m
% Meas.: 64.79
Water Temp.: None
ADCP Temp.: 4.3 °C

ADCP:

Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243
Firmware: 56.04
Bin Size: 6 cm
Blank: 10 cm
BT Mode: Auto
BT Pings: Dyn
WT Mode: Auto
WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS3

Project Name: DSS3_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	2.00	4.00	343	38.4	126	27.7	0.834	0.580	193	132.0	124.2	09:23	09:27	0.64	1.56	1	1
001	L	2.00	4.00	363	38.6	124	28.6	0.881	0.373	192	128.3	117.7	09:27	09:31	0.58	1.63	0	0
002	R	2.00	4.00	311	38.2	125	27.6	0.628	0.308	192	130.4	122.8	09:32	09:36	0.69	1.56	0	1
003	L	2.00	4.00	384	38.0	121	27.5	0.777	0.516	188	127.7	117.2	09:36	09:40	0.56	1.60	0	1
Mean		2.00	4.00	350	38.3	124	27.8	0.780	0.444	191	129.6	120.5	**Total**	00:16	0.62	1.59	0	1
5Dev		0.00	0.00	31	0.249	2.33	0.515	0.110	0.125	2.53	2.0	3.6			0.06	0.03		
5D/M		0.00	0.00	0.09	0.01	0.02	0.02	0.14	0.28	0.01	0.02	0.03			0.10	0.02		

Remarks: Q with RiverPro 191 m3/s using BT with 1% error, no GPS.

Station Number:
Station Name: Sagavanirktok River ASS1 Channel 1

Meas. No.: 1
Date: 07/01/2016

Party: JK/TT
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: N/A

Width: 69.8 m
Area: 102.6 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.98 m/
s Discharge: 203 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None
(19.0°) Depth: Composite
(BT) Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.60 m/s
Max. Depth: 2.43 m
Mean Depth: 1.47 m
% Meas.: 74.09
Water Temp.: None
ADCP Temp.: 16.5 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 12813 Firmware: 56.03
Bin Size: 6 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: ASS1 Channel 1

Project name: ass1 ch1 20160701q203cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	2.00	6.00	271	23.5	147	25.9	0.688	0.296	197	70.0	102.2	15:31	15:34	0.46	1.93	3	11
001	L	2.00	6.00	248	25.5	151	26.8	0.597	0.334	204	69.8	101.9	15:35	15:38	0.39	2.00	0	5
002	R	2.00	6.00	228	25.1	153	26.0	0.513	0.371	205	69.7	103.5	15:39	15:41	0.53	1.98	1	6
003	L	2.00	6.00	304	25.8	150	27.6	0.550	0.526	205	69.8	102.6	15:42	15:46	0.34	2.00	0	4
Mean		2.00	6.00	262	25.0	150	26.6	0.587	0.382	203	69.8	102.6	**Total**	00:14	0.43	1.98	1	7
5Dev		0.00	0.00	33	1.02	2.65	0.781	0.076	0.101	3.84	0.2	0.7			0.08	0.03		
5D/M		0.00	0.00	0.12	0.04	0.02	0.03	0.13	0.26	0.02	0.00	0.01			0.19	0.02		

Remarks: Q with RiverPro 203 m3/s using BT with 2% error, 202 m3/s using VTG with 2% error. Two channels, total Q 203+47=250 m3/s.

Station Number:
Station Name: Sagavanirktok River ASS1 Channel 2

Meas. No.: 1
Date: 07/01/2016

Party: JK/TT
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: N/A

Width: 83.4 m
Area: 64.6 m2
G.H.Change: 0.000 m

Processed by: DV Mean
Velocity: 0.733 m/s
Discharge: 47.3 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (19.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.40 m/s
Max. Depth: 1.51 m
Mean Depth: 0.774 m
% Meas.: 59.93
Water Temp.: None
ADCP Temp.: 16.7 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 12813 Firmware: 56.03
Bin Size: 6 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: ASS1 Channel 2

Project name: ass1 ch2 20160701q47cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	5.00	2.00	400	13.7	28.7	5.13	0.056	0.049	47.6	86.9	67.6	14:48	14:51	0.41	0.70	1	14
001	R	4.00	2.00	406	13.5	28.4	4.82	0.269	0.045	47.0	81.9	62.9	14:52	14:55	0.39	0.75	1	12
002	L	4.00	2.00	487	14.2	28.3	4.99	0.288	0.043	47.9	82.2	62.9	14:56	15:00	0.33	0.76	1	12
003	R	4.00	2.00	528	13.4	28.0	4.90	0.279	0.064	46.7	82.8	65.1	15:00	15:05	0.31	0.72	2	13
Mean		4.25	2.00	455	13.7	28.3	4.96	0.223	0.050	47.3	83.4	64.6	**Tota1**	00:17	0.36	0.73	1	13
5Dev		0.50	0.00	63	0.347	0.273	0.130	0.112	0.010	0.529	2.3	2.2			0.05	0.03		
5D/M		0.12	0.00	0.14	0.03	0.01	0.03	0.50	0.19	0.01	0.03	0.03			0.13	0.04		

Remarks: Q with RiverPro 47 m3/s using BT with 1% error, 46 m3/s using VTG with 3% error. Two channels, total Q 203+47=250 m3/s.

Station Number:
Station Name: Sagavanirktok River ASS1

Meas. No.: 2
Date: 08/03/2016

Party: JK/TT
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: 238.01 m

Width: 58.1 m
Area: 81.7 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.58 m/s
Discharge: 129 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.6°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.26 m/s
Max. Depth: 2.66 m
Mean Depth: 1.41 m
% Meas.: 75.53
Water Temp.: None
ADCP Temp.: 8.5 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 12813 Firmware: 56.03
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: ASS1

Project Name: ass1_20160803q129cms.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	7.00	1.00	348	14.7	96.8	16.6	0.260	0.293	129	58.4	82.4	14:20	14:24	0.39	1.56	0	14
002	L	7.00	1.00	356	14.6	97.1	17.0	0.343	0.142	129	59.4	82.4	14:29	14:33	0.34	1.57	0	11
003	R	7.00	1.00	250	14.7	98.6	15.7	0.342	0.170	130	56.5	80.3	14:34	14:37	0.39	1.61	2	8
Mean		7.00	1.00	318	14.7	97.5	16.4	0.315	0.202	129	58.1	81.7	**Total**	00:16	0.37	1.58	1	11
5Dev		0.00	0.00	59	0.060	0.978	0.638	0.048	0.080	0.451	1.5	1.2			0.03	0.03		
5D/M		0.00	0.00	0.19	0.00	0.01	0.04	0.15	0.40	0.00	0.03	0.01			0.07	0.02		

Remarks: Q with RiverPro 129 m3/s using BT with 0% error, 128 m3/s using VTG with 1% error.

Station Number:
Station Name: Sagavanirktok River ASS1

Meas. No.: 3
Date: 08/30/2016

Party: JH/JK	Width: 61.6 m	Processed by: DV
Boat/Motor: 15' Jon boat w 40 hp jet	Area: 79.8 m2	Mean Velocity: 1.62 m/s
Gauge Height: N/A	G.H.Change: 0.000 m	Discharge: 129 m3/s

Area Method: Mean Flow	ADCP Depth: 0.060 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.6°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.33 m/s	Type/Freq.: StreamPro / 2000 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.62 m	Serial #: 12813	Firmware: 31.12
BT Error Vel.: 1.00 m/s	Mean Depth: 1.30 m	Bin Size: 10 cm	Blank: 3 cm
WT Error Vel.: 10.00 m/s	% Meas.: 73.20	BT Mode: 10	BT Pings: 2
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: 12	WT Pings: 6
WT Up Vel.: 10.00 m/s	ADCP Temp.: 11.9 °C	WV : 170	WO : 1, 4
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: ASS1

Project Name: ass1_20160830q129cms.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	7.00	1.00	287	17.4	95.0	17.1	0.367	0.121	130	62.2	80.4	00:30	00:33	0.36	1.62	2	12
001	R	9.00	1.00	264	18.0	92.6	16.8	0.767	0.188	128	62.7	78.2	00:33	00:36	0.36	1.64	0	8
002	L	9.00	1.00	297	17.8	92.7	16.8	0.803	0.216	128	62.9	79.4	00:37	00:40	0.33	1.62	0	8
003	R	9.00	1.00	261	15.0	97.0	16.1	0.554	0.098	129	58.8	81.2	00:41	00:44	0.36	1.59	1	8
Mean		8.50	1.00	277	17.1	94.3	16.7	0.623	0.156	129	61.6	79.8	**Total**	00:13	0.36	1.62	1	9
SDev		1.00	0.00	18	1.40	2.08	0.434	0.203	0.055	0.764	1.9	1.3			0.02	0.02		
SD/M		0.12	0.00	0.06	0.08	0.02	0.03	0.33	0.36	0.01	0.03	0.02			0.05	0.01		

Remarks: Q with RiverPro 129 m3/s using BT with 1% error, 127 m3/s using VTG with 2% error.

Station Number:
Station Name: Sagavanirktok River ASS1

Meas. No.: 4
Date: 07/07/2017

Party: JK/JH
Boat/Motor: Kayak
Gauge Height: N/A

Width: 58.4 m
Area: 75.4 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.43 m/s
Discharge: 108 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.3°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.37 m/s
Max. Depth: 2.58 m
Mean Depth: 1.29 m
% Meas.: 75.70
Water Temp.: None
ADCP Temp.: 16.4 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: ASS1

Project Name: ass1_7072017q104cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	10.0	2.00	209	11.8	82.8	13.2	0.591	0.574	109	58.0	76.8	06:30	06:33	0.50	1.42	0	4
002	R	15.0	2.00	171	11.4	81.9	14.0	1.28	0.673	109	58.5	72.9	06:40	06:42	0.42	1.50	2	0
003	L	15.0	2.00	219	11.0	81.2	13.3	1.07	0.360	107	59.8	77.8	06:43	06:45	0.41	1.37	1	3
004	R	12.0	2.00	185	11.2	80.8	13.3	0.907	0.299	106	57.4	74.1	06:46	06:48	0.40	1.44	2	1
Mean		13.0	2.00	196	11.3	81.7	13.4	0.961	0.476	108	58.4	75.4	**Total**	00:17	0.43	1.43	1	2
5Dev		2.45	0.00	22	0.356	0.894	0.373	0.290	0.176	1.46	1.0	2.3			0.05	0.05		
5D/M		0.19	0.00	0.11	0.03	0.01	0.03	0.30	0.37	0.01	0.02	0.03			0.11	0.04		

Remarks: Q with RiverPro 108 m3/s using BT with 1% error, 104 m3/s using VTG with 3% error.

Station Number: Meas. No.: 5
Station Name: Sagavanirktok River DSS2 Channel 1 Date: 06/25/2016

Party: JK/TT
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: 135.53 m

Width: 272.3 m Area: 284.4 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.70 m/s
Discharge: 482 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (19.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.78 m/s
Max. Depth: 2.83 m
Mean Depth: 1.04 m
% Meas.: 66.38
Water Temp.: None
ADCP Temp.: 12.1 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 12813 Firmware: 56.03
Bin Size: 50 cm Blank: 50 cm
BT Mode: 0 BT Pings: 1
WT Mode: 1 WT Pings: 1
WV : 170

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS2 Channel 1

Project Name: dss2 20160625q482cms.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	5.00	4.00	705	101	318	66.0	0.385	-0.013	485	273.2	281.6	05:52	05:59	0.71	1.72	12	15
001	L	5.00	4.00	746	97.1	319	60.7	0.312	0.161	477	272.7	286.2	06:02	06:09	0.68	1.67	1	14
002	R	8.00	4.00	698	100	320	62.7	0.612	-0.121	484	266.1	278.2	06:12	06:19	0.75	1.74	1	13
003	L	8.00	3.00	880	99.1	322	59.6	0.530	0.015	482	277.4	291.5	06:21	06:29	0.66	1.65	2	14
Mean		6.50	3.75	757	99.3	320	62.2	0.460	0.010	482	272.3	284.4	**Total**	00:37	0.70	1.70	4	14
5Dev		1.73	0.50	85	1.63	1.85	2.79	0.136	0.116	3.57	4.7	5.8			0.04	0.04		
5D/M		0.27	0.13	0.11	0.02	0.01	0.04	0.30	11.07	0.01	0.02	0.02			0.06	0.03		

Remarks: Q with RiverPro 482 m3/s using BT with 1% error, 463 m3/s using VTG with 3% error. Two channels, total Q 482+2=484 m3/s.

Station Number:
Meas. No.: 5

Station Name: Sagavanirktok River DSS2 Channel 2
Date: 06/25/2016

Party: JK/TT	Width: 13.9 m	Processed by: DV Mean
Boat/Motor: 15' Jon boat w 40 hp jet	Area: 6.0 m2	Velocity: 0.338 m/s
Gauge Height: 135.53 m	G.H.Change: 0.000 m	Discharge: 2.03 m3/s

Area Method: Avg. Course	ADCP Depth: 0.060 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (19.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.19 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.742 m	Serial #: 12813	Firmware: 56.03
BT Error Vel.: 1.00 m/s	Mean Depth: 0.432 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 44.67	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 11.4 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: NO   Evaluation: NO
Meas. Location: DSS2

Project Name: ivaskside-6-25-16_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	2.00	2.00	215	0.816	0.931	0.221	-0.012	0.080	2.04	14.1	6.0	06:59	07:01	0.11	0.34	7	30
001	R	2.00	2.00	144	0.859	0.881	0.232	-0.020	0.068	2.02	13.8	6.1	07:01	07:03	0.13	0.33	3	27
Mean		2.00	2.00	179	0.837	0.906	0.227	-0.016	0.074	2.03	13.9	6.0	**Total**	00:03	0.12	0.34	5	29
5Dev		0.00	0.00	50	0.030	0.035	0.008	0.006	0.008	0.010	0.2	0.1			0.01	0.01		
5D/M		0.00	0.00	0.28	0.04	0.04	0.03	0.35	0.11	0.00	0.02	0.01			0.09	0.02		

Remarks: Q with RiverPro 2 m3/s using BT with 1% error, no GPS data. Two channels, total Q 482+2=484 m3/s.

Station Number:
Station Name: Sagavanirktok River DSS2

Meas. No.: 6
Date: 08/02/2016

Party: JK/TT
Boat/Motor: Kayak
Gauge Height: 135.04 m

Width: 116.7 m Area: 165.7 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.17 m/s
Discharge: 192 m3/s

Area Method: Avg. Course
Nav. Method: Bottom Track
MagVar Method: None (18.7°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.140 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 0.10 m/s
WT Error Vel.: 0.30 m/s
BT Up Vel.: 0.30 m/s
WT Up Vel.: 2.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.49 m/s
Max. Depth: 2.72 m
Mean Depth: 1.42 m
% Meas.: 72.70
Water Temp.: None
ADCP Temp.: 8.4 °C

ADCP:
Type/Freq.: StreamPro / 2000 kHz
Serial #: 1180 Firmware: 31.12
Bin Size: 10 cm Blank: 3 cm
BT Mode: 10 BT Pings: 2
WT Mode: 12 WT Pings: 6

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS2

Project Name: dss2 20160802q192cms.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	15.0	15.0	192	29.1	146	20.2	1.02	1.18	198	112.9	152.8	12:09	12:14	0.43	1.29	1	1
001	R	15.0	15.0	130	28.7	140	21.5	1.66	1.71	193	117.4	172.8	12:16	12:19	0.63	1.12	8	3
003	R	20.0	15.0	124	27.2	133	21.0	2.04	2.03	186	119.8	171.5	12:33	12:36	0.63	1.08	2	3
Mean		16.7	15.0	148	28.3	140	20.9	1.58	1.64	192	116.7	165.7	**Total**	00:26	0.56	1.17	3	2
5Dev		2.89	0.00	38	1.03	6.46	0.697	0.518	0.429	6.14	3.5	11.2			0.11	0.11		
5D/M		0.17	0.00	0.25	0.04	0.05	0.03	0.33	0.26	0.03	0.03	0.07			0.20	0.10		

Remarks: Q with StreamPro 192 m3/s using BT with 3% error, 176 m3/s using VTG with 3% error.

Station Number: Meas. No.: 7

Station Name: Sagavanirktok River DSS2 Date: 08/31/2016

Party: JH/JK	Width: 103.1 m Area:	Processed by: DV
Boat/Motor: Kayak	162.1 m2	Mean Velocity: 1.40 m/s
Gauge Height: 135.14 m	G.H.Change: 0.000 m	Discharge: 227 m3/s

Area Method: Mean Flow	ADCP Depth: 0.170 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: DGPS	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.7°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
		Control2: Unspecified	
		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.31 m/s	Type/Freq.: StreamPro / 2000 kHz	
WT 3-Beam Solution: YES	Max. Depth: 3.11 m	Serial #: 1180	Firmware: 31.12
BT Error Vel.: 0.10 m/s	Mean Depth: 1.57 m	Bin Size: 10 cm	Blank: 3 cm
WT Error Vel.: 0.30 m/s	% Meas.: 74.31	BT Mode: 10	BT Pings: 2
BT Up Vel.: 0.30 m/s*	Water Temp.: None	WT Mode: 12	WT Pings: 6
WT Up Vel.: 3.50 m/s	ADCP Temp.: 8.8 °C		
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: NO

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS2

Project Name: dss2 20160831q227cms.mmt

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
002	L	6.00	20.0	115	30.5	175	27.1	0.370	1.47	234	98.9	161.5	12:04	12:07	0.76	1.45	0	3
003	*R*	*8.00*	*20.0*	*148*	*28.6*	*158*	*23.0*	*0.797*	*1.01*	*212*	*100.6*	*158.4*	*12:08*	*12:11*	*0.82*	*1.34*	*4*	*6*
004	*L*	*7.00*	*20.0*	*85*	*31.8*	*180*	*25.7*	*0.228*	*3.25*	*241*	*100.3*	*161.8*	*12:13*	*12:15*	*0.92*	*1.49*	*0*	*4*
005	R	*10.0*	*20.0*	*133*	*31.5*	*162*	*23.2*	*1.08*	*1.50*	*219*	*105.3*	*161.8*	*12:15*	*12:18*	*0.71*	*1.35*	*5*	*4*
006	L	*10.0*	*20.0*	*97*	*32.1*	*174*	*23.2*	*0.670*	*3.33*	*234*	*105.4*	*163.6*	*12:21*	*12:23*	*0.88*	*1.43*	*0*	*3*
007	R	*10.0*	*20.0*	*123*	*31.1*	*161*	*24.9*	*1.28*	*1.66*	*220*	*107.8*	*165.6*	*12:23*	*12:26*	*0.72*	*1.33*	*0*	*5*
Mean		8.50	20.0	116	30.9	168	24.5	0.738	2.04	227	103.1	162.1	**Total**	00:21	0.80	1.40	2	4
5Dev		1.76	0.00	23	1.27	9.25	1.66	0.404	0.994	11.4	3.6	2.4			0.09	0.07		
5D/M		0.21	0.00	0.20	0.04	0.05	0.07	0.55	0.49	0.05	0.03	0.01			0.11	0.05		

Remarks: Q with StreamPro 221 m3/s using BT with 10% error, 227 m3/s using VTG with 5% error.

Discharge for transects in *italics* have a total Q more than 5% from the mean

*value not consistent for all transects

Station Number: Meas. No.: 8

Station Name: Sagavanirktok River DSS2 Channel 1 Date: 05/27/2017

Party: JK/HT/JB	Width: 115.9 m	Processed by: DV
Boat/Motor: Helicopter	Area: 229.9 m2	Mean Velocity: 1.98 m/s
Gauge Height: 136.21 m	G.H.Change: 0.000 m	Discharge: 454 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.76 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 3.91 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 1.99 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 77.83	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.1 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS2 Channel 1

Project Name: sag20170527_dss2ch1_q455cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	1.00	3.00	195	39.6	349	61.4	0.144	0.217	450	122.1	238.7	12:17	12:19	1.06	1.89	2	0
001	R	1.00	1.00	135	38.1	348	56.7	0.378	0.053	443	115.2	224.4	12:19	12:21	1.45	1.98	13	0
002	L	1.00	1.00	139	38.6	348	60.2	0.177	0.073	447	118.1	239.4	12:21	12:23	1.40	1.87	4	0
003	R	1.00	2.00	123	39.7	370	67.0	0.222	0.341	477	108.0	217.3	12:24	12:25	1.53	2.20	1	0
Mean		1.00	1.75	148	39.0	354	61.3	0.230	0.171	454	115.9	229.9	**Total**	00:08	1.36	1.98	5	0
5Dev		0.00	0.96	32	0.762	10.8	4.24	0.104	0.135	15.4	5.9	10.9			0.21	0.15		
5D/M		0.00	0.55	0.22	0.02	0.03	0.07	0.45	0.79	0.03	0.05	0.05			0.15	0.08		

Remarks: Q with RiverPro 455 m3/s using BT with 3% error, 415 m3/s using VTG with 4% error. Four channels, total Q 455+20.3+70+7.2=552.5 m3/s.

