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September 30, 2021

Mr. Kevin Fisher
Community Services
Rural Land Development, Land Development Branch
Government of Yukon
Whitehorse, YT

SLR Project No.: 234.30008.00002

Client Reference No.: C00061764

Dear Kevin,

RE: Review of chromium present in soils at Turner Street, Dawson

SUMMARY OF KEY FINDINGS

- The Dawson City area has had multiple instances of infilling, with locally sourced materials containing naturally elevated concentrations of metals, including chromium.
- 67 samples of fill material have been analysed from 14 sites in the downtown Dawson City area.
- Between two sampling events in 2019 and 2021, 10 (+1 duplicate) soil samples were collected from the site at Turner Street, three of which exceeded the applicable Yukon Contaminated Sites Regulation (Yukon CSR) residential land use (RL) standards.
- Comparison of the mean chromium concentrations and ranges between the Dawson City area background levels and the levels at the site of interest indicate that chromium concentrations at the site of interest are within the range considered background.
- Although chromium concentrations at the site of interest exceed the Yukon CSR standard for the protection of groundwater to freshwater surface water, they are consistent with background chromium concentrations and therefore this site should not be considered contaminated.

1.0 INTRODUCTION

In May 2021, SLR was contracted by the Government of Yukon (YG) to conduct soil sampling at Lot 12, Block 14, Turner Street, Dawson, YT, (the site) for the purpose of determining if soil chromium concentrations measured in excess of the Yukon CSR soil standards for residential lands present unacceptable risk. The outcome of that study determined that overall, no complete and significant pathways were identified and the Limited HHERA concluded that risks to human and environmental receptors related to chromium in soil on site are expected to be acceptable under the conditions evaluated (SLR Consulting (Canada) Ltd, 2021).

While that assessment concluded that the risk was acceptable, the levels of chromium measured in some of the samples collected from the site are above the standards set in Yukon CSR, meaning that while the site meets risk-based standards, it remains classed as contaminated for numerical standards. It is therefore

inferred that elevated chromium concentrations are related to natural background concentrations in the area or to fill material that contained elevated background concentrations. This report sets out the rationale for this inference .

Our approach to confirming, or otherwise, this inference was as follows:

- Review historical infilling of the Dawson area.
- Review metals in soil data made available from previous work for YG on background metals concentrations in Dawson.
- Conduct a simple statistical evaluation of chromium (III+VI) concentrations at the site and other sites in Dawson.
- Compile the findings into a short letter report.

Background soil chromium concentrations were determined from samples from 14 sites in the downtown Dawson city area (the reference sites).

2.0 SOIL INFILLING IN DAWSON CITY

Anecdotal information indicates that large areas of the city centre have been infilled for various reasons over the years, including for flood protection, infilling of former sloughs or channels of the Klondike and Yukon Rivers, and raising or levelling land prior to construction. Additionally, the Dawson region is part of an extensive permafrost zone with between 50% and 90% of the land underlain by permafrost (Heginbottom, et al., 1995) and imported fill material has been used to support collapsing foundations caused by sub-building permafrost melting.

There are four known fill sources used in Dawson City, though documentation of these fill events and sampling of their materials has been minimal. The four cases of infilling are described below:

- Material from the Moosehide (Dawson) Slide was used as fill in the late 1970s to fill in low lying properties for dyke improvements. This material is composed of serpentinite rock, which is a type of ultramafic rock consisting predominantly of magnesium silicate and iron oxide minerals. Soils derived from Serpentinite bedrock are known to contain elevated levels of chromium and nickel (Brideau, et al., 2006).
- Documentation indicates that much of the dyke in Dawson was built up using White Channel gravels which are known to be high in quartz (Leonoff, 1986).
- Anecdotal information from Highways and Public Works indicates that material from the Midnight Dome pit, which also contains serpentinite rock, was used as fill for Front Street (Harper St. to the power plant) prior to paving Front St. in the 1980s (Kormendy & MacDougall, 2016) and to raise the dyke along Front St (Nagano, 2016).
- There is anecdotal information that material from Dog Island, in the middle of the Yukon River, has also been used as fill.

3.0 CHROMIUM IN SOILS

3.1 TURNER STREET SITE

The site is a rectangular parcel of land approximately 464 m^2 in area. It is generally flat and is currently vacant. It is in a residential area and Turner Street is to the northeast. The confluence of the Klondike and Yukon Rivers is located 110 m west of the site, hence the surficial soils are assumed to be fill material

imported to raise land for flood defence. The soil dataset for the site consists of 10 soil samples (+1 duplicate) collected from the top 10 cm of soil in 2019 and 2021.

