

Updated Taku River Mainstem Channel Profile



Prepared for
Redfern Resources Limited

Submitted by
Gartner Lee Limited

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1. Introduction

Navigation on the Taku River is largely constrained by the tidally influenced sand flats at the mouth of the river between Taku Lodge and Taku Point. Navigation becomes increasingly challenging upstream of the US/Canada border where the river becomes more braided and less constrained to a single mainstem channel. Accordingly, a detailed bathymetric analysis has been completed of these two river sections to characterize constraints to navigation. Between the sand flats and the international border, the mainstem river channel is relatively well defined and presents fewer limitations to river navigation. To confirm this interpretation, a mainstem channel depth profile was measured in summer 2007 as part of the sand flats bathymetric survey. Further details on the sand flats survey and methods are presented in the "*Channel Depth Analysis of the Lower Taku River*", Gartner Lee Limited 2007.

In January 2008, a report on the bathymetry of the Taku River in Alaska was provided to the Department of Natural Resources to support Redfern's application for a Title 41 Fish Habitat Permit and a Title 38 Land Use Permit. That analysis focused on river flows at or above 26,000 cfs (740 m³/s) that represents average summer flows. The results of that analysis showed that at average summer flows, there was sufficient depth of water in the main river channel for conventional shallow draft tug use.

Since that time, State regulators have requested that Redfern provide an analysis of the channel depth at lower flows. This report includes the results of this additional analysis.

2. Methods

Continuous depth soundings were collected along the mainstem channel from Taku Point to the mouth of the Tulsequah River in British Columbia on July 6th, 2007. Measurements were collected using a Sonarmite v2.0 Portable Bluetooth Echo Sounder linked to a Trimble XT GPS and digital data recorded mounted on the transom of a locally chartered river boat. The local river boat operator generally followed the mainstem channel, although given the relatively high river stage at the time of the survey, the route followed does not absolutely follow the deepest part of the river, or thalweg. However, the results of the profile do provide a general indication of typical minimum channel depth associated with the river mainstem.

River discharge at the time of the survey was relatively high due to high discharge and flooding in the summer of 2007. Accordingly, the channel depth data was reduced to represented normal summer river conditions and levels when normal open water barging would occur. Discharge at the time of the survey was 34,900 cfs (3,185 m³/s). Average summer discharge is 26,000 cfs (740 m³/s). Measured channel depth data was corrected using the stage-discharge relationship

for the USGS's hydrology station at Canyon Island for the upstream end of the survey. The stage-discharge relationship developed by Sandwell (1995) for Taku Lodge was used to reduce the downstream end of the channel profile survey.

3. Results and Discussion

3.1 Average Summer Discharge: 26,000 cfs (740 m³/s)

Mainstem channel depth results are illustrated in Figure 1, attached. The profile shows the reduced depth data corresponding to average summer water levels. Water depth measurements less than 3 ft (1 m) are portrayed with a yellow dot, whereas water depths greater than 3ft (1m) are shown in green. Three feet is the typical depth required to operate a shallow draft river tug and barge.

The profile confirmed that the major constraint to navigation on the river is the sand flats area. The detailed bathymetric survey work conducted in summer of 2007 mapped the channels through the sand flats. Upstream of the mudflats, the mainstem channel depth is typically 10 feet (3 m) increasing to 18 feet (5.5 m) deep on average in the Canyon Island area. The water depth data shows occasional shallow measurements upstream of the sand flats. Given the sporadic nature of these measurements, these likely represent locations where the boat strayed from the thalweg and/or anomalous measurements.

The Canyon Island river level gauge records river levels throughout the year. River levels typically fluctuate between gauge heights 33 ft to 37 ft (a fluctuation range of 4 feet (1.2 m)) during the "open water season" as described in the Tulsequah Chief ACB Transportation System project description. The water level / gauge height corresponding to summer flow of 26,000 cfs is 34.7 ft. The water depth profile shown on Figure 1 corresponds to this gauge height. During the transition season (freeze-up and break-up), river levels range between 29 and 33 ft gauge height. Therefore, water levels measured on the gauge near Canyon Island during flows between 17,660 cfs and 8,830 cfs are approximately 33.8 ft. and 31.4ft. respectively. During barge operations, the gauge heights will be monitored daily to assist the barge master in assessing the navigability of the river as discharge approaches 8,830 cfs during the transition seasons.