Station Number: Meas. No.: 8

Station Name: Sagavanirktok River DSS2 Channel 2 Date: 05/27/2017

Party: JK/HT/JB	Width: 44.8 m	Processed by: DV
Boat/Motor: Helicopter	Area: 20.2 m2	Mean Velocity: 1.01 m/s
Gauge Height: 136.21 m	G.H.Change: 0.000 m	Discharge: 20.3 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.58 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.885 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.450 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 55.32	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.1 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS2 Channel 2

Project Name: sag20170527_dss2ch2_q20cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
004	L	2.00	5.00	94	6.68	11.3	2.18	0.042	0.171	20.3	45.6	21.2	12:28	12:29	0.92	0.96	4	0
005	R	1.00	3.00	93	6.43	11.5	2.71	0.275	0.054	21.0	45.9	21.4	12:29	12:30	0.83	0.98	19	0
006	L	3.00	3.00	94	5.84	11.1	2.26	0.870	0.064	20.1	42.4	19.1	12:31	12:32	0.83	1.05	9	0
007	R	2.00	8.00	105	6.18	11.0	2.19	0.168	0.137	19.7	45.3	19.0	12:33	12:34	0.83	1.04	7	0
Mean		2.00	4.75	96	6.28	11.2	2.34	0.339	0.107	20.3	44.8	20.2	**Total**	00:05	0.85	1.01	10	0
5Dev		0.82	2.36	6	0.358	0.222	0.251	0.367	0.057	0.534	1.6	1.3			0.04	0.05		
5D/M		0.41	0.50	0.06	0.06	0.02	0.11	1.08	0.53	0.03	0.04	0.07			0.05	0.05		

Remarks: Q with RiverPro 20.3 m3/s using BT with 3% error, 19.7 m3/s using VTG with 4% error. Four channels, total Q 455+20.3+70+7.2=552.5 m3/s.

Station Number: Meas. No.: 8

Station Name: Sagavanirktok River DSS2 Channel 3 Date: 05/27/2017

Party: JK/HT/JB	Width: 93.7 m	Processed by: DV
Boat/Motor: Helicopter	Area: 43.2 m2	Mean Velocity: 1.62 m/s
Gauge Height: 136.21 m	G.H.Change: 0.000 m	Discharge: 70.0 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.40 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.955 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.462 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 52.68	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.0 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS2 Channel 3

Project Name: sag20170527_dss2ch3_q70cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
008	L	8.00	10.0	112	20.3	38.8	11.3	0.663	0.991	72.1	92.4	44.2	12:36	12:37	1.17	1.63	6	0
009	R	10.0	12.0	128	20.1	35.2	11.9	0.899	1.56	69.7	93.1	42.5	12:37	12:39	0.97	1.64	2	0
010	L	10.0	15.0	103	18.8	36.9	10.5	0.737	1.80	68.7	99.1	45.0	12:39	12:40	1.26	1.53	3	0
011	R	10.0	12.0	118	20.1	36.7	10.6	0.779	1.49	69.6	90.2	41.3	12:40	12:41	1.04	1.69	3	0
Mean		9.50	12.3	115	19.9	36.9	11.1	0.770	1.46	70.0	93.7	43.2	**Total**	00:05	1.11	1.62	4	0
SDev		1.00	2.06	11	0.683	1.45	0.670	0.099	0.342	1.43	3.8	1.6			0.13	0.07		
SD/M		0.11	0.17	0.09	0.03	0.04	0.06	0.13	0.23	0.02	0.04	0.04			0.12	0.04		

Remarks: Q with RiverPro 70 m3/s using BT with 2% error, 67 m3/s using VTG with 3% error. Four channels, total Q 455+20.3+70+7.2=552.5 m3/s.

Station Number:
Station Name: Sagavanirktok River DSS2 Channel 4

Meas. No.: 8
Date: 05/27/2017

Party: JK/HT/JB	Width: 68.6 m	Processed by: DV
Boat/Motor: Helicopter	Area: 12.1 m2	Mean Velocity: 0.593 m/s
Gauge Height: 136.21 m	G.H.Change: 0.000 m	Discharge: 7.19 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 1.16 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.317 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.177 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 14.76	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.7 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: DSS2 Channel 4

Project Name: sag20170527_dss2ch4_q7cms.
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
012	L	30.0	12.0	65	2.60	1.06	0.439	2.61	0.472	7.19	68.6	12.1	12:44	12:45	0.81	0.59	9	0
Mean		30.0	12.0	65	2.60	1.06	0.439	2.61	0.472	7.19	68.6	12.1	**Total**	00:00	0.81	0.59	9	0
SDev																		
SD/M																		

Remarks: Q with RiverPro 7.2 m3/s using BT, 6.7 m3/s using VTG, 1 transect only. Four channels, total Q 455+20.3+70+7.2=552.5 m3/s.

Station Number: Meas. No.: 9

Station Name: Sagavanirktok River DSS2 Channel 1 Date: 05/28/2017

Party: JK/HT/JB
Width: 126.9 m
Processed by: DV
Boat/Motor: Helicopter
Area: 224.4 m2
Mean Velocity: 2.40 m/s
Gauge Height: 136.20 m
G.H.Change: 0.000 m
Discharge: 536 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 8.13

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Rating No.: 1
Adj.Mean Vel: 0.00 m/s
Qm Rating: U
Rated Area: 0.000 m2
Diff.: 0.000%
Control1: 14-Shore Ice
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.94 m/s
Max. Depth: 3.65 m
Mean Depth: 1.77 m
% Meas.: 76.27
Water Temp.: None
ADCP Temp.: 0.9 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243
Firmware: 56.04
Bin Size: 6 cm
Blank: 10 cm
BT Mode: Auto
BT Pings: Dyn
WT Mode: Auto
WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS2 Channel 1

Project Name: sag20170528_dss2ch1_q536cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	3.00	15.0	135	49.3	409	78.9	0.290	3.99	542	133.1	239.0	10:00	10:01	1.47	2.27	1	0
001	R	2.00	15.0	113	47.3	411	74.5	0.019	2.73	535	123.5	208.1	10:01	10:03	1.67	2.57	4	0
002	L	2.00	15.0	126	46.9	421	72.9	1.61	3.52	546	128.1	231.7	10:03	10:05	1.36	2.36	1	1
003	R	1.00	15.0	121	46.5	405	84.4	0.801	1.44	538	118.9	207.2	10:05	10:06	1.47	2.60	1	1
004	L	2.00	15.0	119	45.0	400	70.2	1.62	5.03	522	129.2	231.4	10:07	10:08	1.33	2.25	1	0
005	R	3.00	15.0	117	46.6	408	76.1	1.27	2.22	534	128.8	228.9	10:08	10:10	1.45	2.33	1	0
Mean		2.17	15.0	121	46.9	409	76.2	0.934	3.15	536	126.9	224.4	**Total**	00:10	1.46	2.40	1	0
5Dev		0.75	0.00	8	1.42	7.01	5.00	0.679	1.29	8.31	5.0	13.4			0.12	0.15		
5D/M		0.35	0.00	0.06	0.03	0.02	0.07	0.73	0.41	0.02	0.04	0.06			0.08	0.06		

Remarks: Q with RiverPro 536 m3/s using BT with 2% error, 465 m3/s using VTG with 8% error. Four channels, total Q 536+29.7+89+19.4=674.1 m3/s.

Station Number: Meas. No.: 9

Station Name: Sagavanirktok River DSS2 Channel 2 Date: 05/28/2017

Party: JK/HT/JB	Width: 36.5 m	Processed by: DV
Boat/Motor: Helicopter	Area: 25.1 m2	Mean Velocity: 1.18 m/s
Gauge Height: 136.20 m	G.H.Change: 0.000 m	Discharge: 29.7 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 14.56		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.04 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.915 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.687 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 63.40	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.0 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS2 Channel 2

Project Name: sag20170528_dss2ch2_q25cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
010	L	2.00	5.00	70	6.48	18.4	3.16	0.383	0.478	28.9	36.5	25.2	10:19	10:20	0.84	1.15	0	0
011	R	3.00	5.00	73	6.55	18.2	3.32	0.628	0.358	29.0	37.4	25.5	10:20	10:21	0.79	1.14	0	0
012	L	3.00	2.00	67	6.72	19.2	3.42	0.396	0.037	29.8	37.4	25.9	10:21	10:22	0.91	1.15	0	0
013	R	2.00	2.00	105	7.28	19.4	3.86	0.413	-0.010	31.0	34.8	23.9	10:22	10:23	0.61	1.30	0	0
Mean		2.50	3.50	78	6.76	18.8	3.44	0.455	0.216	29.7	36.5	25.1	**Total**	00:03	0.79	1.18	0	0
5Dev		0.58	1.73	18	0.362	0.602	0.301	0.116	0.239	0.940	1.2	0.9			0.13	0.08		
5D/M		0.23	0.49	0.23	0.05	0.03	0.09	0.25	1.11	0.03	0.03	0.04			0.16	0.06		

Remarks: Q with RiverPro 29.7 m3/s using BT with 3% error, 25.3 m3/s using VTG with 2% error. Four channels, total Q 536+29.7+89+19.4=674.1 m3/s.

Station Number: Meas. No.: 9

Station Name: Sagavanirktok River DSS2 Channel 3 Date: 05/28/2017

Party: JK/HT/JB	Width: 88.6 m	Processed by: DV
Boat/Motor: Helicopter	Area: 48.0 m2	Mean Velocity: 1.85 m/s
Gauge Height: 136.20 m	G.H.Change: 0.000 m	Discharge: 88.9 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 7.07		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.47 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.13 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.542 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 57.62	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.0 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS2 Channel 3

Project Name: sag20170528_dss2ch3_q89cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
006	L	20.0	3.00	86	20.9	51.3	13.8	1.61	0.925	88.5	86.9	48.2	10:13	10:14	1.24	1.84	6	1
007	R	20.0	3.00	98	20.3	50.0	13.4	1.73	0.631	86.0	82.9	45.1	10:14	10:15	1.07	1.91	12	0
008	L	20.0	6.00	92	21.4	50.9	14.3	1.63	1.14	89.4	90.9	49.4	10:15	10:16	1.10	1.81	7	0
009	R	20.0	6.00	95	22.5	52.6	14.0	1.75	0.687	91.6	93.8	49.3	10:16	10:17	1.21	1.86	9	2
Mean		20.0	4.50	92	21.3	51.2	13.9	1.68	0.846	88.9	88.6	48.0	**Total**	00:04	1.15	1.85	9	1
SDev		0.00	1.73	5	0.933	1.09	0.393	0.071	0.234	2.29	4.8	2.0			0.08	0.04		
SD/M		0.00	0.38	0.06	0.04	0.02	0.03	0.04	0.28	0.03	0.05	0.04			0.07	0.02		

Remarks: Q with RiverPro 89 m3/s using BT with 3% error, 80 m3/s using VTG with 4% error. Four channels, total Q 536+29.7+89+19.4=674.1 m3/s.

Station Number:
Station Name: Sagavanirktok River DSS2 Channel 4

Meas. No.: 9
Date: 05/28/2017

Party: JK/HT/JB	Width: 91.1 m	Processed by: DV
Boat/Motor: Helicopter	Area: 24.6 m2	Mean Velocity: 0.789 m/s
Gauge Height: 136.20 m	G.H.Change: 0.000 m	Discharge: 19.4 m3/s

Area Method: Avg. Course	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 14.55		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.48 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.390 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.270 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 28.24	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.7 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: DSS2 Channel 4

Project Name: sag20170528_dss2ch4_q19cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
014	L	15.0	10.0	120	10.0	5.49	1.93	1.22	0.739	19.4	91.1	24.6	10:26	10:27	0.98	0.79	5	1
Mean		15.0	10.0	120	10.0	5.49	1.93	1.22	0.739	19.4	91.1	24.6	**Total**	00:01	0.98	0.79	5	1
SDev																		
SD/M																		

Remarks: Q with RiverPro 19.4 m3/s using BT, 15.9 m3/s using VTG, one transect only. Four channels, total Q 536+29.7+89+19.4=674.1 m3/s.

Station Number: Meas. No.: 10

Station Name: Sagavanirktok River DSS2 Date: 07/09/2017

Party: JK/JH	Width: 85.6 m	Processed by: DV
Boat/Motor: Kayak	Area: 121.3 m2	Mean Velocity: 1.46 m/s
Gauge Height: 135.38 m	G.H.Change: 0.000 m	Discharge: 178 m3/s

Area Method: Mean Flow	ADCP Depth: 0.060 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.7°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 4.42 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.14 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 1.42 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 74.87	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 12.5 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: NO

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS2

Project Name: dss2_7092017q172cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	2.00	10.0	317	22.9	134	21.3	0.050	0.770	179	86.5	122.0	09:42	09:46	0.46	1.47	4	8
001	R	3.00	5.00	223	21.7	131	21.4	0.089	0.215	175	86.0	121.6	09:48	09:51	0.62	1.44	2	11
002	L	3.00	10.0	244	22.8	134	21.3	0.084	0.882	179	86.1	121.8	09:51	09:54	0.60	1.47	2	5
003	R	3.00	5.00	203	22.6	133	22.2	0.112	0.231	179	83.8	119.7	09:57	09:59	0.71	1.49	2	12
Mean		2.75	7.50	246	22.5	133	21.5	0.084	0.525	178	85.6	121.3	**Total**	00:17	0.60	1.46	3	9
5Dev		0.50	2.89	50	0.550	1.20	0.463	0.026	0.351	2.04	1.2	1.1			0.10	0.02		
5D/M		0.18	0.38	0.20	0.02	0.01	0.02	0.31	0.67	0.01	0.01	0.01			0.17	0.02		

Remarks: Q with RiverPro 178 m3/s using BT with 1% error, 172 m3/s using VTG with 2% error.

Station Number: Meas. No.: 11

Station Name: Sagavanirktok River DSS2 Date: 08/06/2017

Party: JB/JK	Width: 135.8 m	Processed by: DV
Boat/Motor: Kayak	Area: 182.1 m2	Mean Velocity: 1.73 m/s
Gauge Height: 135.47 m	G.H.Change: 0.000 m	Discharge: 313 m3/s

Area Method: Avg. Course	ADCP Depth: 0.060 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.4°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.30 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.70 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 1.34 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 76.67	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 13.4 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: NO

Performed Moving Bed Test: NO

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS2

Project Name: sag_08062017_dss2_q313cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	5.00	5.00	309	34.9	243	38.4	0.041	0.326	317	141.4	197.8	12:41	12:44	0.84	1.60	1	7
002	R	12.0	10.0	258	33.8	237	37.6	0.896	0.149	310	130.3	166.5	12:46	12:49	0.86	1.86	20	8
Mean		8.50	7.50	283	34.4	240	38.0	0.469	0.238	313	135.8	182.1	**Total**	00:08	0.85	1.73	10	7
5Dev		4.95	3.54	36	0.791	4.11	0.540	0.605	0.125	4.96	7.9	22.2			0.02	0.18		
5D/M		0.58	0.47	0.13	0.02	0.02	0.01	1.29	0.53	0.02	0.06	0.12			0.02	0.11		

Remarks: Q with RiverPro 313 m3/s using BT with 2% error, 260 m3/s using VTG with 20% error.

Station Number: Meas. No.: 12

Station Name: Sagavanirktok River DSS2 Channel 1 Date: 09/07/2017

Party: JK/KP
Boat/Motor: Kayak
Gauge Height: 135.49 m

Width: 144.0 m
Area: 188.6 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.94 m/s
Discharge: 366 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: On Site (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.81 m/s
Max. Depth: 2.61 m
Mean Depth: 1.32 m
% Meas.: 79.07
Water Temp.: None
ADCP Temp.: 5.3 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS2 Channel 1

Project Name: DSS2_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	12.0	12.0	457	36.2	285	38.6	0.392	-0.045	361	166.3	189.3	10:26	10:31	0.71	1.91	12	6
001	R	3.00	8.00	325	38.0	299	40.6	0.032	0.338	378	129.5	188.2	10:33	10:36	0.90	2.01	7	7
002	L	3.00	12.0	355	36.2	290	39.9	0.035	0.051	366	144.1	181.2	10:41	10:45	0.96	2.02	3	7
011	R	3.00	3.00	371	36.2	282	39.6	0.022	0.020	357	135.9	195.7	11:19	11:23	0.78	1.83	4	8
Mean		5.25	8.75	377	36.6	289	39.7	0.120	0.091	366	144.0	188.6	**Total**	00:56	0.84	1.94	6	7
5Dev		4.50	4.27	57	0.903	7.53	0.816	0.181	0.169	9.08	16.1	5.9			0.11	0.09		
5D/M		0.86	0.49	0.15	0.02	0.03	0.02	1.51	1.86	0.02	0.11	0.03			0.14	0.05		

Remarks: Q with RiverPro 366 m3/s using BT with 2% error, 299 m3/s using VTG with 5% error. Three channels, total Q 366+24.7+2.1=393 m3/s.

Station Number:
Station Name: Sagavanirktok River DSS2 Channel 2

Meas. No.: 12
Date: 09/07/2017

Party: JK/KP
Boat/Motor: Kayak
Gauge Height: 135.49 m

Width: 34.9 m
Area: 25.8 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.964 m/s
Discharge: 24.7 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: On Site (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.31 m/s
Max. Depth: 1.22 m
Mean Depth: 0.739 m
% Meas.: 66.21
Water Temp.: None
ADCP Temp.: 5.4 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243
Firmware: 56.04
Bin Size: 2 cm
Blank: 10 cm
BT Mode: Auto
BT Pings: Dyn
WT Mode: Auto
WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: DSS2 Channel 2

Project Name: sag_09072017_dss2ch2_q24.7cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
003	L	2.00	2.00	221	6.47	15.1	3.04	0.051	0.068	24.7	34.9	23.9	10:49	10:51	0.34	1.03	6	4
004	R	3.00	2.00	198	5.04	16.1	2.46	0.068	0.135	23.8	32.0	23.4	10:51	10:53	0.35	1.02	0	2
009	L	2.00	2.00	156	5.72	16.6	2.74	-0.035	0.083	25.1	37.2	27.0	11:12	11:14	0.45	0.93	25	3
010	R	2.00	2.00	129	5.13	17.6	2.29	-0.011	0.113	25.1	35.4	28.7	11:14	11:15	0.53	0.88	2	5
Mean		2.25	2.00	176	5.59	16.3	2.64	0.018	0.100	24.7	34.9	25.8	**Total**	00:26	0.42	0.96	8	3
SDev		0.50	0.00	41	0.661	1.07	0.330	0.049	0.030	0.645	2.1	2.5			0.09	0.07		
SD/M		0.22	0.00	0.23	0.12	0.07	0.13	2.69	0.30	0.03	0.06	0.10			0.21	0.08		

Remarks: Q with RiverPro 24.7 m3/s using BT with 3% error, 22.3 m3/s using VTG with 14% error. Three channels, total Q 366+24.7+2.1=393 m3/s.

Station Number:
Station Name: Sagavanirktok River DSS2 Channel 3

Meas. No.: 12
Date: 09/07/2017

Party: JK/KP
Boat/Motor: Kayak
Gauge Height: 135.49 m

Width: 7.6 m
Area: 2.3 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.890 m/s
Discharge: 2.05 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: On Site (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.30 m/s
Max. Depth: 0.527 m
Mean Depth: 0.305 m
% Meas.: 41.25
Water Temp.: None
ADCP Temp.: 5.4 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS2 Channel 3

Project Name: DSS2_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
005	L	1.00	2.00	88	0.823	0.801	0.211	0.044	0.102	1.98	7.8	2.4	11:02	11:03	0.11	0.82	26	0
006	R	1.00	2.00	100	0.867	0.858	0.224	0.084	0.077	2.11	7.5	2.2	11:03	11:04	0.10	0.94	0	0
007	L	1.00	2.00	65	0.804	0.808	0.194	0.091	0.081	1.98	7.8	2.4	11:04	11:05	0.14	0.82	0	0
008	R	1.00	2.00	101	0.869	0.907	0.197	0.057	0.081	2.11	7.1	2.2	11:05	11:06	0.10	0.98	8	0
Mean		1.00	2.00	88	0.841	0.844	0.207	0.069	0.085	2.05	7.6	2.3	**Total**	00:04	0.11	0.89	9	0
SDev		0.00	0.00	17	0.032	0.049	0.014	0.022	0.011	0.075	0.3	0.1			0.02	0.08		
SD/M		0.00	0.00	0.19	0.04	0.06	0.07	0.32	0.13	0.04	0.04	0.05			0.18	0.09		

Remarks: Q with RiverPro 2.1 m3/s using BT with 4% error, 2.2 m3/s using VTG with 12% error. Three channels, total Q 366+24.7+2.1=393 m3/s.

