

## **GLACIER DAMMED LAKES RECONNAISSANCE**

### **1. Background**

Glaciers cover large areas of Alaska. The highest concentration occurs along the Pacific Coast and in the south-central part of the State. Many of these glaciers flow across the junction of adjoining valleys and cause lakes to form along the lateral edges of these large valley glaciers. Water may flow into or under the ice to some extent, but it is very common for the blockage to be so complete that water accumulates behind the ice dam, creating a glacier dammed lake (GDL). These lakes can be breached and release large volumes of water in a short period of time. There are a several different mechanisms of release proposed with the actual mechanism often unknown.

GDL's often fill and release on a semi-regular schedule ranging from months to years between releases. After a GDL releases, and drains, the combination of rainfall, rainfall runoff, snowfall, snow melt and glacier melt contribute to the refilling of the lake. The semi-regular release interval will differ for each GDL. The resulting outburst floods are also known as Jokulhlaups. One characteristic of these floods is steady increase in discharge until the lake has completely drained at which point discharge recedes rapidly to pre-flood flows. This increase in discharge is thought to occur as a result of enlargement of the sub-glacial flow path as heat is released by the flowing water. After the water has drained, the opening begins to close off and the lake begins to fill again.

Data from GDL floods from around the world indicate that the peak flood flows can be directly related to maximum lake volume. Researchers have offered several different equations to estimate peak flow based on maximum lake volume. Lake volumes are the primary data required to forecast the peak flood flow upon release of a glacier dammed lake. One method for estimating volume is through a visual estimation of lake stage or water surface elevation.

Numerous glacier dammed lakes exist within Alaska. The Snow and Skilak glacier dammed lakes are familiar to those along the Snow and Kenai River due to the flooding or high water levels which can occur after these lake releases. A release of the Skilak GDL in January of 2007 caused significant damage in the communities of Soldotna and Kenai on the lower Kenai River.

### **2. General Mission Guidance**

GDL reconnaissance consists of annual pre-, during, and post-event photographic monitoring of glacier dammed lake water levels. Glacier-dammed lakes often release in the fall months, but can release as early as mid-summer. Periodic summer/fall photographs are used to document lake levels for threat assessment.

The primary lakes within southcentral Alaska requiring regular reconnaissance are the Snow, Skilak and Moose lakes. Site specific guidance is provided in subsequent sections herein. However; there are additional known and unknown GDL's that may require reconnaissance on an as-needed basis. Site specific guidance for lakes not listed here will be included in the request for Civil Air Patrol flight support on an event basis.

**a. Alaska Pacific River Forecast Center Contact Information**

The main point of contact for glacier dammed lake reconnaissance missions is the Alaska Pacific River Forecast Center (APRFC).

The Alaska Pacific Forecast Center is staffed 7 days a week between the hours of 7 am and 5 pm during the summer open water season and during normal business hours during the winter. The principle points of contact are the on-call duty hydrologist and meteorologist.

Office Phone: 907-266-5160

Duty Hydrologist Cell: 907-350-9219 (24hrs 365 days)

Email: [nws.ar.aprfc@noaa.gov](mailto:nws.ar.aprfc@noaa.gov) (group email forward to APRFC staff)

**b. General Location**

All three glacier-dammed lakes are in the vicinity of Seward, Alaska and thus the Seward, Kenai and Anchorage CAP Squadrons would be the most cost effective squadrons to conduct the mission. All flight time estimates are based upon missions being based in Seward. The river basin affected by these lakes is the heavily-used Kenai River basin.

**c. Mission Procedures and Deliverables**

Civil Air Patrol Flight Support Request: To request a Civil Air Patrol overflight, submit (email) NWS Request for Civil Air Patrol Flight Support form as follows:

**Subject:** CAP Support Request

**To:** [nws.ofcm.cap@noaa.gov](mailto:nws.ofcm.cap@noaa.gov)

**cc:** [nws.opscenter@noaa.gov](mailto:nws.opscenter@noaa.gov); [chris.maier@noaa.gov](mailto:chris.maier@noaa.gov)

note: OFCM phone 301-628-0045 fax 301-713-1744

Mission Deliverables: The primary mission deliverables are photographs of each lake and general observations noted by the mission crew. Photographs should be geo-tagged if possible and be hi resolution. Most new digital cameras and smart cellular phones offer the option to add GPS coordinates to pictures (geo-tagging).

