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# Technical Memorandum

**DATE:** May 1, 2018

**TO:** Ron Storie
Thompson Nicola Regional District

**CC:** Jason Tomlin
Thompson Nicola Regional District

**FROM:** Jason Miller, P.Eng.

**RE:** **2018 STUMP LAKE EMERGENCY RESPONSE**
**Stump Lake Site Visit and Downstream Assessment**
**Our File 2755.006-300**

## 1. Introduction and Background

Kerr Wood Leidal Associates Ltd. (KWL) has been retained by the Thompson Nicola Regional District (TNRD) to provide hydrotechnical engineering support during the 2018 freshet. The purpose of this technical memorandum is to describe a site visit conducted to Stump Lake (where there are flooding concerns related to the 2018 freshet), and to provide assistance to the TNRD in responding to the flood threat.

The initial KWL scope of work includes:

- A site visit to assess existing conditions and potential downstream consequences (should there be outflow from the lake).
- Identify options for controlling the lake level to reduce the potential for flooding.
- Recommendations of next steps to support emergency preparedness.

The TNRD is responsible for direct communication with property owners, while KWL is responsible for hydrotechnical input.

### 1.1 Background

Stump Lake is located about 40 km NE of Merritt (Figure 1), within the Nicola River watershed. The lake has a surface area of about 6.8 $km^2$, with inflow entering on the north end of the lake and a historical outlet on the south end of the lake. Highway 5A is located on the west shore of the lake. Residential properties have been developed at various locations around the circumference of the lake.

Although there is a lake outlet, it is understood that outflow has not occurred from the lake in at least 30 years. The lake level drops each summer due to evaporation and ground infiltration. Following high inflow from the 2017 freshet, the lake level increased greater than 1 m, to an elevation that had the potential to flood homes. According to the TNRD, the lake level lowered by only about 0.4 m (18 inches) during the 2017 summer. Given the relatively high lake level entering 2018, and high early 2018 freshet inflow, the lake level is currently high and expected to rise further as the freshet continues.

# 2. Site Visit

A site visit was conducted on April 28, 2018 by Jason Miller, P.Eng. (KWL) and Jeptha Ball (EMBC). The purpose of the site visit was to assess the lake elevation, potential flood related impacts, install a manual staff gauge, and review areas downstream of the lake which may be impacted by outflow from the lake. The site visit did not include any discussions with residents. Figure 1 shows Stump Lake and various locations visited during the site visit, and Figure 2 shows the downstream area between Stump Lake and Nicola Lake.

The site visit started at the north end of the lake. A culvert on Stumplake Creek, the main tributary flowing into Stump Lake (Figure 1), was blocked. This caused overtopping of the road and subsequent erosion to the road, cutting off road access and flooding a field at Stump Lake Ranch. The flow in the tributary was estimated to be 1 $m^3/s$ to 2 $m^3/s$.

A manual staff gauge was installed at an access on the northwest corner of the lake, near the north side boat launch (Figure 1). KWL understands that the individuals who may read the staff gauge also reside at the north end of the lake. Immediately following installation, the staff gauge read 0.5 inches.

Next, the outlet of Stump Lake was assessed. At this location the remnants of an historical control structure were observed; the works included earthworks berms and a decant channel (Figure 1). However, it was apparent from the condition of the works that none of the elements had been functional for many years. Based on information Jeptha Ball collected in 2017, it is estimated the decant channel invert is about 1.5 m in elevation above the lake level (at the time of the April 28, 2018 site visit).

