Report on Creek Parameters

2019 – 2020 reporting year

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Prepared for

Kalesnikoff Lumber Company and The Wolverton Creek Waterusers

Prepared by

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This report documents findings on Wolverton Creek for the Wolverton Creek Water Users and Kalesnikoff Lumber Ltd. m The following information relies heavily on creek users for the documentation of observations and sample collection. This summary report is not intended to be a comprehensive assessment of the creek.

Thank you to Doug Adair, and MJ Bourgeois for assisting with sample collection and water system maintenance; much of the data below and conclusions drawn from it would not be possible without your dedication.

Program background

The present water monitoring program is structured around recommendations from L.H. MacDonald's monitoring guidelines (1). Sample frequency was established based on recommendations from J. Allan Issacson, Forest Hydrologist, Idaho State, USA. The program relies on manual readings taken on a stream flow gauge located below the waterfall and water user intakes. Flow measurements were discontinued in 2017. In the past, gauge readings were used alongside other parameters to track flow. Inconsistent gauge readings for the 2019 – 2020 reporting period due to rock movement prevented the use of water level data in the following report.

Wolverton Creek water users obtained samples throughout the year and following storm events or heavy rain. Collection was emphasized during spring freshet and fall rain events, as well as during periods where creek waters appear turbid. Samples were kept cool and dark prior to lab delivery. Collected samples were tested for turbidity and conductivity. For the purposes of microbiological testing for drinking water quality evaluation, samples are collected aseptically by an employee of Passmore Laboratory Ltd between July and November and tested for thermotolerant (fecal) coliforms and E. coli.

Physical tests were performed at Passmore Laboratory Ltd. and follow carefully outlined methods (2). Passmore Laboratory Ltd. is certified by the Provincial Enhanced Water Quality Assurance Program (EWQA) which regulates microbiological testing of drinking water.

Program objectives

- Collect water quality and flow data using a systematic sampling regime.
- Determine the number of days per year that parameters exceed provincial drinking water quality guidelines as a function of discharge.
- Examine trends in drinking water quality in Wolverton Creek as forest conditions change in the watershed.

Wolverton Watershed Characteristics

Wolverton Creek watershed is located just north of Slocan Park, and 30 km north of Castlegar. The creek drains the Norns Range west to the Slocan River. The Wolverton Creek watershed is 15.27 square km in size, and Wolverton Creek is 5.47 km in length. It is a second order stream with a northeast aspect.

Figure 1 shows rockfall fragments surrounding the water level gauge at Wolverton Creek. As a result, water gauge readings will not be discussed in the following report.

Figure 1: Wolverton Creek gauge

Temperature

Historically, Wolverton Creek displays relatively cool (below 15 degrees C) water temperatures year-round (Figure 2). For the 2019 – 2020 sampling period, 27 samples were obtained; all were found at 15 C or less. Yearly temperature fluctuations follow the expected hydrological cycle of temperature highs and lows, and a minor decrease in maximum temperatures and increase in minimum temperatures is seen through the years. No obvious changes in trends are discernable.