Photographs shall include 5-10 photos taken of the lake from various oblique angles and 5-10 photographs taken of the lake stage markers as described below.

Photographs should be a minimum of 3-5 mega pixel in file size to provide the necessary resolution for zooming in to identify the lake stage markers.

**d. Schedule**

Reconnaissance flights will generally be requested three to four times per year, but may be requested more often as conditions warrant. Table 1 provides the typical flight schedule:

**Table 1. Reconnaissance Flight Schedule (Typical)**

Approximate Dates	Lakes
Mid July	Moose, Skilak and Snow
Mid August	Moose, Skilak and Snow
Mid September	Snow and Skilak

If the lakes are filling rapidly, additional flights will likely be requested. If the mountain snowfall comes late, flights may be requested in October subject to availability of funds.

All flights are weather dependent and subject to all applicable rules and regulations governing CAP flights. The River Forecast Center has access to both the local Weather Forecast Office and Alaska Aviation Weather Unit. Site specific weather briefings can be coordinated and are recommended to take advantage of periods of good weather.

#### ***e. Products and transmission***

The final products shall include geo-tagged photographs and visual observations. These shall both be submitted by email to: [nws.ar.aprfc@noaa.gov](mailto:nws.ar.aprfc@noaa.gov).

Email messages shall be limited to 15 MB in size. Depending on image file size, sending 2 or 3 photos per email will generally work well. Multiple emails will be required to transfer the information to the Alaska Pacific River Forecast Center. Images and pilot reports will be stored electronically at the APRFC and made available upon request. Important details of each flight will be logged into the APRFC glacier dammed lake database.

#### ***f. Estimated Travel Times***

The Seward Civil Air Patrol Squadron estimates the time to fly from Seward to Snow Glacier dammed lake to be approximately 1 hr and the flight from Seward to Skilak glacier approximately 45 min. To do both in one flight would take approximately 1hr 40 min since they are in opposite directions after departing from Seward. Moose Lake will be flown in conjunction with the Snow Lake and will add an additional 5 minutes to the flight mission.

### **3. Ad-Hoc Mission Guidance**

The three glacier dammed lakes that are regularly flown release on a predictable schedule. Throughout Alaska there are hundreds of additional glacier dammed lakes that fill and release annually. Many GDL's are transient features that many not release on a predictable schedule and can also lie dormant for many years and possibly decades. If information is received about a possible glacier dammed lake that is filling that upon release has the potential to cause significant damage downstream a request may be made for an ad-hoc aerial observations and photographs. If a request is made the following information will be provided:

- GPS coordinates of the Lake

- Map showing the location of the lake
- Existing oblique photographs (if available) of the lake

#### 4. Specific Mission Guidance

##### a. Snow Glacier Dammed Lake

Snow Glacier Lake Gage Location:

- Latitude: 60.4844 N
- Longitude: 148.9175 W
- Approximate Elevation: 2700 ft

The following maps and photographs show the location of both the lake and lake level markings (stage gage).