Finally, the site visit assessed the potential surface flow route that Stump Lake outflow would take if the lake were to rise above the decant channel invert (Figure 2). Ultimately, the outflow from Stump Lake would reach Nicola Lake. The following infrastructure was noted along the outflow route (from Stump Lake, moving in downstream order):

- A 900 mm CSP[1] culvert under Highway 5A, approximately 1.7 km downstream from the lake.
  - Based on preliminary hydraulic calculations, it is estimated this culvert could convey about 1 $m^3/s$, and possibly up to 3 $m^3/s$ if surcharged about 2 m above the crown of the culvert.
- A 600 mm CSP culvert under a private road approximately 385 m downstream of the highway crossing.
  - This culvert could be easily replaced, if required.
- Two privately owned dams (joint Ducks Unlimited Canada and private ownership).
  - The first reservoir is approximately 5.5 km downstream of the private road crossing.
  - The first dam does not appear to be regulated but is licensed for Conservation and Irrigation Purposes; Point of Diversion ID PD54443. According to Jeptha Ball, this dam has a vertical sump and pump with no visible discharge facilities.
  - The dam downstream is reported on the Provincial Dam Database to be a 3-m high earthfill structure, 520 m long. Provincial Dam File D130215-00. It has a sheetpile weir discharge facility.

[1] CSP: corrugated steel pipe.

- A culvert under a driveway (Guichon Ranch).
  - It appeared that water would flow through a field and pond upstream of the driveway culvert.
- A second registered dam (Gerard Guichon Ranch Ltd.)
  - The reservoir is approximately 1.5 km downstream of the previous dam.
  - The Provincial dam data base indicates the structure is earthfill, 4 m in height, 210 m in length. Dam file: D130220-00.

Downstream of the noted infrastructure, the outflow would flow through open agricultural fields approximately 900 m before entering Nicola Lake (Figure 3).

# 3. Hazard and Mitigation Options

Based on anecdotal observations, the Stump Lake level has been steadily rising during the 2018 freshet. Information provided by a local resident shows an increase of 2.5 cm (1") over 24 hours on April 27, to 6 cm (2.5") over 24 hours on April 30. Given a lake surface area of about 6.8 $km^2$, that translates into an inflow rate of about 2 $m^3/s$ (April 27) to 4.7 $m^3/s$ (April 30).

Options to mitigate increases in Stump Lake level by discharging lake water downstream are likely to be limited by the capacity of the culvert under Highway 5A, or the downstream dams. It is anticipated the outflow from Stump Lake will need to be limited to 2 $m^3/s$ or less to limit impacts to this downstream infrastructure.

Possible options are described below and shown conceptually on Figure 3. The timeframe for the options is based from the time of option initiation (i.e. once approvals are in place).

**1. Do Nothing**

The "no nothing" option would result in flooding of certain properties around the lake (see Figure 1). If the rate of lake level rise estimated for April 30, 2018 (6 cm per day) were to continue, it would take about 25 days for the lake level to reach the elevation of the existing lake outlet, at which point the lake would begin to outflow downstream toward Nicola Lake. (If the lake level rises faster than 6 cm per day, it will take less time for the lake level to reach the elevation of the lake outlet).

**2. Pumping**

Lake level increases could be mitigated through pumping. To discharge at a rate of 2 $m^3/s$ about eight 25 cm (10 inch) pumps are required.

To supply and install the system of pumps and pipes required to discharge 2 $m^3/s$, the cost would be in the order of $240,000. Assuming the pumps would be required to operate for a period of 4 weeks, fuel costs could be a further $150,000, with operational labour an additional cost. A 15% allowance should be included for environmental (on site monitoring) and engineering (hydrotech, survey and field services) support ($60,000). It is anticipated that a pumping system could be sourced and supplied in about two weeks from a company such as Canadian Dewatering.

This option would be a short-term solution to lower the lake one time and would not provide for long-term management of the Stump Lake level.

### 3. Siphon

A siphon could be installed at the lake outlet to provide outflow and reduce the lake level. Once primed, a siphon will flow based on gravity (i.e. no on-going pumping costs). In order to support a siphon, hard pipe would need to be laid with valves on either end. Pumping would be required to prime the siphon.

Given the site constraints (elevation to be overcome, available driving head), it is anticipated that multiple pipes (13 - 400 mm dia. pipes, each about 350 m long) would be required to convey the desired flow with a total required pipe length of about 5,000 m.

The associated cost to supply and install would be in the order of $3M.

This option would also be a short-term solution to lower the lake one time and would not provide long-term management of the Stump Lake water level.