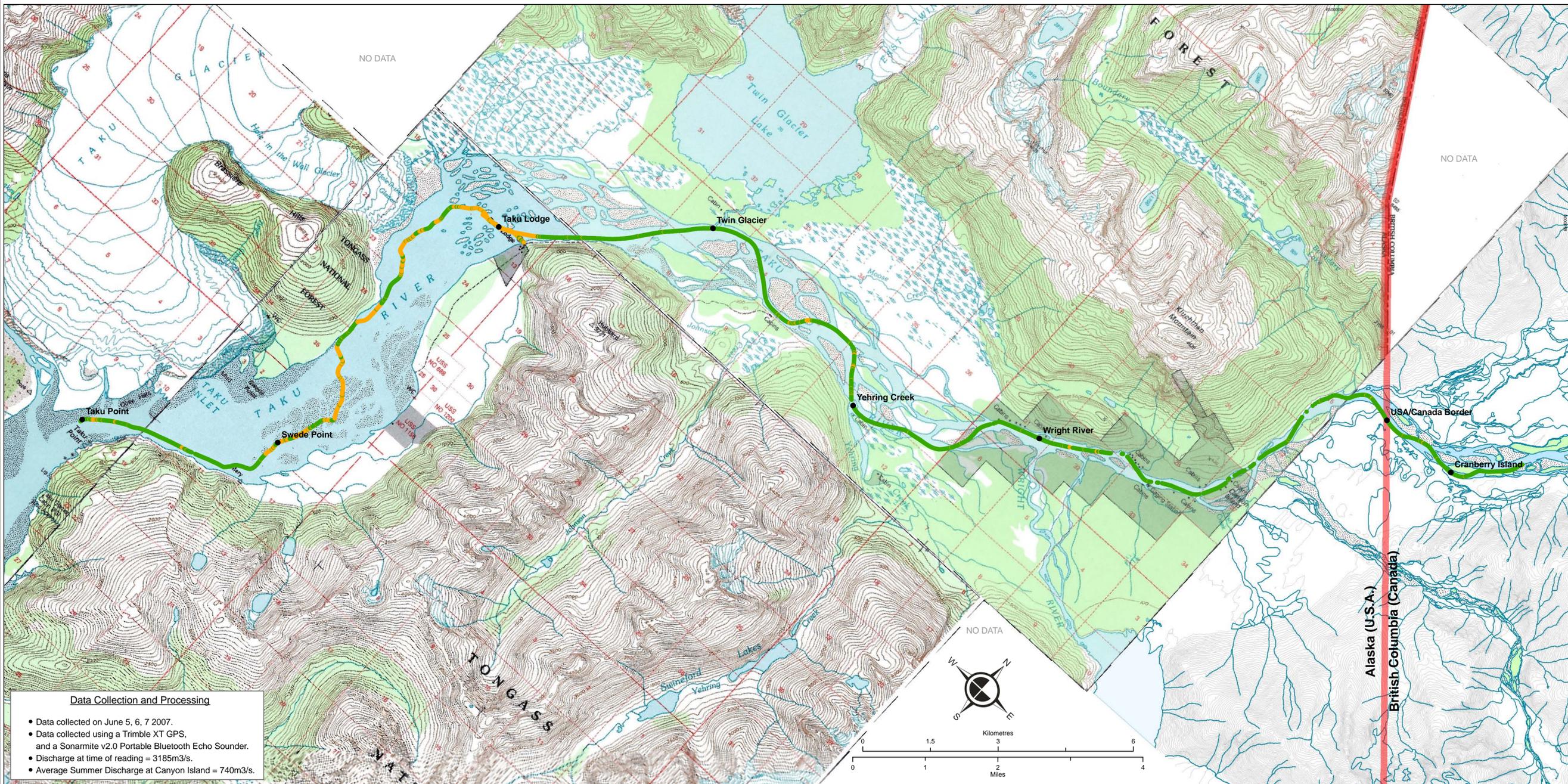
3.2 Low Flow Conditions: 17,660 cfs (500) and 8830 cfs; (250 m³/s)

