Newsletter of the Alaska-Pacific River Forecast Center and
Alaska's NWS Service Hydrologists

Kuigmek: one who watches the river

December, 2018

Please Note:

Observers, don't forget to send in your Freeze up Forms! These can now be completed on the web at https://www.weather.gov/aprfc/freezeForm, or let us know if you need a paper copy. Also note that the web form can be submitted multiple times if you want to submit the timing of 'unsafe', 'freezeup', and other events separately.

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Autumn on the Koyukuk River

Figure 1: Koyukuk River at Bettles with ice starting to form. Photo credit: Rich Thorne, Bettles observer

River Profile: The Koyukuk River, called *Ooghekuhno'* in *Denaakk'e (Koyukon)*, flows about 425 miles along its main fork before joining the Yukon River. The North Fork of the Koyukuk starts in the Gates of the Arctic National Park in the Central Brooks Mountain Range; the Middle and Southern Forks also start in the Brooks Range, but further to the east. The communities of Evansville, Bettles, Alatna, Allakaket, Hughes, and Huslia are all situated along the main stem of the river, and the village of Koyukuk lies on the Yukon River just below the confluence with the Koyukuk River. The Koyukuk has nearly a dozen major tributaries including the Alatna, the John, and the Kanuti. About 600 people live near the river in this area. In 1994, heavy rains caused devastating floods in Allakaket and Hughes and other serious impacts along the Koyukuk. Ice jams and snowmelt can also cause local flooding, which highlights the importance of our community observers.

Water Year Review and Freeze-Up Conditions

Alaska's Water Year 2018 (Oct 1, 2017-Sept 30, 2018) was characterized by a record-breaking warm winter in the northern and western parts of the state, extremely low concentrations of sea ice in the Bering Sea, and more than average precipitation in the southwestern part of the state. The warm season brought persistent drought in Southeast, and persistent precipitation to the Interior, Southwest, and eastern North Slope. The Chena, Sagavanirktok, and Kuparuk Rivers went into Fall 2018 freezeup with very high, if not record water levels, while Southeast remains in drought. Figure 2 shows the condition of 12 Alaska Rivers at long-term gages going into freeze up.

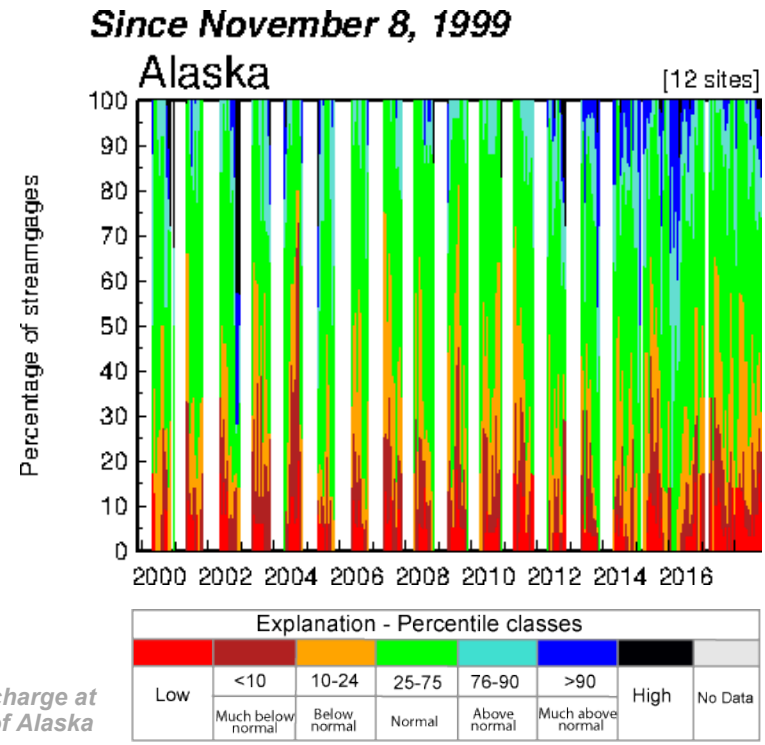

Figure 2: USGS characterization of water discharge at 12 long-term gages across the state of Alaska