Station Number:
Station Name: Sagavanirktok River East Bank at MP389

Meas. No.: 17
Date: 05/20/2017

Party: JK/HT/JB
Boat/Motor: Helicopter
Gauge Height: 58.48 m

Width: 166.7 m
Area: 198.4 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.47 m/s
Discharge: 291 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: 2-Ice Anchor
Control2: 14-Shore Ice
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.10 m/s
Max. Depth: 1.98 m
Mean Depth: 1.19 m
% Meas.: 72.48
Water Temp.: None
ADCP Temp.: 0.2 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243   Firmware: 56.04
Bin Size: 6 cm   Blank: 10 cm
BT Mode: Auto   BT Pings: Dyn
WT Mode: Auto   WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: MP389.5

Project Name: sag20170520_mp389.5q290cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	5.00	1.00	264	40.7	210	36.6	1.40	-0.019	288	169.9	207.4	09:46	09:49	1.03	1.39	0	0
001	R	6.00	1.00	245	42.0	211	36.2	0.448	-0.009	289	163.9	195.7	09:50	09:53	1.29	1.48	2	0
002	L	6.00	1.00	187	43.9	214	38.3	0.126	-0.036	296	175.8	204.7	09:53	09:55	1.43	1.45	2	0
003	R	5.00	1.00	173	42.3	208	37.3	0.761	-0.031	288	157.2	185.9	09:55	09:58	1.54	1.55	11	1
Mean		5.50	1.00	217	42.2	211	37.1	0.684	-0.024	291	166.7	198.4	**Total**	00:11	1.32	1.47	4	0
SDev		0.58	0.00	44	1.29	2.73	0.935	0.544	0.012	3.99	8.0	9.7			0.22	0.07		
SD/M		0.10	0.00	0.20	0.03	0.01	0.03	0.80	0.51	0.01	0.05	0.05			0.17	0.04		

Remarks: Q with RiverPro 291 m3/s using BT with 1% error, 246 m3/s using VTG with 4% error.

Station Number:
Station Name: Sagavanirktok River East Bank at MP389

Meas. No.: 18
Date: 05/21/2017

Party: JK/HT/JB	Width: 172.6 m	Processed by: DV
Boat/Motor: Helicopter	Area: 189.2 m2	Mean Velocity: 1.27 m/s
Gauge Height: 58.42 m	G.H.Change: 0.000 m	Discharge: 241 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 2-Ice Anchor	
Discharge Method: None		Control2: 14-Shore Ice	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.49 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.84 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 1.10 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 71.06	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.1 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: MP389

Project Name: sag20170521_q240cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	3.00	2.00	289	37.1	174	29.7	0.113	0.999	242	160.6	185.9	13:34	13:37	0.96	1.30	2	0
001	R	15.0	2.00	183	37.4	168	30.8	1.47	1.11	239	172.2	180.1	13:37	13:39	1.40	1.33	1	0
002	L	5.00	3.00	201	37.9	173	30.5	0.641	1.03	243	180.3	197.0	13:39	13:42	1.38	1.23	5	1
003	R	3.00	3.00	164	37.2	169	31.1	0.281	1.26	239	177.4	193.7	13:42	13:44	1.66	1.23	2	0
Mean		6.50	2.50	209	37.4	171	30.5	0.625	1.10	241	172.6	189.2	**Total**	00:10	1.35	1.27	2	0
5Dev		5.74	0.58	55	0.353	2.99	0.599	0.602	0.115	2.19	8.7	7.6			0.29	0.05		
5D/M		0.88	0.23	0.26	0.01	0.02	0.02	0.96	0.10	0.01	0.05	0.04			0.21	0.04		

Remarks: Q with RiverPro 241 m3/s using BT with 1% error, 216 m3/s using VTG with 3% error.

Station Number:

Station Name: Sagavanirktok River East Bank at MP389 Channel 1

Meas. No.: 19

Date: 05/24/2017

Party: HT/JK/JB	Width: 257.2 m	Processed by: DV
Boat/Motor: Helicopter	Area: 240.2 m2	Mean Velocity: 0.993 m/s
Gauge Height: 58.21 m	G.H.Change: 0.000 m	Discharge: 239 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 2-Ice Anchor	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.76 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.64 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.935 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 72.05	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.4 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: NO* Evaluation: NO*

Meas.Location: MP389 Channel 1

Project Name: sag20170524_mp389qch1_240cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	5.00	5.00	431	42.4	176	21.8	0.379	0.259	240	254.8	242.8	08:28	08:33	1.33	0.99	2	0
001	R	5.00	5.00	506	42.6	166	24.8	0.344	0.226	234	259.4	234.5	08:33	08:38	1.19	1.00	1	0
002	L	3.00	1.00	352	39.9	174	24.9	0.192	0.020	239	248.1	242.2	08:38	08:42	1.45	0.99	1	0
003	R	5.00	5.00	454	43.7	171	24.9	0.318	-0.072	240	266.7	241.3	08:42	08:47	1.27	1.00	0	0
Mean		4.50	4.00	435	42.2	172	24.1	0.308	0.108	239	257.2	240.2	**Total**	00:18	1.31	0.99	1	0
5Dev		1.00	2.00	64	1.59	4.03	1.55	0.081	0.160	2.73	7.8	3.8			0.11	0.01		
5D/M		0.22	0.50	0.15	0.04	0.02	0.06	0.26	1.48	0.01	0.03	0.02			0.08	0.01		

Remarks: Q with RiverPro 239 m3/s using BT with 1% error, 234 m3/s using VTG with 6% error. Two channels, total Q 239+18=257 m3/s.

*Compass calibration and evaluation were not necessary because the instrument's compass was previously calibrated and evaluated at this location (the instrument was in place).

Station Number:
Station Name: Sagavanirktok River East Bank at MP389 Channel 2

Meas. No.: 19
Date: 05/24/2017

Party: HT/JK/JB	Width: 76.3 m	Processed by: DV
Boat/Motor: Helicopter	Area: 45.7 m2	Mean Velocity: 0.398 m/s
Gauge Height: 58.21 m	G.H.Change: 0.000 m	Discharge: 18.2 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 2-Ice Anchor	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.85 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.36 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.599 m	Bin Size: 6 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 59.86	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.6 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas.Location: MP389 Channel 2

Project Name: sag20170524_mp389ch2_18cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
004	*L*	*1.00*	*1.00*	*153*	*4.27*	*10.4*	*1.79*	*0.172*	*0.047*	*16.6*	*72.6*	*42.3*	*08:59*	*09:01*	*0.88*	*0.39*	*10*	*3*
005	R	1.00	5.00	221	4.80	10.9	1.86	0.125	0.336	18.0	73.7	46.8	09:04	09:06	0.74	0.39	4	1
006	*L*	*3.00*	*1.00*	*195*	*5.43*	*11.2*	*2.13*	*0.407*	*0.033*	*19.2*	*82.0*	*48.6*	*09:06*	*09:08*	*0.90*	*0.40*	*15*	*0*
008	R	1.00	1.00	230	5.63	11.1	2.00	0.171	0.018	18.9	76.9	45.1	09:09	09:11	0.75	0.42	10	1
Mean		1.50	2.00	199	5.03	10.9	1.94	0.219	0.109	18.2	76.3	45.7	**Total**	00:11	0.82	0.40	10	1
SDev		1.00	2.00	35	0.619	0.385	0.153	0.127	0.152	1.17	4.2	2.7			0.08	0.01		
SD/M		0.67	1.00	0.17	0.12	0.04	0.08	0.58	1.40	0.06	0.06	0.06			0.10	0.04		

Remarks: Q with RiverPro 18.2 m3/s using BT with 6% error, 17.3 m3/s using VTG with 22% error. Two channels, total Q 239+18=257 m3/s.

Discharge for transects in *italics* have a total Q more than 5% from the mean

*Compass calibration and evaluation were not necessary because the instrument's compass was previously calibrated and evaluated at this location (the instrument was in place).

Station Number:

Station Name: Sagavanirktok River East Bank at MP387 Channel 1

Meas. No.: 20

Date: 05/26/2017

Party: HT/JK/JB	Width: 169.9 m	Processed by: DV
Boat/Motor: Helicopter	Area: 169.1 m2	Mean Velocity: 1.64 m/s
Gauge Height: 58.09 m	G.H.Change: 0.000 m	Discharge: 263 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 3.50		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 4.41 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 23.1 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 1.04 m	Bin Size: 12 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 70.51	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.9 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES   Evaluation: YES

Meas. Location: MP387 Channel 1

Project Name: sag20170526_mp387_263cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
002	L	**10.0**	**5.00**	**647**	**41.2**	**189**	**33.0**	**3.03**	**0.110**	**267**	**245.5**	**222.6**	**19:53**	**20:01**	**1.25**	**1.20**	**7**	**0**
004	*R*	***25.0***	***3.00***	***435***	***41.5***	***198***	***37.1***	***6.13***	***0.220***	***283***	***91.9***	***123.3***	***20:01***	***20:06***	***1.70***	***2.30***	***6***	***0***
005	L	***20.0***	***2.00***	***447***	***36.4***	***185***	***33.8***	***7.09***	***-0.019***	***262***	***176.6***	***179.9***	***20:07***	***20:12***	***1.54***	***1.46***	***7***	***0***
006	*R*	***25.0***	***1.00***	***359***	***35.4***	***169***	***29.7***	***5.26***	***0.294***	***240***	***165.5***	***150.4***	***20:12***	***20:16***	***1.96***	***1.59***	***6***	***1***
Mean		**20.0**	**2.75**	**472**	**38.6**	**185**	**33.4**	**5.38**	**0.151**	**263**	**169.9**	**169.1**	**Total**	**00:23**	**1.61**	**1.64**	**6**	**0**
5Dev		**7.07**	**1.71**	**123**	**3.16**	**12.5**	**3.02**	**1.73**	**0.136**	**18.0**	**62.9**	**42.6**			**0.30**	**0.47**		
5D/M		**0.35**	**0.62**	**0.26**	**0.08**	**0.07**	**0.09**	**0.32**	**0.90**	**0.07**	**0.37**	**0.25**			**0.19**	**0.29**		

Remarks: Q with RiverPro 263 m3/s using BT with 7% error, 216 m3/s using VTG with 24% error. Two channels, total Q 263+439=702 m3/s.

Discharge for transects in *italics* have a total Q more than 5% from the mean

Station Number:

Station Name: Sagavanirktok River East Bank at MP387 Channel 2

Meas. No.: 20

Date: 05/26/2017

Party: HT/JK/JB	Width: 381.1 m	Processed by: DV
Boat/Motor: Helicopter	Area: 323.4 m2	Mean Velocity: 1.36 m/s
Gauge Height: 58.09 m	G.H.Change: 0.000 m	Discharge: 439 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 3.77		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 4.69 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.63 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.848 m	Bin Size: 50 cm	Blank: 50 cm
WT Error Vel.: 10.00 m/s	% Meas.: 69.39	BT Mode: 0	BT Pings: 1
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: 1	WT Pings: 1
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.7 °C	WV : 170	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: YES   Evaluation: YES

Meas. Location: MP387 Channel 2

Project Name: sag20170526_mp387ch2_439cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
007	L	15.0	3.00	335	66.3	309	62.0	0.884	1.38	440	386.7	352.2	20:20	20:24	1.85	1.25	8	0
008	R	3.00	3.00	356	75.3	301	64.1	1.22	1.44	444	369.8	297.5	20:24	20:28	1.79	1.49	12	0
009	L	3.00	3.00	316	67.9	303	60.1	1.27	1.34	434	386.7	320.5	20:28	20:32	1.97	1.35	7	0
Mean		7.00	3.00	335	69.8	305	62.1	1.12	1.38	439	381.1	323.4	**Total**	00:11	1.87	1.36	9	0
5Dev		6.93	0.00	20	4.80	4.09	1.96	0.210	0.055	4.80	9.7	27.5			0.09	0.12		
5D/M		0.99	0.00	0.06	0.07	0.01	0.03	0.19	0.04	0.01	0.03	0.08			0.05	0.09		

Remarks: Q with RiverPro 439 m3/s using BT with 1% error, 407 m3/s using VTG with 12% error. Two channels, total Q 263+439=702 m3/s.

Station Number: Meas. No.: 21
Station Name: Sagavanirktok River East Bank at MP387 Channel 1 Date: 05/27/2017

Party: HT/JK/JB
Boat/Motor: Helicopter
Gauge Height: 57.99 m
Width: 250.4 m
Area: 190.0 m2
G.H.Change: 0.000 m
Processed by: DV
Mean Velocity: 1.20 m/s
Discharge: 227 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 3.16

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s Rating No.: 1
Adj.Mean Vel: 0.00 m/s Qm Rating: U
Rated Area: 0.000 m2 Diff.: 0.000%
Control1: 2-Ice Anchor
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 5.35 m/s
Max. Depth: 2.44 m
Mean Depth: 0.760 m
% Meas.: 69.33
Water Temp.: None
ADCP Temp.: 1.2 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: MP387 Channel 1

Project Name: sag20170527_mp387ch1_q227cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	10.0	3.00	274	35.9	157	27.3	1.37	0.178	222	256.0	198.9	14:04	14:07	1.59	1.12	2	0
001	R	7.00	4.00	268	42.9	159	29.6	0.682	0.386	233	224.4	177.3	14:08	14:10	1.71	1.31	6	0
002	L	15.0	5.00	364	39.8	153	27.5	0.231	0.292	221	263.1	192.0	14:10	14:14	1.30	1.15	19	0
003	R	5.00	5.00	289	42.9	161	29.1	0.247	0.310	233	257.9	191.8	14:14	14:17	1.54	1.22	11	0
Mean		9.25	4.25	298	40.4	157	28.4	0.632	0.292	227	250.4	190.0	**Total**	00:12	1.54	1.20	9	0
5Dev		4.35	0.96	44	3.34	3.46	1.14	0.533	0.086	6.79	17.6	9.1			0.17	0.09		
5D/M		0.47	0.23	0.15	0.08	0.02	0.04	0.84	0.29	0.03	0.07	0.05			0.11	0.07		

Remarks: Q with RiverPro 227 m3/s using BT with 3% error, no GPS. Three channels, total Q 227+340+39=606 m3/s.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 2

Meas. No.: 21
Date: 05/27/2017

Party: HT/JK/JB	Width: 182.5 m	Processed by: DV
Boat/Motor: Helicopter	Area: 207.0 m2	Mean Velocity: 1.64 m/s
Gauge Height: 57.99 m	G.H.Change: 0.000 m	Discharge: 340 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 2-Ice Anchor	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 1.95		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.54 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.60 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 1.13 m	Bin Size: 12 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 70.72	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.0 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: MP387 Channel 2

Project Name: sag20170527_mp387ch2_q340cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
004	L	15.0	5.00	173	48.4	238	46.9	3.68	1.94	339	177.4	199.9	14:21	14:23	1.60	1.69	0	0
005	R	15.0	2.00	172	48.2	239	42.7	3.84	0.308	334	184.9	210.5	14:23	14:25	1.62	1.59	0	0
006	L	15.0	3.00	137	49.0	240	46.5	3.14	1.00	339	184.8	213.0	14:25	14:27	1.99	1.59	1	0
007	R	15.0	1.00	182	50.5	245	47.2	4.72	0.103	348	182.7	204.5	14:27	14:29	1.63	1.70	0	0
Mean		15.0	2.75	166	49.0	240	45.8	3.84	0.839	340	182.5	207.0	**Total**	00:08	1.71	1.64	0	0
SDev		0.00	1.71	20	1.04	3.29	2.09	0.654	0.830	5.67	3.5	5.9			0.19	0.06		
SD/M		0.00	0.62	0.12	0.02	0.01	0.05	0.17	0.99	0.02	0.02	0.03			0.11	0.04		

Remarks: Q with RiverPro 340 m3/s using BT with 2% error, no GPS. Three channels, total Q 227+340+39=606 m3/s.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 3

Meas. No.: 21
Date: 05/27/2017

Party: HT/JK/JB	Width: 84.5 m	Processed by: DV
Boat/Motor: Helicopter	Area: 42.0 m2	Mean Velocity: 0.946 m/s
Gauge Height: 57.99 m	G.H.Change: 0.000 m	Discharge: 38.7 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 2-Ice Anchor	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 3.94		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 4.06 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.12 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.499 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 54.74	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.7 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: MP387 Channel 3

Project Name: sag20170527_mp387ch3_q39cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
009	L	5.00	1.00	148	12.9	21.4	4.58	0.244	-0.029	39.2	73.0	36.1	14:35	14:36	1.38	1.09	4	0
010	R	3.00	8.00	271	13.1	20.5	4.76	0.192	-0.933	37.7	111.6	53.4	14:36	14:39	1.00	0.70	12	0
011	L	2.00	5.00	133	13.4	21.3	4.17	0.234	0.408	39.5	75.4	36.7	14:39	14:40	1.51	1.08	3	0
012	R	5.00	5.00	198	11.5	21.5	4.77	0.356	0.266	38.4	78.2	42.0	14:40	14:42	1.16	0.92	4	0
Mean		3.75	4.75	187	12.8	21.2	4.57	0.257	-0.072	38.7	84.5	42.0	**Total**	00:07	1.26	0.95	6	0
5Dev		1.50	2.87	62	0.855	0.454	0.282	0.070	0.602	0.820	18.1	8.0			0.23	0.18		
5D/M		0.40	0.60	0.33	0.07	0.02	0.06	0.27	8.36	0.02	0.21	0.19			0.18	0.19		

Remarks: Q with RiverPro 39 m3/s using BT with 2% error, no GPS. Three channels, total Q 227+340+39=606 m3/s.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 1

Meas. No.: 22
Date: 05/28/2017

Party: HT/JK/JB	Width: 186.4 m	Processed by: DV
Boat/Motor: Helicopter	Area: 158.5 m2	Mean Velocity: 1.59 m/s
Gauge Height: 57.74 m	G.H.Change: 0.000 m	Discharge: 251 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 2.58		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.87 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.81 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.850 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 69.12	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.3 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: MP387 Channel 1

Project Name: sag20170528_mp387ch1_q251cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	20.0	5.00	185	41.3	171	29.4	3.30	0.393	246	187.6	171.8	11:44	11:46	1.61	1.43	7	0
001	R	20.0	5.00	170	45.4	171	32.3	2.03	1.21	252	180.2	152.4	11:47	11:49	1.73	1.65	13	0
002	*L*	*20.0*	*15.0*	*164*	*44.4*	*184*	*31.0*	*1.98*	*2.09*	*264*	*201.5*	*164.3*	*11:49*	*11:51*	*1.66*	*1.61*	*9*	*0*
003	R	*15.0*	*15.0*	*170*	*42.4*	*167*	*31.2*	*0.937*	*0.613*	*242*	*176.5*	*145.5*	*11:51*	*11:53*	*1.70*	*1.67*	*8*	*0*
Mean		18.8	10.0	172	43.4	173	31.0	2.06	1.08	251	186.4	158.5	**Total**	00:08	1.67	1.59	9	0
5Dev		2.50	5.77	9	1.86	7.42	1.16	0.965	0.760	9.35	11.1	11.8			0.05	0.11		
5D/M		0.13	0.58	0.05	0.04	0.04	0.04	0.47	0.70	0.04	0.06	0.07			0.03	0.07		

Remarks: Q with RiverPro 251 m3/s using BT with 4% error, 231 m3/s using VTG with 3% error. Five channels, total Q 251+8.7+363+4.2+17.6=645 m3/s.

Discharge for transects in *italics* have a total Q more than 5% from the mean

Station Number:

Station Name: Sagavanirktok River East Bank at MP387 Channel 2

Meas. No.: 22

Date: 05/28/2017

Party: HT/JK/JB	Width: 33.4 m	Processed by: DV
Boat/Motor: Helicopter	Area: 9.6 m2	Mean Velocity: 0.903 m/s
Gauge Height: 57.74 m	G.H.Change: 0.000 m	Discharge: 8.66 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 3.82		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 1.75 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.475 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.287 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 37.51	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.1 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: NO

Performed Moving Bed Test: YES

Performed Compass Calibration: YES   Evaluation: YES

Meas. Location: MP387 Channel 2

Project Name: sag20170528_mp387ch2_q8.7cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
004	L	5.00	5.00	61	3.95	3.25	0.869	0.246	0.341	8.66	33.4	9.6	11:55	11:56	0.71	0.90	7	0
Mean		5.00	5.00	61	3.95	3.25	0.869	0.246	0.341	8.66	33.4	9.6	**Total**	00:00	0.71	0.90	7	0
5Dev																		
5D/M																		

Remarks: Q with RiverPro 8.7 m3/s using BT and 8.2 m3/s using VTG, one transect only. Five channels, total Q 251+8.7+363+4.2+17.6=645 m3/s.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 3

Meas. No.: 22
Date: 05/28/2017

Party: HT/JK/JB
Boat/Motor: Helicopter
Gauge Height: 57.74 m

Width: 188.8 m
Area: 203.4 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.79 m/s
Discharge: 363 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 2.48

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: 14-Shore Ice
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.90 m/s
Max. Depth: 2.53 m
Mean Depth: 1.08 m
% Meas.: 71.53
Water Temp.: None
ADCP Temp.: 1.1 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: MP387 Channel 3

Project Name: sag20170528_mp387ch3_q363cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
005	L	20.0	2.00	178	53.4	259	45.8	1.32	0.460	360	193.1	206.3	12:01	12:03	1.52	1.75	0	0
006	R	20.0	2.00	129	52.7	250	52.7	1.24	0.346	357	178.4	190.2	12:03	12:05	1.94	1.88	1	0
007	L	20.0	1.00	179	51.9	256	43.9	1.13	0.249	354	194.8	210.4	12:05	12:07	1.52	1.68	0	0
008	R	20.0	1.00	126	55.6	269	52.6	1.06	0.132	379	186.8	199.3	12:07	12:09	2.02	1.90	7	0
009	L	20.0	1.00	166	53.1	266	45.8	1.03	0.247	366	195.7	213.4	12:09	12:11	1.66	1.71	1	0
010	R	20.0	1.00	124	54.0	255	52.9	1.10	0.116	363	181.1	189.9	12:11	12:12	2.04	1.91	8	0
011	L	20.0	1.00	167	51.4	253	48.4	1.12	0.294	355	189.9	206.3	12:13	12:15	1.52	1.72	1	0
012	R	20.0	1.00	194	52.7	269	49.3	1.09	0.108	373	190.8	211.6	12:15	12:18	1.39	1.76	4	0
Mean		20.0	1.25	157	53.1	260	48.9	1.14	0.244	363	188.8	203.4	**Total**	00:16	1.70	1.79	3	0
5Dev		0.00	0.46	28	1.30	7.36	3.55	0.096	0.124	8.79	6.3	9.3			0.26	0.09		
5D/M		0.00	0.37	0.18	0.02	0.03	0.07	0.08	0.51	0.02	0.03	0.05			0.15	0.05		

Remarks: Q with RiverPro 363 m3/s using BT with 2% error, 320 m3/s using VTG with 11% error. Five channels, total Q 251+8.7+363+4.2+17.6=645 m3/s.