Figures 3 and 4 illustrate the channel depth at river discharges of 17,660 cfs and 8,830 cfs, respectively. As is shown on Figure 3, there is a continuous channel upstream of the tidal flats with depth greater than 3 feet. As river discharge approaches 8829 cfs, however, the data suggests that there are two locations between Yehring Creek and Twin Glacier that may pose navigational challenges. It should be noted, however, that the bathymetric data was obtained

during very high flows in 2007, and may not reflect the deepest portion of the thalweg (as it was difficult to identify precisely during the flood conditions). To confirm depths at these locations, additional cross-sectional bathymetric data will be collected during the spring of 2008. It should also be noted that multiple barging trips were successfully completed on the Taku River in late summer, 2007, at flows as low as 9160 cfs (260 m³/s), demonstrating that a continuous channel of sufficient depth and width is present along the thalweg, upstream of the tidal flats area.

4. Conclusions

The Taku River mainstem channel profile data confirms the presence of a continuous channel upstream of the tidal flats with depth adequate for the operation of shallow draft tug and barge during the open water season at flows greater than 17,660 cfs. As flows approach 8830 cfs, there appear to be two areas upstream of the tidal flats where there may be additional constraints to navigation, due to the shallowness of the channel. These areas will be surveyed in detail in spring 2008 to confirm the depth and width of the channel. The evidence presented by the successful river barging completed in summer 2007 at flows as low as 9160 cfs complements this conclusion.



Key To Features

- Survey Route

- Depths Along Route (ft)**

 - >3
 - <3

- Land Cover**

 - Vegetated area
 - Glacier
 - Sandbar

- Topography**

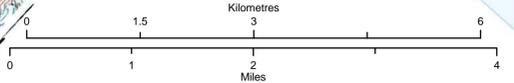
 - Index (100m)
 - Intermediate (20m)

- Water Features**

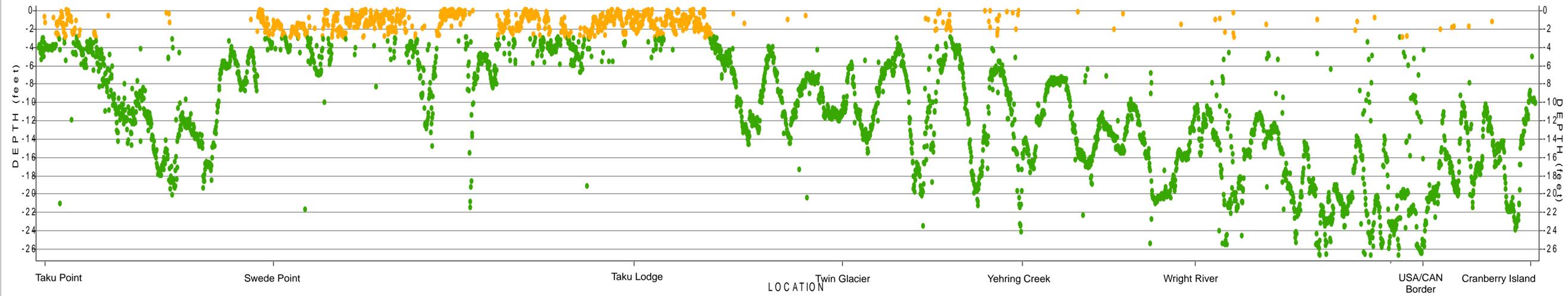
 - Streams
 - Lakes / Rivers

Data Collection and Processing

- Data collected on June 5, 6, 7 2007.
- Data collected using a Trimble XT GPS, and a SonarMite v2.0 Portable Bluetooth Echo Sounder.
- Discharge at time of reading = 3185m³/s.
- Average Summer Discharge at Canyon Island = 740m³/s.



