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Appendix A. 2022 Lake Packets
## ACRONYMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>°C</td>
<td>Celsius</td>
</tr>
<tr>
<td>µS/cm</td>
<td>microsiemens/centimeter</td>
</tr>
<tr>
<td>ADF&amp;G</td>
<td>Alaska Department of Fish and Game</td>
</tr>
<tr>
<td>ADNR</td>
<td>Alaska Department of Natural Resources</td>
</tr>
<tr>
<td>BLM</td>
<td>Bureau of Land Management</td>
</tr>
<tr>
<td>ft</td>
<td>foot/feet</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic information system</td>
</tr>
<tr>
<td>GPS</td>
<td>Global positioning system</td>
</tr>
<tr>
<td>mm</td>
<td>millimeter</td>
</tr>
<tr>
<td>MM gal</td>
<td>Million gallons</td>
</tr>
<tr>
<td>NTU</td>
<td>Nephelometric turbidity units</td>
</tr>
<tr>
<td>pH</td>
<td>Potential hydrogen</td>
</tr>
<tr>
<td>ROD</td>
<td>Record of Decision</td>
</tr>
<tr>
<td>ROP</td>
<td>Record of Operating Procedures</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

Owl Ridge Natural Resource Consultants, Inc. (Owl Ridge) sampled 13 lakes for fish presence, water depth, and water quality from July 23, 2022 to August 19, 2022. The lakes are distributed in three areas: north of Nuiqsut along the Nigliq Channel of the Colville River, west of Nuiqsut in the proposed Willow development area, and south-southwest of Nuiqsut and east of the Colville River in the Bear Exploration Area (Table 1; Figures 1 through 4; Appendix A). Two additional lakes, Lake L9911 and Lake M0112, were surveyed only for detailed depth contours to support civil design, and are included in this report to present high resolution bathymetric maps of select areas of each lake (Appendix A). All surveys were conducted to support planned Willow Area infrastructure design and potential use of water during winter operations and exploration activities. All fish sampling in 2022 was conducted under Alaska Department of Fish and Game (ADF&G) Aquatic Resource Permit No. SF2022-152.

The purpose of these surveys is to estimate the volume of water available for potential industrial use and to document fish presence and habitat use in lakes that may be used to support year-round and seasonal operations.

The objectives of these surveys are to:

1. Identify fish species present in selected lakes within the project study areas.
2. Measure water chemistry parameters to assess suitability of water for potential uses.
3. Obtain lake bathymetry and water volume estimates for selected lakes.

The surveyed lakes may be used as sources of freshwater during exploration and potential future development for ice road and ice pad construction, drilling support, potable water supplies, and other industrial and operational uses. The inventory of fish and fish habitat provides information to assist permitting decisions for potential water use activities and ice-road routing.

Lakes are divided into three categories based on fish sampling results: 1) lakes containing species sensitive to habitat changes potentially associated with water withdrawal (sensitive fish); 2) lakes containing species more resistant to habitat changes (resistant fish); and 3) lakes containing no fish. Species sensitive to potential impacts of water withdrawal (such as reduced dissolved oxygen and increased dissolved solids) include anadromous species such as broad whitefish, least cisco, and humpback whitefish and resident species such as Arctic grayling, lake trout, and round whitefish. Resistant species are limited to Alaska blackfish and ninespine stickleback (Moulton 2002). Alaska blackfish are particularly resistant to low dissolved oxygen and can use atmospheric oxygen to survive winter (Armstrong 1994). Residents of the Yukon Delta have reported observing Alaska blackfish oriented along cracks in the ice during winter to use atmospheric oxygen in ponds that have gone anoxic. Ninespine stickleback can also withstand low dissolved oxygen (Lewis et al. 1972), although not to the same extent as Alaska blackfish. However, ninespine stickleback can withstand higher levels of dissolved solids, and often frequent brackish nearshore waters during summer.

Regulatory agencies managing water withdrawals from surface waters on the North Slope generally adhere to similar criteria to govern maximum volumes of water and ice that may be withdrawn from fish-
bearing and non-fish-bearing lakes. Withdrawal of unfrozen liquid water from lakes and the removal of ice aggregate from grounded areas ≤ 4 feet (ft) deep may be authorized on a site-specific basis depending on water volume and depth, and the waterbody’s fish community.

The ADF&G, Alaska Department of Natural Resources (ADNR) and Bureau of Land Management (BLM) (per the 2022 Record of Decision (ROD) in Required Operating Procedures (ROP) B-2) restrict water withdrawal as follows:

<table>
<thead>
<tr>
<th>Water withdrawal and ice aggregate removal criteria by agency</th>
<th>Alaska Department of Fish and Game</th>
<th>Alaska Department of Natural Resources</th>
<th>Bureau of Land Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No fish present</strong></td>
<td>No authority</td>
<td>Water withdrawal: up to 20% of the total lake volume</td>
<td>Water withdrawal: up to 35% of the total lake volume</td>
</tr>
<tr>
<td></td>
<td>Ice aggregate: combined ice and unfrozen water shall not exceed 20% of the total lake volume</td>
<td>Ice aggregate: combined ice and unfrozen water shall not exceed 35% of the total lake volume</td>
<td></td>
</tr>
<tr>
<td><strong>Resistant fish species present</strong></td>
<td>Water withdrawal: up to 30% of lake volume under 5 ft of ice</td>
<td>Ice aggregate: combined ice and unfrozen water shall not exceed 30% of the total lake volume under 5 ft of ice</td>
<td>Ice aggregate: only ice aggregate may be removed from lakes that are ≤ 5 ft deep, combined ice and unfrozen water shall not exceed 30% of the total lake volume under 5 ft of ice</td>
</tr>
<tr>
<td></td>
<td>Ice aggregate: combined ice and unfrozen water shall not exceed 30% of the total lake volume under 5 ft of ice</td>
<td>Ice aggregate: combined ice and unfrozen water shall not exceed 30% of the total lake volume under 5 ft of ice</td>
<td></td>
</tr>
<tr>
<td><strong>Sensitive fish species present</strong></td>
<td>Water withdrawal: up to 15% of lake volume under 7 ft of ice</td>
<td>Ice aggregate: combined ice and unfrozen water shall not exceed 15% of the total lake volume under 7 ft of ice</td>
<td>Ice aggregate: only ice aggregate may be removed from lakes that are ≤ 7 ft deep, combined ice and unfrozen water shall not exceed 15% of the total lake volume under 7 ft of ice</td>
</tr>
<tr>
<td></td>
<td>Ice aggregate: combined ice and unfrozen water shall not exceed 15% of the total lake volume under 7 ft of ice</td>
<td>Ice aggregate: combined ice and unfrozen water shall not exceed 15% of the total lake volume under 7 ft of ice</td>
<td></td>
</tr>
</tbody>
</table>

Water withdrawal requests outside of the established criteria are evaluated by regulators on a site-by-site basis and usually require written justification. Exceptions to the criteria can lead to additional monitoring at the requested water source.
2. METHODS

2.1. Fish Sampling

Fish sampling methods consist of gill nets, minnow traps, seine nets and/or visual surveys supplemented with dip nets. Lakes are sampled with short-duration gill net sets for typically seven to nine hours of total soak time unless fish are captured sooner. The gill nets are multimesh, 120 ft long, with six panels of variable mesh ranging in size from 1.0 to 3.5 inches stretched mesh. These net types have been used to collect inventory-level data from lakes throughout the North Slope during similar surveys, so are used to maintain consistency across sampling years and areas. Sets are kept to a short duration to minimize the chance for entangling waterfowl and to minimize fish mortality. Nets are placed in habitats expected to be used by fish for feeding or for movement between feeding areas and removed after fish are detected. Captured fish are identified, measured to the nearest millimeter (mm) in fork length and released. The duration of each set is recorded to calculate effort and catch rates.

