MEMO

Date: October 19, 2016 HCP Ref No.: CZN7932

From: John Wilcockson

To: David Harpley, Canadian Zinc Corp

Subject: **Prairie Creek Mine, All season road IR2 replies - DRAFT**

This memo addresses an information request (IR #7) from the Makenzie Valley Environmental Impact Review Board (MVEIRB) as part of the second set of Prairie Creek Mine all season road IRs. IR MVEIRB #7 regards the Sundog Creek re-alignment and undertakings #26 and #32. The IR is as follows:

Comment

Tetra Tech (July 5, 2016 and August 10, 2016) and Allnorth (August 10, 2016 and August 17, 2016) provided additional details on the proposed Sundog Creek realignment as well as a high level commentary on monitoring that will be undertaken. Canadian Zinc provided a response to Undertaking #32. These documents provide a clear description of the proposed works. However, design of river channels that are intended to mimic natural processes (hydrology, sediment transport and channel evolution) is challenging. Even more so when the existing morphology is braided. These natural processes contribute to the physical attributes of the channel and downstream reaches that support the biologic productivity (flora and fauna) of the system. Due to the risk to biologic productivity and to the natural character of the watercourse, monitoring with potential for adaptive management is recommended.

Recommendation

Would CanZinc commit to developing a detailed monitoring plan for fish and fish habitat that includes adaptive management prior to construction? This plan should include the following:

- *Describe which proposed activities would be monitored; characterize existing conditions, post-construction conditions, and future conditions;*
- *Review and consider the document "Long-term Aquatic Monitoring Guidelines for New and Upgraded Hydroelectric Projects (Lewis et. al., 2012)", which provides some stream channel morphology monitoring techniques that might be applicable (with adaptation), including aerial and ground based photo documentation, bed material sampling and cross section surveys; and*
- *Implement a before-after-control-impact (BACI) sampling approach (an upstream reach may provide an appropriate control site) because the morphology of braided rivers is not static (rather a dynamic equilibrium is expected) and could change naturally, even without the proposed realignment.*

Response

We feel that the risk of the planned diversion affecting biological productivity, resulting in serious harm to local fish populations, is low. Our position is based on the following points:

Point 1 – benthic community recovery in the new channel after diversion will mirror existing natural cycles'

Significant portions of Sundog Creek in the area of the diversion naturally go dry, and the recovery observed in the new channel would mimic the recovery in the existing channel when it goes dry. The following photos (Figure 1 and Figure 2) show conditions in July 2014, when over half of Sundog Creek within the planned diversion went dry. We evaluated discharge data for Prairie Creek, a neighbouring watershed, located immediately west of Sundog Creek. Due to their proximity, both creeks likely experience similar incident quantities of precipitation. Water Survey of Canada has Prairie Creek instantaneous discharge data for 1975 to 1990, 2013, 2014 as well as provisional data for 2015 and 2016 (i.e., 18 years of data). Prairie Creek discharge rates at the time of the Hatfield July 2014 field visit were slightly lower than the first quartile of Prairie Creek, suggesting that Sundog is likely as dry or drier than what was observed in 2014 about 20% of the time (summer low flows).

Figure 1 Sundog Creek at start of proposed diversion (km 35.3) in July 2014, showing dry thalweg (photo 1).