Station Number:

Station Name: Sagavanirktok River East Bank at MP387 Channel 4

Meas. No.: 22

Date: 05/28/2017

Party: HT/JK/JB	Width: 23.0 m	Processed by: DV
Boat/Motor: Helicopter	Area: 6.1 m2	Mean Velocity: 0.691 m/s
Gauge Height: 57.74 m	G.H.Change: 0.000 m	Discharge: 4.20 m3/s

Area Method: Avg. Course	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 4.74		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 1.46 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.432 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.264 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 32.21	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.0 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: NO

Performed Moving Bed Test: YES

Performed Compass Calibration: YES   Evaluation: YES

Meas. Location: MP387 Channel 4

Project Name: sag20170528_mp387ch4_q4.2cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
013	R	5.00	5.00	74	1.82	1.35	0.414	0.384	0.229	4.20	23.0	6.1	12:19	12:20	0.36	0.69	3	1
Mean		5.00	5.00	74	1.82	1.35	0.414	0.384	0.229	4.20	23.0	6.1	**Total**	00:00	0.36	0.69	3	1
SDev																		
SD/M																		

Remarks: Q with RiverPro 4.2 m3/s using BT and 4.1 m3/s using VTG, one transect only. Five channels, total Q 251+8.7+363+4.2+17.6=645 m3/s.

Station Number:

Station Name: Sagavanirktok River East Bank at MP387 Channel 5

Meas. No.: 22

Date: 05/28/2017

Party: HT/JK/JB	Width: 28.7 m	Processed by: DV
Boat/Motor: Helicopter	Area: 13.6 m2	Mean Velocity: 1.30 m/s
Gauge Height: 57.74 m	G.H.Change: 0.000 m	Discharge: 17.6 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 3.05		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.89 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.965 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.476 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 58.26	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.9 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: NO

Performed Moving Bed Test: YES

Performed Compass Calibration: YES   Evaluation: YES

Meas. Location: MP387 Channel 5

Project Name: sag20170528_mp387ch5_q17cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
014	R	1.00	5.00	68	4.92	9.82	2.08	0.178	0.273	17.3	29.7	12.8	12:21	12:22	0.61	1.35	26	0
015	L	2.00	5.00	70	4.51	10.7	2.09	0.325	0.356	18.0	27.7	14.4	12:22	12:23	0.55	1.25	0	0
Mean		1.50	5.00	69	4.71	10.3	2.09	0.252	0.315	17.6	28.7	13.6	**Total**	00:01	0.58	1.30	13	0
5Dev		0.71	0.00	1	0.291	0.646	0.011	0.104	0.059	0.529	1.4	1.1			0.04	0.07		
5D/M		0.47	0.00	0.02	0.06	0.06	0.01	0.41	0.19	0.03	0.05	0.08			0.07	0.05		

Remarks: Q with RiverPro 17.6 m3/s using BT with 3% error, 17.2 m3/s using VTG with 2% error. Five channels, total Q 251+8.7+363+4.2+17.6=645 m3/s.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 1

Meas. No.: 23
Date: 05/30/2017

Party: HT/JK/JB	Width: 146.0 m	Processed by: DV
Boat/Motor: Helicopter	Area: 146.7 m2	Mean Velocity: 1.72 m/s
Gauge Height: 57.78 m	G.H.Change: 0.000 m	Discharge: 252 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 1.87		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.46 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.05 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 1.00 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 71.79	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.7 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: MP387 Channel 1

Project Name: sag20170530_mp387ch1_q252cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	3.00	5.00	175	36.7	183	30.7	0.451	0.533	251	144.7	155.1	14:21	14:23	1.71	1.62	0	1
001	R	7.00	5.00	160	40.8	180	29.7	1.17	0.231	252	152.0	147.8	14:24	14:26	1.41	1.71	6	0
002	L	7.00	5.00	131	39.1	179	31.0	0.367	0.826	250	144.5	144.8	14:26	14:27	1.58	1.73	0	0
003	R	7.00	5.00	158	39.8	181	31.7	0.615	0.586	254	142.9	139.0	14:27	14:29	1.37	1.83	1	0
Mean		6.00	5.00	156	39.1	181	30.8	0.652	0.544	252	146.0	146.7	**Total**	00:07	1.52	1.72	2	0
5Dev		2.00	0.00	18	1.77	1.71	0.845	0.363	0.245	1.72	4.1	6.7			0.16	0.09		
5D/M		0.33	0.00	0.12	0.05	0.01	0.03	0.56	0.45	0.01	0.03	0.05			0.10	0.05		

Remarks: Q with RiverPro 252 m3/s using BT with 1% error, 238 m3/s using VTG with 1% error. Four channels, total Q 252+4.4+465+24=746 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 2

Meas. No.: 23
Date: 05/30/2017

Party: HT/JK/JB	Width: 32.9 m	Processed by: DV
Boat/Motor: Helicopter	Area: 9.6 m2	Mean Velocity: 0.454 m/s
Gauge Height: 57.78 m	G.H.Change: 0.000 m	Discharge: 4.38 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 4.49		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.16 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.447 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.293 m	Bin Size: 50 cm	Blank: 50 cm
WT Error Vel.: 10.00 m/s	% Meas.: 35.05	BT Mode: 0	BT Pings: 1
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: 1	WT Pings: 1
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.7 °C	WV : 170	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: MP387 Channel 2

Project Name: sag20170530_mp387ch2_q4.4cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
004	L	5.00	3.00	58	2.03	1.54	0.450	0.195	0.170	4.38	32.9	9.6	14:32	14:33	0.76	0.45	0	0
Mean		5.00	3.00	58	2.03	1.54	0.450	0.195	0.170	4.38	32.9	9.6	**Total**	00:00	0.76	0.45	0	0
5Dev																		
5D/M																		

Remarks: Q with RiverPro 4.4 m3/s using BT and 4.3 m3/s using VTG, one transect only. Four channels, total Q 252+4.4+465+24.8=746 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 3

Meas. No.: 23
Date: 05/30/2017

Party: HT/JK/JB
Boat/Motor: Helicopter
Gauge Height: 57.78 m

Width: 203.8 m
Area: 248.2 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.88 m/s
Discharge: 465 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 1.72

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.75 m/s
Max. Depth: 2.40 m
Mean Depth: 1.23 m
% Meas.: 73.87
Water Temp.: None
ADCP Temp.: 0.8 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 50 cm Blank: 50 cm
BT Mode: 0 BT Pings: 1
WT Mode: 1 WT Pings: 1
WV : 170

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: MP387 Channel 3

Project Name: sag20170530_mp387ch3_q465cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
005	L	12.0	2.00	245	59.8	337	67.9	1.25	1.56	467	223.5	269.5	14:35	14:38	1.45	1.73	12	0
006	R	12.0	2.00	225	59.3	341	59.0	1.03	0.558	461	223.6	237.5	14:38	14:41	1.50	1.94	21	0
007	L	12.0	3.00	155	54.9	344	59.3	0.906	1.50	460	185.4	248.3	14:41	14:43	1.70	1.85	3	0
008	R	12.0	2.00	171	56.4	352	61.0	1.24	0.222	471	182.7	237.7	14:43	14:45	1.59	1.98	5	0
Mean		12.0	2.25	199	57.6	343	61.8	1.10	0.958	465	203.8	248.2	**Total**	00:10	1.56	1.88	10	0
5Dev		0.00	0.50	43	2.36	6.41	4.12	0.166	0.670	4.89	22.8	15.0			0.11	0.11		
5D/M		0.00	0.22	0.22	0.04	0.02	0.07	0.15	0.70	0.01	0.11	0.06			0.07	0.06		

Remarks: Q with RiverPro 465 m3/s using BT with 1% error, 431 m3/s using VTG with 3% error. Four channels, total Q 252+4.4+465+24=746 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 4

Meas. No.: 23
Date: 05/30/2017

Party: HT/JK/JB	Width: 36.1 m	Processed by: DV
Boat/Motor: Helicopter	Area: 18.0 m2	Mean Velocity: 1.39 m/s
Gauge Height: 57.78 m	G.H.Change: 0.000 m	Discharge: 24.8 m3/s

Area Method: Avg. Course	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 1.69		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.78 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.18 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.504 m	Bin Size: 50 cm	Blank: 50 cm
WT Error Vel.: 10.00 m/s	% Meas.: 57.00	BT Mode: 0	BT Pings: 1
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: 1	WT Pings: 1
WT Up Vel.: 10.00 m/s	ADCP Temp.: 0.5 °C	WV : 170	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: MP387 Channel 4

Project Name: sag20170530_mp387ch4_q24cms.
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
009	R	1.00	3.00	84	6.43	14.5	3.63	0.262	0.296	25.1	31.0	17.1	14:48	14:49	0.58	1.47	10	0
011	L	1.00	4.00	111	6.94	13.8	3.47	0.085	0.247	24.6	41.2	18.9	14:51	14:52	0.68	1.30	26	1
Mean		1.00	3.50	97	6.68	14.2	3.55	0.174	0.271	24.8	36.1	18.0	**Total**	00:03	0.63	1.39	18	1
5Dev		0.00	0.71	19	0.358	0.443	0.107	0.125	0.035	0.351	7.2	1.3			0.07	0.12		
5D/M		0.00	0.20	0.20	0.05	0.03	0.03	0.72	0.13	0.01	0.20	0.07			0.10	0.09		

Remarks: Q with RiverPro 24.8 m3/s using BT with 1% error, 25.9 m3/s using VTG with 6% error. Four channels, total Q 252+4.4+465+24=746 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number:

Station Name: Sagavanirktok River East Bank at MP387 Channel 1

Meas. No.: 24

Date: 05/31/2017

Party: HT/JK/JB	Width: 157.4 m	Processed by: DV
Boat/Motor: Helicopter	Area: 126.5 m2	Mean Velocity: 1.42 m/s
Gauge Height: 57.75 m	G.H.Change: 0.000 m	Discharge: 179 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: DGPS	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
		Control2: Unspecified	
		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.38 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 1.50 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.804 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 66.93	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.2 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: NO* Evaluation: NO*

Meas. Location: MP387 Channel 1

Project Name: sag20170531_mp387ch1_q197cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	8.00	5.00	216	37.8	123	23.3	1.03	0.426	186	158.6	125.5	15:20	15:22	1.11	1.48	2	0
001	R	5.00	5.00	238	36.0	116	22.0	0.201	0.408	175	155.9	123.1	15:22	15:25	1.04	1.42	3	0
002	L	5.00	5.00	169	35.5	114	21.3	0.301	0.364	172	157.8	126.2	15:25	15:27	1.42	1.36	1	0
003	R	7.00	5.00	203	35.1	126	22.2	0.582	0.272	184	157.2	131.4	15:27	15:29	1.11	1.40	0	0
Mean		6.25	5.00	206	36.1	120	22.2	0.529	0.368	179	157.4	126.5	**Total**	00:09	1.17	1.42	2	0
5Dev		1.50	0.00	29	1.21	5.35	0.829	0.371	0.069	6.64	1.1	3.5			0.17	0.05		
5D/M		0.24	0.00	0.14	0.03	0.04	0.04	0.70	0.19	0.04	0.01	0.03			0.14	0.03		

Remarks: Q with RiverPro 197 m3/s using BT with 1% error, 179 m3/s using VTG with 4% error. Three channels, total Q 197+13.9+448=659 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number:
Station Name: Sagavanirktok River East Bank at MP387 Channel 2

Meas. No.: 24
Date: 05/31/2017

Party: HT/JK/JB	Width: 23.6 m	Processed by: DV
Boat/Motor: Helicopter	Area: 11.9 m2	Mean Velocity: 1.17 m/s
Gauge Height: 57.75 m	G.H.Change: 0.000 m	Discharge: 13.9 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 3.71		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 1.95 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.785 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.504 m	Bin Size: 50 cm	Blank: 50 cm
WT Error Vel.: 10.00 m/s	% Meas.: 56.57	BT Mode: 0	BT Pings: 1
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: 1	WT Pings: 1
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.1 °C	WV : 170	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: MP387 Channel 2

Project Name: sag20170531_mp387ch2_q14cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
004	R	3.00	2.00	95	4.01	7.87	1.48	0.356	0.203	13.9	23.6	11.9	15:33	15:34	0.41	1.17	0	0
Mean		3.00	2.00	95	4.01	7.87	1.48	0.356	0.203	13.9	23.6	11.9	**Total**	00:00	0.41	1.17	0	0
SDev																		
SD/M																		

Remarks: Q with RiverPro 13.9 m3/s using BT and 13.3 m3/s using VTG, one transect only. Three channels, total Q 197+13.9+448=659 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number:

Station Name: Sagavanirktok River East Bank at MP387 Channel 3

Meas. No.: 24

Date: 05/31/2017

Party: HT/JK/JB	Width: 184.7 m	Processed by: DV
Boat/Motor: Helicopter	Area: 222.9 m2	Mean Velocity: 2.01 m/s
Gauge Height: 57.75 m	G.H.Change: 0.000 m	Discharge: 448 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 3.24		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 3.75 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.70 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 1.21 m	Bin Size: 50 cm	Blank: 50 cm
WT Error Vel.: 10.00 m/s	% Meas.: 74.62	BT Mode: 0	BT Pings: 1
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: 1	WT Pings: 1
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.2 °C	WV : 170	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: NO* Evaluation: NO*

Meas. Location: MP387 Channel 3

Project Name: sag20170531_mp387ch3_q449cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
005	L	8.00	3.00	227	59.2	333	56.7	0.430	0.598	450	185.8	221.4	15:37	15:40	1.35	2.03	1	0
006	R	8.00	1.00	281	56.9	337	54.9	0.523	0.054	450	187.5	228.8	15:40	15:43	1.30	1.97	2	0
007	L	8.00	1.00	251	57.9	332	55.2	0.431	0.216	446	181.1	220.5	15:43	15:46	1.18	2.02	0	0
009	R	8.00	1.00	310	57.5	336	54.3	0.476	0.036	448	184.3	220.8	15:47	15:51	1.07	2.03	1	0
Mean		8.00	1.50	267	57.9	335	55.3	0.465	0.226	448	184.7	222.9	**Total**	00:14	1.23	2.01	1	0
5Dev		0.00	1.00	36	0.978	2.37	1.01	0.044	0.261	2.10	2.7	4.0			0.13	0.03		
5D/M		0.00	0.67	0.14	0.02	0.01	0.02	0.10	1.15	0.00	0.01	0.02			0.10	0.02		

Remarks: Q with RiverPro 448 m3/s using BT with 0% error, 415 m3/s using VTG with 3% error. Three channels, total Q 197+13.9+448=659 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number:
Station Name: Sagavanirktok River DSS1

Meas. No.: 4
Date: 06/26/2016

Party: JK/TT
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: 25.42 m

Width: 69.3 m
Area: 127.6 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.66 m/s
Discharge: 212 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (19.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.85 m/s
Max. Depth: 2.78 m
Mean Depth: 1.84 m
% Meas.: 77.73
Water Temp.: None
ADCP Temp.: 15.6 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 12813 Firmware: 56.03
Bin Size: 6 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS1

Project Name: dss1_6-26-16_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	1.00	5.00	355	19.9	165	26.0	0.183	0.246	212	69.4	130.0	15:12	15:16	0.30	1.63	1	5
001	L	2.00	5.00	317	20.4	163	24.9	0.362	0.615	210	67.9	124.8	15:18	15:22	0.35	1.68	2	3
002	R	2.00	6.00	304	20.9	166	26.1	0.565	0.565	214	70.2	127.4	15:23	15:26	0.35	1.68	0	4
003	L	2.00	6.00	377	20.7	166	26.3	0.619	0.874	214	69.8	128.4	15:26	15:30	0.29	1.67	0	3
Mean		1.75	5.50	338	20.5	165	25.8	0.432	0.575	212	69.3	127.6	**Total**	00:17	0.33	1.66	1	4
5Dev		0.50	0.58	34	0.418	1.10	0.656	0.200	0.258	2.14	1.0	2.2			0.03	0.02		
5D/M		0.29	0.10	0.10	0.02	0.01	0.03	0.46	0.45	0.01	0.01	0.02			0.10	0.01		

Remarks: Q with RiverPro 212 m3/s using BT with 1% error, 209 m3/s using VTG with 1% error.

Station Number:
Station Name: Sagavanirktok River DSS1

Meas. No.: 5
Date: 08/01/2016

Party: JK/TT
Boat/Motor: 15' Jon boat w 40 hp jet
Gauge Height: 25.09 m

Width: 67.8 m
Area: 104.0 m2
G.H.Change: 0.000 m

Processed by: DV Mean
Velocity: 0.827 m/s
Discharge: 85.9 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.8°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 1.87 m/s
Max. Depth: 3.03 m
Mean Depth: 1.53 m
% Meas.: 70.46
Water Temp.: None
ADCP Temp.: 11.5 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 12813 Firmware: 56.03
Bin Size: 6 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS1

Project Name: DSS1_080116_Q_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	2.00	6.00	328	15.3	60.3	9.89	0.199	0.236	86.0	66.8	101.7	15:39	15:43	0.37	0.85	8	21
002	L	3.00	8.00	286	14.5	59.3	9.45	0.619	0.259	84.2	69.8	107.6	15:44	15:47	0.38	0.78	7	19
003	R	2.00	8.00	249	14.0	61.8	9.60	0.561	0.332	86.3	66.3	105.7	15:48	15:51	0.45	0.82	0	15
005	L	2.00	6.00	265	15.6	60.8	10.6	0.181	0.118	87.3	68.5	101.2	15:57	16:00	0.43	0.86	3	15
Mean		2.25	7.00	282	14.9	60.6	9.89	0.390	0.236	85.9	67.8	104.0	**Total**	00:20	0.41	0.83	5	17
SDev		0.50	1.15	34	0.733	1.04	0.531	0.232	0.089	1.32	1.6	3.1			0.04	0.04		
SD/M		0.22	0.16	0.12	0.05	0.02	0.05	0.60	0.38	0.02	0.02	0.03			0.09	0.04		

Remarks: Q with RiverPro 86 m3/s using BT with 2% error, 85 m3/s using VTG with 2% error.

Station Number:
Station Name: Sagavanirktok River DSS1

Meas. No.: 6
Date: 09/02/2016

Party: JH/JK	Width: 66.6 m	Processed by: DV
Boat/Motor: 15' Jon boat w 40 hp jet	Area: 100.8 m2	Mean Velocity: 1.32 m/s
Gauge Height: 25.24 m	G.H.Change: 0.000 m	Discharge: 133 m3/s

Area Method: Mean Flow	ADCP Depth: 0.060 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: None (18.8°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: Unspecified	
Discharge Method: None		Control2: Unspecified	
% Correction: 0.00		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.74 m/s	Type/Freq.: StreamPro / 2000 kHz	
WT 3-Beam Solution: YES	Max. Depth: 2.63 m	Serial #: 12813	Firmware: 31.12
BT Error Vel.: 1.00 m/s	Mean Depth: 1.51 m	Bin Size: 10 cm	Blank: 3 cm
WT Error Vel.: 10.00 m/s	% Meas.: 71.69	BT Mode: 10	BT Pings: 2
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: 12	WT Pings: 6
WT Up Vel.: 10.00 m/s	ADCP Temp.: 6.8 °C	WV : 170	WO : 1, 4
Use Weighted Mean Depth: YES			

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: DSS1

Project Name: dss1 20160902q133cms.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	2.00	4.00	331	20.6	96.6	16.3	0.381	0.168	134	65.6	103.7	12:13	12:17	0.32	1.29	0	9
001	L	2.00	7.00	302	20.3	95.5	17.1	0.416	0.572	134	67.9	98.9	12:18	12:22	0.33	1.35	0	6
002	R	2.00	4.00	395	20.8	95.0	16.1	0.474	0.158	132	66.3	99.8	12:22	12:27	0.27	1.33	0	7
Mean		2.00	5.00	342	20.6	95.7	16.5	0.424	0.299	133	66.6	100.8	**Total**	00:13	0.30	1.32	0	7
5Dev		0.00	1.73	48	0.244	0.844	0.544	0.047	0.236	0.868	1.2	2.5			0.03	0.03		
5D/M		0.00	0.35	0.14	0.01	0.01	0.03	0.11	0.79	0.01	0.02	0.03			0.11	0.02		

Remarks: Q with RiverPro 133 m3/s using BT with 1% error, 133 m3/s using VTG with 1% error.