Minnow traps are used to sample for smaller fish species, such as ninespine stickleback and Alaska blackfish, which are not susceptible to capture by gill nets. Minnow traps baited with preserved salmon eggs are set at the edge of surveyed lakes in areas expected to provide cover or feeding habitat. The traps are set and retrieved concurrent with other sampling.

When conditions are appropriate, such as maximum lake depths not exceeding four feet, a visual survey supplemented with dip net sampling and/or beach seining is conducted. Ninespine stickleback are often observed in shallow water along the lake margin and because of their affinity for nearshore vegetation, they are vulnerable to hand-held dip nets. During visual surveys, frequent sweeps through vegetated areas are made with a small mesh dip net. The length of the visual/dip net survey is measured with a handheld global positioning system (GPS). If ninespine stickleback are observed, minnow traps and seines are not always used. Table 2 provides a summary of fish sampling effort and catch rates.

2.2. Water Chemistry and Bathymetric Sampling

In situ water chemistry measurements include surface measures of water temperature, specific conductance, potential hydrogen (pH), turbidity, and dissolved oxygen. Measurements are recorded from the approximate middle of each lake with a calibrated YSI ProDSS water quality meter. Two additional water samples are collected from each lake and sent to Pollen Environmental for laboratory determination of chloride, sodium, calcium, magnesium, and hardness (as CaCO3). Table 3 provides a summary of water chemistry data collected at each lake.

Bathymetric data are collected by two methods to estimate lake volume. The first method includes collecting detailed bathymetric data for lakes deeper than 4 ft, while the second method consists of collecting spot depths to approximate maximum depth for lakes less than 4 ft deep. For lakes deeper than 4 ft, locations and depths are recorded at approximately one- to two-second intervals using a Lowrance Model HDS-7 Gen 2 integrated GPS/depth sounder attached to an inflatable boat powered by a 9.9 horsepower outboard. At least eight depth transects on each lake are targeted for collection. Additional transects are conducted on lakes L9911 and M0112 to produce high-resolution depth contours. For those
lakes, only a portion of the surface area is surveyed, however up to 80 transects are conducted at approximately 40-foot intervals to collect detailed depth data.

Lake volume is estimated using bathymetry mapping of the depth intervals. GPS location and transect depth data are first imported into ArcGIS Pro as shapefiles for continued mapping and analysis. The shoreline of each lake is then delineated using 0.75-meter unmanned aerial vehicle (UAV) imagery and locations along the shore are assigned a depth value of 0.0 ft. The “Topo to Raster” method is used to interpolate elevation values of each lake. A 3x3 moving window is then applied to filter noisy data. The resulting raster is then classified using 1-foot contour intervals and mapped as a colored isarithmic surface. Where maximum depth is 10 ft or less, 1-ft intervals are plotted, and where maximum depth exceeds 10 ft, 2-ft intervals are plotted.

Once the surface area of each contour is obtained, volume is then estimated using the formula for truncated cones:

\[ V = \frac{h}{3}(A_1 + A_2 + (A_1A_2)^{1/2}) \]

Where \( h \) = vertical depth of the stratum; \( A_1 \) = area of the upper surface; and \( A_2 \) = area of the lower surface of the stratum whose volume is to be determined. The volumes of individual strata are summed to obtain the volume of the desired depth intervals.

Spot depth measurements are used for estimating lake volume for lakes less than 4 ft deep. These lakes are too shallow to conduct boat-based depth transect surveys. The deepest point of the lake is identified by wading and measuring depths with a surveyor’s tape. Modified prop cone volume estimates are used to estimate volumes based on maximum depth.

The area of a lake potentially available for ice aggregate is estimated by calculating the area of each lake that is 4 ft or less in depth, assuming ice will attain thickness of at least 4 ft prior to the need for aggregate and thus will be grounded. If the ice is thinner than 4 ft at the time of ice removal, then the available area for ice removal will be less. Table 4 provides a summary of water volume and ice chip availability estimates for lakes surveyed in 2022.

The procedure for estimating the gallons of water available as ice aggregate is as follows:

1. Subtract the area of the 4-ft depth contour from the lake outline (0-ft contour) to provide the area (in acres) less than 4 ft deep.
2. Convert the upper one foot of the acreage less than 4 ft deep to cubic yards.
3. Reduce the cubic yards by 9 percent to account for ice expansion as the water freezes.
4. Multiply the remaining volume by 202 gallons per cubic yard to arrive at the final estimate of gallons available for use.

### 2.3. Water and Ice Withdrawal

When sensitive fish species are present the amount of water allowed for winter withdrawal, based on the ADF&G, ADNR, and BLM standard criteria, is currently set at 15 percent of the volume of the lake deeper than 7 ft. When only resistant fish species (i.e., ninespine stickleback and Alaska blackfish) are present, water withdrawal is 30 percent of the volume deeper than 5 ft. In 2007, ADNR initiated a
withdrawal limit of 20 percent of the total lake volume if fish are not present. The amounts may or may not be present at the time of withdrawal, depending on ice thickness at the time water is needed.

2.4. Lake Summary Information

Lake Numbering Protocol:

The lake numbering protocol used for the survey is based on the researcher and year code combination. The lake number contains several pieces of information, including the code of the sampler and the initial year of sampling as noted below. Original lake names are retained through subsequent sampling events.

Sampler Code:

- MC = McElderry and Craig (1981); fish sampling 1979
- B = Bendock; fish sampling 1977-1986
- L = Lobdell; water chemistry sampling 1991-1999
- M = Moulton; fish and bathymetric sampling 1995-2014
- M = Morris and Moulton; fish, water chemistry, and bathymetric sampling 2015, 2019
- M = Morris and McFarland; fish, water chemistry, and bathymetric sampling 2020, 2021, 2022
- MM = Morris and Moulton; fish, water chemistry, and bathymetric sampling 2016-2018
- MB = Michael Baker Jr., Inc.; water chemistry and bathymetry sampling 2002-2012
- N = Netsch et al. (1977); NPRA fish sampling 1977
- R = Reanier; depth sampling 2000-2007

First Two Numerals:
Year of Initial Sampling (e.g., if Moulton sampled a lake previously sampled by McElderry and Craig, then the McElderry and Craig lake number is used)

Last Two Numerals:
Numbers 01 through 99 are used to identify the individual lake sampled within a given year.