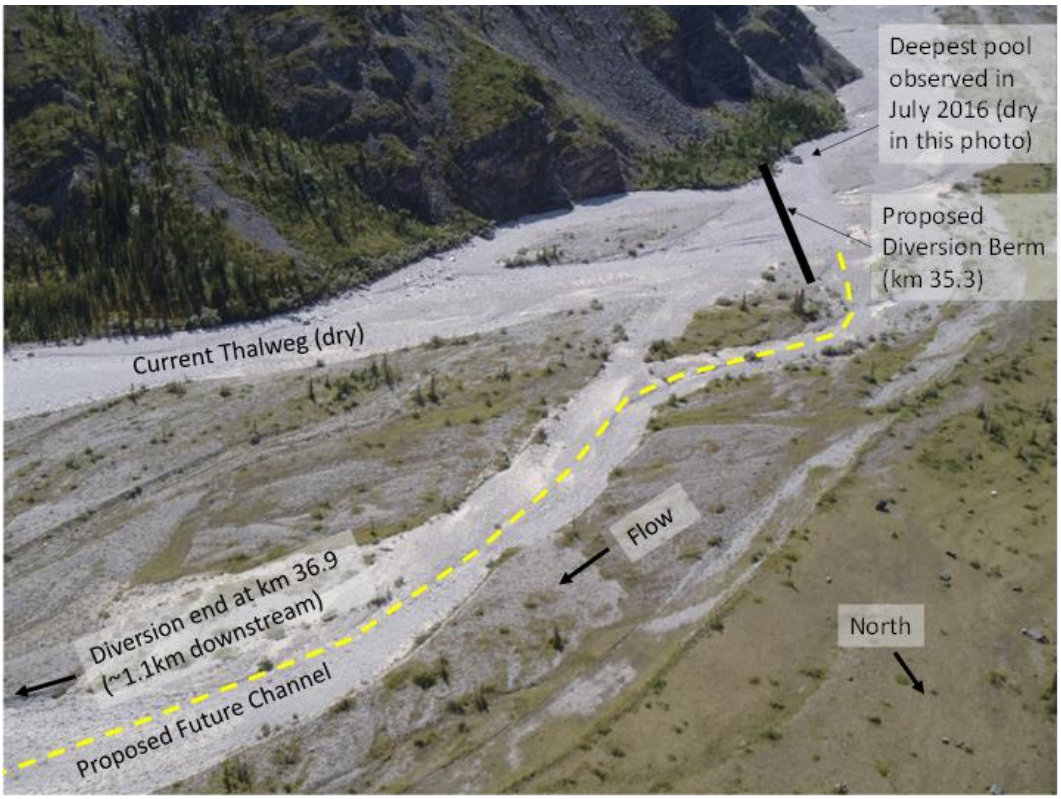


Figure 2 **Sundog Creek in July 2014, showing a dry channel upstream of km 36.2 (photo 2).**