Water Depths: Taku Point to Cranberry Island

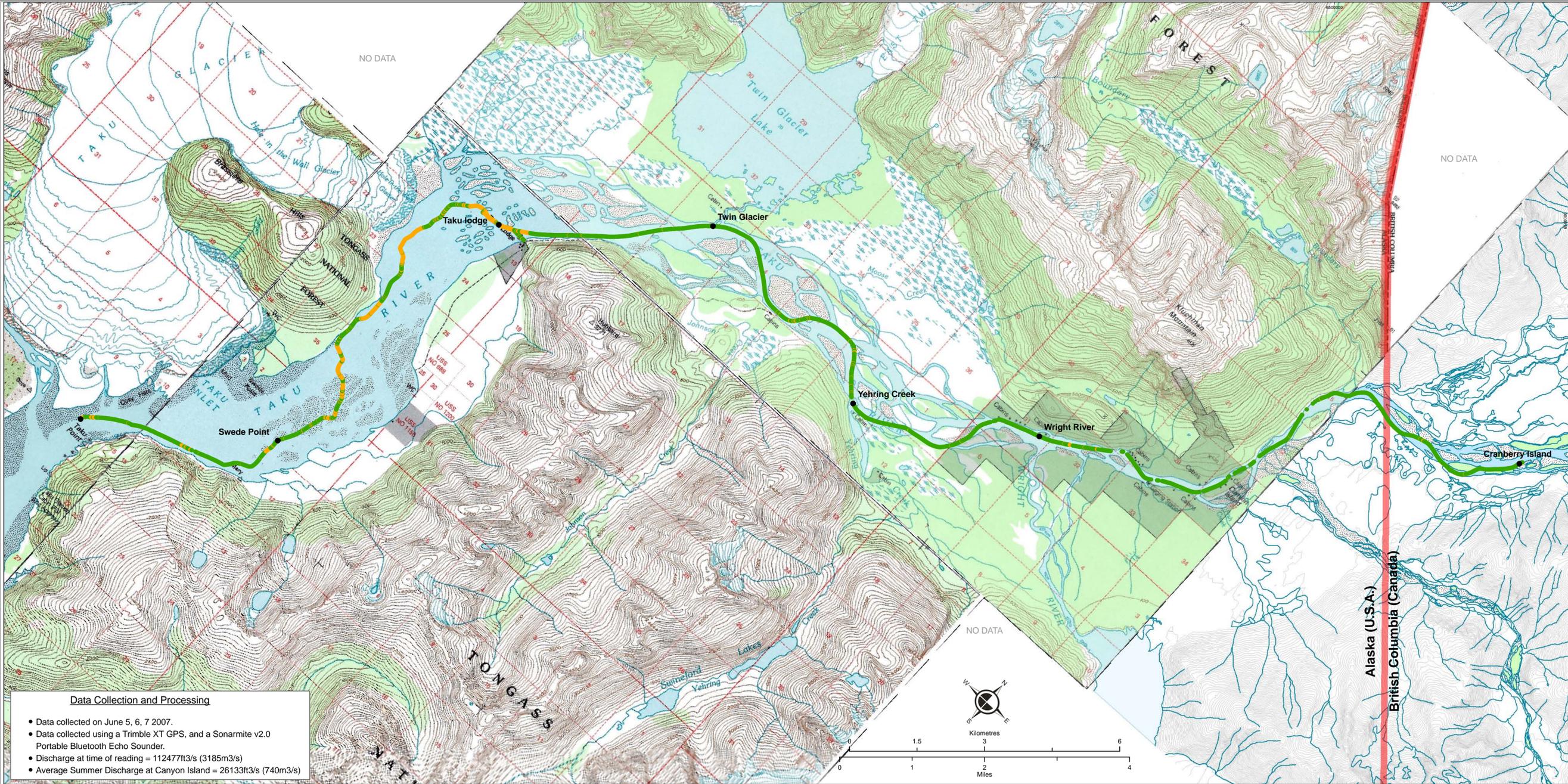


Map Sources/Notes:
 Water Depth Measurements Collected on June 7/2007 by Gartner Lee Ltd. field staff.
 Topographic Images derived from Digital Raster Graphic (DRG) Images produced by the USGS, Terrain Resource Information Management (TRIM) base data compiled by the Ministry of Environment, Lands and Parks, Geographic Data BC, Province of British Columbia at a scale of 1:20,000