For each lake in the survey, the following information is accounted for and provided as applicable:

1. A diagram of the lake bathymetry
2. Other names used for the same lake
3. Lake location – latitude and longitude
4. The U.S. Geological Survey (USGS) quadrangle sheet and the township and range in which the lake is situated
5. Surface area in acres
6. Maximum depth in feet
7. Presence or absence of an outlet
8. Method used to calculate lake volumes
9. Calculated total lake volume at the time of survey
10. Water volume under 4 ft of ice
11. Water volume under 5 ft of ice
12. Water volume under 7 ft of ice
13. Acres of potential ice aggregate
14. Gallons of water represented by the upper 1 ft of ice available for ice aggregate
15. Maximum recommended under-ice winter water withdrawal
16. Water chemistry measurements
17. Catch record, including gear used, date sampled, species caught and size range
18. Map depicting potential ice aggregate removal areas
19. Map depicting measured depth transects
20. Photo documentation – inlet and/or outlet or overview photograph as applicable
3. RESULTS

3.1. Physical Observations

All lakes surveyed in 2022 are depicted in Figures 1 through 4 and Appendix A. Water use from surveyed lakes may be either from direct withdrawal of water from below the ice or by collecting ice aggregate from the lake surface.

Maximum depths of lakes surveyed in 2022, excluding Lake L9911 and M0112, range from 2.4 ft to 21.6 ft, with six lakes deeper than 7.0 ft (Table 1). Most of the deeper lakes are located along the Nigliq Channel (Figure 2) within the Colville River floodplain. In that area, the lake types consist mostly of low perched drainage lakes with direct or indirect connections to the Colville River.

Lakes L9911 and M0112 (Figure 3) were surveyed exclusively for high-resolution depth contours for a select portion of each lake to support planned Willow Area infrastructure design. Lake L9911 was previously surveyed by Lobdell in 1999 and Moulton in 1999 and 2004. Lake M0112 was previously surveyed by Moulton in 2001.

Lake L9325 (Figure 2) was flooded by the Nigliq Channel during break-up 2020 and a channel was eroded connecting the lake to the river. The lake was partially drained in June 2020 as the connection channel developed and has since dropped approximately 4 feet in water surface elevation, exposing mud shoals and creating new lake margins. Recent aerial imagery is not available, and the new lake edges are digitized using approximations of field notes and pictures, and coarse resolution satellite imagery (Sentinel Hub 2022). Since the partial draining, the water surface elevation of both the lake and the river channel now appear directly correlated with one another. Consequently, the surface area, volume, and maximum depth of Lake L9325 is also related to the stage height of the Nigliq Channel. Previous bathymetric surveys were conducted on Lake L9325 by Moulton in 1999. Maximum depths of Lake L9325 measured 17.3 feet in 1999, and 13.4 feet in 2022, with a reduction in the estimated total lake volume from 61.86 million gallons in 1999, to 24.197 million gallons in 2022 (Appendix A).

Volume estimates for Lake L9323 decreased from 249.29 million gallons in 2001, to 235.056 million gallons in 2022. Differences in estimates are due to natural changes in lake bathymetry and updated data collection and processing methods that were approved by agency staff to produce more accurate estimates, that were fully implemented by 2003.

3.2. Biological Observations

In 2022, five fish species were documented in the 13 lakes surveyed for fish. Sensitive fish species were documented in two lakes, and include least cisco, humpback whitefish, and round whitefish (Table 2). Resistant fish were captured in eight lakes, and no fish were captured in three lakes (Table 2). Lakes M2107 and M2205 were only surveyed with dipnets and visually for fish due to maximum depths less than 3.5 ft and the resultant lack of viable overwintering habitat. Lake L9323 was only surveyed visually and with dipnets for fish to reduce disturbance of breeding yellow billed loons on the lake and because the lake is well documented to contain sensitive fish species in prior surveys, and is sometimes flooded by the Colville River. All other lakes were surveyed using the methods described in Section 2.1 above.
Lakes L9323, L9325, M9934, and MC7908 were surveyed in 2022, as well as previous years. Lake-specific details are shown in Tables 2, 3, and 4, and in the Lake Data Packets in Appendix A.

### 3.3. Water Chemistry Measurements

Water chemistry parameters and field and laboratory results for chloride, sodium, calcium, magnesium, and hardness are listed in Table 3 lakes sampled in 2022. Surface water temperatures fluctuated but decreased through the sampling period. Water temperatures averaged 9.2 degrees Celsius (°C) and ranged from 5.9°C on August 23 to 13.1°C on August 4, 2022. Specific conductance was generally lowest in isolated tundra lakes and highest in well-connected drainage lakes. Specific conductance varied and ranged from 84.7 microsiemens/centimeter (µS/cm) at Lake L9323 to 258.7 µS/cm at Lake L9325 and averaged 143.3 µS/cm. Specific conductivity was highest at Lake L9325 because of a direct connection to the Nigliq Channel, which typically has higher conductivity values than most lakes in the area. Turbidity ranged from 0.31 nephelometric turbidity units (NTU) at Lake M2205 on August 23, 2022 to 12.83 NTU at Lake L9325 on August 3, 2022 and averaged 4.12 NTU. Turbidity was highest at Lake L9325 for the same reasons as mentioned above for specific conductance, due to a direct connection with the Niglig Channel. Aside from Lake L9325, turbidity was generally lower in deep lakes and higher in shallow lakes, however, regardless of lake depth or size, turbidity was mostly influenced by wind events. In 2022, pH remained relatively stable across the lakes, ranging from 7.2 to 8.7 units. Laboratory results for chloride, sodium, calcium, magnesium, and hardness fell within the expected range of values for lakes in each geographic area and are listed in Table 3. Most values were highest in Lake L9325, due to the direct connection to the Nigliq Channel which at times moves higher salinity more turbid water into the lake. Values from the other lakes sampled were lower than found in Lake L9325 and relatively similar to one another. Lab samples were not taken from Lake M2107 due to the abundance of potable water sources in the nearby area and its small size (2.4 feet maximum depth, 4.457 MM gal total volume) (Table 4)).
4. DISCUSSION

4.1. Evaluation of Fish Concerns

Fish sampling, depth, and water chemistry measurements are used to evaluate the potential of lakes to support fish. If fish are captured or visually observed during sampling, the lake is classified as fish-bearing. Gill net set duration was relatively short at all lakes where sensitive fish species were present because fish were captured almost immediately after net deployment. The absence of catch does not necessarily indicate a lake does not support fish. However, based on sampling results over the past 22 years by Moulton (1998), in conjunction with established multimethod fish species detection probabilities developed by Haynes et al. (2013), the methods employed have a high probability of detecting fish species if they are present.

Lakes deeper than 7 ft are likely to maintain unfrozen higher quality water below the ice during winter and have higher potential to overwinter fish. Maximum volumes of water and ice that may be withdrawn from fish-bearing and non-fish-bearing lakes, per agency requirements outlined in Section 1 above, are described below.

4.2. Available Water and Ice Chips

The 15 lakes surveyed in 2022, excluding lakes L9911 and M0112, contain an estimated 278.241 million gallons of available under-ice water (Table 4). Nearly 90 percent of the available under-ice water is derived from lake K1703 (Table 4). An additional 826.036 million gallons is potentially harvestable as ice aggregate, of which over 84 percent is from lakes K1703, M2201, M2202, and MC7908 (Table 5). However, use of combined water and ice aggregate volume above the 278.241 million gallons available could require additional justification, agency coordination, and monitoring.
5. REFERENCES


TABLES
Table 1. Summary of data collected at lakes sampled in 2022 for winter water use, ConocoPhillips Alaska, Inc.