Station Number:
Station Name: Sagavanirktok River DSS1

Meas. No.: 7
Date: 05/24/2017

Party: JK/HT/JB
Boat/Motor: Helicopter
Gauge Height: 25.69 m

Width: 138.9 m
Area: 118.3 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.985 m/s
Discharge: 117 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: 2-Ice Anchor
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.47 m/s
Max. Depth: 1.80 m
Mean Depth: 0.851 m
% Meas.: 70.14
Water Temp.: None
ADCP Temp.: 0.9 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243
Firmware: 56.04
Bin Size: 6 cm
Blank: 10 cm
BT Mode: Auto
BT Pings: Dyn
WT Mode: Auto
WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: DSS1

Project Name: sag20170524_mp405_117cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	5.00	2.00	258	22.7	82.1	12.6	0.459	0.361	118	138.1	114.4	13:36	13:39	0.85	1.03	15	0
001	R	15.0	1.00	151	20.7	80.9	14.8	0.210	-0.025	117	138.5	118.9	13:39	13:41	1.41	0.98	9	1
002	L	15.0	2.00	180	20.5	82.8	13.4	0.417	0.167	117	137.8	120.0	13:41	13:43	1.14	0.98	4	0
003	R	15.0	2.00	154	20.2	81.2	12.6	0.388	-0.154	114	141.4	119.9	13:43	13:44	1.36	0.95	6	0
Mean		12.5	1.75	185	21.0	81.7	13.3	0.369	0.087	117	138.9	118.3	**Total**	00:08	1.19	0.99	9	0
SDev		5.00	0.50	50	1.15	0.871	1.03	0.110	0.225	1.70	1.6	2.6			0.26	0.03		
SD/M		0.40	0.29	0.27	0.05	0.01	0.08	0.30	2.58	0.01	0.01	0.02			0.21	0.03		

Remarks: Q with RiverPro 117 m3/s using BT with 1% error, 99 m3/s using VTG with 15% error.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number: Meas. No.: 8
Station Name: Sagavanirktok River DSS1 Date: 05/26/2017

Party: JK/HT/JB
Boat/Motor: Helicopter
Gauge Height: N/A

Width: 303.2 m
Area: 331.6 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.00 m/s
Discharge: 332 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: 2-Ice Anchor
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 4.41 m/s
Max. Depth: 2.25 m
Mean Depth: 1.09 m
% Meas.: 72.60
Water Temp.: None
ADCP Temp.: 0.8 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: DSS1

Project Name: sag20170526_dss1_332cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	3.00	1.00	254	49.1	239	44.7	0.603	0.164	334	300.9	327.2	21:44	21:47	1.78	1.02	7	0
001	R	2.00	1.00	249	51.0	246	39.7	0.172	0.523	338	319.6	345.8	21:47	21:50	1.92	0.98	12	0
002	L	2.00	2.00	196	45.0	234	41.6	0.150	0.442	321	295.9	324.3	21:51	21:53	2.33	0.99	6	1
003	R	2.00	2.00	251	49.1	245	41.0	0.204	0.189	335	296.5	329.0	21:53	21:56	1.91	1.02	10	0
Mean		2.25	1.50	237	48.6	241	41.8	0.282	0.330	332	303.2	331.6	**Total**	00:11	1.99	1.00	9	1
5Dev		0.50	0.58	28	2.50	5.62	2.10	0.215	0.180	7.33	11.2	9.6			0.23	0.02		
5D/M		0.22	0.38	0.12	0.05	0.02	0.05	0.76	0.55	0.02	0.04	0.03			0.12	0.02		

Remarks: Q with RiverPro 332 m3/s using BT with 2% error, 292 m3/s using VTG with 11% error.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number: | Meas. No.: 9

Station Name: Sagavanirktok River DSS1 | Date: 05/27/2017

Party: JK/HT/JB | Width: 247.3 m | Processed by: DV

Boat/Motor: Helicopter | Area: 325.7 m2 | Mean Velocity: 1.03 m/s

Gauge Height: 25.85 m | G.H.Change: 0.000 m | Discharge: 336 m3/s

Area Method: Mean Flow | ADCP Depth: 0.050 m | Index Vel.: 0.00 m/s | Rating No.: 1

Nav. Method: Bottom Track | Shore Ens.:10 | Adj.Mean Vel: 0.00 m/s | Qm Rating: U

MagVar Method: Model (18.0°) | Bottom Est: Power (0.1667) | Rated Area: 0.000 m2 | Diff.: 0.000%

Depth: Composite (BT) | Top Est: Power (0.1667) | Control1: 2-Ice Anchor

Discharge Method: None | Control2: Unspecified

% Correction: 0.00 | Control3: Unspecified

Screening Thresholds:

BT 3-Beam Solution: YES

WT 3-Beam Solution: YES

BT Error Vel.: 1.00 m/s

WT Error Vel.: 10.00 m/s

BT Up Vel.: 10.00 m/s

WT Up Vel.: 10.00 m/s

Use Weighted Mean Depth: YES

Max. Vel.: 2.57 m/s

Max. Depth: 2.50 m

Mean Depth: 1.32 m

% Meas.: 73.65

Water Temp.: None

ADCP Temp.: 1.1 °C

ADCP:

Type/Freq.: RiverPro/RioPro / 1200 kHz

Serial #: 1243 | Firmware: 56.04

Bin Size: 2 cm | Blank: 10 cm

BT Mode: Auto | BT Pings: Dyn

WT Mode: Auto | WT Pings: Dyn

WZ : 5

Performed Diag. Test: YES

Performed Moving Bed Test: YES

Performed Compass Calibration: NO* Evaluation: NO*

Meas. Location: DSS1

Project Name: sag20170527_dss1_335cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	3.00	2.00	172	44.7	247	43.9	1.60	0.239	337	246.3	320.0	16:05	16:07	2.11	1.05	9	0
001	R	2.00	2.00	180	45.6	247	43.5	2.13	0.385	338	247.6	325.2	16:08	16:10	2.03	1.04	0	0
002	L	2.00	4.00	272	41.7	247	38.0	1.11	0.506	329	244.7	328.5	16:10	16:13	1.48	1.00	0	0
003	R	2.00	4.00	178	44.2	248	44.1	2.03	0.296	339	250.4	328.9	16:13	16:15	2.07	1.03	0	0
Mean		2.25	3.00	200	44.0	247	42.4	1.72	0.357	336	247.3	325.7	**Total**	00:10	1.92	1.03	2	0
5Dev		0.50	1.15	48	1.66	0.508	2.94	0.464	0.116	4.74	2.4	4.1			0.30	0.02		
5D/M		0.22	0.38	0.24	0.04	0.00	0.07	0.27	0.33	0.01	0.01	0.01			0.15	0.02		

Remarks: Q with RiverPro 336 m3/s using BT with 1% error, no GPS.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number: Meas. No.: 10
Station Name: Sagavanirktok River DSS1 Channel 1 Date: 05/28/2017

Party: JK/HT/JB
Boat/Motor: Helicopter
Gauge Height: 25.69 m

Width: 250.6 m
Area: 327.7 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.09 m/s
Discharge: 357 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 2.97

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s Rating No.: 1
Adj.Mean Vel: 0.00 m/s Qm Rating: U
Rated Area: 0.000 m2 Diff.: 0.000%
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.56 m/s
Max. Depth: 2.66 m
Mean Depth: 1.31 m
% Meas.: 74.03
Water Temp.: None
ADCP Temp.: 1.4 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 50 cm Blank: 50 cm
BT Mode: 0 BT Pings: 1
WT Mode: 1 WT Pings: 1
WV : 170

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: DSS1 Channel 1

Project Name: sag20170528_dss1ch1_q347cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	4.00	3.00	293	47.1	262	42.8	2.34	0.126	354	242.0	313.0	13:32	13:35	1.25	1.13	0	0
001	R	3.00	2.00	251	47.6	262	44.0	2.92	0.416	357	249.2	330.6	13:36	13:39	1.39	1.08	5	0
002	L	3.00	3.00	303	47.8	267	42.0	2.87	0.250	359	249.7	325.7	13:39	13:43	1.23	1.10	0	0
003	R	4.00	3.00	295	45.6	268	40.3	4.81	0.101	359	261.3	341.3	13:43	13:46	1.33	1.05	0	0
Mean		3.50	2.75	285	47.0	264	42.3	3.24	0.223	357	250.6	327.7	**Total**	00:14	1.30	1.09	1	0
5Dev		0.58	0.50	23	0.968	3.17	1.56	1.08	0.144	2.37	8.0	11.8			0.07	0.03		
5D/M		0.16	0.18	0.08	0.02	0.01	0.04	0.33	0.65	0.01	0.03	0.04			0.06	0.03		

Remarks: Q with RiverPro 357 m3/s using BT with 1% error, 334 m3/s using VTG with 8% error. Two channels, total Q 357+7=364 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number:
Station Name: Sagavanirktok River DSS1 Channel 2

Meas. No.: 10
Date: 05/28/2017

Party: JK/HT/JB
Boat/Motor: Helicopter
Gauge Height: 25.69 m

Width: 38.4 m
Area: 9.2 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.796 m/s
Discharge: 7.29 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 2.36

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 1.54 m/s
Max. Depth: 0.472 m
Mean Depth: 0.239 m
% Meas.: 32.34
Water Temp.: None
ADCP Temp.: 2.3 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243
Firmware: 56.04
Bin Size: 2 cm
Blank: 10 cm
BT Mode: Auto
BT Pings: Dyn
WT Mode: Auto
WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: NO* Evaluation: NO*
Meas. Location: DSS1 Channel 2

Project Name: sag20170528_dss1ch2_q7cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
004	R	10.0	15.0	65	2.33	2.36	0.519	0.649	1.43	7.29	38.4	9.2	13:51	13:51	0.38	0.80	2	0
Mean		10.0	15.0	65	2.33	2.36	0.519	0.649	1.43	7.29	38.4	9.2	**Total**	00:00	0.38	0.80	2	0
5Dev																		
5D/M																		

Remarks: Q with RiverPro 7 m3/s using BT and 7 m3/s using VTG, one transect only. Two channels, total Q 357+7=364 m3/s.

* Compass calibration and evaluation were not performed because same-day compass calibration and evaluation from a nearby gauging site were used.

Station Number: Meas. No.: 11

Station Name: Sagavanirktok River DSS1 Channel 1 Date: 05/30/2017

Party: JK/JB/HT
Boat/Motor: Helicopter
Gauge Height: 25.63 m

Width: 242.2 m
Area: 333.2 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.32 m/s
Discharge: 438 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 2.97

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: 14-Shore Ice
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.27 m/s
Max. Depth: 2.59 m
Mean Depth: 1.38 m
% Meas.: 74.76
Water Temp.: None
ADCP Temp.: 0.8 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS1 Channel 1

Project Name: sag20170530_dss1ch1_438cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	2.00	2.00	212	55.2	328	55.3	3.60	0.229	442	238.2	321.3	12:59	13:02	1.57	1.38	1	0
001	R	1.00	3.00	293	54.4	329	50.6	1.45	0.247	436	244.9	340.7	13:02	13:06	1.29	1.28	2	0
003	L	2.00	3.00	192	55.1	324	54.0	2.75	0.502	437	239.8	327.3	13:08	13:10	1.75	1.34	0	0
004	R	2.00	3.00	307	53.9	328	51.2	3.32	0.163	437	246.0	343.5	13:10	13:14	1.25	1.27	1	0
Mean		1.75	2.75	251	54.7	327	52.8	2.78	0.285	438	242.2	333.2	**Total**	00:14	1.46	1.31	1	0
5Dev		0.50	0.50	57	0.608	1.97	2.23	0.955	0.149	2.82	3.8	10.6			0.24	0.05		
5D/M		0.29	0.18	0.23	0.01	0.01	0.04	0.34	0.52	0.01	0.02	0.03			0.16	0.04		

Remarks: Q with RiverPro 438 m3/s using BT with 1% error, 407 m3/s using VTG with 5% error. Two channels, total Q 438+11=449 m3/s.

Station Number:
Station Name: Sagavanirktok River DSS1 Channel 2

Meas. No.: 11
Date: 05/30/2017

Party: JK/JB/HT	Width: 36.0 m	Processed by: DV
Boat/Motor: Helicopter	Area: 9.9 m2	Mean Velocity: 1.14 m/s
Gauge Height: 25.63 m	G.H.Change: 0.000 m	Discharge: 11.3 m3/s

Area Method: Mean Flow	ADCP Depth: 0.050 m	Index Vel.: 0.00 m/s	Rating No.: 1
Nav. Method: Bottom Track	Shore Ens.:10	Adj.Mean Vel: 0.00 m/s	Qm Rating: U
MagVar Method: Model (18.0°)	Bottom Est: Power (0.1667)	Rated Area: 0.000 m2	Diff.: 0.000%
Depth: Composite (BT)	Top Est: Power (0.1667)	Control1: 14-Shore Ice	
Discharge Method: Distributed		Control2: Unspecified	
% Correction: 4.01		Control3: Unspecified	

Screening Thresholds:		ADCP:	
BT 3-Beam Solution: YES	Max. Vel.: 2.09 m/s	Type/Freq.: RiverPro/RioPro / 1200 kHz	
WT 3-Beam Solution: YES	Max. Depth: 0.560 m	Serial #: 1243	Firmware: 56.04
BT Error Vel.: 1.00 m/s	Mean Depth: 0.274 m	Bin Size: 2 cm	Blank: 10 cm
WT Error Vel.: 10.00 m/s	% Meas.: 39.35	BT Mode: Auto	BT Pings: Dyn
BT Up Vel.: 10.00 m/s	Water Temp.: None	WT Mode: Auto	WT Pings: Dyn
WT Up Vel.: 10.00 m/s	ADCP Temp.: 1.1 °C	WZ : 5	
Use Weighted Mean Depth: YES			

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES   Evaluation: YES
Meas. Location: DSS1 Channel 2

Project Name: sag20170530_dss1ch2_q11.3cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
005	L	3.00	12.0	112	4.63	4.43	0.964	0.289	0.951	11.3	36.0	9.9	13:18	13:19	0.45	1.14	11	0
Mean		3.00	12.0	112	4.63	4.43	0.964	0.289	0.951	11.3	36.0	9.9	**Total**	00:01	0.45	1.14	11	0
SDev																		
SD/M																		

Remarks: Q with RiverPro 11 m3/s using BT and 11 m3/s using VTG, one transect only. Two channels, total Q 438+11=449 m3/s.

Station Number: Meas. No.: 12

Station Name: Sagavanirktok River DSS1 Channel 1 Date: 05/31/2017

Party: JK/JB/HT
Boat/Motor: Helicopter
Gauge Height: 25.63 m

Width: 244.8 m
Area: 324.2 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.31 m/s
Discharge: 425 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 4.07

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.00 m/s
Max. Depth: 2.52 m
Mean Depth: 1.32 m
% Meas.: 73.94
Water Temp.: None
ADCP Temp.: 1.2 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS1 Channel 1

Project Name: sag20170531_dss1ch1_425cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	L	2.00	3.00	222	53.3	312	52.2	3.44	0.366	421	235.8	309.9	13:31	13:34	1.60	1.36	0	0
001	R	3.00	3.00	388	53.0	320	51.3	5.58	0.194	430	246.5	343.2	13:34	13:39	1.16	1.25	1	0
002	L	3.00	5.00	188	54.3	311	52.4	5.26	0.584	423	242.4	309.3	13:39	13:41	1.78	1.37	0	0
003	R	4.00	3.00	307	53.6	316	50.9	6.80	0.152	427	254.7	334.4	13:42	13:45	1.30	1.28	7	0
Mean		3.00	3.50	276	53.5	314	51.7	5.27	0.324	425	244.8	324.2	**Total**	00:13	1.46	1.31	2	0
SDev		0.82	1.00	90	0.553	4.10	0.722	1.39	0.197	3.96	7.9	17.2			0.28	0.06		
SD/M		0.27	0.29	0.33	0.01	0.01	0.01	0.26	0.61	0.01	0.03	0.05			0.19	0.04		

Remarks: Q with RiverPro 425 m3/s using BT with 1% error, 405 m3/s using VTG with 3% error. Two channels, total Q 425+5=430 m3/s.

Station Number:

Station Name: Sagavanirktok River DSS1 Channel 2

Meas. No.: 12

Date: 05/31/2017

Party: JK/JB/HT
Boat/Motor: Helicopter
Gauge Height: 25.63 m

Width: 36.6 m
Area: 7.3 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.727 m/s
Discharge: 5.30 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: Model (18.0°)
Depth: Composite (BT)
Discharge Method: Distributed
% Correction: 4.29

ADCP Depth: 0.050 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 1.50 m/s
Max. Depth: 0.435 m
Mean Depth: 0.199 m
% Meas.: 24.72
Water Temp.: None
ADCP Temp.: 1.6 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 2 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS1 Channel 2

Project Name: sag20170531_dss1ch2_5.2cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	MBT Corrected Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
004	L	3.00	20.0	62	1.95	1.31	0.394	0.445	1.20	5.30	36.6	7.3	13:48	13:49	0.43	0.73	16	0
Mean		3.00	20.0	62	1.95	1.31	0.394	0.445	1.20	5.30	36.6	7.3	**Total**	00:00	0.43	0.73	16	0
5Dev																		
5D/M																		

Remarks: Q with RiverPro 5.3 m3/s using BT and 5.2 m3/s using VTG, one transect only. Two channels, total Q 425+5=430 m3/s.

Station Number:
Station Name: Sagavanirktok River DSS1

Meas. No.: 13
Date: 07/08/2017

Party: JK/JH
Boat/Motor: Kayak
Gauge Height: 25.06 m

Width: 89.7 m
Area: 104.3 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 0.754 m/s
Discharge: 78.6 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.1°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.83 m/s
Max. Depth: 2.09 m
Mean Depth: 1.16 m
% Meas.: 72.18
Water Temp.: None
ADCP Temp.: 15.7 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243
Firmware: 56.04
Bin Size: 2 cm
Blank: 10 cm
BT Mode: Auto
BT Pings: Dyn
WT Mode: Auto
WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS1

Project Name: dss1_7082017q79cms
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	2.00	8.00	375	13.9	56.2	6.50	0.327	0.503	77.5	89.5	104.6	12:11	12:15	0.36	0.74	0	9
001	L	2.00	8.00	324	14.1	57.4	6.87	0.323	0.368	79.1	90.0	104.0	12:15	12:19	0.42	0.76	0	8
002	R	2.00	8.00	316	14.3	57.0	7.01	0.403	0.421	79.1	90.3	105.0	12:19	12:23	0.41	0.75	1	9
003	L	2.00	8.00	262	14.2	56.3	7.62	0.236	0.355	78.8	89.0	103.5	12:23	12:26	0.49	0.76	1	9
Mean		2.00	8.00	319	14.1	56.7	7.00	0.322	0.412	78.6	89.7	104.3	**Total**	00:14	0.42	0.75	0	9
5Dev		0.00	0.00	46	0.161	0.546	0.465	0.068	0.067	0.772	0.6	0.7			0.05	0.01		
5D/M		0.00	0.00	0.15	0.01	0.01	0.07	0.21	0.16	0.01	0.01	0.01			0.12	0.01		

Remarks: Q with RiverPro 79 m3/s using BT with 1% error, 78 m3/s using VTG with 1% error.

Station Number:

Station Name: Sagavanirktok River DSS1

Meas. No.: 14

Date: 08/05/2017

Party: JB/JK

Boat/Motor: 15' Jon boat w 40 hp jet

Gauge Height: 25.31 m

Width: 82.2 m

Area: 124.0 m2

G.H.Change: 0.000 m

Processed by: DV

Mean Velocity: 1.25 m/s

Discharge: 155 m3/s

Area Method: Avg. Course

Nav. Method: Bottom Track

MagVar Method: None (18.1°)

Depth: Composite (BT)

Discharge Method: None

% Correction: 0.00

ADCP Depth: 0.060 m

Shore Ens.:10

Bottom Est: Power (0.1667)

Top Est: Power (0.1667)

Index Vel.: 0.00 m/s

Adj.Mean Vel: 0.00 m/s

Rated Area: 0.000 m2

Control1: Unspecified

Control2: Unspecified

Control3: Unspecified

Rating No.: 1

Qm Rating: U

Diff.: 0.000%

Screening Thresholds:

BT 3-Beam Solution: YES

WT 3-Beam Solution: YES

BT Error Vel.: 1.00 m/s

WT Error Vel.: 10.00 m/s

BT Up Vel.: 10.00 m/s

WT Up Vel.: 10.00 m/s

Use Weighted Mean Depth: YES

Max. Vel.: 2.50 m/s

Max. Depth: 2.32 m

Mean Depth: 1.51 m

% Meas.: 76.32

Water Temp.: None

ADCP Temp.: 13.7 °C

ADCP:

Type/Freq.: RiverPro/RioPro / 1200 kHz

Serial #: 1243 Firmware: 56.04

Bin Size: 2 cm Blank: 10 cm

BT Mode: Auto BT Pings: Dyn

WT Mode: Auto WT Pings: Dyn

WZ : 5

Performed Diag. Test: NO

Performed Moving Bed Test: YES

Performed Compass Calibration: YES Evaluation: YES

Meas. Location: DSS1

Project Name: sag_08052017_dss1_q156cms

Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
001	R	2.00	5.00	264	18.1	119	17.1	1.39	0.476	156	82.7	125.7	13:49	13:52	0.46	1.24	0	0
002	L	2.00	5.00	177	17.8	117	17.1	0.427	0.502	153	83.7	126.0	13:52	13:55	0.56	1.21	0	0
003	R	2.00	5.00	194	18.4	120	17.1	0.969	0.523	157	82.9	125.4	13:55	13:57	0.56	1.25	0	0
004	L	2.00	0.00	210	18.6	119	17.9	0.245	0.000	155	78.4	120.4	13:57	14:00	0.51	1.29	0	0
005	L	2.00	5.00	198	18.4	118	18.1	0.400	0.509	155	83.4	122.7	14:03	14:06	0.54	1.26	1	0
Mean		2.00	4.00	208	18.3	119	17.5	0.687	0.402	155	82.2	124.0	**Total**	00:16	0.53	1.25	0	0
SDev		0.00	2.24	33	0.292	1.31	0.503	0.480	0.225	1.65	2.2	2.4			0.04	0.03		
SD/M		0.00	0.56	0.16	0.02	0.01	0.03	0.70	0.56	0.01	0.03	0.02			0.08	0.02		

Remarks: Q with RiverPro 155 m3/s using BT with 1% error, 155 m3/s using VTG with 1% error.

