April 6, 2019

Julian Morse
Regulatory Officer
Mackenzie Valley Land and Water Board
7th Floor, 4922 48th St.
PO Box 2130
Yellowknife, NT
X1A 2P6

Jonathan Tsetso
Nahanni National Park Reserve
Parks Canada
PO Box 348
Fort Simpson NT
X0E 0N0

Dear Mr. Morse and Mr. Tsetso:

Re: Sundog Creek Diversion, Prairie Creek Mine All Season Road
MV2014F0013, MV2014L8-0006, PC2014F0013, PC2014L8-0006

With this letter, Canadian Zinc Corporation (CZN) is providing notification and information to support our belief that it is no longer necessary to divert Sundog Creek in order to construct an all season road (ASR) for the section Km 35.2-36.4, as contemplated in EA1415-002. This belief is a result of further consideration of the road alignment along the south bank of Sundog Creek, and adjustment of the alignment to reduce the encroachment on the existing main channel of the creek. The net result is not only the conservation and preservation of the hydraulic capacity of the existing channel, but much less fish habitat loss and thus less of a requirement for offset. Details are provided below.

Rationale for Further Road Alignment Consideration

Fisheries and Oceans Canada (DFO) approached CZN shortly after the commencement of the last phase of the ASR permitting process to voice concerns with respect to the long-term stability and function of the creek diversion. Because of the perceived uncertainties, DFO advised that they would be requiring stringent monitoring and habitat offset plans. As a result, DFO encouraged CZN to further consider ways to minimize issues.
Road Alignment

A report from Allnorth (our road design consultant) is attached providing details of the adjustment to the road alignment over the reach of the previously proposed creek diversion. In essence, Allnorth has been able to move the road centreline further into or onto the bank of the creek, without compromising road constructability or slope stability concerns. Encroachment on channel fish habitat (defined as the Q2 water level) still occurs in places, but is much less. In these locations, the road will be appropriately armoured, and channel capacity will be maintained since the channel is broad in this location and the north bank is very shallow and will accommodate channel widening. In this respect, the Km 35.2-36.4 location will be no different from the Km 37.5-37.8 location just downstream where the road also encroaches on the main channel of the creek and will require armouring.

Fish Habitat

A report from Hatfield Consultants is attached which provides an update of the anticipated fish habitat loss associated with the adjusted road alignment, as well as habitat offset (proposals). The overall habitat loss estimated for the ASR is now almost half of what it was at the end of the EA. Maintaining the creek channel in its current location (i.e. not diverting the creek) will render the previously defined habitat offset proposal (an over-wintering pool) unsuitable because it would be prone to infilling during flood flows. Consequently, revised offset proposals have been defined by Hatfield in their report.

Collared Pika

Regarding the channel reach originally proposed for diversion, the nearest recorded collared pika presence is in BP 34 (previously (2016) Km 34.4, now Km 34.6). Pika habitat and sign was noted adjacent to the road alignment where it parallels the previously proposed creek diversion reach, but the locations were unoccupied at the time of the survey. The continued absence of pikas will need to be confirmed prior to construction. However, there does not appear to be an impediment to moving the road alignment further into the slope over the reach location in terms of effects on pikas.

Significance Regarding Report of EA

We have reviewed the measures and suggestions contained in the Report of EA and conclude that, with no creek diversion, Measure 9-1, and the related studies, no longer apply but all other measures and suggestions remain applicable, and suitably address the adjusted construction approach. While the road alignment has been adjusted to minimize channel encroachment over the reach originally proposed for diversion, the magnitude of the adjustment is not significant in terms of effects on other valued components, and does not alter the assessment of those components. Further, the alignment adjustment is considered to be part of the road design process leading to detailed design, in which adjustments are made to enhance the road in terms of safety, reducing risks, reducing potentially negative impacts, and reducing fish habitat loss.
Engagement with Indigenous Groups

CZN has notified Indigenous groups of our intention not to proceed with the creek diversion and why, and has provided initial information to support this, explaining that we see the change as positive because the new road construction approach is less invasive, has a lower risk of negative impacts, and results in much less fish habitat loss and requirement for offset. Further engagement on this topic is planned.

Sincerely,
CANADIAN ZINC CORPORATION

David P. Harpley
VP, Environment and Permitting Affairs
RE:  PRAIRIE CREEK ASR; LOWER SUNDOG ALIGNMENT KP 35.2 to KP 36.4 ADJACENT TO PREVIOUSLY PROPOSED CREEK DIVERSION

1 BACKGROUND

On February 19, 2019, Canadian Zinc (CZN) submitted a Post EA Information Package in response to a Mackenzie Valley Land and Water Board – Parks Canada letter dated October 9, 2018, for All Season Road Applications-Water Licence MV/PC2014L8-0006 and Land Use Permit MV/PC2014F0013-Prairie Creek Mine, Prairie Creek, NT.