NOTE: '-' = no data available.

<table>
<thead>
<tr>
<th>Lake Name</th>
<th>Latitude ¹</th>
<th>Longitude ¹</th>
<th>Township</th>
<th>Range</th>
<th>Section</th>
<th>Surface Area (ac)</th>
<th>Maximum Depth (ft)</th>
<th>Lake Volume (MM gals)</th>
<th>Volume Calculation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1703</td>
<td>69.90509</td>
<td>-151.21930</td>
<td>6N; 6N; 7N; 7N</td>
<td>3E; 4E; 3E; 4E</td>
<td>1; 5, 6, 7, 8; 36; 31, 32</td>
<td>2328.7</td>
<td>7.7</td>
<td>4218.156</td>
<td>Contours</td>
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<tr>
<td>L9323</td>
<td>70.29803</td>
<td>-150.99691</td>
<td>11N; 11N</td>
<td>4E; 5E</td>
<td>13, 24; 19</td>
<td>98.3</td>
<td>21.6</td>
<td>235.056</td>
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</tr>
<tr>
<td>L9325</td>
<td>70.28239</td>
<td>-150.98749</td>
<td>11N; 11N</td>
<td>4E; 5E</td>
<td>25; 30</td>
<td>24.821</td>
<td>13.4</td>
<td>24.197</td>
<td>Contours</td>
</tr>
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<td>L9911</td>
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<td>9N; 10N</td>
<td>1E; 1E</td>
<td>1, 2; 35, 36</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
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<td>10N</td>
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<td>70.13556</td>
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<td>1W</td>
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<td>2.4</td>
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<td>6.5</td>
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<td>Contours</td>
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<td>3E</td>
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</tr>
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<td>-151.29806</td>
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<td>3E</td>
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<td>-150.96596</td>
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<td>110.615</td>
<td>Contours</td>
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<td>MC7908</td>
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<td>-151.33079</td>
<td>6N</td>
<td>3E</td>
<td>10, 11, 14, 15, 23</td>
<td>700.0</td>
<td>5.9</td>
<td>726.330</td>
<td>Contours</td>
</tr>
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</table>

¹ Datum: NAD83

² Lake volume estimates are based off measurements recorded on the surveyed date and subject to change according to the stage height of the Nigliq Channel of the Colville River.

³ Lakes only sampled for high-resolution depth contours.
### Table 2. Summary of fish sampling for lakes surveyed in 2022, ConocoPhillips Alaska, Inc.

NOTE: ‘--’ = no data available.

<table>
<thead>
<tr>
<th>Lake Name</th>
<th>Sample Date</th>
<th>Gill Nets</th>
<th>Minnow Traps</th>
<th>Seine</th>
<th>Dipnet/Visual Survey</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Set Duration (hr)</td>
<td>Fish Species¹ ²</td>
<td>Fish Species¹ ²</td>
<td>Effort (hauls)</td>
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<td>None</td>
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</tr>
<tr>
<td>L9323</td>
<td>8/15/2022</td>
<td>--</td>
<td>--</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>L9325</td>
<td>8/3/2022</td>
<td>25.3</td>
<td>RDWF, HBWF</td>
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<td>--</td>
</tr>
<tr>
<td>L9911³</td>
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<tr>
<td>M0112⁴</td>
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<td>RDWF, HBWF, LSCS</td>
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<td>--</td>
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¹ Sensitive species include: BDWF = broad whitefish, HBWF = humpback whitefish, LSCS = least cisco, RDWF = round whitefish
² Resistant species include: BKFH = Alaska Blackfish and NSSB = ninespine stickleback
³ Lake only sampled for high-resolution depth contours. Historical fish data from Lobdel (1999).
⁴ Lake only sampled for high-resolution depth contours. Historical fish data from Owl Ridge (2017) and Moutlon (2001).
<table>
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<tr>
<th>Lake Name</th>
<th>Date</th>
<th>Temperature (°C)</th>
<th>Calcium (mg/l)</th>
<th>Magnesium (mg/l)</th>
<th>Sodium (mg/l)</th>
<th>Chloride (mg/l)</th>
<th>Total Hardness [CaCO3] (mg/l)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
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<td>20.0</td>
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<td>1.45</td>
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<td>34.0</td>
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<td>144.8</td>
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<td>46.5</td>
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<td>2.3</td>
<td>5.7</td>
<td>16.0</td>
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<td>110.9</td>
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<td>--</td>
<td>172.2</td>
<td>7.33</td>
<td>8.1</td>
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<td>2.1</td>
<td>17.0</td>
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<td>5.4</td>
<td>51.1</td>
<td>114.8</td>
<td>4.42</td>
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<td>33.0</td>
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<td>11.0</td>
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<td>104.2</td>
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<td>6.9</td>
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<td>1.94</td>
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<td>4.8</td>
<td>11.0</td>
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\(^1\) Lab samples not taken.
### Table 4. Recommended maximum water volumes available for under-ice water withdrawal from lakes surveyed in 2022 for ConocoPhillips Alaska, Inc. exploration needs.

**NOTE:** The table does not include volume related to ice aggregate. Requested water based on 15% of winter volume deeper than 7 ft when sensitive species are present, 30% of winter volume deeper than 5 ft when resistant fish are likely to be present, 20% of total lake volume when no fish are present.

**NOTE:** '--' = no data available.

<table>
<thead>
<tr>
<th>Lake Name</th>
<th>Surface Area (ac)</th>
<th>Max. Depth in 2022 (ft)</th>
<th>Calculated Volume (MM gal)</th>
<th>20% of Total Lake Volume (MM gal)</th>
<th>30% of Water Under 5 ft of Ice (MM gal)</th>
<th>15% of Water Under 7 ft of Ice (MM gal)</th>
<th>Sensitive Fish Species Present</th>
<th>Resistant Fish Species Present</th>
<th>Recommended Maximum Under-Ice Withdrawal (MM gal)</th>
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<tbody>
<tr>
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<td>6.639</td>
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<td>BKFH, NSSB</td>
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<td>0.000</td>
<td>None</td>
<td>BKFH, NSSB11</td>
<td>0.000</td>
</tr>
</tbody>
</table>

1 Sensitive species include: BDWF = broad whitefish, HBWF = humpback whitefish, LSCS = least cisco, RDWF = round whitefish, and SLSC = slimy sculpin
2 Resistant species include: BKFH = Alaska Blackfish and NSSB = ninespine stickleback
3 Sensitive fish were assumed present for some lakes based on habitat, maximum depths, and connections to adjoining lake basins. More detail is presented in individual lake packets.
5 Lake volume estimates are based off measurements recorded on the surveyed date and subject to change according to the stage height of the Nigliq Channel of the Colville River.
6 Fish data from Owl Ridge (2022) and historically from Moutlon (1999).
8 Lakes only sampled for high-resolution depth contours.
9 Historical fish data from Moutlon (2001).
10 Data from Owl Ridge (2022) and Moutlon (1999).
11 Data from Owl Ridge (2022) and Moutlon (1996).
Table 5. Estimated area available for removing ice aggregate, based on the area covered by water depths less than 4 feet surveyed in 2022, ConocoPhillips Alaska, Inc.

