



June 3, 2011

Mr. Vern Christensen
Executive Director
Mackenzie Valley Environmental Impact Review Board
#200 Scotia Centre
5102 – 50th Avenue
Yellowknife, NT X1A 2N7

Via email: vchristensen@reviewboard.ca

**Re: EA0809-002, Prairie Creek Mine, Canadian Zinc Corporation:
Technical Report Submission**

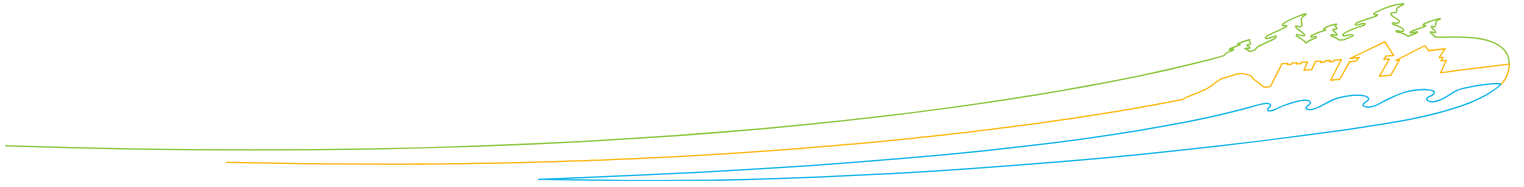
Dear Mr. Christensen,

Please find attached Parks Canada's Technical Report for the Canadian Zinc Corporation Prairie Creek Mine (EA0809-002). Parks Canada has considered all information submitted prior to May 20th at noon Mountain Time in our report. If you have any questions or concerns, please do not hesitate to contact Mike Sutor at 867.695.7665 and mike.sutor@pc.gc.ca, or Katherine Cumming at 204.984.1929 and katherine.cumming@pc.gc.ca. Thank you for your consideration.

Sincerely,

for Rob Kent
Field Unit Superintendent, Southwest NWT, Parks Canada

cc: Eric Betsaka Associate Superintendent, Nahanni National Park Reserve of Canada



Technical Report

Canadian Zinc Corporation Prairie Creek Mine Proposal

EA 0809-002

June 03, 2011



Executive Summary

On behalf of the people of Canada, Parks Canada is responsible for the protection and presentation of nationally significant examples of Canada's natural and cultural heritage and to foster public understanding, appreciation and enjoyment in ways that ensure their ecological and commemorative integrity for present and future generations. In July 2008, Parks Canada and Canadian Zinc Corporation signed a Memorandum of Understanding (MOU) that acknowledged the interests of both parties so that they may co-exist. This was followed by Nahanni's expansion in June of 2009. The proposed Prairie Creek mine is now surrounded by the expanded Nahanni National Park Reserve of Canada and the proposed winter access road includes 77 km within the park. As per this MOU and its legislated responsibility, Parks Canada is participating in the environmental assessment process as a regulator for a portion of the road and as an expert advisor on the potential impacts of the development on the ecological integrity of the park.

This technical report is organized in two sections which address issues associated with the road (spills, road construction, karst, vegetation and wildlife) and the mine site separately.

The following conclusions were reached with respect to the road:

- Analysis of the probability of a spill occurring on the road and consequences of a spill occurring conclude that there is a high risk of an impact to the ecological integrity of the park from spills. The proponent has committed to a spill contingency plan and additional mitigations, but there remains uncertainty in their implementation. Parks Canada has made recommendations to ensure continual improvement in the prevention, management, and monitoring of spills.
- Descriptions of winter road water withdrawal quantities and locations, aggregate quantities and locations, road construction techniques and stream crossings are either incomplete or too generic. While geotechnical information comparing alternate routes through the karst area have not been included by the proponent, an acceptable route is expected to be found in the area. Recommendations are made with respect to monitoring the karst and vegetation associated with the road route during operation.
- Grizzly bears, wolverine, moose, Dall's sheep and woodland caribou are all species of interest that could be impacted by the road. As Northern Mountain Woodland caribou are considered a species of "special concern" under Schedule 1 of the *Species at Risk Act* and the species has known winter habitat along the road, mitigating impacts and monitoring them is required by the *Species at Risk Act*. Appropriate road design and operational procedures are needed to mitigate impacts to wildlife, but not all details are available. Recommendations for responding to wildlife close to the road during operation and monitoring are made.
- In general, the road has been designed largely at a conceptual level and there are many unknowns about the project design, mitigations proposed, and potential for conflicts between mitigation commitments.