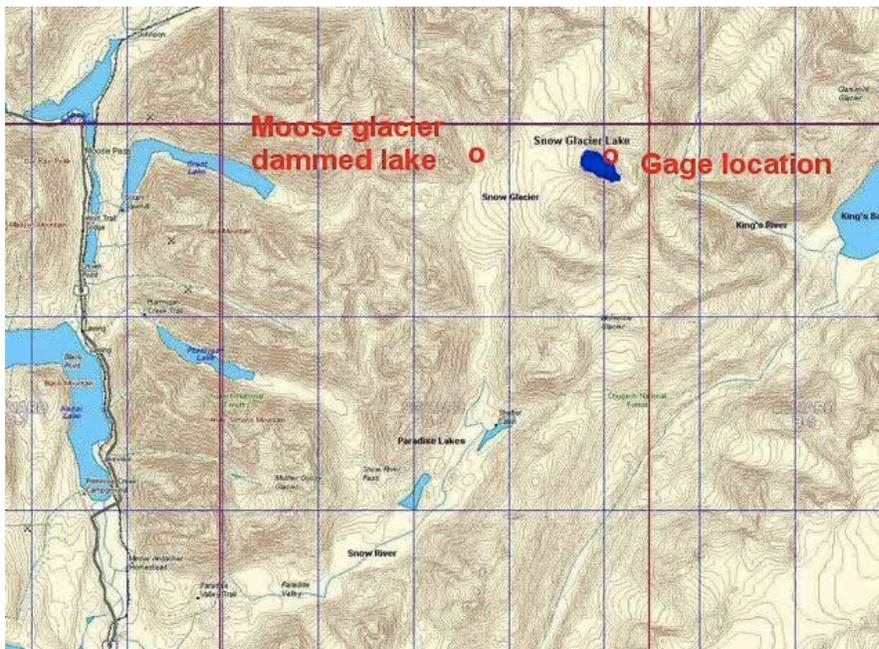
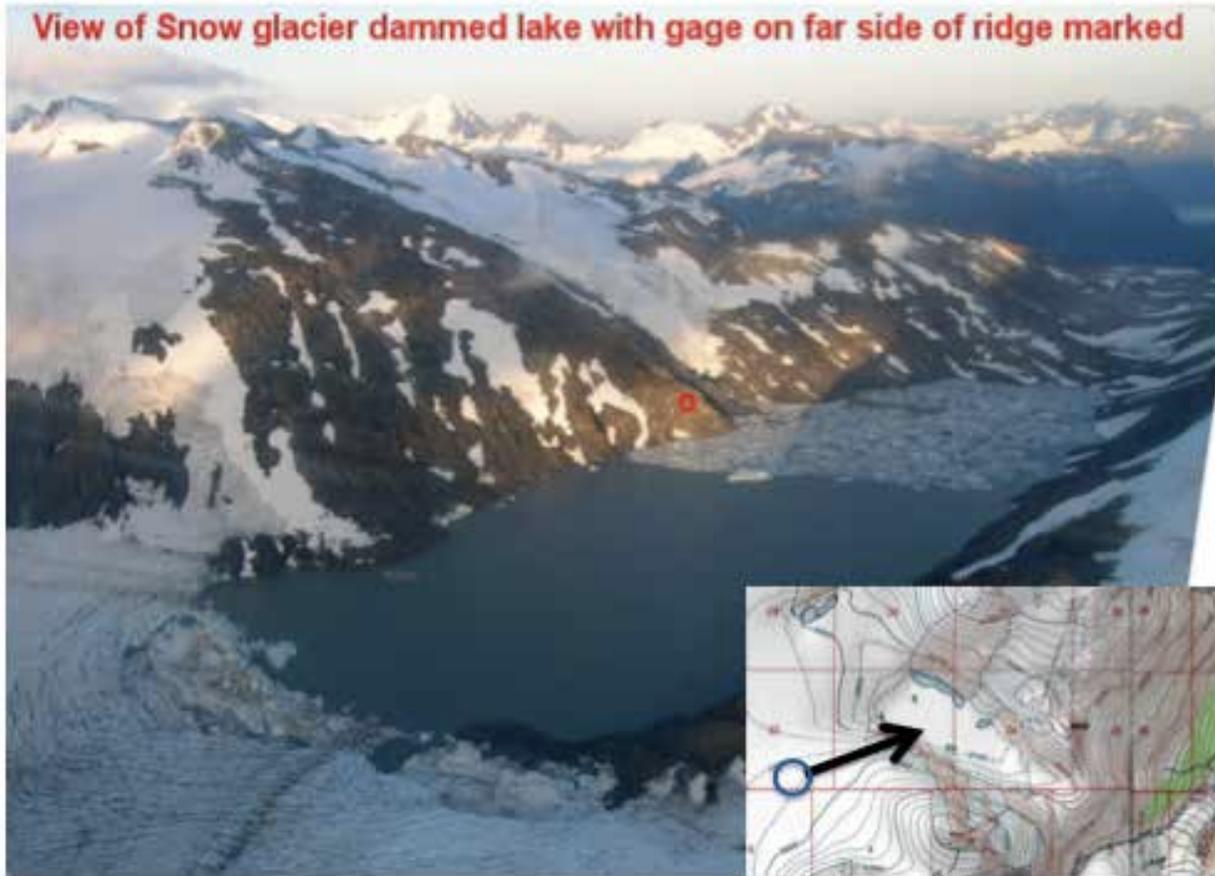


Figure 1. Map of the Snow and Moose Glacier Dammed Lakes. Snow Glacier dammed lake is shown in blue.



