MEMO

Date: October 29, 2016 HCP Ref No.: CZN7932

From: John Wilcockson

To: David Harpley, Canadian Zinc Corp

Subject: **Prairie Creek Mine, all season road undertaking 7 IR replies – DFO IRs**

This memo responds to DFO IR#2, 4, 7, 8 and 9 from the proposed all season road undertaking 7 information requests.

DFO #2 –LIARD RIVER FIELD NOTES

Comment - A habitat datasheet for the Liard River was presented as Attachment 2 in the Hatfield memo submitted to MVEIRB on September 6, 2016. However, the field notes from September 2014 from which this habitat datasheet was later developed do not appear to be present.

Recommendation - Please provide field notes from September 2014 from which the habitat datasheet for the Liard River was derived. Information Requests

Response – Corresponding pages of the field notebook have been provided (Attachment 1). However, although the field notes were consulted while retrospectively creating the habitat data sheet for the Liard Crossing, data contained consisted only of surveyed bank elevations. The main purpose of the Liard crossing visit on September 25, 2014 was to collect bathymetry and bank elevation data. The habitat sheet was constructed primarily from photos, survey data, and bathymetry data (provided in the bathymetry memo), satellite imagery and the personal information of Chris Jaeggle (Hatfield), who led the September 25, 2014 field program.

On October 7th, 2016, Dave Harpley (CZN) visited the Nahanni access road Liard River crossing approximately 2 km upstream of the proposed crossing site. Based on his observations, the sediments at this location are similar to those at the crossing location. Figure 1 and Figure 2 show the substrates comprising the banks at the location 2 km upstream on the Liard River.

Figure 1 Substrates on the bank of the Liard River at the existing barge crossing (1).

Figure 2 Substrates on the bank of the Liard River at the existing barge crossing (2).

DFO #4 – TABLE 2 [OF OFFSETTING EXCEL WORKSHEET]

Comment Allnorth describes on page 3 "The proposed construction of an upstream dike to deflect and shelter the ramp structure will greatly assist in reducing hydrological forces on the ramp." Fisheries and Oceans Canada's understanding is that the proposed construction appears as follows. The footprint of the area in blue, below ("??? m2") has not been provided.

Recommendation **4a**. Is this dike included in the calculations of the ramp's footprint in fish habitat, presented in the Hatfield memo submitted to DFO and PCA on September 6, 2016? If it is, is there a habitat restoration plan that would be deployed to remove the dyke following the mine closure? **4b**. Please provide

a geospatial description of the realignment (size of impact for the permanently altered channel of Sundog Creek where flow is being altered by the major stream diversion) i.e., where it starts and ends. **4c**. Since the permanently altered channel in the major realignment will have only backwater flows, please address the risk that fish will become isolated and stranded at a greater frequency in this region following the construction of the diversion channel than during baseline conditions. **4d**. Please describe the expected flow regime in this permanently altered channel of Sundog Creek, including timing, duration, extent, velocity and depth of flows after diversion in comparison to the baseline state (including annual, Q2, Q10 and Q100 scenarios). This should be performed either after the discrepancies between the various types of hydraulic modeling of flows in Sundog Creek have been rectified, or for each type of modelling in the event that differences cannot be reconciled, as a precautionary approach.

Response - The word “ramp” was used in the DAR and appendices to refer to the landing areas for the barge on the Liard River. However, since the IR appears to be primarily about the diversion on Sundog Creek, we assume that “ramp” was intended to refer to the dike/berm to be installed to ensure the stream is diverted into the new channel.

4a. The footprint of the dike/berm on Sundog Creek was included in calculations in the draft excel offsetting table, Worksheet tab 3. “SD div berm footprint”.

Regarding habitat restoration, see the reply to Parks IR#12: “the structure will be removed to leave a natural stream bank next to the stream channel, i.e. not lower than the channel which would induce the channel to change course. The stream bank will consist of gravel-cobble material, similar to that in the floodplain, to protect it from erosion and generation of fines.” The intent would be mimic the current habitat of the berm footprint.