During the EA process, and included within the February 19, 2019 submission, CZN’s approach for the ASR within the lower Sundog Creek section was to construct the ASR along the south side of Sundog Creek, adjacent to the main channel. This approach included a planned diversion of the main channel of Sundog Creek to a secondary channel, starting at approximately KP 35.2, extending to around KP 36.4, where the diversion would rejoin the natural main channel. In recent discussions with DFO, they expressed concerns regarding the diversion. In response, CZN asked Allnorth to investigate adjustments to the ASR alignment to minimize fish habitat encroachment, and route the road tight along the south bank of Sundog Creek.

This memo describes the approach applied to the revised alignment design to mitigate habitat loss within the Q₂ flood level. It also provides an outline of the process to complete a detailed road design to mitigate impacts and risks associated with ASR construction.

2 INVESTIGATION

For the revised alignment, Tetra Tech Canada Inc. (Tetra Tech) provided calculated Q₂ elevations at point locations within lower Sundog. Hatfield Consultants (Hatfield) provided additional interpretation of “habitat” (assumed as Q₂). This data was incorporated into plan and cross section views of the road design, and the alignment was adjusted accordingly based on terrain limitations, while minimizing the Q₂ road footprint. With this approach, a portion of the ASR would be constructed using a ¾ to full bench cut into the lower base of the side slope along the Sundog valley. Portions of the lower Sundog valley contain side slopes ranging in angle from 40 to 70%, consisting of large talus, fragmented rock, and at a number of locations, bedrock. Portions of the road cut/fill slopes will require slope stability...
measures such as gabion baskets or potentially engineered retaining walls. This will be determined in subsequent road design stages.

The revised road alignment along the previously proposed diversion reach is shown in the attached updated preliminary design drawings. The previous road alignment is also reflected, and in most cases shows that the adjustments are quite small, however the result in minimizing habitat encroachment is quite significant. In this review of the road alignment, we also considered the road sections of KP 34.8 - 35.2 and 36.4 - 37.8 to make minor changes resulting in reductions in fish habitat loss. Updated preliminary design drawings are provided for these road sections also.

3 CONCLUSION

Allnorth was able to successfully minimize fish habitat encroachment, although limited intrusion within the Q2 flood level will still occur where terrain constricts the road location.

Additional measures to be applied for future detailed design include:

- Clearly define and identify the Q2 (habitat) in the field, and carry out accurate mapping for design purposes;
- Field investigate terrain, slope characteristics, and soil types along the proposed ASR alignment within lower Sundog;
- Complete additional site survey at critical sections as required to facilitate final IFC road designs and construction approach;
- Identify expected road footprint encroachment within the Q2 flood level; and,
- Identify additional opportunities to apply further road alignment adjustments in combination with measures such as gabion baskets, rock stacked walls or engineered retaining structures on road cut/fill slopes to reduce footprint encroachment.

We would be pleased to discuss this memorandum with you at your convenience.

Yours truly,

Allnorth Consultants Limited

Prepared By: 

[Signature]

Ernest Kragt
Project Coordinator

Reviewed and Approved by:

Don Williams, P.Eng.
Division Manager

APR 05 2019
### DRAWING LIST

<table>
<thead>
<tr>
<th>DRAWING NO</th>
<th>DRAWING TITLE</th>
<th>REVISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>18GP0151-100-1920-200</td>
<td>PLAN AND PROFILE DRAWINGS km 34+740 to km 35+000</td>
<td>0</td>
</tr>
<tr>
<td>18GP0151-100-1920-201</td>
<td>PLAN AND PROFILE DRAWINGS km 35+000 to km 36+000</td>
<td>0</td>
</tr>
<tr>
<td>18GP0151-100-1920-202</td>
<td>PLAN AND PROFILE DRAWINGS km 36+000 to km 37+000</td>
<td>0</td>
</tr>
<tr>
<td>18GP0151-100-1920-203</td>
<td>PLAN AND PROFILE DRAWINGS km 37+000 to km 38+000</td>
<td>0</td>
</tr>
<tr>
<td>18GP0151-100-1920-120</td>
<td>CROSS SECTION DRAWINGS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DESCRIPTION:**

**ISSUED FOR REVIEW**

**ISSUE DATE:** 19/04/05

---

**PRAIRIE CREEK**

**LOWER SUNDOG AMENDMENT**

km 34+740 to km 38+000
PRAIRIE CREEK
ALL SEASON ROAD
km 0+000 to km 170+000
ALTERNATIVE #1