NOTE: Ice thickness is typically 4 ft by early January.

NOTE: ‘--’ = no data available.

<table>
<thead>
<tr>
<th>Lake Name</th>
<th>Surface Area (ac)</th>
<th>Max. Depth in 2022 (ft)</th>
<th>Acres Covered by Water Shallower than 4 ft</th>
<th>Gallons of Water as Chips (MM gal)</th>
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<td>M0112(^2)</td>
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<td>700.0</td>
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<td>641.8</td>
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</tbody>
</table>

\(^1\) Lake volume estimates are based off measurements recorded on the surveyed date and subject to change according to the stage height of the Nigliq Channel of the Colville River.

\(^2\) Lakes only sampled for high-resolution depth contours.
FIGURES
APPENDICES
Appendix A. 2022 Lake Packets.
Lake L9323

Other Names: W5.1
Location: 70.29803°N 150.99691°W (NAD83)
USGS Quad Sheet: Harrison Bay B-2: T11N R4E Sec. 13, 24; T11N R5E Sec. 19 (Umiat)
Habitat: Perched Lake - Low
Area: 98.3 acres
Maximum Depth: 21.6 feet in 2022
Active Outlet: No
Volume Method: Contours
Total Lake Volume: 235.056 million gallons
Volume Under 4 ft of ice: 116.747 million gallons
Volume Under 5 ft of ice: 90.411 million gallons
Volume Under 7 ft of ice: 44.265 million gallons
Potential Ice Aggregate: 17.5 acres (water depth 4 ft or less)
(5.177 million gallons)

Maximum Recommended Winter Removal: 6.639 million gallons
(15% of volume under 7 feet of ice)
(Sensitive fish present)

Water Chemistry:

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<tr>
<th>Year of Test</th>
<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
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</tr>
<tr>
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<td>--</td>
<td>--</td>
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<td>2001</td>
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<td>61</td>
<td>3.6</td>
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<td>71</td>
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<td>84.7</td>
<td>4.5</td>
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Last Revised on 10/7/2022
Prepared by: Owl Ridge Natural Resource Consultants
www.owlridgenrc.com
### Catch Record:

<table>
<thead>
<tr>
<th>Gear</th>
<th>Date</th>
<th>Effort</th>
<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
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<tbody>
<tr>
<td>Gill Net</td>
<td>Jul 21 96</td>
<td>5.6</td>
<td>Broad whitefish</td>
<td>3</td>
<td>400-512</td>
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<td></td>
<td></td>
<td>Round whitefish</td>
<td>1</td>
<td>217</td>
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<td></td>
<td></td>
<td>Least cisco</td>
<td>50</td>
<td>181-319</td>
</tr>
<tr>
<td>Gill Net</td>
<td>Jul 27 99</td>
<td>6.1</td>
<td>Broad whitefish</td>
<td>1</td>
<td>495</td>
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<td>Least cisco</td>
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<td>227-305</td>
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<td>Round whitefish</td>
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<td>Fyke Net</td>
<td>Jul 12-25, 01</td>
<td>473.2</td>
<td>Broad whitefish</td>
<td>7</td>
<td>137-159</td>
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<td></td>
<td>and Aug 18-25, 01</td>
<td></td>
<td>Humpback whitefish</td>
<td>25</td>
<td>47-192</td>
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<td>Least cisco</td>
<td>486</td>
<td>42-285</td>
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<td>Round whitefish</td>
<td>22</td>
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<td>Alaska blackfish</td>
<td>43</td>
<td>51-100</td>
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<td>Slimy sculpin</td>
<td>25</td>
<td>35-84</td>
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<td>Ninespine stickleback</td>
<td>565</td>
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<td>Visual + Dip Net</td>
<td>15-Aug-22</td>
<td>3 yd.</td>
<td>Ninespine stickleback</td>
<td>1</td>
<td>--</td>
</tr>
</tbody>
</table>
Lake L9323

Active Outlet: No

Overview
Date: 8/15/2022
Orientation: Looking to the northwest
Notes: None
Map based on available satellite imagery (Sentinel on August 2, 2022) to show the drop in lake surface elevation. Surface elevations will be validated with higher resolution data once available.
Lake L9325

Other Names: None known
Location: 70.28239°N 150.98749°W (NAD83)
USGS Quad Sheet: Harrison Bay B-2: T11N R4E Sec. 25; T11N R5E Sec. 30 (Umiat)
Habitat: Tapped Lake
Area: 24.8 acres
Maximum Depth: 13.4 feet in 2022
Active Outlet: Yes
Volume Method: Contours
Total Lake Volume: 24.197 million gallons
Volume Under 4 ft of ice: 1.701 million gallons
Volume Under 5 ft of ice: 0.462 million gallons
Volume Under 7 ft of ice: 0.120 million gallons
Potential Ice Aggregate: 21.0 acres (water depth 4 ft or less)
(15% of volume under 7 feet of ice)
Maximum Recommended Winter Removal: 0.018 million gallons
(Sensitive fish present)

Water Chemistry:

<table>
<thead>
<tr>
<th>Year of Test</th>
<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
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<tbody>
<tr>
<td>1993</td>
<td>6.3</td>
<td>1.9</td>
<td>3.4</td>
<td>5.0</td>
<td>24.0</td>
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<td>--</td>
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</tr>
<tr>
<td>1999</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>102.4</td>
<td>--</td>
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<tr>
<td>2022</td>
<td>12.0</td>
<td>32.0</td>
<td>34.0</td>
<td>50.0</td>
<td>129.2</td>
<td>258.7</td>
<td>12.8</td>
<td>8.2</td>
<td>7.5</td>
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Catch Record:

<table>
<thead>
<tr>
<th>Gear</th>
<th>Date</th>
<th>Effort</th>
<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>Jul 24 99</td>
<td>2.6 hr.</td>
<td>Broad whitefish</td>
<td>3</td>
<td>233-437</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Least cisco</td>
<td>1</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Round whitefish</td>
<td>5</td>
<td>146-306</td>
</tr>
<tr>
<td>Gill Net, Sinking</td>
<td>02-Aug-22</td>
<td>25.3 hr.</td>
<td>Humpback whitefish</td>
<td>3</td>
<td>148-369</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Round whitefish</td>
<td>3</td>
<td>209</td>
</tr>
</tbody>
</table>

Last Revised on 10/7/2022
Map based on available satellite imagery (Sentinel on August 2, 2022) to show the drop in lake surface elevation. Surface elevations will be validated with higher resolution data once available.
Map based on available satellite imagery (Sentinel on August 2, 2022) to show the drop in lake surface elevation. Surface elevations will be validated with higher resolution data once available.
Active Outlet: Yes

Overview
Date: 8/2/2022
Orientation: Looking to the west
Notes: Lake outlet into Nigliq Channel, visible at far end of lake