Station Number:
Station Name: Sagavanirktok River DSS1

Meas. No.: 15
Date: 09/06/2017

Party: JK/KP
Boat/Motor: Kayak
Gauge Height: 25.32 m

Width: 82.7 m
Area: 115.3 m2
G.H.Change: 0.000 m

Processed by: DV
Mean Velocity: 1.64 m/s
Discharge: 189 m3/s

Area Method: Mean Flow
Nav. Method: Bottom Track
MagVar Method: None (18.0°)
Depth: Composite (BT)
Discharge Method: None
% Correction: 0.00

ADCP Depth: 0.060 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)

Index Vel.: 0.00 m/s
Adj.Mean Vel: 0.00 m/s
Rated Area: 0.000 m2
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Rating No.: 1
Qm Rating: U
Diff.: 0.000%

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 3.30 m/s
Max. Depth: 2.40 m
Mean Depth: 1.40 m
% Meas.: 74.02
Water Temp.: None
ADCP Temp.: 4.9 °C

ADCP:
Type/Freq.: RiverPro/RioPro / 1200 kHz
Serial #: 1243 Firmware: 56.04
Bin Size: 6 cm Blank: 10 cm
BT Mode: Auto BT Pings: Dyn
WT Mode: Auto WT Pings: Dyn
WZ : 5

Performed Diag. Test: NO
Performed Moving Bed Test: YES
Performed Compass Calibration: YES Evaluation: YES
Meas. Location: DSS1

Project Name: DSS1_0.mmt
Software: 2.17

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	2.00	7.00	242	24.4	143	23.1	0.463	1.03	192	85.6	117.9	13:59	14:02	0.50	1.63	1	0
001	L	2.00	3.00	224	24.3	138	23.8	0.315	0.180	187	82.0	113.3	14:02	14:05	0.50	1.65	0	0
002	R	2.00	3.00	193	23.2	141	25.1	0.665	0.171	190	81.8	119.2	14:06	14:08	0.63	1.60	1	0
003	L	2.00	3.00	239	24.5	138	24.3	0.704	0.221	188	81.2	110.9	14:08	14:11	0.49	1.69	0	0
Mean		2.00	4.00	224	24.1	140	24.1	0.537	0.400	189	82.7	115.3	**Total**	00:12	0.53	1.64	1	0
SDev		0.00	2.00	22	0.577	2.31	0.820	0.182	0.418	2.27	2.0	3.9			0.07	0.04		
SD/M		0.00	0.50	0.10	0.02	0.02	0.03	0.34	1.05	0.01	0.02	0.03			0.13	0.02		

Remarks: Q with RiverPro 189 m3/s using BT with 1% error, 190 m3/s using VTG with 1% error.

APPENDIX F

Stable Isotopes

Sample Type	Latitude (WGS84)	Longitude (WGS84)	Elevation (m, WGS84)	δ^2H VSMOW (‰)	δ^{18}O VSMOW (‰)	Sample Date	Sample Name
Mountain spring April	68.4700	-149.0091	640	-173.90	-22.91	12/7/2016	H20 OW1 4/16/17
Mountain spring April	69.0362	-147.6077	380	-177.47	-23.41	4/16/2017	IVI Hobo 2 4/16/17
Mountain spring April	68.5225	-148.9389	671	-173.88	-23.09	4/16/2017	H20 OF1 4/16/17
Mountain spring April	69.0855	-147.9036	319	-175.18	-23.01	4/17/2017	H20 OF IVI 4/17/17
Mountain spring April	68.9659	-148.1498	420	-174.00	-22.91	4/17/2017	H20 SAV Hobo 4/17/17
Mountain spring December	68.9405	-148.0036	494	-160.18	-21.40	12/7/2016	Sag Tributary 12/7/16 12:18
Mountain spring December	69.0434	-147.5752	380	-160.66	-20.82	12/7/2016	Ivi Gauge 12/7/16 11:30
Mountain spring December	68.8922	-148.0800	495	-156.97	-19.92	12/7/2016	Lupine Spring 12/7/16 12:30
Mountain spring December	68.9845	-147.8918	420	-163.19	-20.99	12/7/2016	Flood Creek sp 12/7/16 12:05
Mountain spring December	69.0296	-147.7125	368	-159.58	-21.00	12/7/2016	Ivi Hillside 12/7/16 4:55
Sag R April	69.9572	-148.7103	55	-179.72	-23.77	4/18/2017	H20 1 4/18/17 69 57 26 148 42 37
Sag R April	69.9167	-148.7070	661	-173.55	-22.91	4/19/2017	SAG H20 4/19/17
Sag R April	69.8869	-148.7172	75	-179.46	-23.86	4/18/2017	3 active overflow 69 53 13 148 43 02
Sag R April	69.9558	-148.7092	57	-176.69	-23.37	4/18/2017	2 active overflow 69 57 21 148 42 33
Sag R April	69.8944	-148.7422	74	-189.27	-25.26	4/18/2017	active Flow 69 53 40 148 44 32
Sag R December	69.0162	-148.8189	340	-160.83	-21.31	11/29/2016	Sag Water A USGS 11/29/16
Sag R December	69.0162	-148.8189	340	-159.29	-20.94	11/29/2016	Sag Water B USGS 11/29/16
Sag R December	69.0162	-148.8189	340	-160.33	-21.12	11/29/2016	Sag Water C USGS 11/29/16
Sag R March	69.0162	-148.8189	340	-174.40	-22.28	3/14/2017	Sag A 3/14
Sag R March	69.0162	-148.8189	340	-174.97	-22.30	3/14/2017	Sag B 3/14
Sag R March	69.0162	-148.8189	340	-171.96	-21.11	3/14/2017	Sag C 3/14
snow	69.0434	-147.5752	380	-196.69	-24.24	12/7/2016	snow Ivishak Vas 12/7/16 (1)
snow	68.8922	-148.0800	495	-215.20	-28.49	12/7/2016	snow Lupine Spring 12/7/16 (5)
snow	69.2290	-147.6184	524	-205.62	-26.71	4/15/2017	FH3 4/15/17
snow	68.7464	-146.8227	810	-250.63	-31.14	4/15/2017	IVI2 4/15/17
snow	68.6425	-147.3518	1478	-203.57	-25.27	4/15/2017	DBM2 4/15/17
snow	69.1022	-146.8254	868	-230.44	-29.02	4/15/2017	ECH1 4/15/17

snow	68.8664	-148.5246	548	-232.31	-29.75	4/15/2017	FH1 4/15/17
snow	68.7705	-147.4323	955	-228.88	-28.82	4/15/2017	SAV1 4/15/17
snow	68.4462	-148.7042	830	-220.71	-28.91	4/16/2017	SAG3 4/16/17
snow	68.6817	-148.0412	750	-212.87	-26.88	4/16/2017	LUP1 4/16/17 -Dup
snow	68.4116	-148.1365	1474	-193.28	-24.77	4/16/2017	DBM1 4/16/17
snow	69.9336	-148.7677	62	-223.02	-28.38	4/17/2017	MI_2
snow	69.7950	-148.7361	90	-191.51	-25.29	4/17/2017	MI_3
snow	69.7130	-148.7165	112	-204.69	-26.56	4/17/2017	MI_4
snow	69.6050	-148.6487	145	-214.42	-27.21	4/17/2017	MI_5
snow	69.5344	-148.5987	160	-210.74	-26.73	4/17/2017	MI_6
snow	69.8886	-148.7747	75	-210.85	-26.99	4/17/2017	FB
snow	70.0032	-148.6792	45	-183.40	-23.47	4/18/2017	MI_1
snow	69.4887	-148.5678	176	-191.60	-24.67	4/18/2017	MI_7
snow	69.4262	-148.6910	280	-204.72	-25.83	4/18/2017	Sagwon
snow	69.1519	-148.8389	310	-196.77	-25.44	4/18/2017	HV
snow	68.9424	-148.8660	430	-214.58	-27.21	4/18/2017	OSH
snow	68.4770	-149.5024	830	-221.49	-28.14	4/18/2017	GAL
snow	68.1304	-149.4784	1450	-195.05	-25.41	4/18/2017	AP
snow	68.4150	-148.9600	730	-174.32	-22.76	4/19/2017	SAG 4/19/17
snow	68.2597	-148.8256	868	-231.44	-29.61	4/16/2017	SAG 2

APPENDIX G

Pit Bathymetry

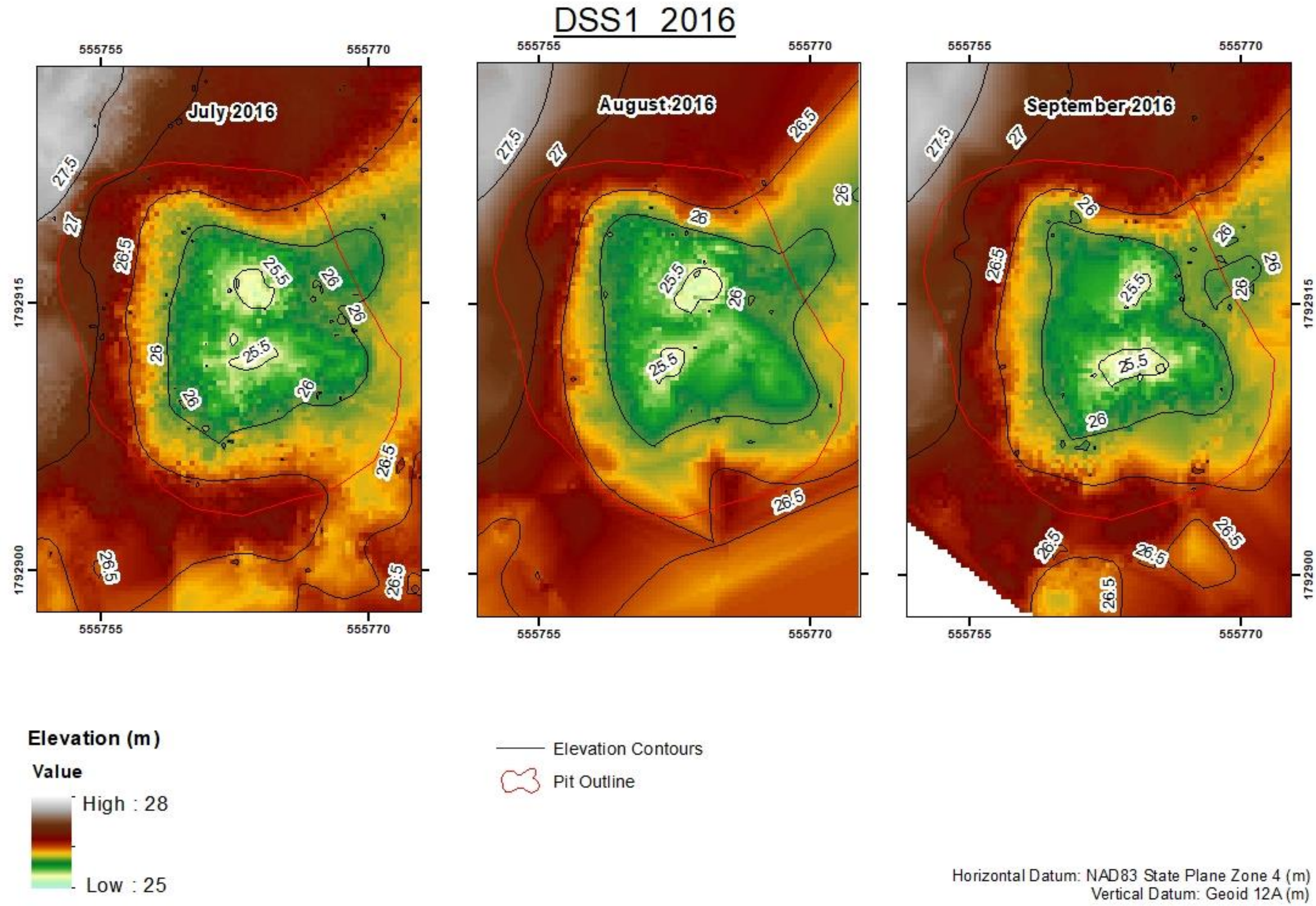

Figure G1: Contour plots of all topo-bathymetric surveys at DSS1 in 2016.

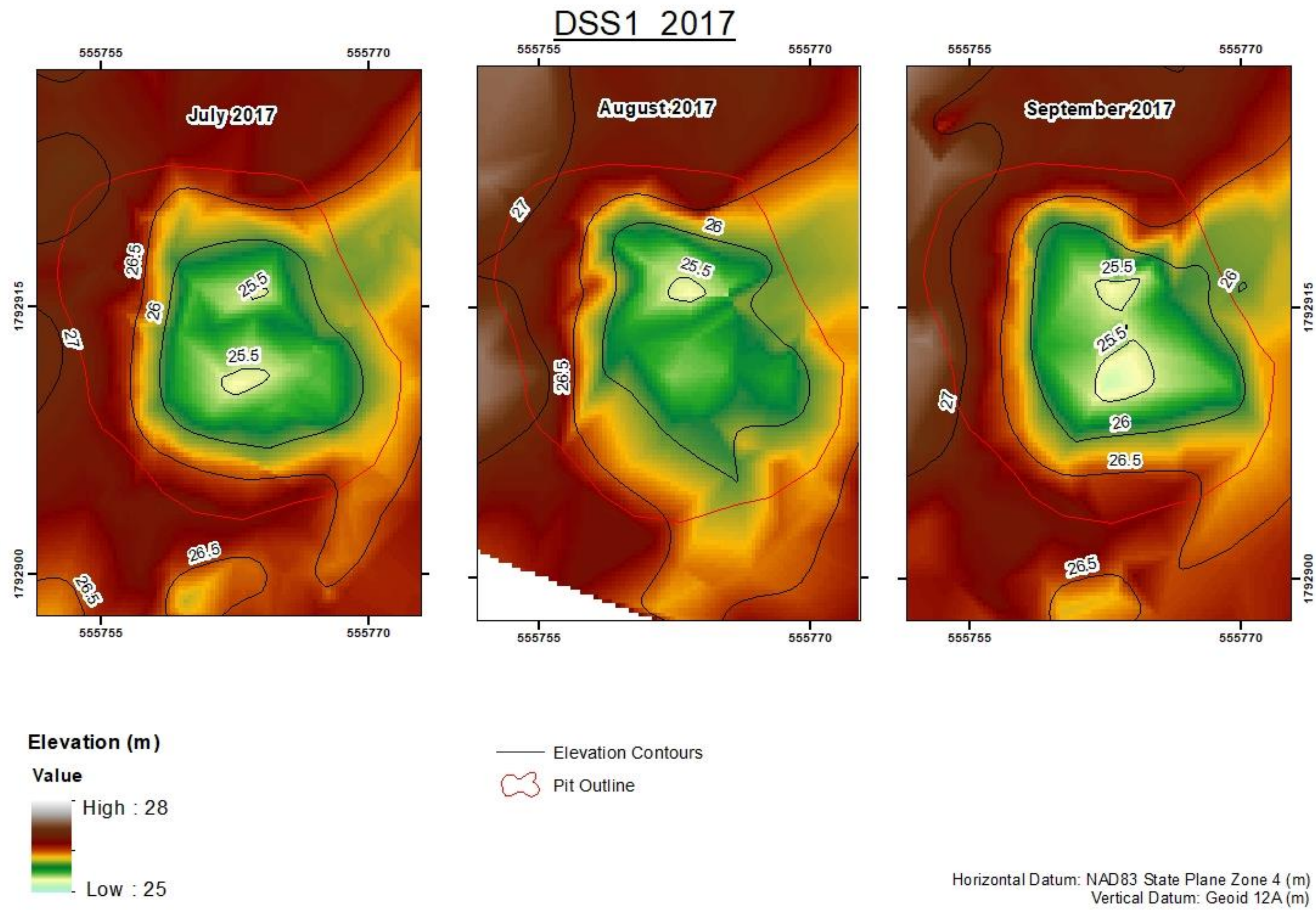

Figure G2: Contour plots of all topo-bathymetric surveys at DSS1 in 2017.

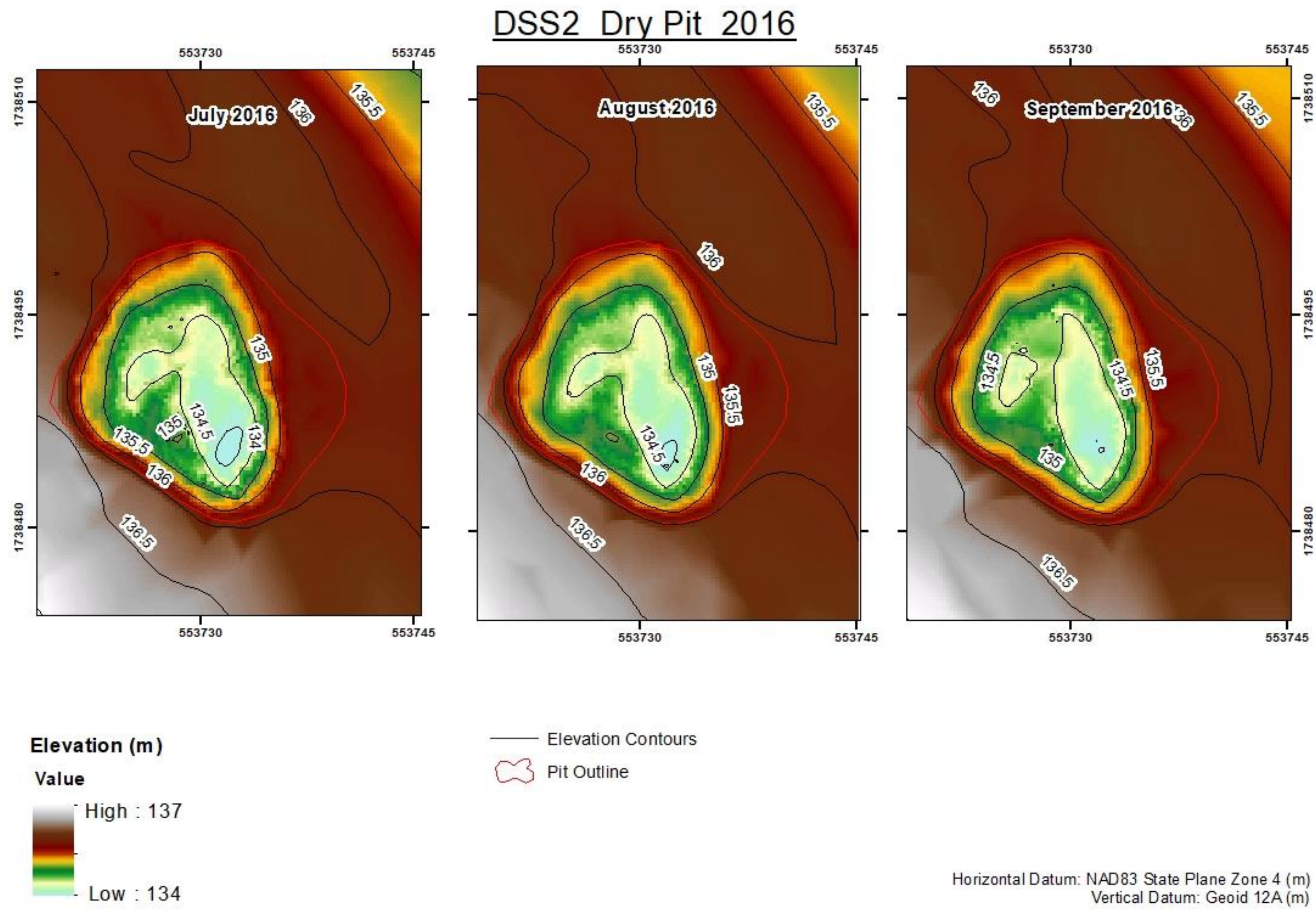

Figure G3: Contour plots of all topo-bathymetric surveys at DSS2 dry pit in 2016.