**Figure 2. Approaching Snow lake, the gage is on the east side of the ridge and is marked with a small red circle in this photo.**

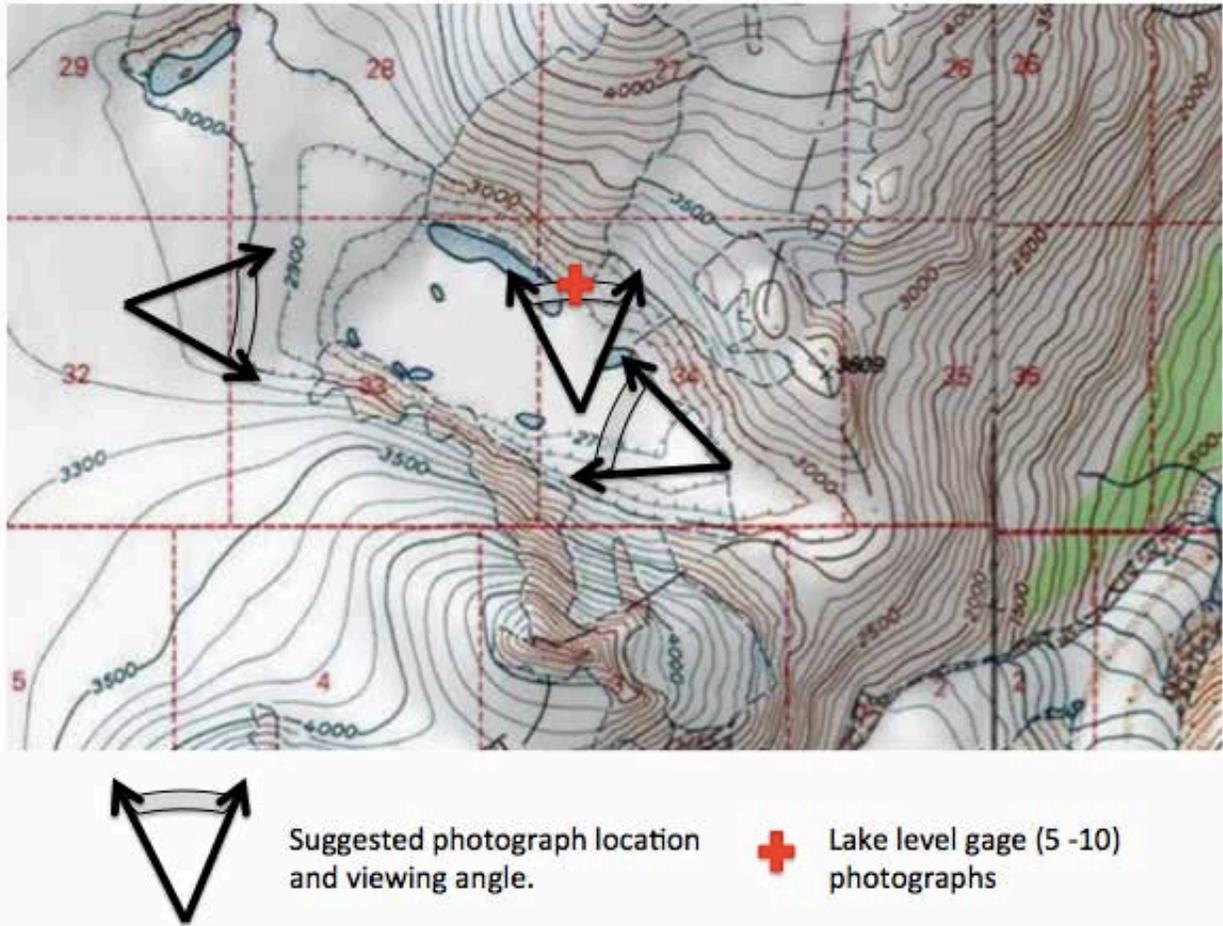
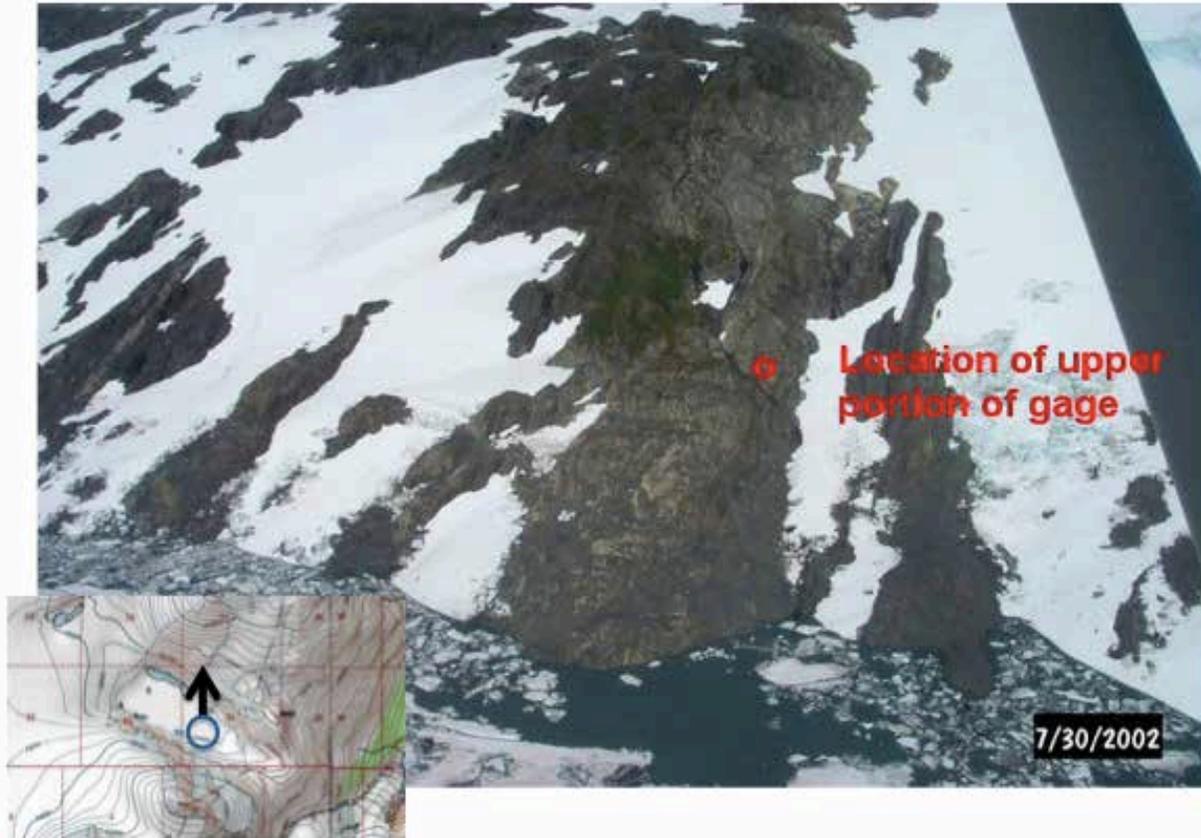