### 4. Excavation to lower the lake outlet

The lake outlet could be lowered in the vicinity of the existing works to control the lake level.

Approximate dimensions of an outlet channel to convey a flow rate of 2 $m^3/s$ would be: 2 m width, 2H:1V side slopes and 0.45 m depth (assuming a 1% gradient).

Based on an assumed excavation cost per lineal metre, and a length of about 500 m, the associated cost would be in the order of $50,000 to $80,000. This assumes there is no bedrock encountered during channel excavation, the material is stockpiled on site and the channel is left in place following the work. Channel grade control works (a few riprap sections in the creek bed) may be required to limit downcutting of the channel. The channel section would require additional survey and engineering to develop a suitable design. An allowance of about $60,000 should be included for environmental (on site monitoring) and engineering (hydrotech, survey and field services) support for this option. Assuming that approval for instream work can be expedited, the work could begin immediately once a contractor (or contractors) are sourced. The channel could be excavated in about five days with two excavators.

This option would allow for long-term management of the Stump Lake water level and would maintain levels near the level of the outflow channel invert. To ensure an optimum outlet configuration that is satisfactory for all stakeholders (property owners, environmental agencies, etc.) it is anticipated that further consultation would be required following the 2018 freshet. It is likely that further design and construction work may be needed to modify the outlet area accordingly. If any works require ongoing operation, such responsibility would need to be assigned.

**Other Considerations:**

Regardless of which option is pursued, various actions and improvements would also be required, including:

- Monitoring of the Highway 5A culvert.
- Upgrading of the 600 mm CSP crossing at the private road.
- Additional assessment of the dams and private driveway crossing.
- Consideration of potential sediment and erosion issues that could result from Stump Lake outflow through the length of Stumplake Creek.

# 4. Recommended Next Steps

KWL understands that the TNRD would like to develop 'trigger' levels, or elevations, to initiate emergency response. For KWL to be able to develop trigger levels, additional information is required, including the elevations of existing buildings around the lake.

The following next steps are recommended to support the development of trigger levels:

- The TNRD should review existing files to locate any available building elevation information.
- A topographic survey should be conducted to reference key assets to a common vertical datum. The survey should include:
  - building elevations for buildings not included in TNRD files;
  - the staff gauge (including elevation of the reference datum); and
  - the existing outlet channel invert.
- The TNRD should communicate with Stump Lake residents and downstream property owners to inform them of the current situation and the potential for flooding.
- The TNRD should make arrangements with a local property owner to read the staff gauge daily, ideally at approximately the same time every day, and to communicate this information to TNRD.
- A more detailed review of the downstream dams should occur in consultation with the Provincial Dam Safety Officer and dam owners prior to discharging any flows from Stump Lake.
- The TNRD should further consider the identified mitigation options, and further develop at least one option in order to be able to respond in the likely event that a flood situation arises in the coming weeks.

Regardless of what steps are taken this year, further permanent measures are likely to remain necessary. Such could include outlet control works (or modification of any works that may be completed this year), or raising/relocation of low buildings.

We trust the foregoing is sufficient for your purposes at this time. Please do not hesitate to contact the undersigned at (250) 503-5812.

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Encl.: Figure 1: Location Map
Figure 2: Stump Lake Outflow Route
Figure 3: Options for Potential Stump Lake Outflow

## Statement of Limitations

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## Revision History

| Revision # | Date | Status | Revision Description | Author |
|---|---|---|---|---|
| 0 | May 1, 2018 | Final | Revised based on client review. | JM / EE |
| B | May 1, 2018 | Draft | Revised based on internal review. | JM / EE |
| A | May 1, 2018 | Draft | Original | JM / EE |