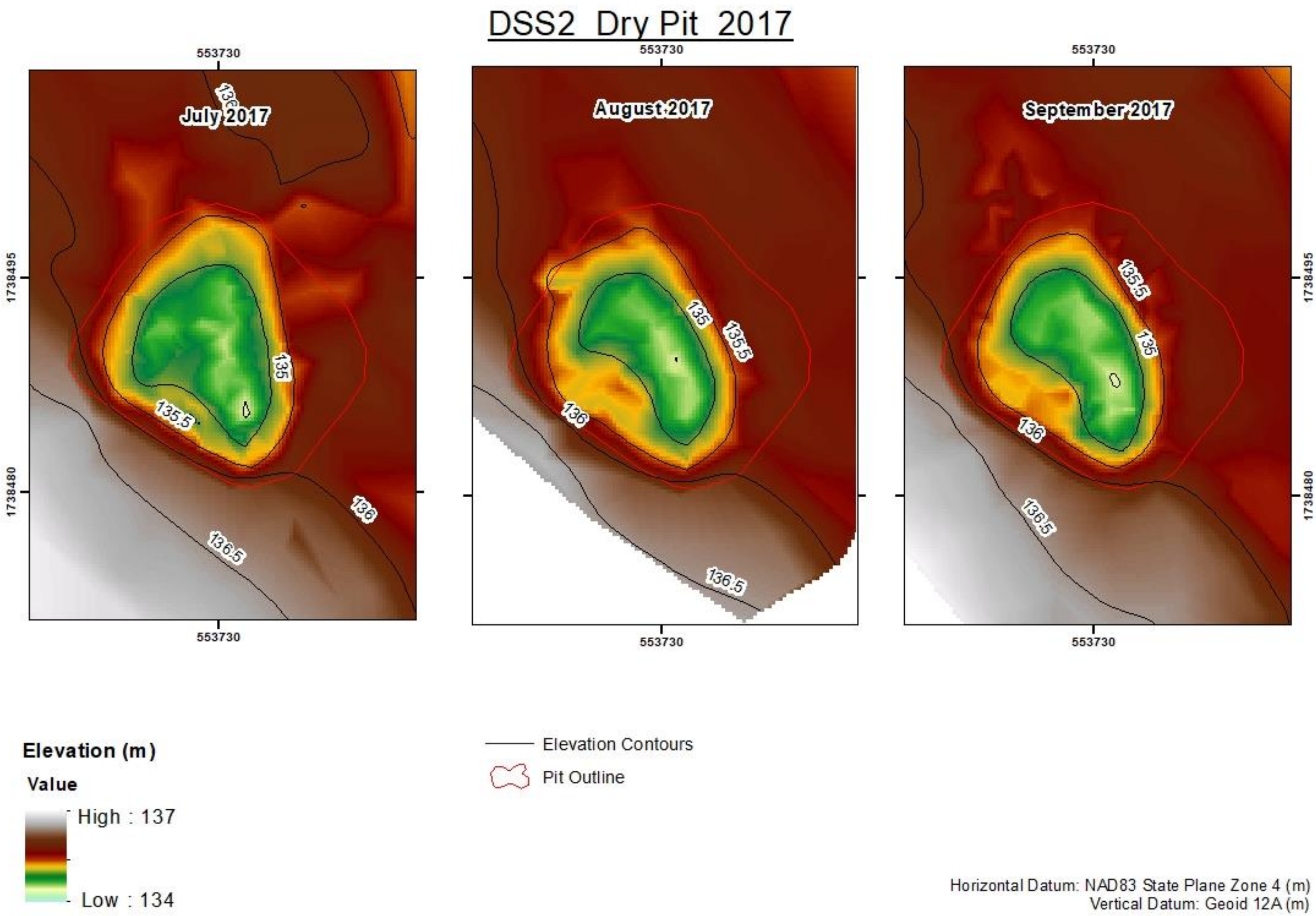

Figure G4: Contour plots of all topo-bathymetric surveys at DSS2 dry pit in 2017.

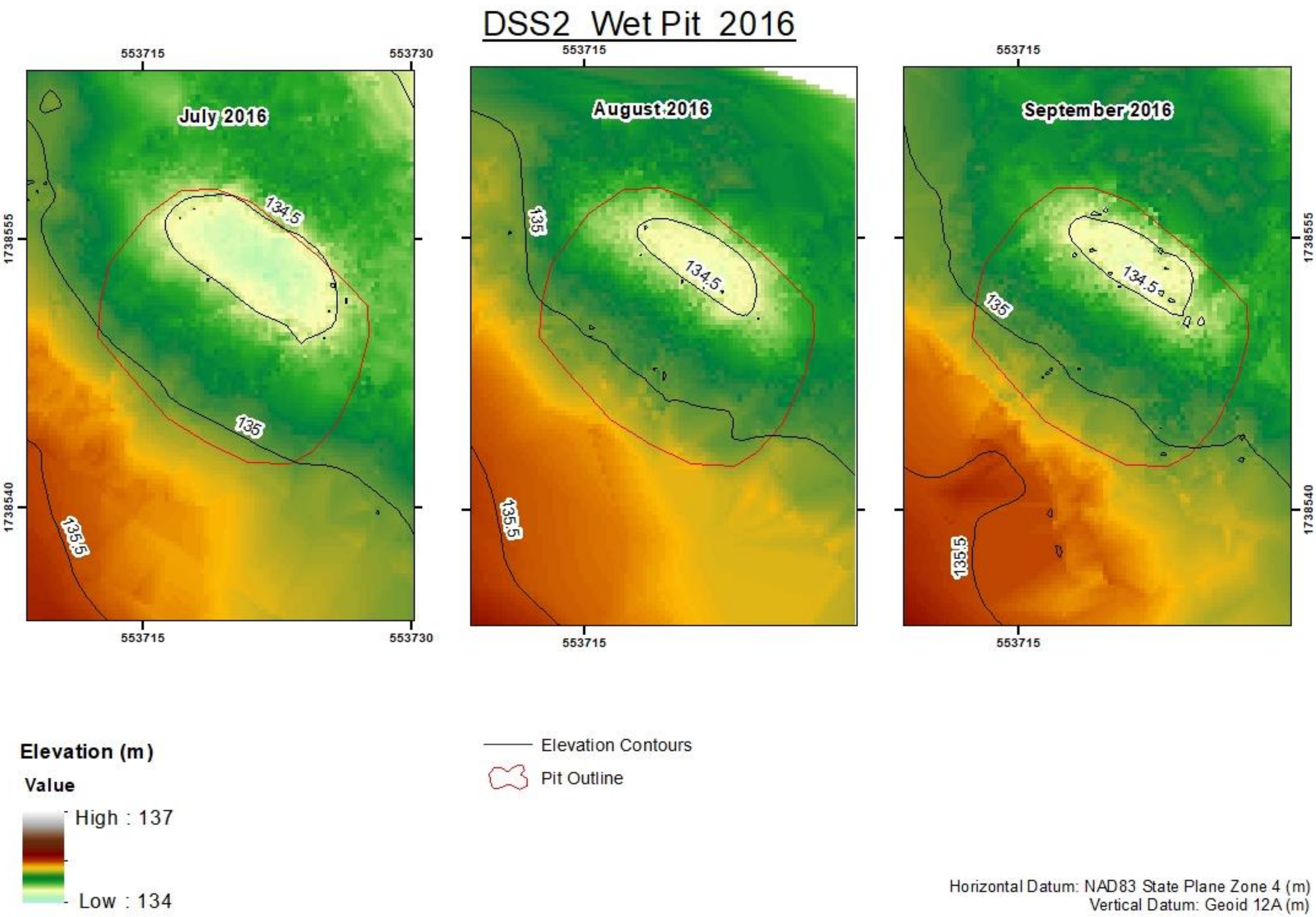

Figure G5: Contour plots of all topo-bathymetric surveys at DSS2 wet pit in 2016.

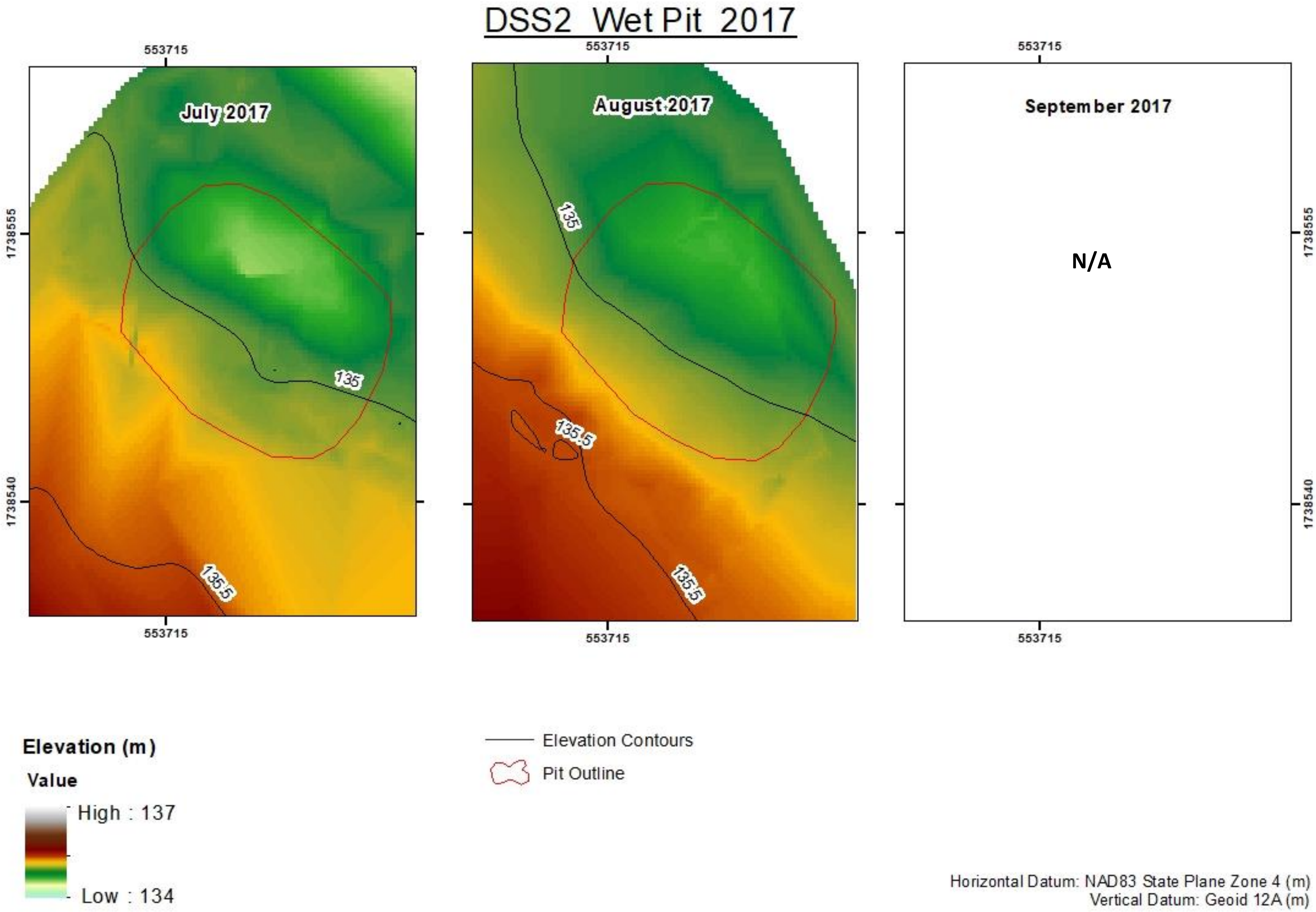

Figure G6: Contour plots of all topo-bathymetric surveys at DSS2 wet pit in 2017.

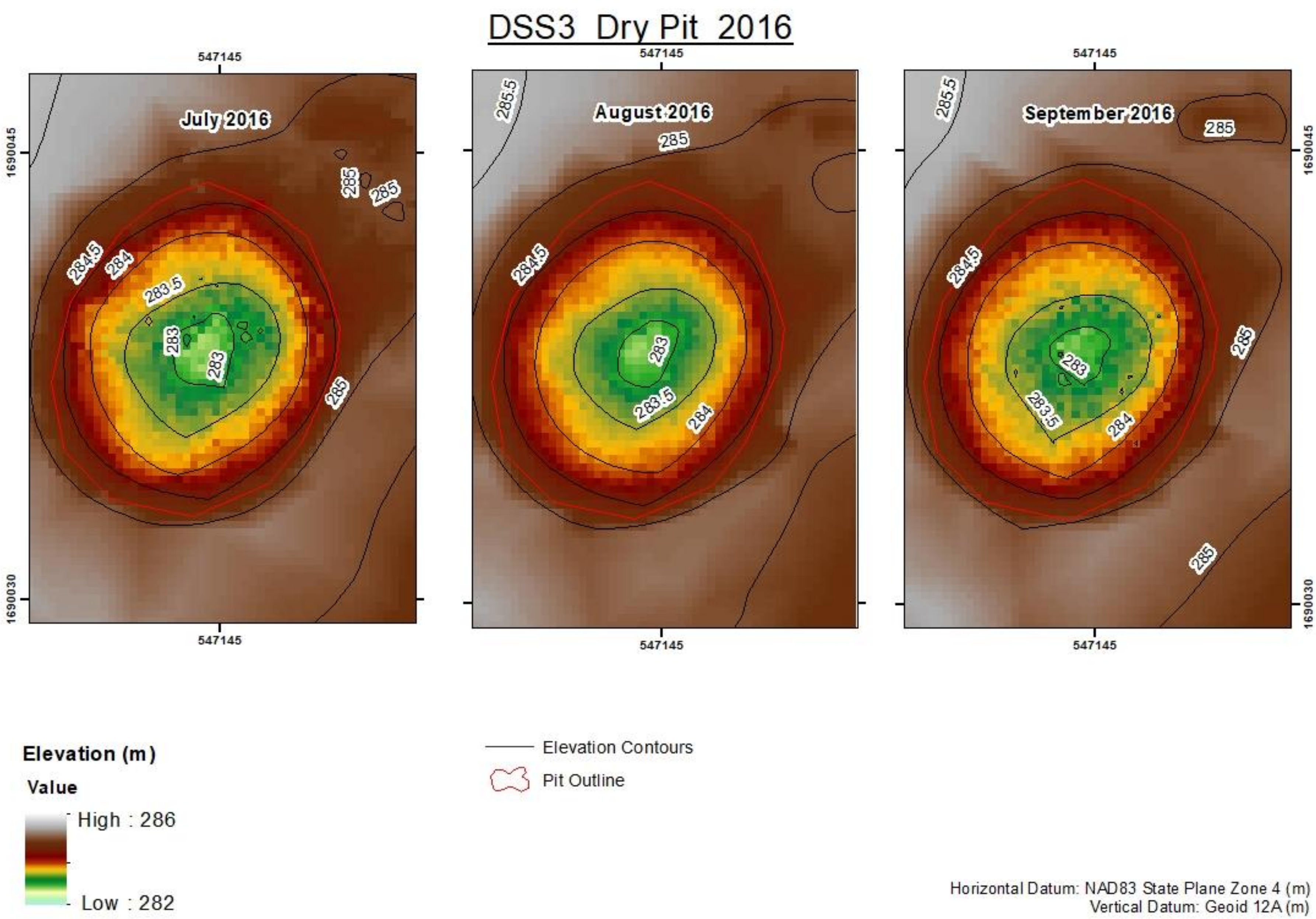

Figure G7: Contour plots of all topo-bathymetric surveys at DSS3 dry pit in 2016.

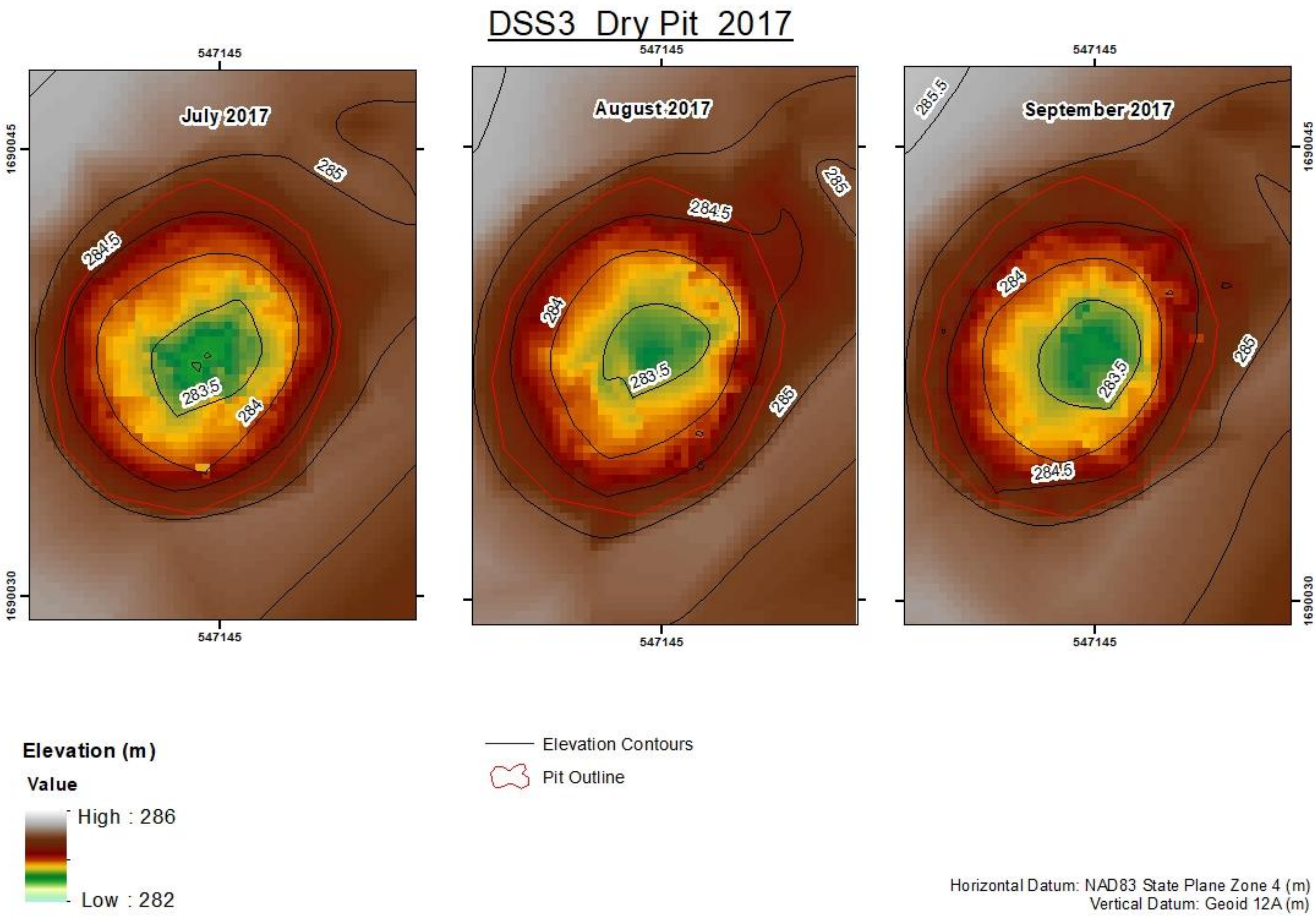

Figure G8: Contour plots of all topo-bathymetric surveys at DSS3 dry pit in 2017.

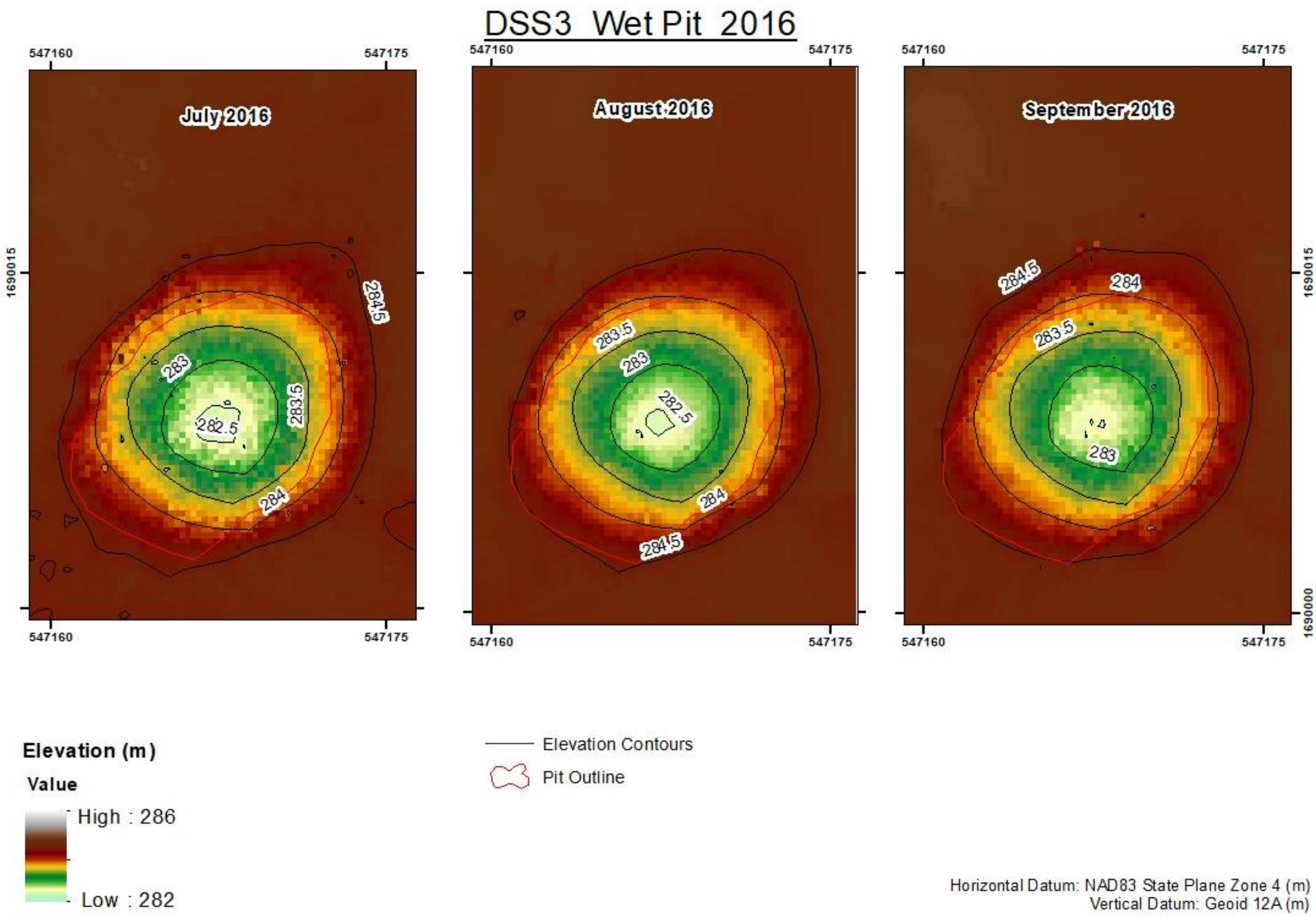

Figure G9: Contour plots of all topo-bathymetric surveys at DSS3 wet pit in 2016.