UTM Zone 8N, NAD 83

Redfern Resources Ltd.
Channel Depth During Taku River Flood Discharge = 740m³/s

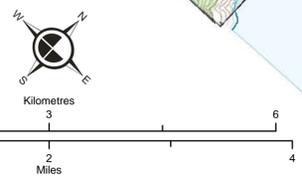


Key To Features

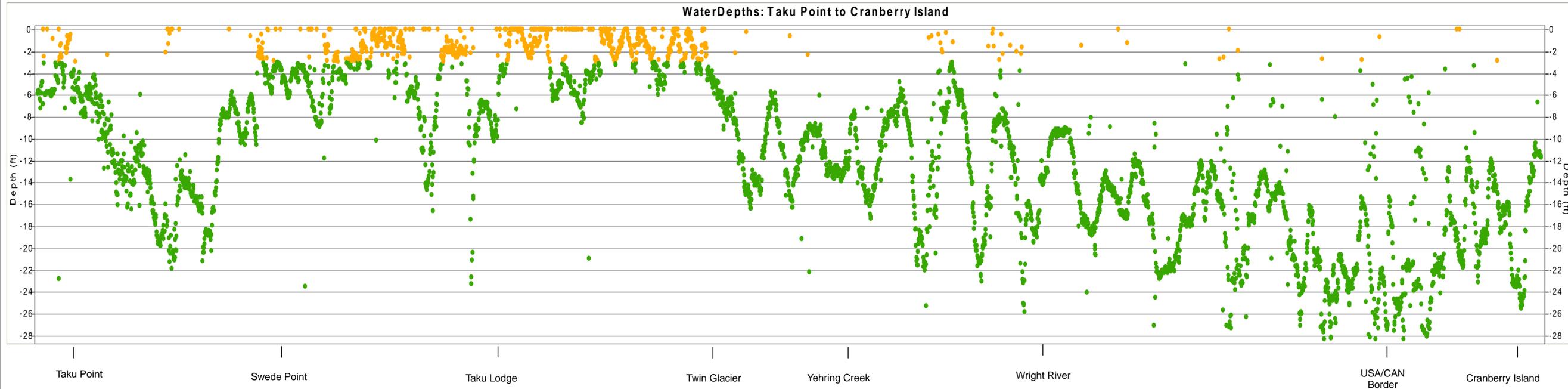
-  Survey Route
- Depths Along Route (ft)**
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 -  <3
- Land Cover**
 -  Vegetated area
 -  Glacier
 -  Sandbar
- Topography (U.S.A.)**
 -  Index (500ft)
 -  Intermediate (100ft)
- Topography (Canada)**
 -  Index (100m)
 -  Intermediate (20m)
- Water Features**
 -  Streams
 -  Lakes / Rivers

Data Collection and Processing

- Data collected on June 5, 6, 7 2007.
- Data collected using a Trimble XT GPS, and a Sonarmite v2.0 Portable Bluetooth Echo Sounder.
- Discharge at time of reading = 112477ft³/s (3185m³/s)
- Average Summer Discharge at Canyon Island = 26133ft³/s (740m³/s)