Atmospheric Rivers were an active means for delivery of impactful precipitation to the North Gulf Coast and Southeast from spring (unusual) through the fall (more typical) and even occasionally during the winter, but we don't yet have a comprehensive effort to archive the properties of these events the way they are being tracked in the western contiguous U.S. Heavy rainfall caused flooding in the Yentna/ Skwentna area in June. Many of the Glacial Dammed Lakes (GDLs) across Alaska released this year, including: Suicide Basin, Skilak, Bear Glacier, Berg Lake, Strandline, Lake Nolake, Hidden Lake, and Salmon Glacier (Hyder). Juneau had minor flooding in July with one of the Suicide Basin GDL releases. These impacts will be discussed in more detail below, as well as the Seward flooding that occurred at the start of the new water year in October 2018.

Flooding on the Yentna River

Figure 3: 2018 flooding on Yentna near Lake Creek. Photo credit: Don Bolton, NWS

Consistent heavy rain led to high water on the Yentna and Skwentna Rivers in mid-June, with flooding in some locations. The picture here is flooding at a fishing lodge on the Yentna River near Lake Creek. The headwaters of the Skwentna and Yentna Rivers begin in the southwestern Alaska Range, and are known as the Yentna River after they come together. The Yentna joins the Susitna River just before it empties into Cook Inlet. There are quite a few lodges in the area where Lake Creek meets the Yentna because the clarity of Lake Creek's water makes it ideal for fishing. The downside to the river proximity for these lodges is their vulnerability to flooding. The Skwentna area also has a number of individual homes and recreational cabins, but we had few reports of impacts to buildings up on the Skwentna. Some local aircraft landing strips were inundated and a layer of silt was left behind. Thanks to our observers out there (Cyndie Abbot and Steve Childs) and everyone who called in to report impacts. The Yentna gage was the third most looked at gage on our website this summer.

Figure 4: location of slope gage on the Yentna River near Lake Creek. National Weather Service at weather.gov/aprfc

Busy Year for Glacier Dammed Lakes

Alaska had many glacial dammed lake outbursts this summer. This occurs when a lake, typically at the side of a glacier, fills to the point that it releases the water downstream. As the released water comes down (often under the glacier), it may fill an intermediate lake or pour directly into a river or ocean. This summer and fall saw releases at Strandline Lake, Skilak Glacial Lake, Bear Glacier, Berg Lake, Lake Nolake, Hidden Lake, Salmon Glacier (Hyder), Sherman Glacier, and the Suicide Basin near Juneau. Some of these systems release consistently every year or two; others release intermittently. Some we monitor closely with agency partners, others are so remote that we can only observe with aircraft or satellite imagery. This summer, the releases from the lake in Suicide Basin into the Mendenhall Valley neighborhood in both July and August were the most impactful, causing campground and road closures, though no flooding of homes was reported. Our graduate student collaborator, Dina Abdel-Fattah, worked with a team of hydrologists at the University of Alaska Southeast this summer and was able to interview community members about the efficacy of the National Weather Service's messaging during the event. We look forward to the results of her study as we plan our service into the future.