LOWER SUNDOG DESIGN
CROSS SECTION
DRAWINGS
km 34+740 to km 38+000

18GP0151-100 1920-302 0
18GP0151-100-1920-318

PRAIRIE CREEK
ALL SEASON ROAD
km 0+000 to km 170+000
ALTERNATIVE #1

LOWER SUNDOG DESIGN
CROSS SECTION
DRAWINGS
km 34+740 to km 38+000

18GP0151-100-1920-318

Permit to practice
Allnorth Consultants Limited

Issued for review
Not for construction
April 5, 2019

David Harpley
VP Environment and Permitting Affairs
Canadian Zinc Corporation
650 W Georgia St #1710,
Vancouver, BC V7Y 1H4

Re: Sundog Creek Road Alignment and Creek Diversion

Dear David:

This letter provides a description of the all-season road (ASR) alignment that parallels Sundog Creek along its south bank from km 34.8 to km 37.8 in relation to fish habitat and the previously proposed creek diversion.

Between km 35.2 and 36.4, Canadian Zinc Corp (CZN) had proposed a diversion of Sundog Creek, diverting the main channel into a secondary channel in order to build the ASR within the main channel which hugs the south side of the valley in this location. However, upon further review by road design engineers Allnorth, the ASR alignment has been adjusted to move it outside of the ordinary high-water mark (HWM; 1:2-year flow\(^1\)), as much as possible, to an extent that diversion of Sundog Creek is no longer considered necessary. This letter discusses the estimated changes to fish habitat loss associated with the adjusted ASR alignment and presents initial ideas to offset the estimated loss.

**Background**

Between km 34 and 39, Sundog Creek flows through a wide flat alluvial floodplain containing an active channel that is braided and somewhat dynamic (Figure 1). At the edges of the alluvial floodplain, the topography is largely characterized by steep slopes consisting of scree or rock, making it challenging to locate a road without encroaching on the creek below the highwater mark. The former road right-of-way between km 35.2 and 36.4 encroached on the existing main channel of Sundog Creek in multiple areas.

---

\(^1\) The typical high-water mark (HWM), defined in DFO guidance documents and used during the EA process was the 1-in-2 year return water level.
The proposed all-season road, including the originally proposed diversion, was recommended for approval by the Mackenzie Valley Review Board (MVRB) in September 2017. Post-EA permitting by the Mackenzie Valley Land and Water Board (MVLWB) and Parks Canada has commenced. DFO recently raised concerns with the proposed creek diversion. Consequently, CZN asked Allnorth to re-evaluate the road alignment.

**Adjusted ASR Alignment**

The adjusted ASR alignment is described in a parallel letter report produced by Allnorth Consultants. Briefly, the adjusted alignment reduces the predicted encroachment on the HWM, and as a consequence, the diversion of Sundog Creek is no longer required. The section between km 35.3 and 36.3 is provided in the map below as an example (Figure 2).

---

2 Allnorth Consultants, 2019. Re: Prairie Creek ASR: Lower Sundog Alignment KP 35.2 to KP36.4 adjacent to previously proposed creek diversion. Memo from Ernest Kragt, Allnorth to David Harpley, CZN, April 5 2019
Taking into account all instances where the updated road prism encroaches on the HWM of Sundog Creek, the total habitat loss is now estimated to be 4,228 m² (Figure 3). This includes locations within the existing channel that was to be diverted (orange labeled boxes in the figure below), as well as locations upstream and downstream. The original road alignment, with the proposed creek diversion, was estimated to represent 7,422 m² of habitat loss (due to encroachments) and 7,037 m² of habitat alteration. Therefore, the adjusted ASR alignment and no creek diversion constitutes a considerable improvement.

3 The area of the channel that would experience lower flows post-diversion, i.e., the “old channel”.

---

**Figure 2** Adjusted all-season road alignment km 35.3 to 36.4, compared to original right of way.
Figure 3  Estimated aquatic habitat loss due to all-season road encroachments onto Sundog Creek.

Offsetting opportunities

Several habitat offsetting opportunities (to counterbalance anticipated residual aquatic habitat losses) have been identified. The existing aquatic habitat of Sundog Creek paralleling the ASR is primarily migratory; with some limited rearing suitability in side/braided channels. Aquatic habitats appear to be largely seasonal given that surface water in much of the creek disappears in July-August, and the remaining surface water\(^4\) either drains before winter or freeze to the bottom, given that ice in this region is typically 1 m deep\(^5\). Consequently, the absence of deep overwintering pools is believed to be a limiting factor to the productivity of Arctic Grayling in the system.