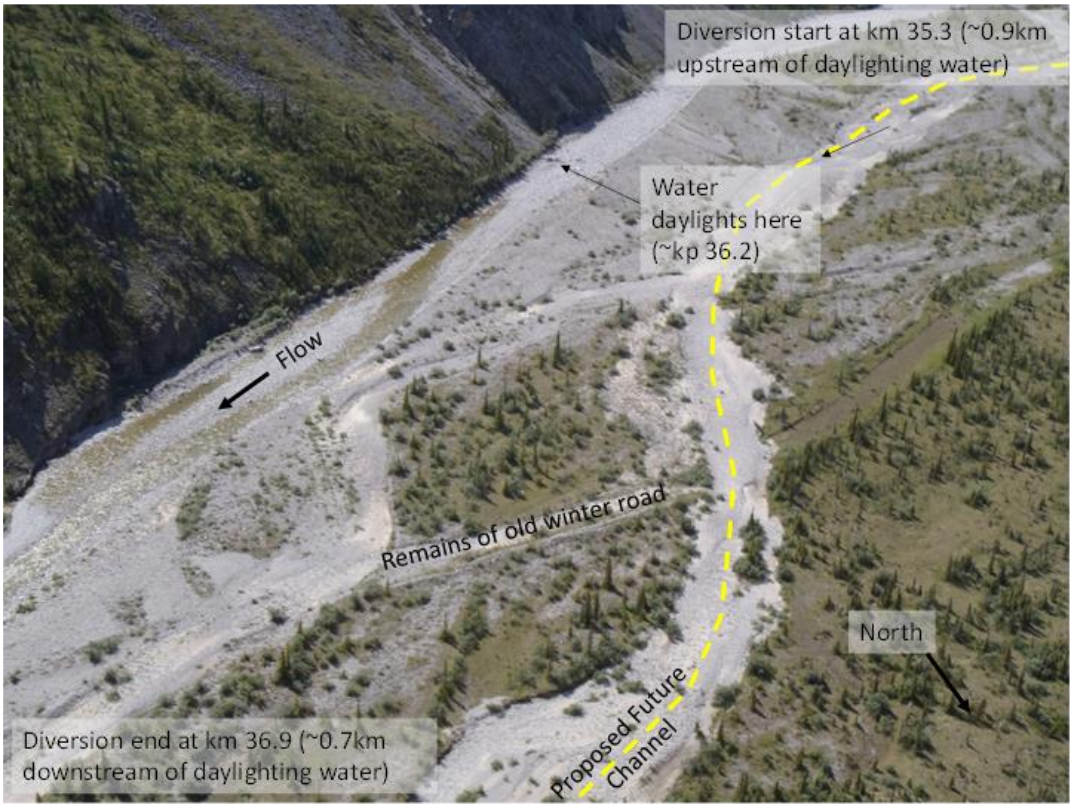
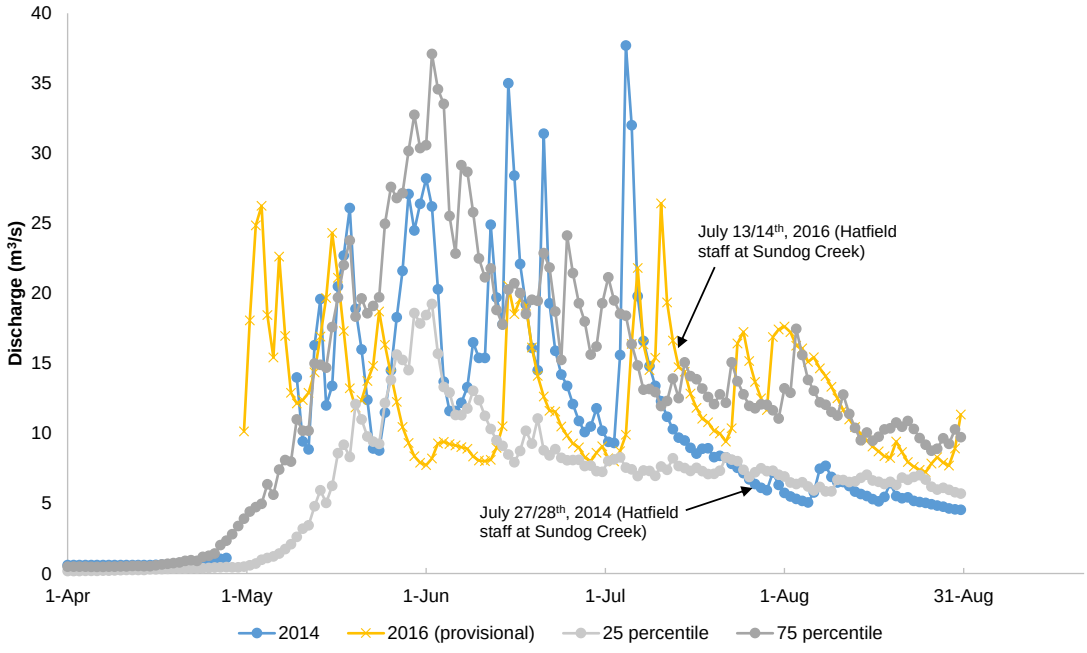


Figure 3 **Discharge rates for a neighbouring watershed, Prairie Creek**



Point 2 – Benthic invertebrate communities in streams can recover quickly

The establishment of benthic invertebrate communities within the proposed new channel is anticipated to occur within a relatively short timeframe. In temperate streams, recolonization occurs within a few weeks if the period of desiccation is short (Fowler 2004). Fowler observed that recolonization is predominantly from the hyporheic zone and upstream drift. In cases where desiccation is longer, recolonization occurs primarily from upstream drift and takes longer. Studies indicate that recolonization in these cases may take a month or longer (Fowler 2004, Stanley et al 1994). In the case of a spill of a toxic substance to a creek, full recovery was confirmed to occur within a year (Casselman et al. 2016). Thus, recolonization of the new Sundog Channel after the diversion should take no more than a year.