Figure 3. Snow Glacier Dammed Lake. Figure shows the approximate location of lake level gage and also provides several possible oblique photograph locations and viewing angles.



**Figure 4. Close up photograph of the Snow lake level gage. Five to ten high resolution photo graphs should be taken of this hillside at various angles.**

**b. Skilak Glacier Dammed Lake**

Skilak Glacier Lake Gage Location:

- Latitude: 60.2006 N
- Longitude: 149.9497 W
- Approximate Elevation: 2900 ft



Figure 5. Location of Skilak Glacier Dammed Lake. Red circle shows the location of the lake stage gage.

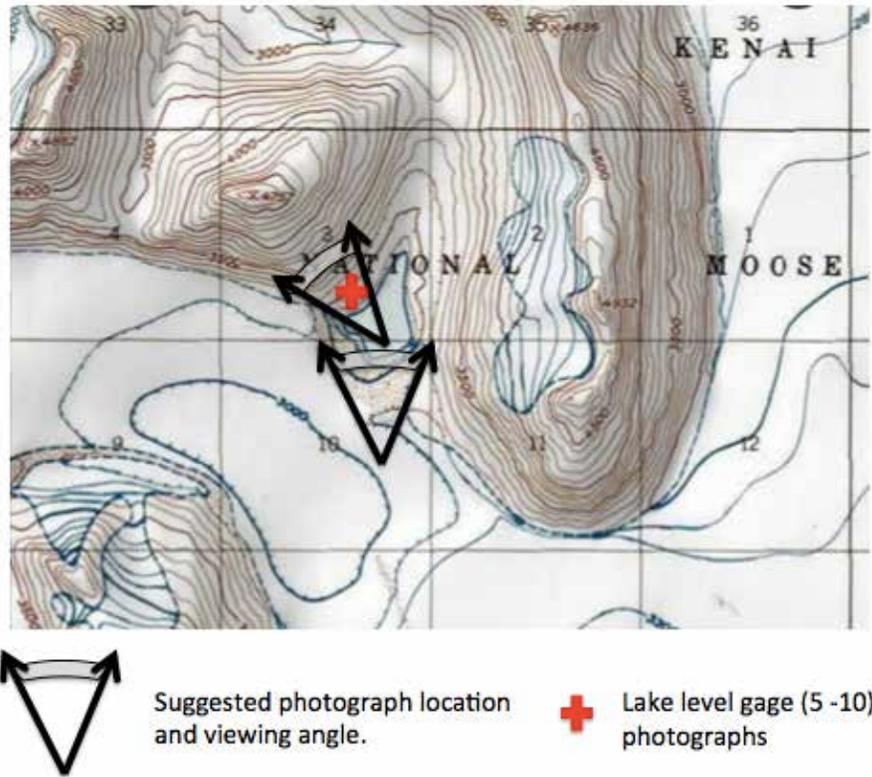


Figure 6. Skilak Lake with suggest photo locations and direction.

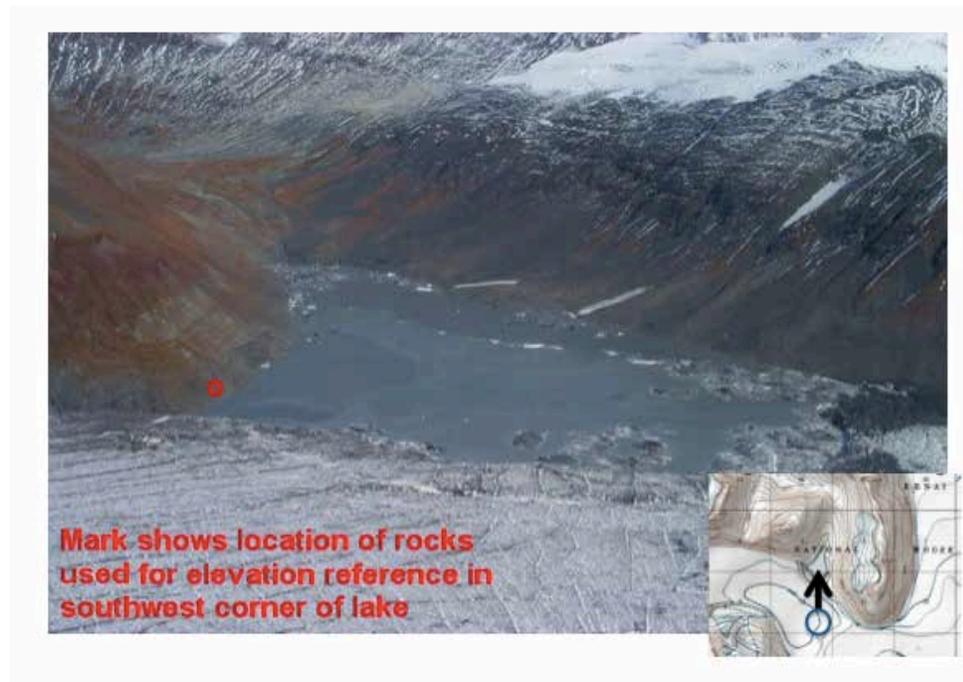


Figure 7. View of Skilak Glacier Dammed Lake. Lake stage gage is located near the red circle in the photograph.



**Figure 8. View of rock used to determine the elevation of Skilak Lake.**

**c. Moose Lake**

Moose Lake Location:

- Latitude 60.4806 N
- Longitude 149.0242 W
- Approximate Elevation 2400 ft

For the Moose GDL, an overall view of the lake as you pass en route to or from the Snow glacier dammed lake is sufficient, since there is no "gage" at this lake.



**Figure 9. Example photograph of the Moose Glacier Dammed Lake. This lake does not have a staff gage or survey known rocks.**