**Thompson Nicola Regional District**

2018 Flood Response

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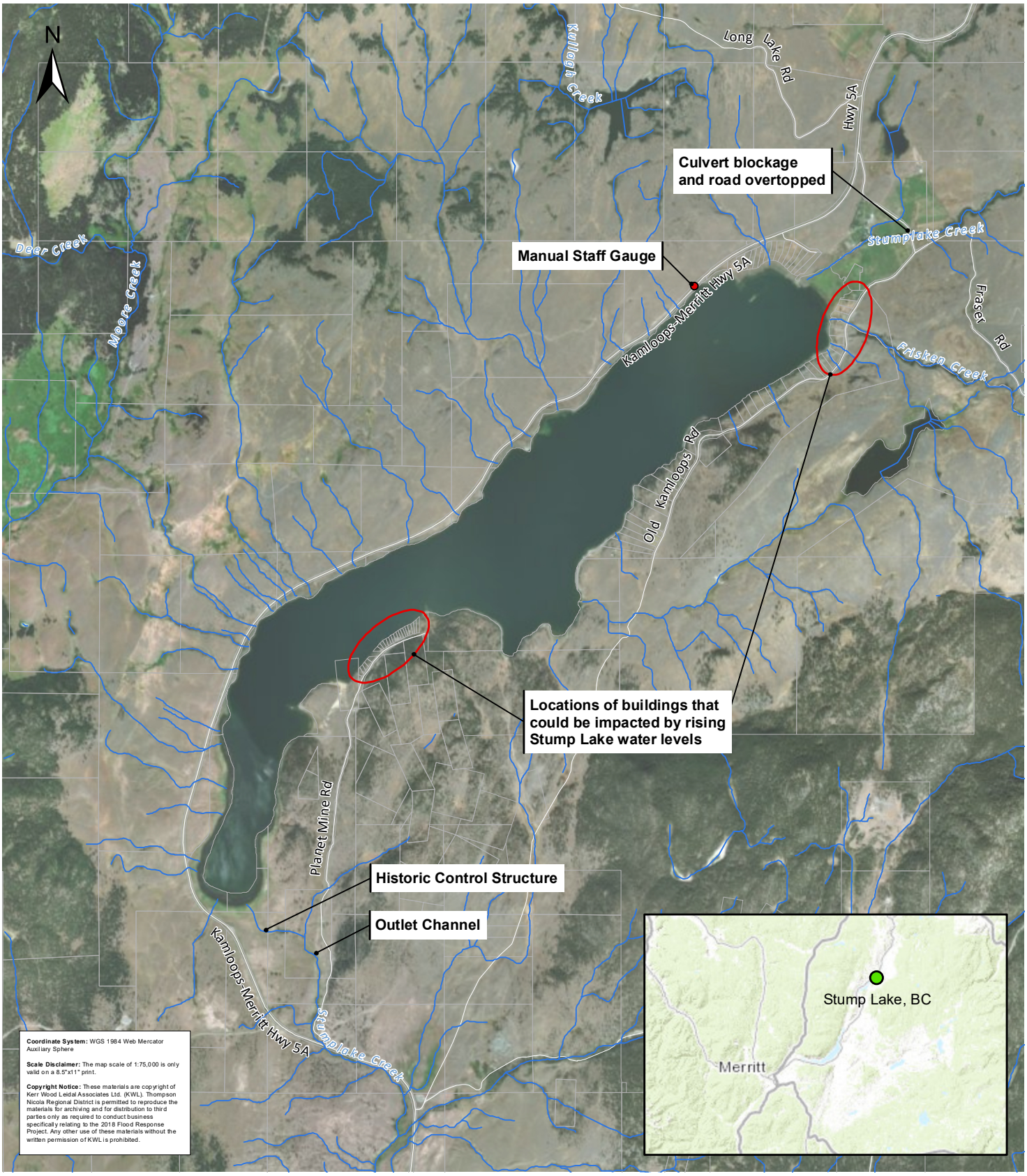


**Coordinate System:** WGS 1984 Web Mercator Auxiliary Sphere

**Scale Disclaimer:** The map scale of 1:75,000 is only valid on a 8.5"x11" print.



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| Project No. | 2755-006 |
| Date | May 2018 |
| Scale | 1:75,000 |