At the mine site, uncertainty remains around potential impacts from mine operations and post-closure on physical processes influencing aquatic ecosystems in Prairie Creek and therefore impacts to aquatic invertebrate and algal communities which contribute to the ecological integrity of Nahanni. Potential toxicity remains unexplained and unmitigated. The predicted mercury levels within the park are consistently higher than site-specific water quality objectives and the potential ecological impacts within Nahanni of these exceedances have not been described. Other water quality parameters will regularly exceed site-specific water quality objectives (SSWQOs) in Prairie Creek in Nahanni. The information provided by the proponent to date



has not clearly demonstrated where all the leachate from the mine will come from after the mine is closed due to optimistic predictions for the paste backfill process. Based on the information provided by the proponent, the proposed approach may not mitigate potential significant adverse impacts to Prairie Creek's aquatic ecosystem and the ecological integrity of Nahanni. Due to uncertainty regarding the potential for significant adverse impacts, Parks Canada is unable to provide specific recommendations in relation to the mine site to the Review Board. One recommendation on aquatic monitoring in Prairie Creek is made.



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1 Introduction

On behalf of the people of Canada, Parks Canada is responsible for the protection and presentation of nationally significant examples of Canada's natural and cultural heritage and to foster public understanding, appreciation and enjoyment in ways that ensure their ecological and commemorative integrity for present and future generations.

Nahanni National Park Reserve of Canada (NNPR or Nahanni) is recognized and treasured nationally and internationally and provides visitors to the park with a once-in-a-lifetime opportunity to experience a majestic northern wilderness, the wonder of uninterrupted vistas, and the solitude and stillness of a remote national park.

Nahanni exists within the Dehcho, a traditional homeland of the Dene for centuries. The tradition of Aboriginal use continues to this day in the park reserve and is provided for under the *Canada National Parks Act*. The lands that are now Nahanni have benefited from the past, and ongoing, stewardship of the local First Nations.

Through the Dehcho Process, Parks Canada and the Dehcho First Nations have established a consensus planning team comprised of representatives from both organizations. On August 20, 2003, the Honourable Sheila Copps, Minister of Canadian Heritage, and Herb Norwegian, Grand Chief of the Dehcho First Nations, announced the signing of an Interim Park Management Arrangement that would guide park management.

1.1 Nahanni National Park Reserve of Canada

Nahanni National Park Reserve of Canada was established in 1976, consisting of an area of 4,766 square kilometres. The park was initially established to protect the South Nahanni River from hydroelectric development, and the original boundary surrounds the River from Rabbitkettle Lake, through canyons south of the current Prairie Creek mine, almost to the community of Nahanni Butte. Under the *Canada National Parks Act*, Nahanni National Park Reserve is protected for public benefit, education and enjoyment, while being maintained to leave it unimpaired for future generations.

In 2009, Nahanni was expanded to an area of approximately 30,000 square kilometers, making it the third largest national park in Canada (Figure 1). The expansion protected a significant portion of the South Nahanni River watershed, the unique features of the Ram plateau, and the globally unique North Nahanni Karst.

The proposed Prairie Creek mine is surrounded by NNPR, but is not on national park lands. In July 2008, Parks Canada and Canadian Zinc Corporation signed a Memorandum of Understanding (MOU) that acknowledged the interests of both parties with the goal of managing each party's interests (park expansion, and mine development and access). A portion of the proposed access and haul road is contained within the park, traversing 77 km from the eastern boundary of the park, through the karst, and into the mountain valleys toward the minesite. As the mine was pre-existing, its operation was anticipated during the negotiations for the



expansion of NNPR. In the *Canada National Parks Act*, the government of Canada specifically allowed for a mining access road (s. 41.1) leading to the Prairie Creek Area. Parks Canada is committed to working with Canadian Zinc Corporation towards our respective goals as outlined in the MOU. We are participating in this environmental assessment process as a regulator for the portion of the road through the park and as an expert advisor on the potential impacts of the development on the ecological integrity of park.

In 2010, the “Nahanni National Park Reserve of Canada Nahʔą Dehé Management Plan” was tabled in Parliament. The Plan outlines the vision, key strategies and targets for managing the park. The plan states:

Wildlife species such as migratory caribou do not stay within the park; likewise, fire does not respect geographic political boundaries, thus Nahanni National Park Reserve must work with others to help maintain the highest possible standards of quality for the waters, lands, air and wildlife of Nahʔą Dehé (pg 19)

1.2 World Heritage Site

Nahanni National Park Reserve was among the first seven World Heritage Sites in the world, and Canada’s first site given this status by the United Nations Education, Science and Cultural Organization’s (UNESCO) World Heritage Convention. World Heritage Sites are parts of the world’s natural and cultural heritage that are so outstanding or scientifically significant that their protection and preservation are considered to be of concern to the world community. This status, conferred in 1978, gives international recognition to Nahanni National Park Reserve (within the previous boundary) as a place exhibiting:

- Outstanding examples of major stages in the earth’s evolutionary history;
- Significant ongoing geological processes; and
- Superlative natural phenomena, formations and features of exceptional natural beauty.