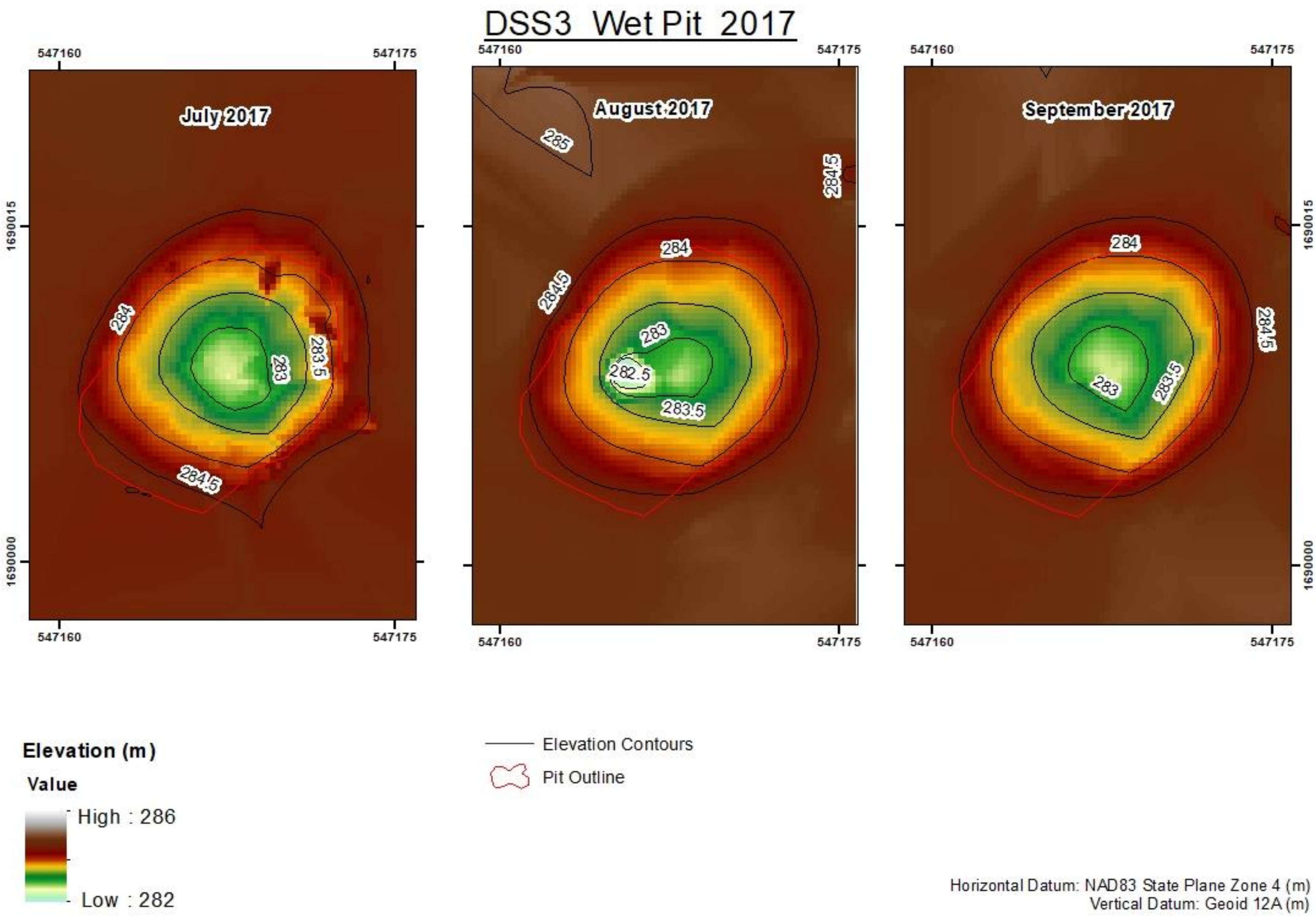

Figure G10: Contour plots of all topo-bathymetric surveys at DSS3 wet pit in 2017.

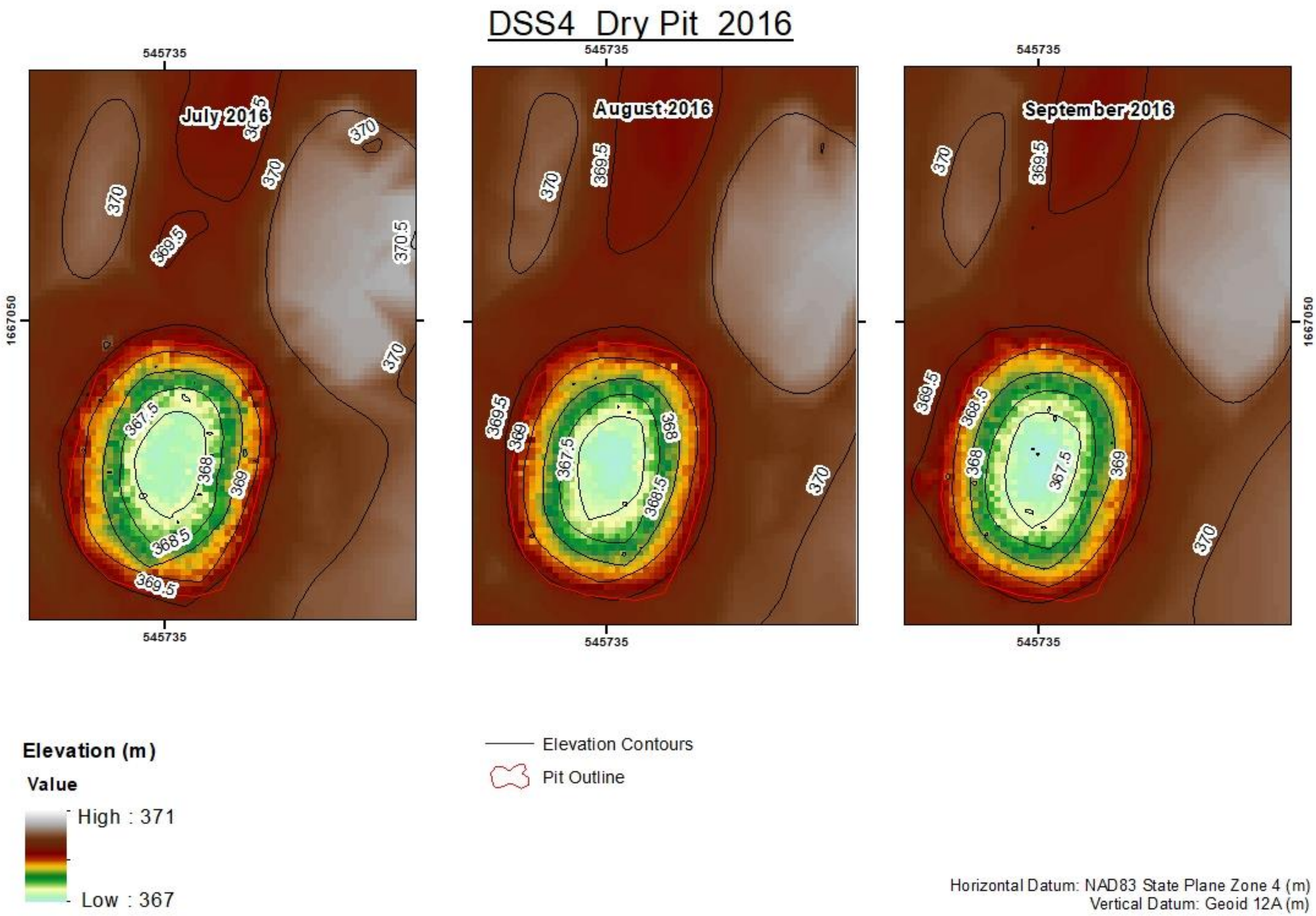

Figure G11: Contour plots of all topo-bathymetric surveys at DSS4 dry pit in 2016.

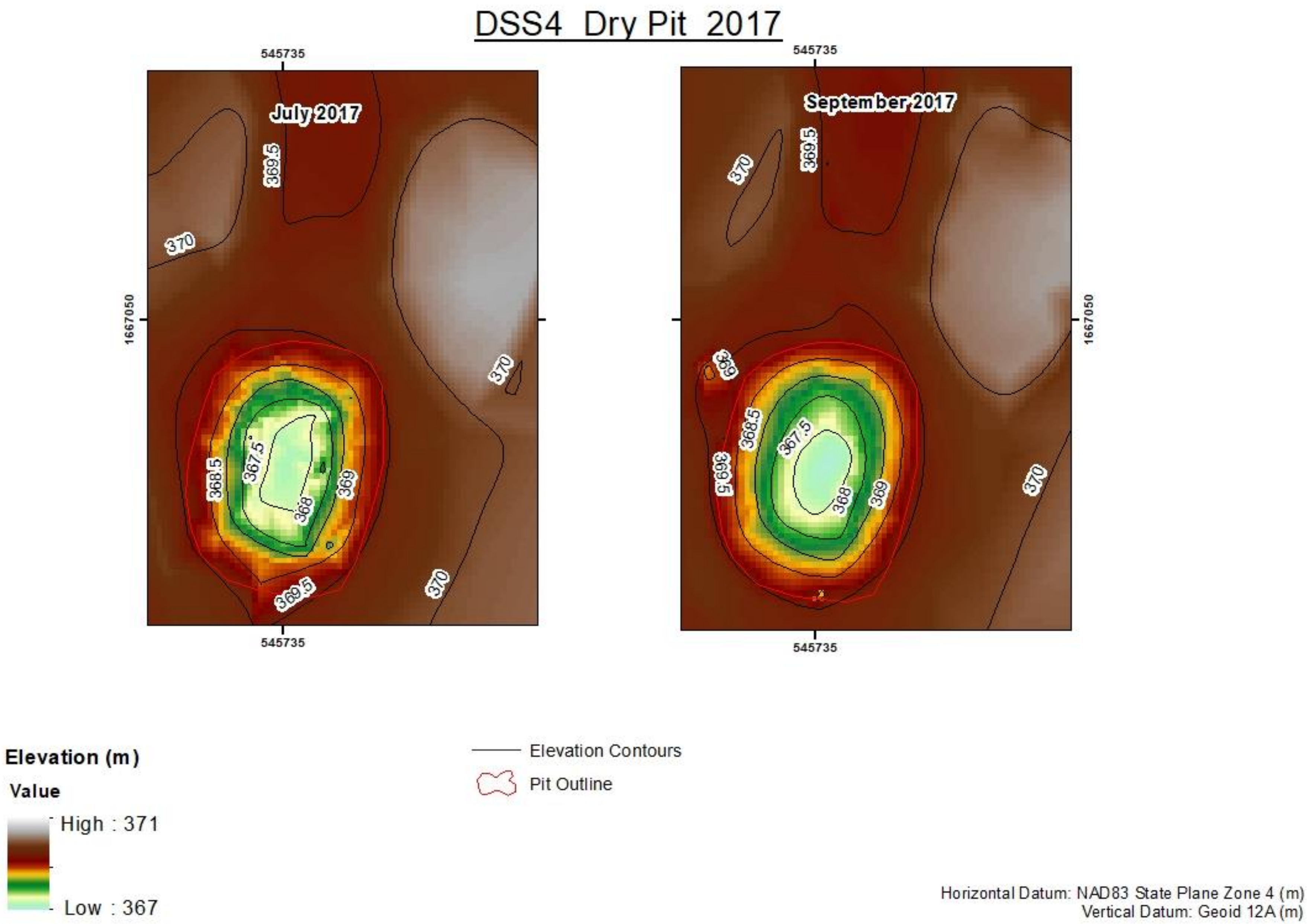

Figure G12: Contour plots of all topo-bathymetric surveys at DSS4 dry pit in 2017.

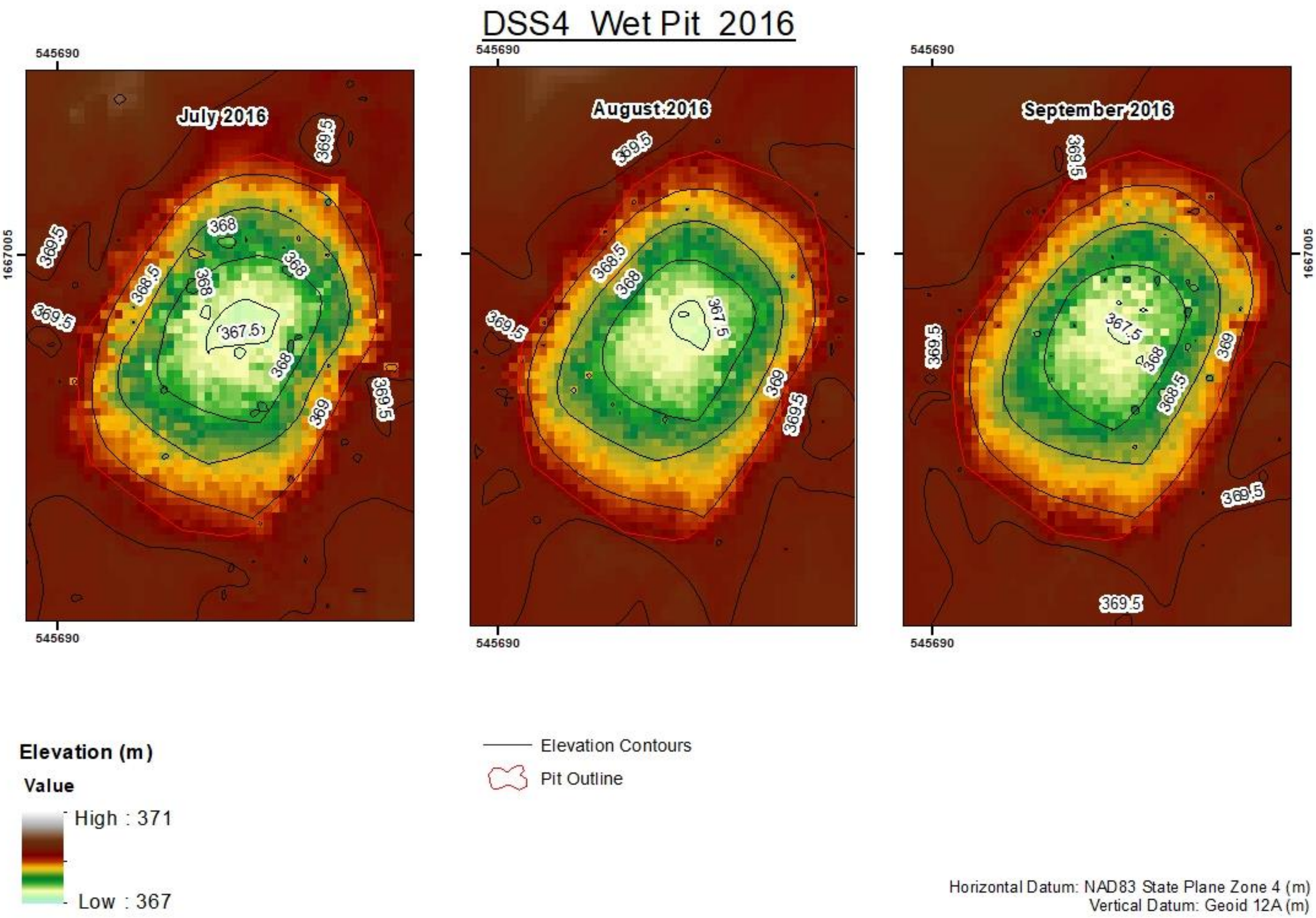

Figure G13: Contour plots of all topo-bathymetric surveys at DSS4 wet pit in 2016.

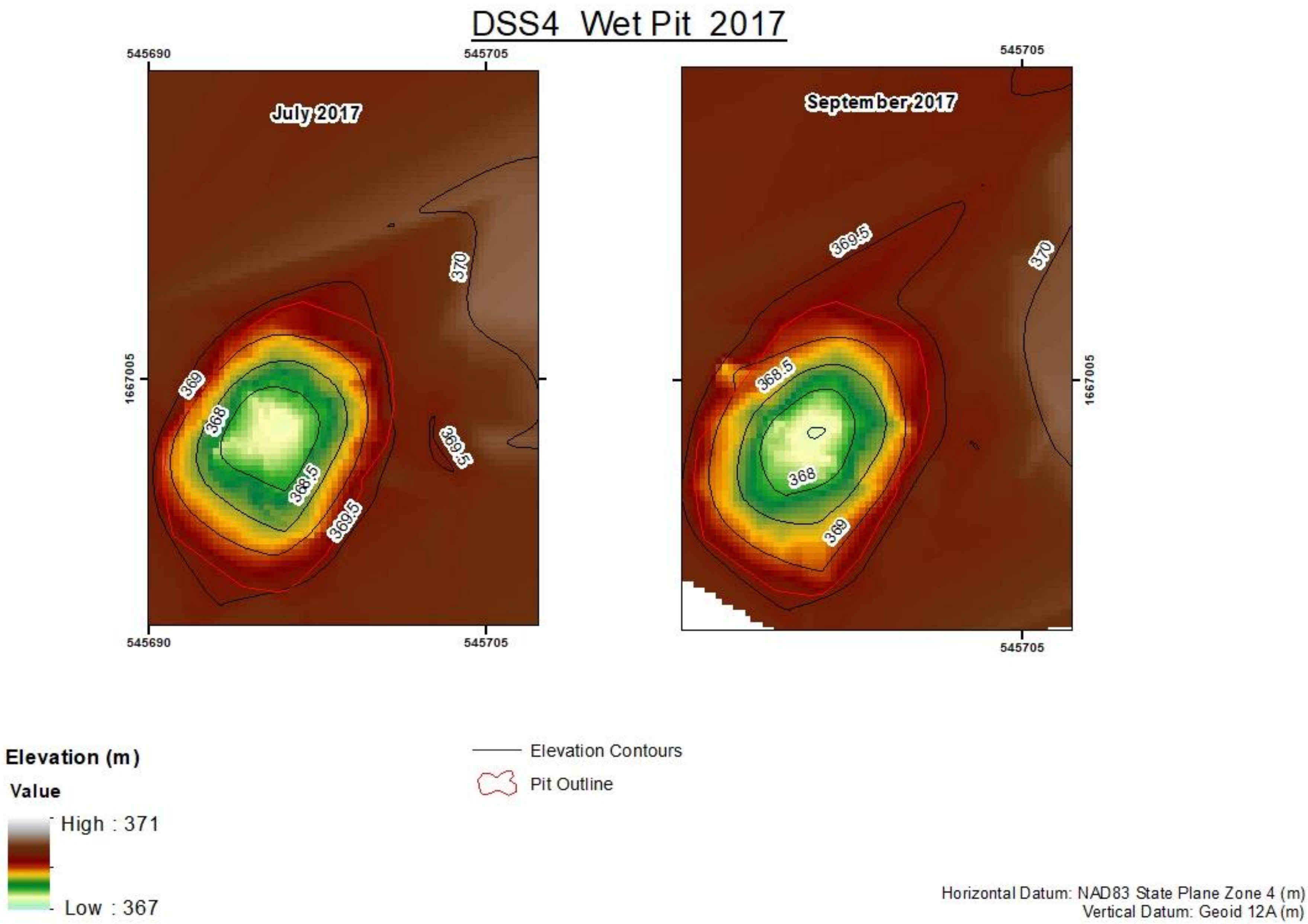

Figure G14: Contour plots of all topo-bathymetric surveys at DSS4 wet pit in 2017