# Location Map

**Figure 1**

**Thompson Nicola Regional District**

2018 Flood Response

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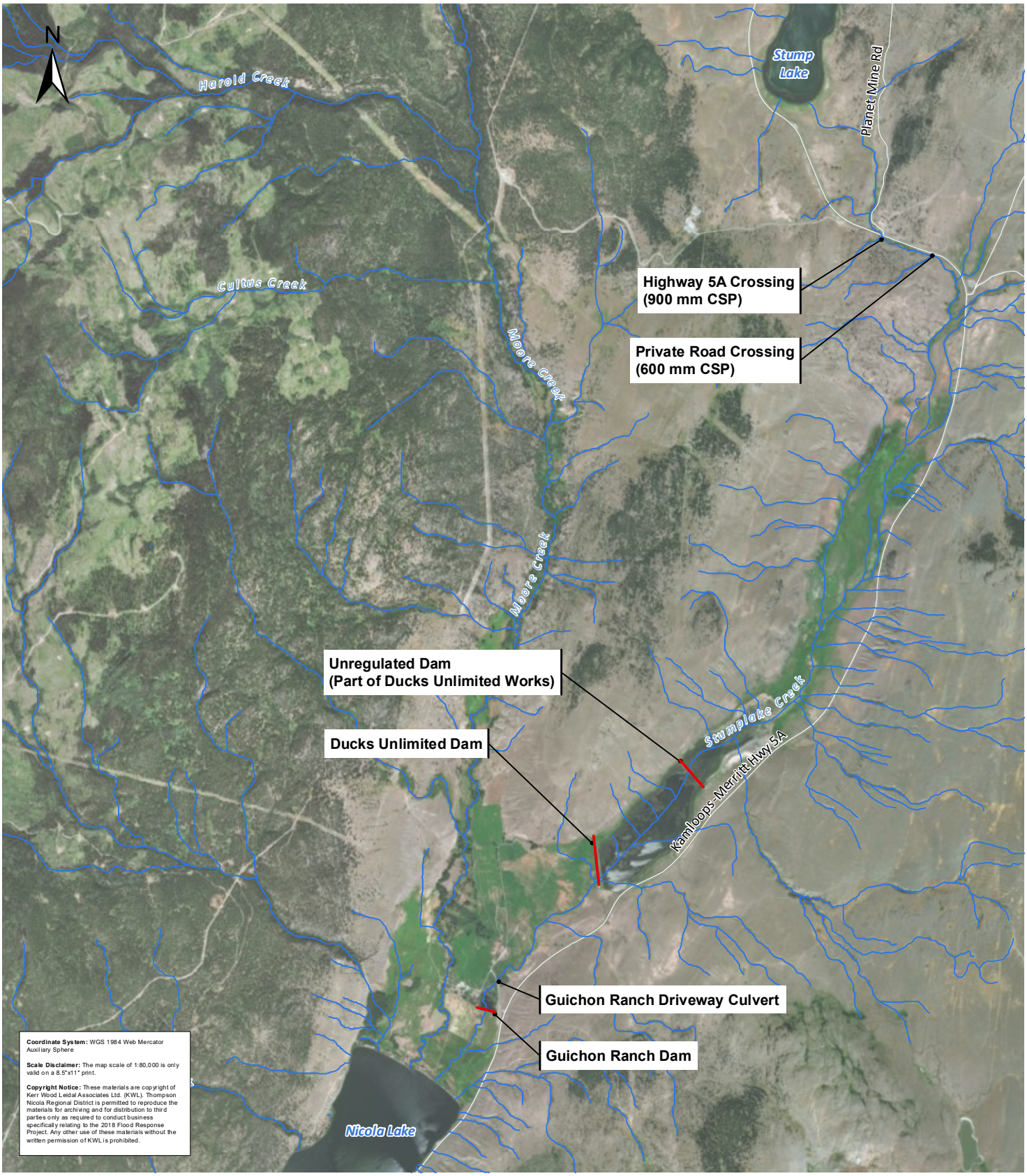