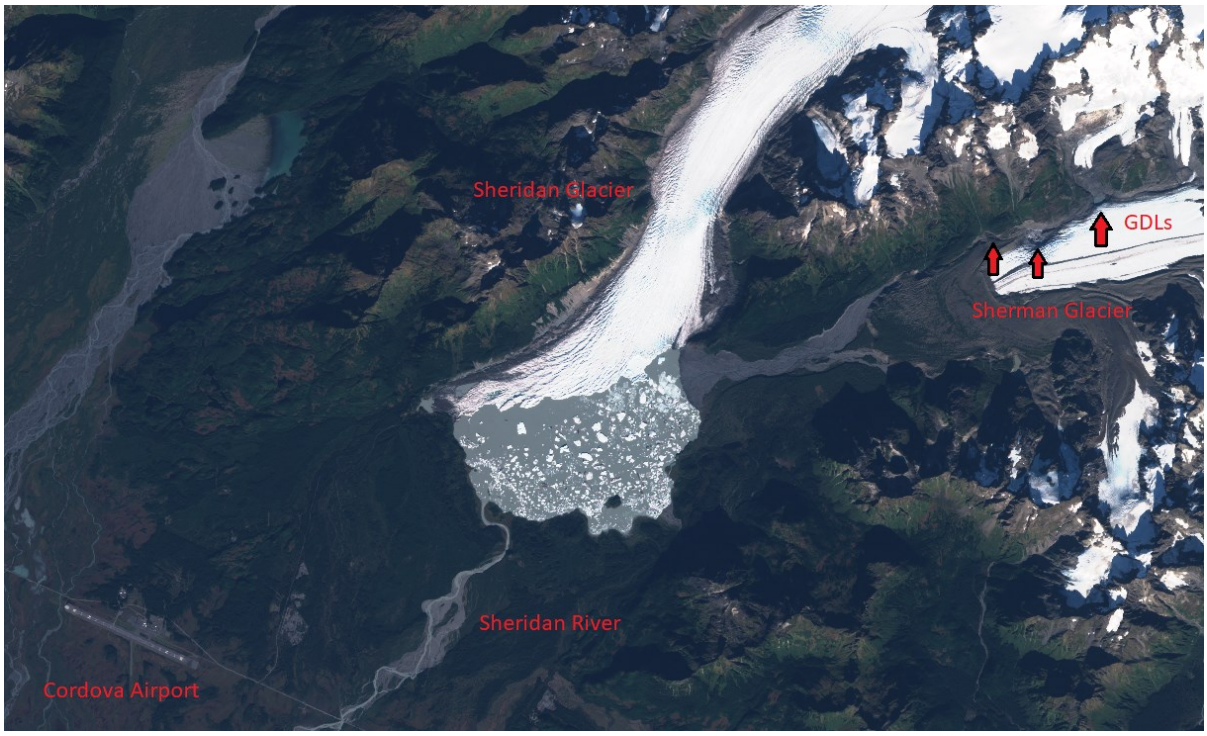

Figure 5: Sentinel-2 multi-spectral satellite imagery shows a series of glacial dammed lakes on Sherman Glacier. When one of these lakes lets go, the water ends up in the Sheridan River near Cordova.

Drought in Southeast Alaska Keeps Going

(Note: a longer version of this article was published in this month's Alaska Center for Climate Assessment and Policy newsletter)

Exceptional drought in Southeast Alaska has persisted for several months, causing impacts to regional reservoir water levels and vegetation. The northern half of the panhandle is categorized by the U.S. Drought Monitor as "Abnormally Dry" and the southern half of the panhandle is considered to be in "Severe Drought." Precipitation, as a percentage of normal, since the start of July, has been much below average in the northern half of the panhandle. Further south, this has been the driest August to October on record, which equates to more than 10 inches below normal (Figure 6).

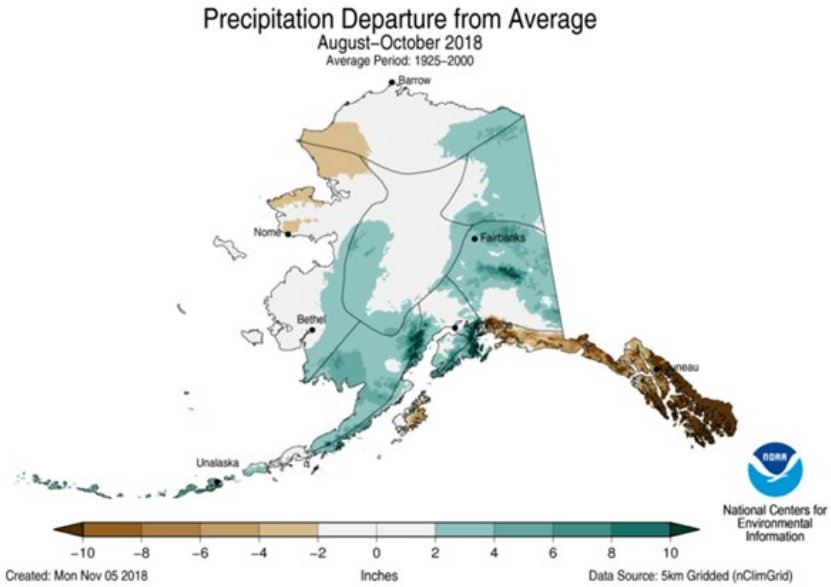

Figure 6: Precipitation anomaly for the period August-October 2018 relative to the period 1925-2000. Credit: NCEI

Precipitation normally ramps up in Southeast Alaska starting in the late summer. This is particularly important for filling reservoirs to supply water for hydroelectricity, as well as for household and commercial usage. July is typically the driest month and reservoirs are often drawn down to their lowest levels of the year. By mid-winter, some of the incoming precipitation gets stored in the snowpack and is not available until the spring melt season. The water resource management goal in the fall is to capture and store as much water as possible without spilling. Data show that the Southeast drought has persisted for more than a water year (October-September) now and the accumulated precipitation is only about two thirds of normal, which in some places are now new record low values.