Parks Canada’s mandate and conservation practices reflect the responsibility of this designation in both the protection and presentation of park values.

1.3 Canadian Heritage River

In 1987, the portion of the South Nahanni River within NNPR was designated as a Canadian Heritage River. The Canadian Heritage Rivers System has been established by federal, provincial and territorial governments to recognize Canada’s outstanding rivers and to ensure their long-term protection and continued enjoyment by Canadians. The South Nahanni River is recognized as an exceptional example of several natural history themes and provides outstanding recreational opportunities in a wilderness area of great scenic beauty.

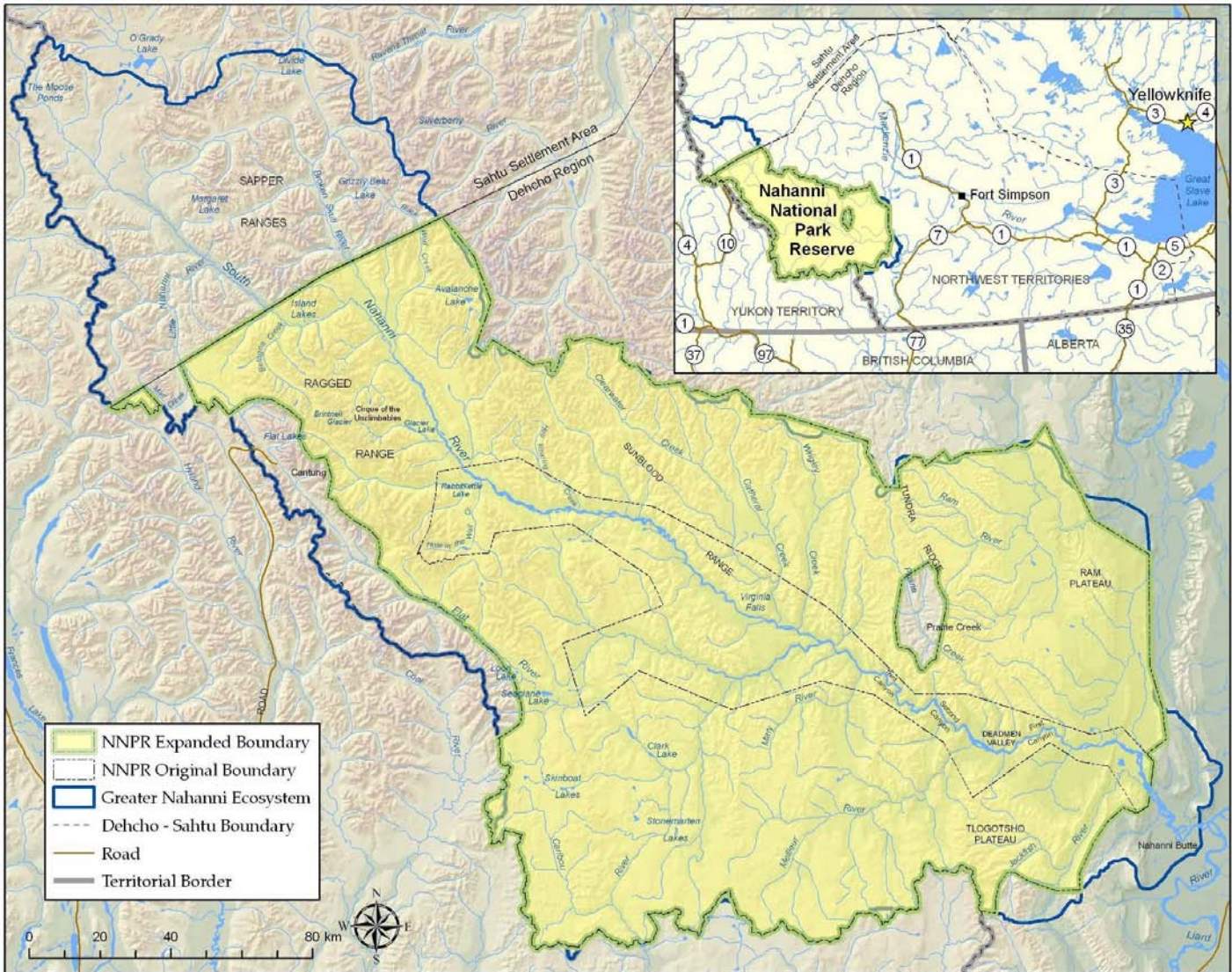


Figure 1. Map of Nahanni National Park Reserve of Canada.