3.2 REFERENCE SITES

Between 2016 and 2020, YG contracted SLR to assess data from ground investigations in the city centre and determine whether these data could be considered for inclusion in a database of soil background metals data. For results to be considered background, there should be no factors that might have caused an increase in metals (such as from waste oil spills) near the sample locations. That study looked at more than 60 investigation and remediation reports and soil relocation permits obtained from Environment Yukon to assess metal concentration data in soil. 14 locations were determined to be representative of the expected background metals concentration in uncontaminated soil. These locations, the reference sites, are considered in this report. Four of the reference sites are close to the Turner Street site, so those four reference sites were also analysed separately. All 14 reference sites are shown in Figure 1 and the locations outlined in red are the four reference sites that were analysed separately.

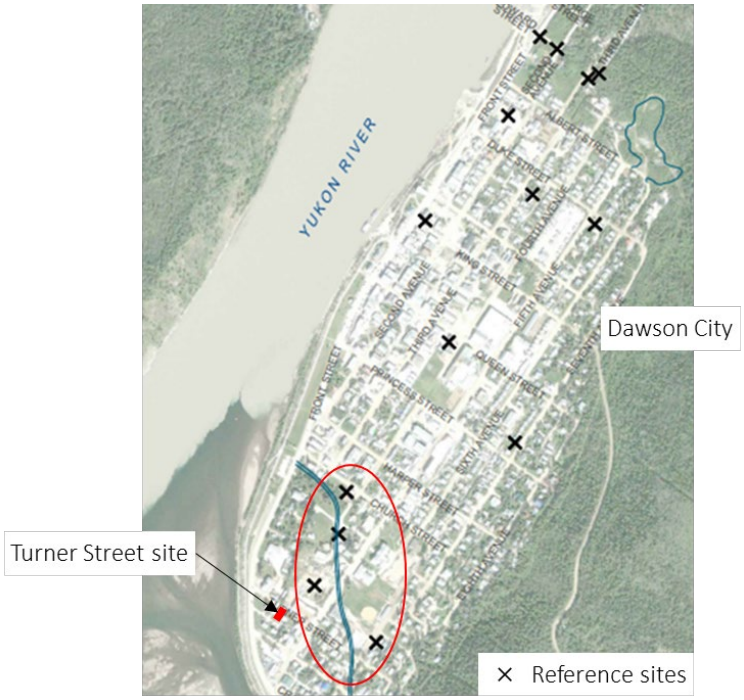

Figure 1 Site location and reference sites

3.3 RESULTS

Statistical data for total chromium from the site and the reference sites is shown in Table 1.

Table 1 Calculated mean, minimum, maximum and range for chromium concentrations at the site

Parameter	Total chromium concentration (µg/g)		
	Turner Street Site	Four closest reference sites	All reference sites
Maximum	109	913	913
Median	44	64	68
Minimum	22	7	2
75th Percentile	60	313	220
25th Percentile	28	13	32
No. of samples	10	4	67

These results are shown graphically in Figure 2.