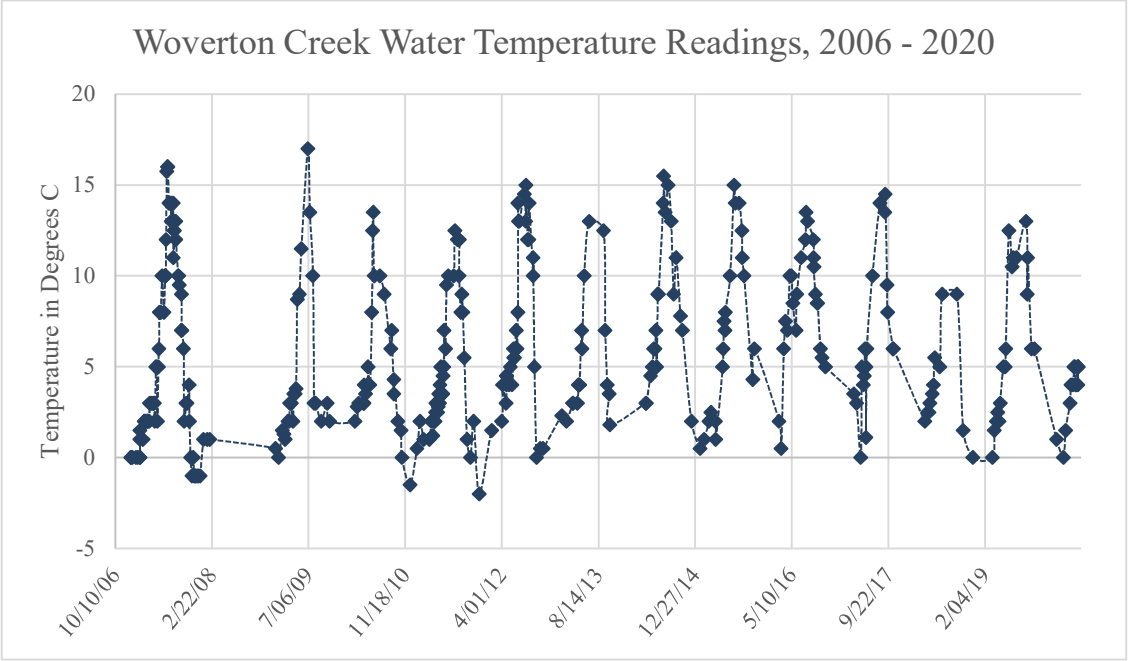

Figure 2: Historical temperature of Wolverton Creek waters

Conductivity

Conductivity describes the specific conductance per cm at 25° C. It measures a fluid's ability to carry an electric charge and is causally related to the concentration of dissolved ions in solution. It is frequently graphed against flow or water level. An inverse relation is expected to be observed between conductivity and flow; as a result, conductivity may be used as a proxy to deduce flow levels when flow data is not available. Due to inconsistent water level data, this report does not evaluate the relationship between the two variables. In turn, conductivity is plotted against turbidity (Figure 3).

Maximum conductivity for this reporting period was observed on 09/14/19, at 41.1 µs/cm. Yearly dips in conductivity, inferring high flow, were observed on 05/25/19 and 06/01/20 at 10.8 and 11.3 µs/cm, respectively. These correlate with the large-scale rain event, which took place at the end of May 2020.

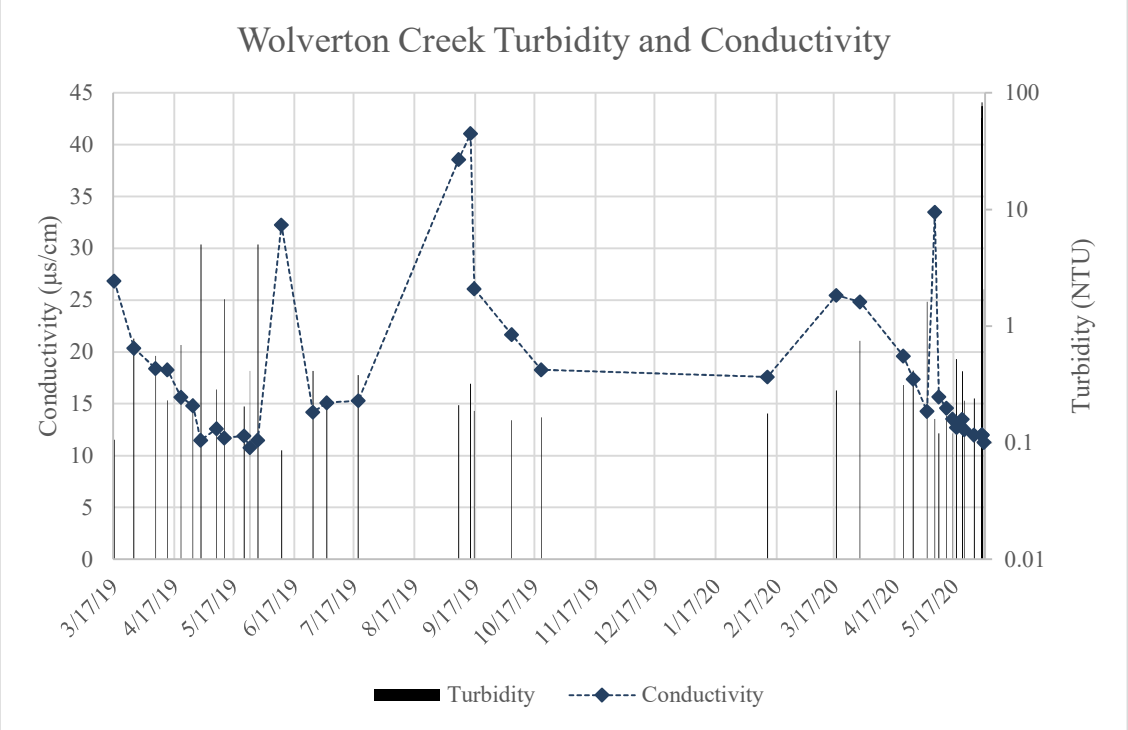

Figure 3: Turbidity and conductivity of Wolverton Creek for the 2019 – 2020 reporting period.

Table 1: Historic conductivity of Wolverton Creek.

Year	Minimum Conductivity (µs/cm) Date Occurred (MM/DD)	Maximum Conductivity (µs/cm) Date Occurred (MM/DD)
2013	8.8 (06/09)	33.5 (09/18)
2014	11.2 (05/28)	62.3 (07/18)
2015	12.5 (05/25)	48.0 (07/09)
2016	10.4 (06/08)	64.2 (10/08)
2017	9.9 (05/23)	41.7 (10/19)
2018	11.5 (07/04)	41.1 (09/14)
2019	10.8 (05/25)	41.1 (09/14)
2020 January – June	11.3 (06/01)	33.5 (05/07)

Turbidity

Turbidity is a measure of the relative clarity of water. It is caused by colloidal matter such as clay, silt, or finely divided organic and inorganic matter suspended in water. Expressed in Nephelometric Turbidity Units (NTU), turbidity measures the scattering effect that particles have on light. It is not a direct measure of suspended particles in the water.