Many communities in Southeast Alaska have reservoirs and Metlakatla (pop. ~1400), in particular, has been concerned about their extremely low water storage. This season, engineers in Metlakatla were forced to shut down both of the electricity-generating turbines on their two reservoirs and instead generate electricity with an aged and costly diesel-fired power system. A newer, back-up diesel generator also failed, leaving the community's power supply extremely vulnerable. Because of this vulnerability, the National Weather Service has been providing core partners in Metlakatla with routine briefings about the likelihood of precipitation in the upcoming 1-3 week time frame.

Impacts of the drought on the Tongass National Forest and other regional ecosystems are still being assessed. As fall precipitation does occur, one question is whether or not moisture is being transported from the North Pacific in narrow bands of heavy precipitation called Atmospheric Rivers (ARs). While there is a growing awareness of ARs being an important mechanism for extreme precipitation in Southern Alaska, there is not currently an operational monitoring system in place as there is for the western contiguous United States.

Those hoping that El Niño may save the day with precipitation in Southeast Alaska this winter may be disappointed. Recent calculations from NOAA's Climate Prediction Center show that even as El Niño likely sets in for the winter, its association with precipitation is weak. Regardless of how it gets there, Southeast communities will certainly be wishing for slow and steady precipitation this holiday season.

Field Trip to Tanana

On October 5th, 2018, a team consisting of Karen Endres, Service Hydrologist from the Weather Forecast Office in Fairbanks, and Eric Holloway, hydrometeorologist from the Alaska-Pacific River Forecast Center (RFC), traveled to Tanana for a site visit. Pat Moore, our observer since 2000, had mentioned during calls to the RFC that he was down to one slope marker for reading water levels on the Tanana River (see the following article for an explanation of slope gages). In 2010, five markers were surveyed at this location, but the other markers had been scoured away during the spring ice breakups in the intervening years. After the NWS team installed new markers and performed a new survey, Pat showed them around town and explained how ice jams form and what conditions are most likely to create flooding there at Tanana. He also arranged a boat ride for the NWS team to take a river discharge measurement three miles downstream, where the Tanana and the Yukon Rivers come together.

Figure 7: Tanana River observer Pat Moore smoking salmon from his fish wheel. Photo credit: Eric Holloway, NWS

In addition to being a river observer, Pat also uses our river forecasts. Pat catches nearly 5,500 fish a year to feed his family and dog team, and he uses our river forecast to understand when to deploy and when to pull his fish wheel from the Yukon River. Good quality measurements from our observers make these forecasts possible and, in turn, help Alaskan communities.

Figure 8: NWS Service Hydrologist Karen Endres making a river discharge measurement from a boat. Photo credit: Eric Holloway.

What is a Slope Gage?

The primary river observation network in Alaska is run by the United States Geological Survey (USGS). The USGS maintains approximately 100 high quality river monitoring stations throughout Alaska. However, most rivers are not monitored and more data are required to adequately monitor and forecast river conditions. Community members who serve as NWS River Observers fill in a critical gap, and many of these Observers use slope gages.

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What is a Slope Gage?

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The stage of a river or lake is the height of the water surface above some established datum or reference elevation. At most Alaska measurement sites, the reference elevation is selected for convenience. For example, rather than reading a gage as 428.3 feet mean sea level, the gage reading is 8.3 feet, with the elevation of the 0.0 reading of the gage corresponding to 420.0 feet. A reading of 8.3 feet also ***does not correspond*** to the water depth in a river. At most sites, the National Weather Service has established flood stages that correspond to the water level that will begin to cause flooding of structures and/or a threat to public safety.