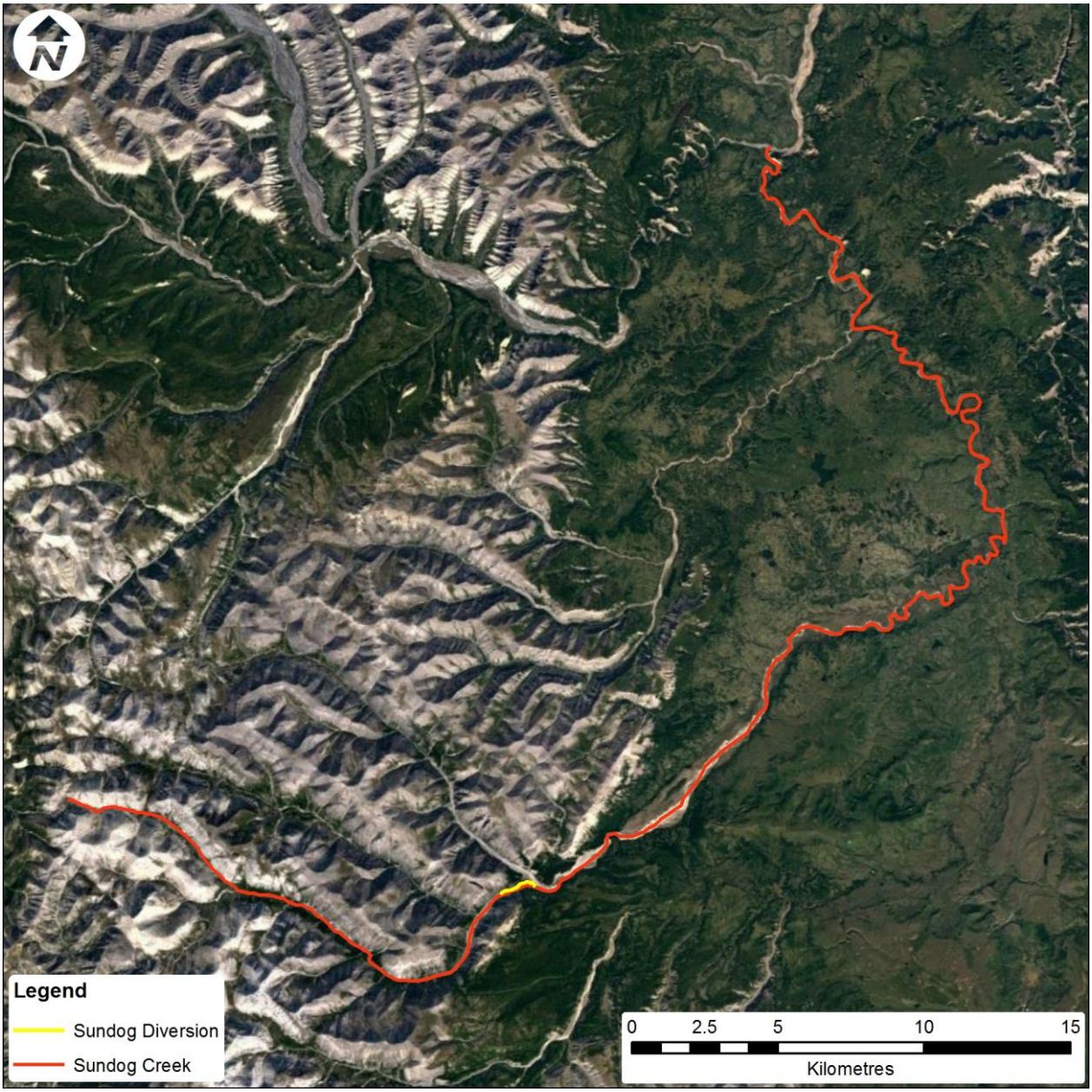
Point 3 – Area to be diverted

Compared to the overall length of Sundog Creek from headwaters to confluence with the Ram River (70 km, Figure 4), the length of the diversion is 1.4 km (yellow line), constituting only 2% of the overall length of Sundog Creek (red line). The top third flows through high elevation mountains comprised of limited riparian vegetation. This is consistent with site observations suggesting oligotrophic conditions where the road parallels Sundog Creek. The bottom two thirds, below the proposed diversion, appears to have substantially more riparian vegetation and thus, is likely to be more productive (Wipfli and Baxter 2011). The bottom third appears to have a lower gradient, suggested by the meandering channel pattern.