Outlet
Date: 8/2/2022
Orientation: Looking to the northeast
Notes: View of lake outlet into Nigliq channel. Flow towards the viewer.
Lake M9934

Other Names: None known
Location: 70.27558°N 150.96596°W (NAD83)
USGS Quad Sheet: Harrison Bay B-2: T11N R5E 30, 31 (Umiat)
Habitat: Drainage Lake
Area: 69.8 acres
Maximum Depth: 19.7 feet in 2022
Active Outlet: Yes
Volume Method: Contours
Total Lake Volume: 110.615 million gallons
Volume Under 4 ft of ice: 31.533 million gallons
Volume Under 5 ft of ice: 16.960 million gallons
Volume Under 7 ft of ice: 3.070 million gallons
Potential Ice Aggregate: 25.1 acres (water depth 4 ft or less)
7.431 million gallons
Maximum Recommended Winter Removal: 0.460 million gallons
(Sensitive fish present)

Water Chemistry:

<table>
<thead>
<tr>
<th>Year of Test</th>
<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
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<tr>
<td>1999</td>
<td>10.6</td>
<td>4.1</td>
<td>4.4</td>
<td>5.8</td>
<td>43.6</td>
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<td>8.1</td>
<td>8.1</td>
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<tr>
<td>2022</td>
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<td>3.6</td>
<td>5.1</td>
<td>6.9</td>
<td>37.0</td>
<td>94.9</td>
<td>1.9</td>
<td>7.8</td>
<td>10.8</td>
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Catch Record:

<table>
<thead>
<tr>
<th>Gear</th>
<th>Date</th>
<th>Effort</th>
<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
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<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>3-Aug-99</td>
<td>4.0 hr.</td>
<td>Least cisco</td>
<td>6</td>
<td>195-291</td>
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<tr>
<td>Gill Net, Sinking</td>
<td>24-Jul-22</td>
<td>25.5 hr.</td>
<td>Humpback whitefish</td>
<td>1</td>
<td>320</td>
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<td></td>
<td></td>
<td>Least cisco</td>
<td>1</td>
<td>309</td>
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<td>Round whitefish</td>
<td>2</td>
<td>249-269</td>
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<td>Visual + Dip Net</td>
<td>24-Jul-22</td>
<td>99 yd.</td>
<td>Alaska blackfish</td>
<td>1</td>
<td>78</td>
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<td>Ninespine stickleback</td>
<td>1</td>
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</table>

Last Revised on 10/7/2022
ICE CHIPS

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Area Available for Ice Chip Collection at M9934

Survey Date: July 24, 2022

(Not to be used for navigation or to direct the operation of heavy equipment)
Active Outlet: Yes

Outlet
Date: 7/24/2022
Orientation: Looking to the north
Notes: Flow away from the viewer

Inlet
Date: 7/24/2022
Orientation: Looking to the south
Notes: Flow towards the viewer
Active Outlet: No

Overview
Date: 8/16/2022
Orientation: Looking to the north
Notes: None
Active Outlet: No

Overview
Date: 8/18/2022
Orientation: Looking to the north
Notes: None
Lake M2105

Other Names: None known
Location: 70.13875°N 152.01411°W (NAD83)
USGS Quad Sheet: Harrison Bay A-4: T9N R1W Sec. 13 (Umiat)
Habitat: Tundra Lake
Area: 8.6 acres
Maximum Depth: 4.8 feet in 2022
Active Outlet: No
Volume Method: Contours
Total Lake Volume: 7.620 million gallons
Volume Under 4 ft of ice: 0.054 million gallons
Volume Under 5 ft of ice: 0.000 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 8.5 acres (water depth 4 ft or less)
2.507 million gallons

Maximum Recommended Winter Removal: 1.524 million gallons
(20% of total volume)
(No fish captured)

Water Chemistry:

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<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
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<td>11.0</td>
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<td>112.1</td>
<td>1.2</td>
<td>8.1</td>
<td>10.6</td>
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Catch Record:

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<th>Date</th>
<th>Effort</th>
<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
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<tbody>
<tr>
<td>Minnow Trap</td>
<td>23-Jul-22</td>
<td>50.0 hr.</td>
<td>None</td>
<td>0</td>
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<tr>
<td>Visual + Dip Net</td>
<td>23-Jul-22</td>
<td>223 yd.</td>
<td>None</td>
<td>0</td>
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Last Revised on 10/7/2022
ICE CHIPS

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

AREA AVAILABLE FOR ICE CHIP COLLECTION AT M2105

Survey Date: July 23, 2022
(Not to be used for navigation or to direct the operation of heavy equipment)
Lake M2105

Overview

Date: 7/23/2022
Orientation: Looking to the northeast
Notes: None
**Lake M2106**

**Other Names:** None known

**Location:** 70.12761°N 152.02245°W (NAD83)

**USGS Quad Sheet:** Harrison Bay A-4: T9N R1W Sec. 13, 24 (Umiat)

**Habitat:** Tundra Lake

**Area:** 21.4 acres

**Maximum Depth:** 7.1 feet in 2022

**Active Outlet:** No

**Volume Method:** Contours

**Total Lake Volume:** 26.061 million gallons

**Volume Under 4 ft of ice:** 2.075 million gallons

**Volume Under 5 ft of ice:** 0.165 million gallons

**Volume Under 7 ft of ice:** 0.000 million gallons

**Potential Ice Aggregate:** 15.5 acres (water depth 4 ft or less)

**Maximum Recommended Winter Removal:** 5.212 million gallons

(20% of total volume)

(No fish captured)

**Water Chemistry:**

<table>
<thead>
<tr>
<th>Year of Test</th>
<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
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<td>110.9</td>
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<td>7.2</td>
<td>6.4</td>
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**Catch Record:**

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<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
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<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>18-Aug-22</td>
<td>32.5 hr.</td>
<td>None</td>
<td>0</td>
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<tr>
<td>Minnow Trap</td>
<td>18-Aug-22</td>
<td>43.9 hr.</td>
<td>None</td>
<td>0</td>
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<tr>
<td>Seine</td>
<td>18-Aug-22</td>
<td>3 hauls</td>
<td>None</td>
<td>0</td>
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<tr>
<td>Visual + Dip Net</td>
<td>18-Aug-22</td>
<td>172 yd.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>

Last Revised on 10/7/2022
Prepared by: Owl Ridge Natural Resource Consultants
www.owlridgenrc.com
ICE CHIPS
- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

AREA AVAILABLE FOR ICE CHIP COLLECTION AT M2106

Survey Date: August 18, 2022
(Not to be used for navigation or to direct the operation of heavy equipment)
Lake M2106

Active Outlet: No

Overview
Date: 8/18/2022
Orientation: Looking to the south
Notes: None
Lake M2107

Other Names: None known
Location: 70.13556°N 152.04749°W (NAD83)
USGS Quad Sheet: Harrison Bay A-4: T9N R1W Sec. 13, 14 (Umiat)
Habitat: Tundra Lake
Area: 17.1 acres
Maximum Depth: 2.4 feet in 2022
Active Outlet: No
Volume Method: Prop Cone
Total Lake Volume: 4.457 million gallons
Volume Under 4 ft of ice: 0.000 million gallons
Volume Under 5 ft of ice: 0.000 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 17.1 acres (water depth 4 ft or less)
5.071 million gallons

Maximum Recommended Winter Removal: 0.891 million gallons
(20% of total volume)
(No fish captured)

Water Chemistry:

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<th>Year of Test</th>
<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (μS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
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<tbody>
<tr>
<td>2022</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>172.2</td>
<td>7.3</td>
<td>8.1</td>
<td>6.7</td>
<td></td>
</tr>
</tbody>
</table>

No lab water chemistry sample taken during survey.