Slope profile gages are installed at river locations that are not spanned by a bridge or do not have a permanently installed staff gage to measure water levels. A slope profile gage consists of a marker or series of markers anchored in the bank. Markers are usually metal rods (rebar) driven into the bank, with a metal survey cap attached to the top of the rod. The NWS installs these markers during the initial site visit when the riverbank is surveyed. The slope gage is read by measuring from one of these markers to the water's edge. An estimate of river stage or water level can then be determined by combining this slope measurement with the riverbank survey that was done by NWS staff. Figure 9 shows a typical river bank with surveyed slope markers in place. Slope measurements are received by the APRFC on a daily basis during open water season. They are converted to a river stage and displayed publicly on the internet, and integrated into our forecast model. The weblink for that site is:

https://www.weather.gov/aprfc/riverConditions

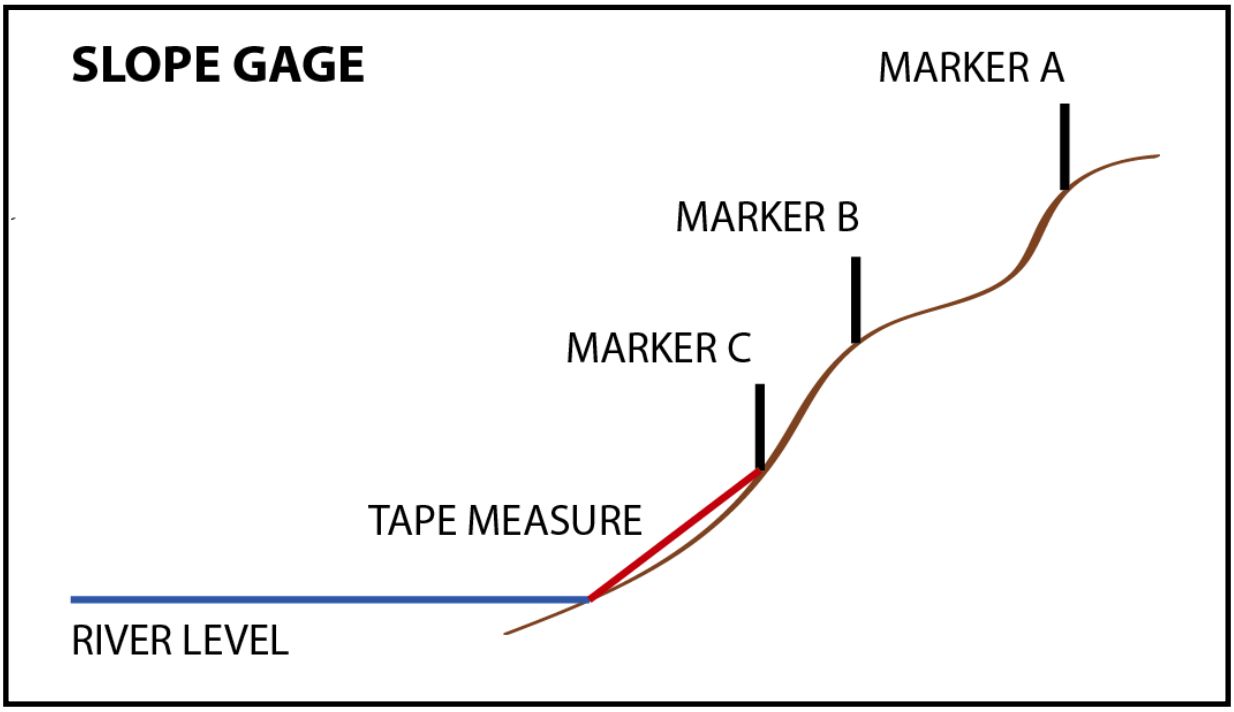


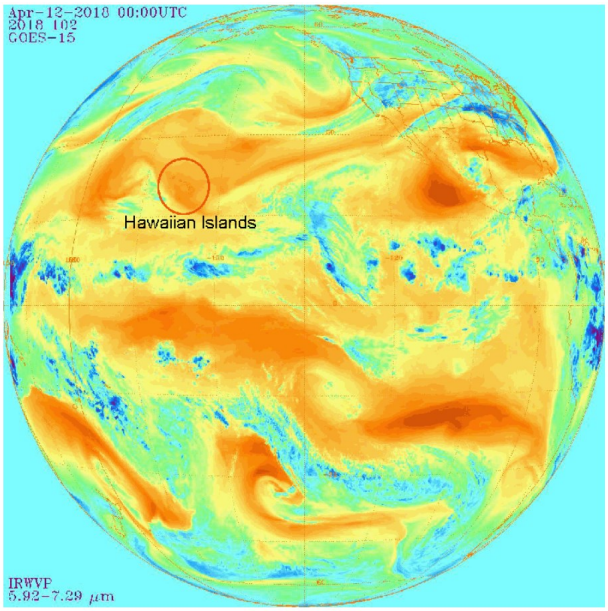
Figure 9: Diagram of a slope gage profile along a river bank.