4b. The area of the existing channel (the area to be altered) was not provided in the first draft of the offsetting table as we considered the proposed new channel as direct mitigation for the habitat change (alteration) to the current channel given the active nature of the Sundog Creek system. However, we have provided a quantified estimate of the area that is proposed to be altered (as a result of the proposed shift in flow direction) in the updated offsetting table. We have also provided an alternate estimate of the area to be altered assuming that the channel returns to the existing channel at km 36.45 instead of km 36.95, as per the discussion during the conference call on October 20, 2016. In either case, it is our opinion that there will be no net loss of fish habitat, since the proposed new channel will provide the same aquatic function as the existing channel.

4c. Isolation and stranding may be a risk during significant summer rain events, and the emergence of pools in the existing channel location (see 4d. below). To address the potential for pool connection to the downstream (undiverted) main channel, we propose mitigation to prevent fish from migrating into the pools by placing coarse material (boulders interspersed with cobble) in low spots that will act as a strainer. It should be noted that surface flows in the Sundog Creek system are not always permanent within much of the existing channel. In July and September, 2014 Sundog Creek surface flows were absent (went to ground) in at least half of the existing channel. In July, we observed flows going to ground at approximately km 32 and resurfacing at km 36.2. We believe that this loss of active stream flow is a fairly regular occurrence, thus the aquatic habitat value of this section of Sundog Creek is naturally diminished.

4d. Please refer to the modelling provided in Tetra Tech EBA’s March 17, 2016 letter report; Sundog Creek Hydrotechnical Assessment (Pages 4 to 20 of Public Registry (PR#178). Figures 8 and 9 show flows in the

area for 2 year and 100 year return periods. Note, the existing channel is shown to be dry. It is possible that, during higher flows and water levels, there may be pools of standing water and limited areas of surface flow in the existing channel due to subsurface flow through permeable alluvium. However, these are unlikely to be connected in any significant way, and are unlikely to be accessible by fish.

DFO #7 – OFFSETTING

Comment - Hatfield has described potential habitat offsetting opportunities in a memo submitted to PCA and DFO on September 6, 2016. This includes a) the creation of deep pools at the downstream extent of the old channel to provide overwintering habitat, and b) the construction of a low gradient side channel off of Sundog Creek either upstream or downstream of the diversion.

Recommendation - Please address the risk that these potential offsetting projects will produce additional impacts to flow in the permanently altered channel downstream of the berm, potentially resulting in further stranding and fish mortality. This should be performed either after the discrepancies between the various types of hydraulic modeling of flows in Sundog Creek have been rectified (DFO IR 1), or for each type of modelling in the event that differences cannot be reconciled, as a precautionary approach..

Response – It is our opinion that there is low risk of causing serious harm to fish from either the channel diversion, or from the proposed offsetting opportunities. The proposed mitigation and offsetting approaches will replicate and enhance habitat features currently within upper Sundog Creek. As noted in our reply to DFO IR#4, entry to the existing channel upstream of the offset pool will be blocked. The connection from the offset pool to the undiverted main channel downstream will be such that when there is water in the downstream channel, there will be water in the connecting channel. Planned monitoring will monitor velocities and effectiveness of boulders placed along the proposed relocated channel that historically has been an active channel within Sundog Creek. Adaptive management will be performed (where necessary, and during periods of no flow) to ensure that velocities are as expected.

The relocated side channel located downstream of the diversion, has a greater potential of seasonal water inundation than any side channels created within or upstream of the diversion. The design of the side channel will avoid the creation of pools which could isolate fish. The deep pool planned for offset will receive hyporheic flow from the current channel, as well as backwater. Due to the depth of this pool (proposed at >2 m) we do not anticipate isolation, stranding, or full freeze up in the winter. Also due to the coarse nature of the alluvium and consequent hyporheic flows, we anticipate good oxygen perfusion into the pond over winter.

DFO #8 – HIGH WATER MARK

Comment Page 1 indicates that “for Sundog Creek, habitat was split into the following broad categories: (A) normally wetted (functional) habitat within the 1:2 year return, (B) normally dry (non-functional) habitat within the 1:2 year return; and (C) habitat outside the 1:2 year return but without established vegetation.”

Recommendation - Please justify why Q2 (1:2 year flood return) is used to delineate possible fish habitat. DFO notes that all three categories (A to C) of aquatic habitat as defined and identified by the proponent in the Hatfield memo currently fall under DFO's definition of the High Water Mark.