Catch Record:

<table>
<thead>
<tr>
<th>Gear</th>
<th>Date</th>
<th>Effort</th>
<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnow Trap</td>
<td>19-Aug-22</td>
<td>38.1 hr.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Seine</td>
<td>19-Aug-22</td>
<td>3 hauls</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>
Active Outlet: No

Overview
Date: 8/19/2022
Orientation: NA
Notes: Picture unavailable
Lake K1703

Other Names: None known
Location: 69.90509°N 151.21930°W (NAD83)
USGS Quad Sheet: Umiat D-2/D-3: T6N R3E Sec. 1; T6N R4E Sec. 5, 6, 7, 8; T7N R3E Sec. 36; T7N R4E Sec. 31, 32 (Umiat)
Habitat: Perched - Low
Area: 2,328.7 acres
Maximum Depth: 7.7 feet in 2022
Active Outlet: No
Volume Method: Contours
Total Lake Volume: 4,218.156 million gallons
Volume Under 4 ft of ice: 1,405.893 million gallons
Volume Under 5 ft of ice: 829.573 million gallons
Volume Under 7 ft of ice: 0.619 million gallons
Potential Ice Aggregate: 560.0 acres (water depth 4 ft or less)
                      166.084 million gallons
Maximum Recommended Winter Removal: 248.871 million gallons
                                   (30% of volume under 5 feet of ice)
                                   (Resistant fish present)

Water Chemistry:

<table>
<thead>
<tr>
<th>Year of Test</th>
<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022</td>
<td>20.0</td>
<td>2.4</td>
<td>2.1</td>
<td>5.2</td>
<td>59.8</td>
<td>121.8</td>
<td>1.5</td>
<td>8.7</td>
<td>9.5</td>
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Catch Record:

<table>
<thead>
<tr>
<th>Gear</th>
<th>Date</th>
<th>Effort</th>
<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>03-Aug-22</td>
<td>38.1 hr.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Visual + Dip Net</td>
<td>03-Aug-22</td>
<td>18 yd.</td>
<td>Ninespine stickleback</td>
<td>1</td>
<td>--</td>
</tr>
</tbody>
</table>

Last Revised on 10/7/2022
ICE CHIPS

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

AREA AVAILABLE FOR ICE CHIP COLLECTION AT K1703

Survey Date: August 3, 2022

(Not to be used for navigation or to direct the operation of heavy equipment)

SCALE:

0 1,000 2,000

Feet

PREPARED BY:

ConocoPhillips
Alaska

NAD83, State Plane Zone 4, Alaska
Active Outlet: No

Inlet
Date: 8/3/2022
Orientation: Looking to the south
Notes: Flow towards the viewer

Inlet
Date: 8/3/2022
Orientation: Looking to the south
Notes: Flow away from the viewer
Lake M2201

Other Names: None known
Location: 69.94204°N 151.29375°W (NAD83)
USGS Quad Sheet: Umiat D-3: T7N R3E Sec. 23, 24, 25, 26; T7N R4E Sec. 19 (Umiat)
Habitat: Tundra Lake
Area: 742.2 acres
Maximum Depth: 6.5 feet in 2022
Active Outlet: No
Volume Method: Contours
Total Lake Volume: 892.112 million gallons
Volume Under 4 ft of ice: 96.787 million gallons
Volume Under 5 ft of ice: 29.939 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 537.0 acres (water depth 4 ft or less)
(159.257 million gallons)

Maximum Recommended Winter Removal: 8.981 million gallons
(30% of volume under 5 feet of ice)
(Resistant fish present)

Water Chemistry:

<table>
<thead>
<tr>
<th>Year of Test</th>
<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022</td>
<td>2.1</td>
<td>17.0</td>
<td>2.1</td>
<td>5.4</td>
<td>51.1</td>
<td>114.8</td>
<td>4.4</td>
<td>8.2</td>
<td>8.2</td>
</tr>
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</table>

Catch Record:

<table>
<thead>
<tr>
<th>Gear</th>
<th>Date</th>
<th>Effort</th>
<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>01-Aug-22</td>
<td>33.1 hr.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Visual + Dip Net</td>
<td>01-Aug-22</td>
<td>52 yd.</td>
<td>Ninespine stickleback</td>
<td>1</td>
<td>--</td>
</tr>
</tbody>
</table>

Last Revised on 10/7/2022
Active Outlet: No

Overview
Date: 8/1/2022
Orientation: Looking to the northeast
Notes: None
Lake M2202

Other Names: None known
Location: 69.93831°N 151.38171°W (NAD83)
USGS Quad Sheet: Umiat D-3: T7N R3E Sec. 21, 22, 27, 28 (Umiat)
Habitat: Tundra Lake
Area: 592.5 acres
Maximum Depth: 3.5 feet in 2022
Active Outlet: No
Volume Method: Contours
Total Lake Volume: 603.755 million gallons
Volume Under 4 ft of ice: 0.719 million gallons
Volume Under 5 ft of ice: 0.000 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 588.9 acres (water depth 4 ft or less)
174.635 million gallons

Maximum Recommended Winter Removal: 0.000 million gallons
(30% of volume under 5 feet of ice)
(Resistant fish present)

Water Chemistry:

<table>
<thead>
<tr>
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<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022</td>
<td>17.0</td>
<td>3.0</td>
<td>21.0</td>
<td>33.0</td>
<td>54.8</td>
<td>211.4</td>
<td>2.9</td>
<td>8.0</td>
<td>12.2</td>
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<tr>
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<th>Number Caught</th>
<th>Fork Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>24-Jul-22</td>
<td>32.2 hr.</td>
<td>None</td>
<td>0</td>
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</tr>
<tr>
<td>Visual + Dip Net</td>
<td>24-Jul-22</td>
<td>2 yd.</td>
<td>Ninespine stickleback</td>
<td>12</td>
<td>--</td>
</tr>
</tbody>
</table>

Last Revised on 10/7/2022 | Prepared by: Owl Ridge Natural Resource Consultants | www.owlridgenrc.com
ICE CHIPS

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips
Lake M2202

Active Outlet: No

Overview
Date: 7/24/2022
Orientation: Looking to the west
Notes: None
Lake M2203

Other Names: None known
Location: 69.90787°N 151.31966°W (NAD83)
USGS Quad Sheet: Umiat D-3: T6N R3E Sec. 2; T7N R3E Sec. 35 (Umiat)
Habitat: Tundra Lake
Area: 220.1 acres
Maximum Depth: 4.5 feet in 2022
Active Outlet: No
Volume Method: Contours
Total Lake Volume: 204.723 million gallons
Volume Under 4 ft of ice: 0.034 million gallons
Volume Under 5 ft of ice: 0.000 million gallons
Volume Under 7 ft of ice: 0.000 million gallons
Potential Ice Aggregate: 219.9 acres (water depth 4 ft or less)
65.224 million gallons
Max. Recommended Winter Removal: 0.000 million gallons
(30% of volume under 5 feet of ice)
(Resistant fish present)