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# Stump Lake Outflow Route

**Figure 2**

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2018 Flood Response

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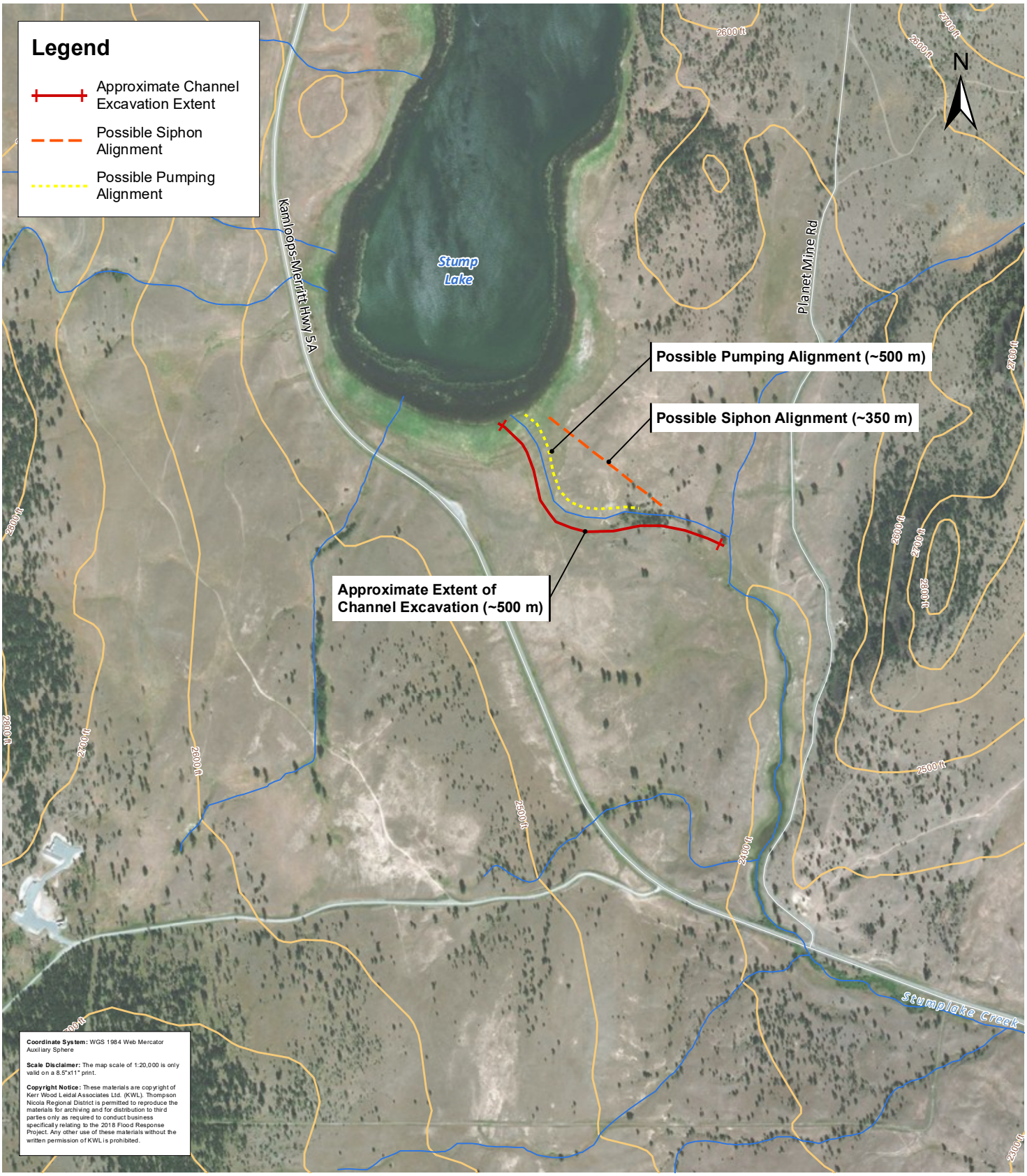


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# Options for Potential Stump Lake Outflow

**Figure 3**