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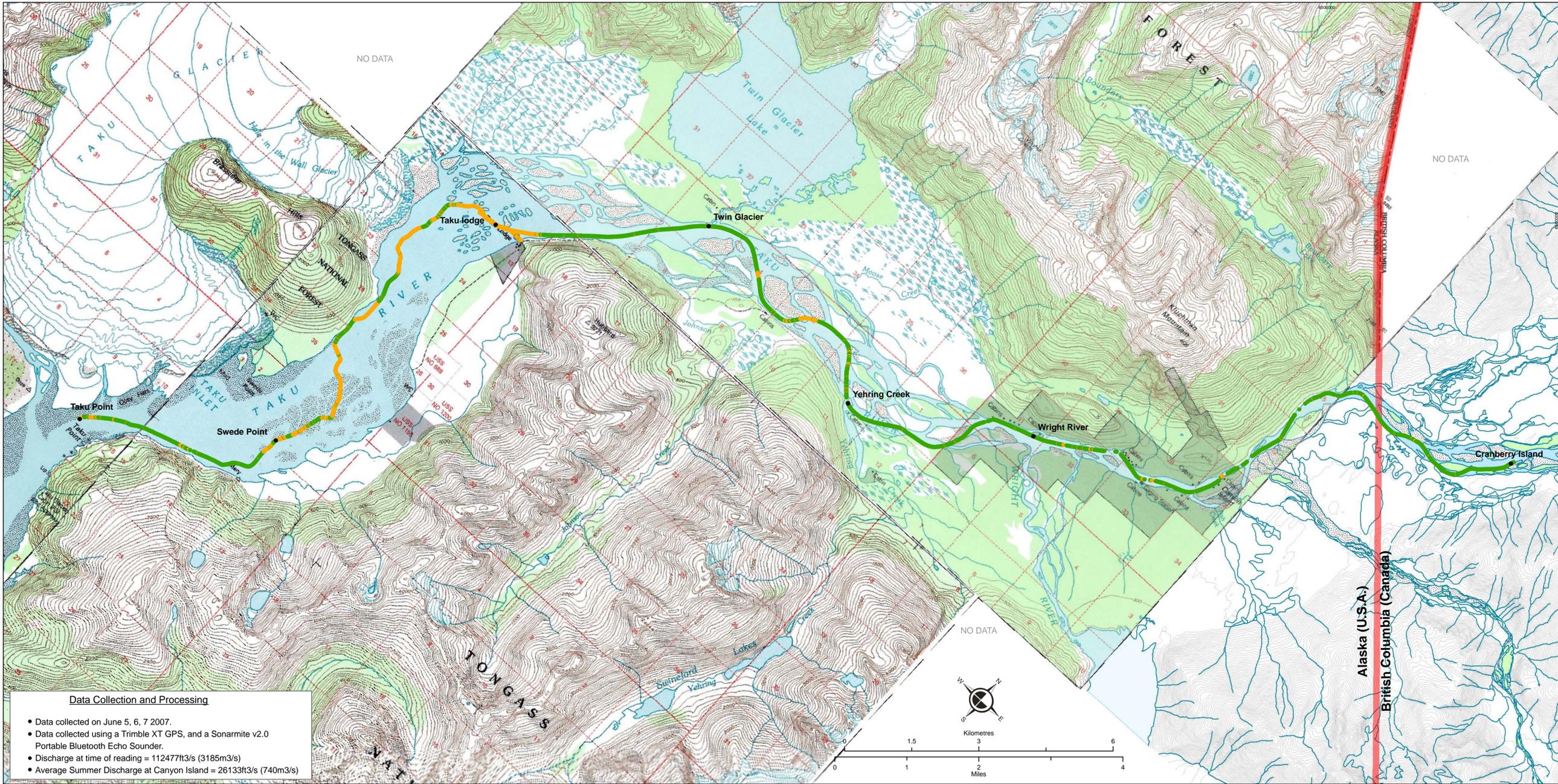


UTM Zone 8N, NAD 83

 Redfern Resources Ltd.
Channel Depth of Taku River Flood
 Discharge = 17657ft³/s (500m³/s)

 Gartner Lee

Figure 3
Version 1

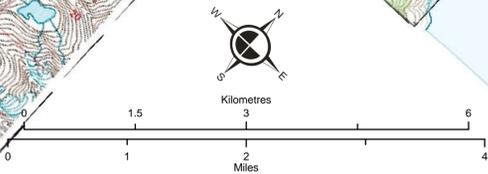


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