Water Chemistry:

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<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022</td>
<td>27.0</td>
<td>3.4</td>
<td>5.5</td>
<td>14.0</td>
<td>81.4</td>
<td>180.9</td>
<td>1.9</td>
<td>8.4</td>
<td>12.9</td>
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<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>04-Aug-22</td>
<td>32.8 hr.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Minnow Trap</td>
<td>04-Aug-22</td>
<td>38.8 hr.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Visual + Dip Net</td>
<td>04-Aug-22</td>
<td>96 yd.</td>
<td>Ninespine stickleback</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Last Revised on 10/7/2022
ICE CHIPS
4 feet or shallower - available for ice chips
Deeper than 4 feet - unavailable for ice chips

AREA AVAILABLE FOR ICE CHIP COLLECTION AT M2203
Survey Date: August 4, 2022
(Not to be used for navigation or to direct the operation of heavy equipment)
Active Outlet: No

Overview
Date: 8/4/2022
Orientation: Looking to the west
Notes: None
Lake M2204

Other Names: None known
Location: 69.87618°N 151.37521°W (NAD83) Umiat
USGS Quad Sheet: D-3: T6N R3E Sec. 10, 15, 16 (Umiat)
Habitat: Tundra Lake
Area: 296.9 acres
Maximum Depth: 12.6 feet in 2022
Active Outlet: No
Volume Method: Contours
Total Lake Volume: 414.661 million gallons
Volume Under 4 ft of ice: 73.513 million gallons
Volume Under 5 ft of ice: 18.818 million gallons
Volume Under 7 ft of ice: 0.329 million gallons

Potential Ice Aggregate: 129.1 acres (water depth 4 ft or less)
38.275 million gallons

Maximum Recommended Winter Removal: 5.645 million gallons
(30% of volume under 5 feet of ice)
(Resistant fish present)

Water Chemistry:

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<tr>
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<th>pH</th>
<th>Water Temperature (°C)</th>
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</thead>
<tbody>
<tr>
<td>2022</td>
<td>20.0</td>
<td>2.3</td>
<td>2.5</td>
<td>6.3</td>
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<td>123.4</td>
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<td>8.4</td>
<td>13.1</td>
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<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>04-Aug-22</td>
<td>33.2 hr.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Visual + Dip Net</td>
<td>04-Aug-22</td>
<td>3 yd.</td>
<td>Ninespine stickleback</td>
<td>1</td>
<td>--</td>
</tr>
</tbody>
</table>

Last Revised on 10/7/2022
Prepared by: Owl Ridge Natural Resource Consultants
www.owlridgenrc.com
Lake M2204

Active Outlet: No

Overview
Date: 8/4/2022
Orientation: Looking to the southwest
Notes: None
Lake M2205

Other Names: None known
Location: 69.89802°N  151.29806°W (NAD83)
USGS Quad Sheet: Umiat D-3: T6N R3E Sec. 1, 2 (Umiat)
Habitat: Tundra Lake
Area: 4.1 acres
Maximum Depth: 3.4 feet in 2022
Active Outlet: No
Volume Method: Prop Cone
Total Lake Volume: 1.499 million gallons
Volume Under 4 ft of ice: 0.000 million gallons
Volume Under 5 ft of ice: 0.000 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 4.1 acres (water depth 4 ft or less)
1.204 million gallons

Maximum Recommended Winter Removal: 0.000 million gallons
(30% of volume under 5 feet of ice)
(Resistant fish present)

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<th>pH</th>
<th>Water Temperature (°C)</th>
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</thead>
<tbody>
<tr>
<td>2022</td>
<td>14.0</td>
<td>2.8</td>
<td>4.8</td>
<td>11.0</td>
<td>51.9</td>
<td>104.2</td>
<td>0.3</td>
<td>7.9</td>
<td>5.9</td>
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<th>Number Caught</th>
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</tr>
</thead>
</table>

Last Revised on 10/7/2022
Prepared by: Owl Ridge Natural Resource Consultants
www.owlridgenrc.com
Active Outlet: No

Overview
Date: 8/23/2022
Orientation: Looking to the north
Notes: None
Lake MC7908

Other Names: None known
Location: 69.87760°N 151.33079°W (NAD83)
USGS Quad Sheet: Umiat D-3: T6N R3E 10, 11, 14, 15, 23 (Umiat)
Habitat: Perched Lake - High
Area: 700.0 acres
Maximum Depth: 5.9 feet in 2022
Active Outlet: No
Volume Method: Contours

Total Lake Volume: 726.330 million gallons
Volume Under 4 ft of ice: 18.973 million gallons
Volume Under 5 ft of ice: 0.000 million gallons
Volume Under 7 ft of ice: 0.000 million gallons
Potential Ice Aggregate: 641.8 acres (water depth 4 ft or less)
                     190.329 million gallons

Maximum Recommended Winter Removal: 0.000 million gallons
(30% of volume under 5 feet of ice)
(Resistant fish present)

Water Chemistry:

<table>
<thead>
<tr>
<th>Year of Test</th>
<th>Calcium (mg/L)</th>
<th>Magnesium (mg/L)</th>
<th>Sodium (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Total Hardness [CaCO3] (mg/L)</th>
<th>Specific Conductance (µS/cm)</th>
<th>Turbidity (NTU)</th>
<th>pH</th>
<th>Water Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022</td>
<td>21.0</td>
<td>2.9</td>
<td>4.8</td>
<td>11.0</td>
<td>64.4</td>
<td>143.4</td>
<td>9.8</td>
<td>8.0</td>
<td>11.1</td>
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Catch Record:

<table>
<thead>
<tr>
<th>Gear</th>
<th>Date</th>
<th>Effort</th>
<th>Species</th>
<th>Number Caught</th>
<th>Fork Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gill Net, Sinking</td>
<td>07-Sep-96</td>
<td>20.0 hr.</td>
<td>Alaska blackfish</td>
<td>4</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>26-Jul-22</td>
<td>33.3 hr.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Minnow Trap</td>
<td>26-Jul-22</td>
<td>47.2 hr.</td>
<td>None</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Visual + Dip Net</td>
<td>26-Jul-22</td>
<td>91 yd.</td>
<td>Ninespine stickleback</td>
<td>2</td>
<td>--</td>
</tr>
</tbody>
</table>

Last Revised on 10/7/2022
Prepared by: Owl Ridge Natural Resource Consultants
www.owlridgenrc.com
ICE CHIPS

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

MC7908
Prepared by:
AREA AVAILABLE FOR ICE CHIP COLLECTION AT MC7908
NAD83, State Plane Zone 4, Alaska
SCALE:
(Not to be used for navigation or to direct the operation of heavy equipment)

Survey Date: July 26, 2022
(Not to be used for navigation or to direct the operation of heavy equipment)
Active Outlet: No

Overview
Date: 7/26/2022
Orientation: Looking to the south
Notes: None