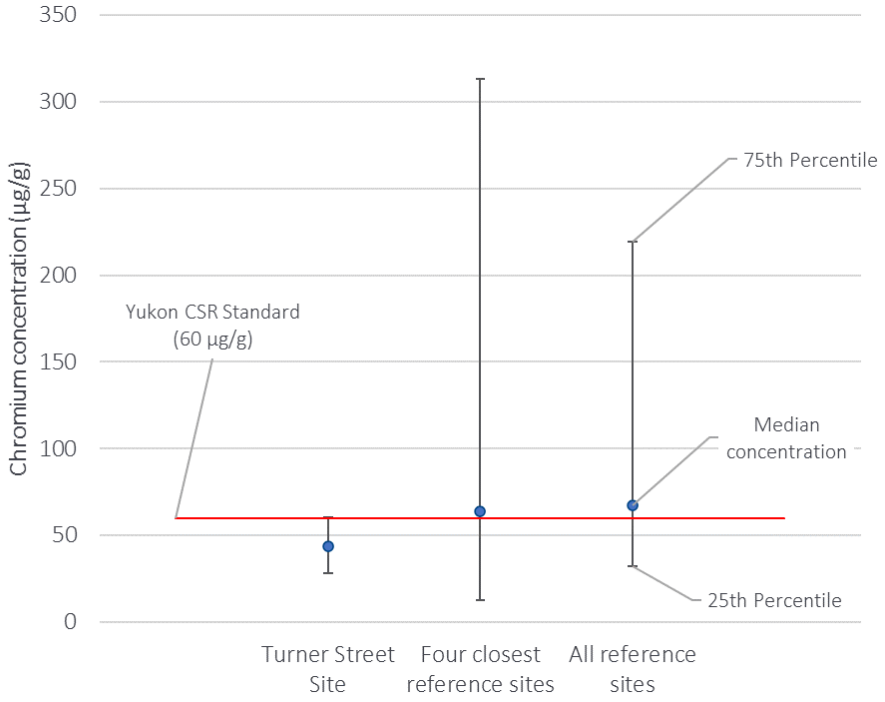

Figure 2 Total chromium concentrations in soils

4.0 DISCUSSION

The data demonstrate that the median chromium concentration in soil from the site is lower than the background chromium concentrations for both the entire background dataset and the data from near the site. The interquartile range of data on site is also within, or below, that of background data from Dawson.

As no evidence for other sources of contamination exist on site, this suggests that the chromium concentrations above the Yukon CSR standards can be considered background. These elevated levels of chromium are expected to be either natural or related to previous infilling in the area.

According to Section 2(2) of the YT CSR "A site is not a contaminated site if the site does not contain any contaminant with a concentration greater than or equal to the local background concentration of that contaminant in the soil, surface water or groundwater". Therefore, the site need not be considered a contaminated site because it is consistent with background chromium concentrations across the City of Dawson.

5.0 SUMMARY

Based on the available information and under the conditions evaluated, the elevated chromium concentrations at the Turner Street site are consistent with background chromium concentrations around Dawson City and therefore the site is not considered to be contaminated.

6.0 STATEMENT OF LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for Community Services, of the Rural Land Development, Land Development Branch of the Yukon Government, hereafter referred to as the "Client". It is intended for the sole and exclusive use of Community Services of the Rural Land Development, Land Development Branch of the Yukon Government. Other than by the Client and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted unless payment for the work has been made in full and express written permission has been obtained from SLR.

This report has been prepared for specific application to this site and conditions existing at the time work for the report was completed. Any conclusions or recommendations made in this report reflect SLR's professional opinion based on limited investigations including: visual observation of the site, surface and subsurface investigation at discrete locations and depths, and laboratory analysis of specific chemical parameters. The results cannot be extended to previous or future site conditions, portions of the site that were unavailable for direct investigation, subsurface locations which were not investigated directly, or chemical parameters and materials that were not addressed. Substances other than those addressed by the investigation may exist within the site; and substances addressed by the investigation may exist in areas of the site not investigated in concentrations that differ from those reported. SLR does not warranty information from third party sources used in the development of investigations and subsequent reporting.

Nothing in this report is intended to constitute or provide a legal opinion. SLR expresses no warranty to the accuracy of laboratory methodologies and analytical results. SLR expresses no warranty with respect to the toxicity data presented in various references or the validity of toxicity studies on which it was based. Scientific models employed in the evaluations were selected based on accepted scientific methodologies and practices in common use at the time and are subject to the uncertainties on which they are based.

SLR makes no representation as to the requirements of compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

The Client may submit this report to the Yukon Environment and/or related Yukon environmental regulatory authorities or persons for review and comment purposes.

7.0 CLOSURE

We trust the information satisfies your needs. Please contact the undersigned if you have any questions.

Yours sincerely,
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REFERENCES

Brideau, M. A. et al., 2006. The Dawson City Landslide (Dawson Map Area, NTS 116B/3), central Yukon. In: D. S. Emond, L. L. Lewis & L. H. and Weston, eds. *Yukon Exploration and Geology.* s.l.:Yukon Geological Survey, pp. 123-137.

Heginbottom, J. A., Dubreil, M. A. & and Harker, P. T., 1995. Permafrost Map of Canada. In: *The National Atlas of Canadda, 5th Edition.* s.l.:Natural Resources Canada, sheet MRC 4177, 1: 7 500 000 scale.

Leonoff, K., 1986. *Dawson City Dyke Improvements, Report on Preliminary Design and Economic Analysis,* s.l.: Yukon Department of Community and Transportation Services.

Nagano, R., 2016. *Personal communication* [Interview] (7 November 2016).

SLR Consulting (Canada) Ltd, 2021. *Additional Soil Characterization and Limited Human Health and Ecological Risk Assessment for Lot 12, Block 14, Government Reserve Additiona, 8395 CLSR, Dawson, YT,* Whitehorse: SLR Consulting.