Four candidate sites have been identified for creating pool habitat (Figure 4 and Figure 5). In this section of Sundog Creek\(^6\) offsetting opportunities are limited by the seasonal absence of surface stream flow connectivity upstream of km 36. Other factors considered for identifying potential candidate sites included:

- Protection from Sundog Creek flows and associated bedload movement, which could result in the in-filling of the new pool(s);

- Stream connectivity and fish movement – fish will require opportunity to effectively access new habitat, particularly during the summer/fall months, and exit during freshet; and

---

\(^4\) Maximum documented depth in this section of Sundog Creek was approximately 1.5 m deep during moderate mid-summer flows.

\(^5\) Based on observations by CZN at an overwintering pool created by CZN within the Prairie Creek watershed.

\(^6\) There may be additional opportunities further upstream, possibly between km 25 and 33.
- Water quantity and dissolved oxygen must be capable of supporting fish throughout winter – this oxygenated water would need to enter the constructed pool via subsurface flow.

Figure 4 Potential locations for habitat offsetting (deep pools).

Figure 5 Potential habitat offsetting locations A, B and C.
Four potential locations for constructed habitat offsets are as follows:

**Opportunity A** – Approximately 110 m long, occupying an area of approximately 1,600 m² and containing two or more overwintering pools, this opportunity is located on a gravel bar at km 36.4 in the lee of an upstream rock spur. The bar is above the HWM and the presence of trees and mature bushes indicate that it is largely protected from high flows. The coarse substrates combined with its proximity to the thalweg would suggest that a pond located here would receive sufficient subsurface perfusion of oxygenated water throughout the winter.

**Opportunity B** – Approximately 80 m long, occupying an area of approximately 800 m², this opportunity is located on a portion of the historical 1980’s winter road. By using the scar of the old road, CZN would be repurposing previously disturbed ground, and the ponds here would likely have sufficient elevation that they would be protected from high flows. Similar to option A, the coarse substrate combined with proximity to the thalweg would suggest that a pond located here would receive sufficient subsurface perfusion of oxygenated water throughout the winter.

**Opportunity C** – Approximately 80 m long, occupying an area of 900 m² and built within the mouth of a small tributary to Sundog Creek. This site is protected by high flows within Sundog Creek, and the occurrence of surface flows throughout the open water season suggest a greater probability of fish access throughout the year.

**Opportunity D** – The largest of the pool habitat opportunities is approximately 200 m long and occupies an area of 5,000 m². Fish would access this pool via a tributary to Sundog Creek, providing a greater probability of fish access throughout the year. Fish were observed within the creek near Opportunity D in 2014, indicating that fish currently have access to the site. Similar to the other sites, the pond would be located within the historical floodplain and connected to the active Sundog floodplain, increasing the likelihood of sufficient subsurface perfusion of oxygenated water throughout the winter.

All of the opportunities proposed above will require additional investigations to demonstrate sufficient subsurface perfusion of oxygenated water throughout the winter, assess the likelihood of fish accessing the sites, and to determine water depths, and thus required pond depths, in winter.

A summary of the estimated habitat loss, as well as habitat potentially gained via offsets, is provided in Table 1 below.

**Table 1** Summary of predicted habitat loss and potential offset opportunities in Sundog Creek, km 34 to 39.

<table>
<thead>
<tr>
<th>Footprint</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Revised loss</td>
<td>4,228 m²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Offset opportunities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool A</td>
<td>1,600 m²</td>
</tr>
<tr>
<td>Pool B</td>
<td>800 m²</td>
</tr>
<tr>
<td>Pool C</td>
<td>900 m²</td>
</tr>
<tr>
<td>Pool D</td>
<td>5,000 m²</td>
</tr>
</tbody>
</table>
Attachment 1 provides images of each of the overwintering pool options.

In addition to the factors listed above, the final choice of offset will also include consideration of underlying/existing habitat at each of the locations, the functionality of the habitat after construction and the habitat value or benefit once constructed. These factors will be captured and incorporated in the habitat balance as part of an application for a Fisheries Act Authorization.

The habitat balance of Sundog Creek will be part of the overall balance calculated for the ASR application for authorization, which will include all predicted aquatic habitat losses and alterations along the 170 km of the proposed ASR.

Please feel free to contact me should you have any questions regarding the information provided in this letter.

Sincerely,

John Wilcockson, MSc, RPBio
Environmental Specialist
HATFIELD CONSULTANTS
Attachment Figure 1  
Drawing of overwintering ponds for offsetting purposes, South bank of Sundog Creek, km 36.5.

Attachment Figure 2  
Drawing of overwintering ponds for offsetting purposes, North bank of Sundog Creek, km 36.2.
Attachment Figure 3 Drawing of an overwintering ponds for offsetting purposes, North bank of Sundog Creek, km 36.2.