High turbidity can prevent microorganism disinfection by means of particle sheltering. Turbidity has been shown to be correlated with the contamination of water by Giardia and Cryptosporidium and serves to estimate the risk of contamination by these pathogens. Ministry Guidelines state maximum allowable turbidity in drinking water is 1 NTU (3).

Wolverton Creek is characterized by generally low turbidity values and showed largely low NTU values for the 2019 – 2020 reporting period (Table 2) (4). A total of 38 samples were collected for this period; of these, 90% of readings obtained in 2019 and 83% in 2020 remained within the drinking water guidelines of 1 NTU. A historical high for Wolverton Creek was recorded on 05/31/20, immediately following a large-scale rain event. Note turbidity was graphed in a logarithmic scale in response to the skewness towards large values; few points were much larger than the bulk of the data (Figure 3).

Table 2: Historic turbidity of Wolverton Creek.

Year	Highest Turbidity Reading	% Samples below 1 NTU	Number of Samples (n)
2017	2	94	18
2018	0.9	85	13
2019	5	90	20
2020 January – June	83	83	18

Coliform bacteria

Coliforms refer to a group of bacteria that have been used for over 90 years as indicators of water potability. Their presence indicates that pathogenic organisms of fecal origin may be present. These may include other bacteria, viruses, protozoa (giardia, cryptosporidium) and multicellular parasites. Provincial guidelines for drinking water state that no total, fecal coliforms or E.coli should be present. This is normally achieved by chlorinating the water. However, total coliforms can be associated with plants only and are not implicated in human infection. Below is a chart showing the counts on samples taken just below the waterfall over 6 weeks. *Elevated fecal and E. coli counts are a reminder that Wolverton, like other valley creeks, is at risk for contamination - especially during Fall after rain events*. However, the counts were not especially high

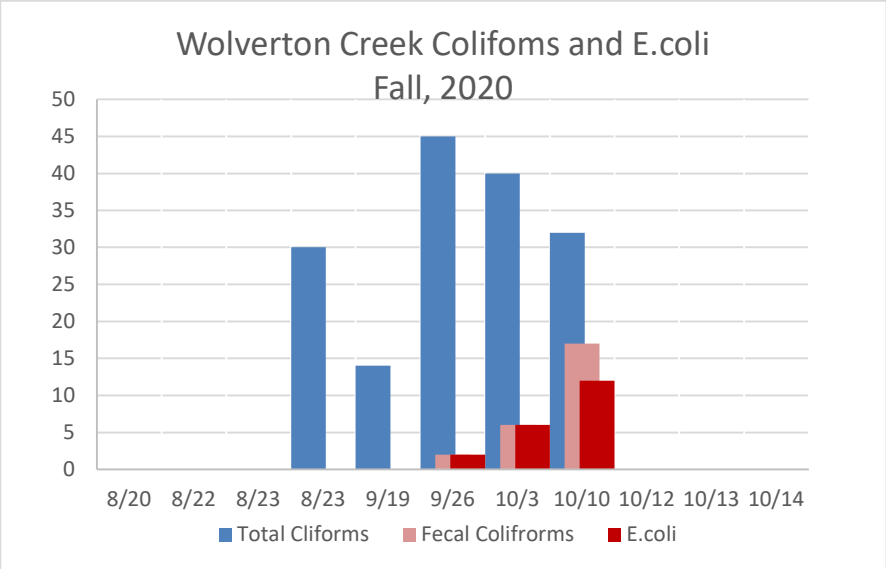

Table 3: Coliform Bacteria in 2020

Date	Total Coliforms CFU/100ml	Fecal Coliforms CFU/100ml	E.coli CFU/100ml
Aug 23	30	Less than 1	Less than 1
Sept 19	14	Less than 1	Less than 1
Sept 26	45	2	2
Oct 03	40	6	6
Oct 10 (after rain)	32	17	2

CFU: Colony forming units

References

(1) Monitoring Guidelines to Evaluate the Effects of Forestry Activities on Streams in the Pacific Northwest & Alaska, L.H McDonald EPA 910/9-91-001

(2) Standard Methods for Examination of Water and Wastewater, American Public Health Association 23t edition, 2017.

(3) Province of British Columbia. 2019. Source Drinking Water Quality Guidelines. Ministry of Environment & Climate Change Strategy. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/drinking-water-and-recreation/source_drinking_water_quality_guidelines_bcenv.pdf

(4) Wolverton Creek Monitoring Summary Report 2018 – 2018, J. Yeow, Passmore Laboratory Ltd.