Fall Flooding in Seward Area

In mid-October, heavy and persistent rains associated with an atmospheric river caused significant flooding of the Kenai Peninsula Borough in and around Seward. Numerous local properties, roads, and bridges were damaged, causing then Governor Bill Walker to issue a disaster declaration. Road closures led to some homes and businesses being inaccessible from the Seward Highway during the period October 12-17. The city, state, and borough all dispatched heavy equipment to help move gravel and debris out of area stream channels where bridges and culverts were threatening to fail. Much of Seward's infrastructure is built on gravel left behind by glacial recession and the historic flow of water. This gravel is relatively easy to mobilize in heavy rains. There were no known injuries from this event, but one individual was rescued in a stranded car. Readers remember, when the road is flooded: turn around, don't drown!

Figure 10: heavy equipment is helping preserve this bridge near Seward by removing gravel from the streambed as it's washed down by heavy rain. Photo courtesy of Alaska DOT&PF.

Pacific Sector Updates



2018 was the most energetic tropical cyclone season on record in the Eastern Pacific. Prior to hurricane season, Kauai and Oahu saw heavy flash flooding during mid-April. During the flash flooding event, more than 532 homes were affected and an estimated $20 million in damage was suffered by public buildings alone, according to the Hawaii Emergency Management Agency. In mid-August, Hurricane Lane passed near Hawaii and generated more accumulated rainfall than any historic cyclone, exceeding 52" on the Big Island. Initial damage estimates from Lane are also about $20 million. These events highlight the importance of NWS's efforts to test and evaluate both the National Water Model and new precipitation estimates, like the Multi-Radar/Multi-Sensor precipitation product, in Hawaii.

Figure 11: Water vapor over Hawaii measured by the GOES-15 satellite during the flash flooding event on April 12, 2018.

Staff News

In November, Celine van Breukelen moved within the NWS from the Alaska-Pacific River Forecast Center to the Anchorage Weather Forecast Office to be the new Service Hydrologist for Southcentral Alaska. She will spend less time forecasting and more time working with core partners in this new position. We are glad she hasn't gone far! The prior Anchorage Service Hydrologist, Andrew Dixon, moved with his family to the WFO in Grand Rapids, MI and is doing well there.

Earthquake Impacts to NWS Alaska

The November 30th Anchorage area earthquake impacted some members of the National Weather Service staff and caused considerable damage in the Alaska Region Headquarters in the downtown Federal Building. Most importantly, no one was injured. Many regional employees have been working out of the Sand Lake facility until office repairs and cleanup are completed at the Federal Building. Our hydrology and meteorology staff have been working closely with the State Emergency Operations Center, especially Eric Holloway, who represents the APRFC as a duty officer for the NWS Alaska Regional Operations Center (ROC). The ROC was designed to respond to exactly these type of emergencies.

Current APRFC Staff and NWS Service Hydrologists

Scott Lindsey, Hydrologist-In-Charge
David Streubel, Development and Operations Hydrologist
Crane Johnson, Service Coordination Hydrologist
Jessica Cherry, Senior Hydrologist
Eric Holloway, Hydrometeorologist
Arleen Lunsford, Hydrometeorologist
Edward Moran, Senior Hydrologist
Rebecca Perry, Hydro Tech and Administrative Support
Vacant, Hydrologist
Vacant, Computer Programming and Administration
Vacant, Senior Hydrometeorologist

WFO Service Hydrologists: Celine van Breukelen (Anchorage), Karen Endres (Fairbanks), Aaron Jacobs (Juneau)

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Figure 12: October, 2018 flooding of Wilson Rd and Rink Creek area in Gustavus, AK. Photo: NWS Spotter Deb Woodruff