Based on the rationale presented, it is our opinion that any change in benthic invertebrate production would be temporary in nature, short in duration, and negligible in magnitude, thus serious harm to local fish populations as a result of the diversion is unlikely.

Of the two fish species found in the upper reaches of Sundog Creek (Arctic grayling and slimy sculpin), grayling is the only sport fish. Based on existing life history information, grayling would likely use the portion of Sundog Creek within the proposed diversion primarily for spawning migrations in spring. Spawning grayling would prefer side channels and tributaries to Sundog (Stewart et al 2007). Juvenile fish may use Sundog Creek for rearing, however; the results of a small amount of electrofishing conducted by Garry Scrimgeour (Parks Canada) and David Harpley (Canadian Zinc Corp) between km 37.7 and 37.85 of Sundog Creek July 2014 only found grayling in a small side channel (i.e., not in the adjacent thalweg).

Figure 4 **Proposed diversion compared to Sundog Creek from headwaters to confluence with Ram River.**



It is our opinion that monitoring the channel morphology of the new channel is warranted to confirm that the new channel is providing habitat similar to the current channel. A key factor will be to ensure that arctic grayling are able to utilize the new channel for migration in spring. Since the new channel parallels the existing channel within the same alluvial deposit, gradients in the new channel will be generally the same as the exiting channel, while our proposed placement of large boulders along the side of the new channel is intended to provide refuge to migrating fish during higher flows.

Monitoring would be conducted to ensure that the new channel is comparable to the existing channel so that migrating fish are able to pass through the diversion. Monitoring would include field-based hydrological

data collection (i.e., velocities and cross sectional profiles), supported by satellite or aerial imagery, when available If velocities are too high, and higher than those predicted for the existing channel, Canadian Zinc Corp would commit to making necessary adjustments to the channel during no flow periods.

Once the stream has been diverted, we recommend bi-annual monitoring (during freshet and low flow) of the channel for the first two years. Subsequently, monitoring will transition to monitoring every second year, or immediately after a 1 in 10 year event or greater (Lewis et. al., 2012).

References

Casselman, J., J. Baird, M. Stol, P.Corbett, C. Robinson, and C. Bettles. 2016. Benthic invertebrate recovery monitoring in Lemon Creek Spill: Biological Monitoring - Final Report. Prepared by SNC-Lavalin Inc. Submitted to, and approved by, BC Ministry of Environment on behalf of Executive Flight Center.

Fowler, R.T. 2004. The recovery of benthic invertebrate communities following dewatering in two braided rivers. Hydrobiologia, 523:1-3, pp17-28.

Lewis, F.J.A., A.J. Harwood, C. Zyla, K.D. Ganshorn, and T. Hatfield. 2013. Long term Aquatic Monitoring Protocols for New and Upgraded Hydroelectric Projects. DFO Can. Sci. Advis. Sec. Res. Doc. 201 2/166. ix + 88 p.

Stanley E.H., D.L. Buschman, A.J. Boulton, N.B. Grimm, S. and G. Fisher. 1994. Invertebrate Resistance and Resilience to Intermittency in a Desert Stream, American Midland Naturalist, 131:2, pp. 288-300, University of Notre Dame.

Stewart, D.B., Mochnacz, N.J., Reist, J.D., Carmichael, T.J., and Sawatzky, C.D. 2007. Fish life history and habitat use in the Northwest Territories: Arctic grayling (*Thymallus arcticus*). Can. Manuscr. Rep. Fish. Aquat. Sci. 2797: vi + 55 p.

Wipfli, M.S., and C.V. Baxter. 2011. Linking Ecosystems, Food Webs, and Fish Production: Subsidies in Salmonid Watersheds. Fisheries 35:8, pp373-387