Response – The use of the 1:2 year flood flow return level was adopted from the following DFO operational statement: Bridge Maintenance Fisheries and Oceans Canada, Nunavut Operational Statement Version3.0 DFO/2007-1329, which states: *"Ordinary high water mark (HWM) – The usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. In flowing waters (rivers, streams) this refers to the "active channel/bank-full level" which is often the 1:2 year flood flow return level."* We note that this advice also appears in other DFO operational statements.

We purposely included category C in order to acknowledge that when wetted (although infrequently), this habitat can also be used by fish. However in our opinion, the loss of any category C habitat will not result in any serious harm to fish, nor result in any changes to aquatic function, or integrity, of Sundog Creek.

DFO #9 – TECHNICAL SESSIONS

Comment During the Technical sessions, there were three other short realignments where small portions the channel of Sundog Creek is proposed to be shifted over to accommodate the road prism. "MR. DAVID HARPLEY: It's Dave Harpley. So while -- while Ernie here is figuring out the exact locations, as you pointed out, one (1) of the encroachment locations is on the screen at thirty-seven point seven (37.7). And there are two (2) more upstream of the diversion, approximately around the thirty-five (35) to thirty-six (36) location." (July 15, 2016 transcripts p. 94). Fisheries and Oceans Canada's understanding of these smaller realignments is illustrated below. Areas identified as "???? m2" must be quantified.

Recommendation - Table 2 of the Hatfield memo only speaks to one small realignment (impact number 10) and the text on page 3 speaks to "limited portions of the active channel" implying multiple small realignments. Furthermore, the entry for this table has not accounted for all habitat impacts and only presents the residual loss in square m (i.e., subtracting "losses" from "gains"). As in the diagram for the large realignment and for the three smaller realignments, the total actual loss and gain should be presented explicitly for each as illustrated above.

Response – We have made a few changes to Table 2. First, we have corrected the impact ID numbers, which were not sequential in the draft table. Second, we have explicitly accounted for the area of those portions of the current channel which will not receive surface flows once Sundog Creek has been realigned. As requested, we have calculated the area of the current channel, considering it to be an alteration. However, we maintain that the realigned channel will provide similar habitat quality and quantity to that provided in the current channel.

The location of the proposed road with respect to Sundog Creek is noted in 5 areas below (for reference, the Km markers for the main realignment are 35.5 to 36.95):

- Km 33.63-34.14 – the thalweg runs along the left bank, opposite to the road. Approximately 70% of the road prism is within the 1:100 flood zone. Within this area, the road prism covers both mature vegetation as well as areas with exposed aggregate material. The road prism in this section of Sundog Creek is all above the 1:2 year flood elevation.
- Km 34.85-35.30 – ~70% of the road prism is within the 100 year flood plain. Of this area, 60% covers dry 1:2 year return flood plain. Of the 1:2 year return flood plain, 5% may encroach on a frequently wetted (as per satellite imagery) portion of Sundog Creek.

- Km 35.51-35.62 – ~80% of the road prism is within the 100 year flood plain. Of this area, 25% covers a normally wetted braided channel, and 25% covers dry 1:2 year return flood plain.
- Km 35.81-36.50 – almost all (>95%) of the road prism is within the 100 year flood plain. Of this area, 60% covers normally wetted braided channel or thalweg, and 10% covers dry 1:2 year return flood plain.
- Km 37.52-38.09 – ~75% of the road prism is within the 100 year flood plain. Of this area, 30% covers a side channel, 40% covers the existing thalweg, and 30% covers dry 1:2 year return flood plain. The northern bank of the main channel will be moved north where there is thalweg encroachment.

Two sets of maps are provided as Attachment 2 showing the planned encroachments. The first set shows both the 1:100 as well as 1:2 floodplains, the second set shows only the 1:2 floodplain as a transparent overlay allowing the wetted channels vs dry gravel bars or banks to be discerned. Allnorth provided estimates of road prism covering 1:100 year and 1:2 year flood areas. Hatfield used the 1:2 year encroachments estimates to calculate Category A and B areas, and 1:100 year encroachment estimates to calculate Category C areas (by subtracting areas containing mature vegetation).

Attachment 1

Field notebook entry for Liard River data collection

Attachment 2

Sundog Creek showing road encroachments