1.4 Report organization

Our analysis of the proposed Prairie Creek Mine is separated into two sections. First the potential impacts from the road on Nahanni are examined under the following headings: spills, road construction, karst landscape, vegetation and wildlife. Second, the proposed mine site is examined for potential impacts on the Prairie Creek aquatic ecosystem in Nahanni. A summary of recommendations follows the analyses.



2 Winter road

Approximately 77 km of the winter access road is in Nahanni. Spills and road construction are two activities that could impact a variety of environmental components and these are examined first. Additional analyses focused on the karst landscape, vegetation, and wildlife in Nahanni follows.

2.1 Spills

As identified in Parks Canada's scoping submission, mitigating spills along the road is important because serious and potentially permanent damage to the ecological integrity of Nahanni is possible depending on where a spill occurs along the road, the conditions under which the spill occurs, and the substance that is spilled. Elements of the ecological integrity of Nahanni that could be impacted by a spill include:

- Hydrological processes, including surface water and ground water flow regimes, physical and chemical water processes and their spatial patterns.
- Landform structure, processes and spatial patterns.
- The physical processes that influence how aquatic ecosystems will operate within the natural range of variation, which include water flow, channel morphology, temperature and chemical processes and regimes.
- Aquatic invertebrate and algal communities.
- Habitat and population structure of bull trout, Arctic grayling and mountain whitefish.

2.1.1 Relevant Documents

Developers Assessment Report (DAR) Page 289, 293, 294, 314, Volume 4 Appendix 28 "Prairie Creek Project 2010 Fuel Spill Contingency Plan: CZN, January 2010"

IR Round 1 Parks_Canada 14, 15, 16, GNWT 1_1, EC-15; Response Appendix F

IR Round 2 Parks_Canada 2-9 with Environment Canada; Response Appendix I

2.1.2 Analysis

When analyzing the risks of spills, two elements are involved: the probability of an incident occurring and the consequences if such an incident occurred.

Probability

In assessing the probability of a spill, we seek to answer the question "How often is a spill expected to occur?" or "How likely is it that a spill will occur?" The winter road travels across extreme topography, a contributing factor to a higher risk of spills. In IR Round 2 Response Appendix I, Canadian Zinc provided an analysis of the probability of a spill. Their analysis shows that 26.5 km are considered moderate to high probability of a spill.

In each of the two years when the road was used previously, there was a spill. In 1981, it was not possible to contain, burn off, or recover a spill (A Joint Submission to the Northwest Territories Water Board on an



Application by Cadillac Explorations Ltd. For Water Use and Waste Disposal Associated with their Prairie Creek Mine, Department of the Environment and Department of Fisheries and Oceans, May 12, 1981). In 1982, again it was not possible to burn off a diesel fuel spill. The contaminated snow and dirt was deposited in a large pit along side the road (Inspection reports March 5, 1982 and March 23, 1982).

Consequences

When a spill occurs, the location and features of the environment determine how important the consequences will be. In assessing the consequences we ask “How easy is it to clean up a spill?”; “What would be affected by a spill?”; and “How important are those things that will be affected by the spill?” On the road to the Prairie Creek mine, the topography and locations near running water and karst will make some spills difficult and potentially impossible to clean up. In IR Round 2 Response Appendix I, Canadian Zinc provided an analysis of the consequences of a spill that showed that on 29.6 km of the road, containment of a spill would not be possible.

Ecologically important areas and processes within Nahanni could potentially be affected by spills that affect aquatic ecosystems (including important bull trout spawning habitat) and karst areas.. Karst areas are more vulnerable to pollution than other underground aquifers for three reasons. Firstly, the rocks are more permeable than other rocks allowing the direct infiltration of water and pollutants into the ground. Secondly, depressions, sinkholes and other openings allow for pollutants to go directly into the ground. Thirdly, underground streams can move the pollutants quickly over a large distance (B. A. Blackwell and Associates Ltd, 1995). A spill could potentially contaminate water underground for a couple of kilometres north and/or 20-30 km south (Brook & Ford, 1976). A large spill could possibly impact an even larger area. In IR Round 2 Response Appendix I, Canadian Zinc provided an analysis of the consequences of a spill that showed 127.7km or 75% of the road is of medium to high consequence if a spill occurred.

Overall assessment

Given the high probability of a spill and the high consequences of a spill, there is a potential for significant adverse environmental effects. In IR Round 2 Response Appendix I, Canadian Zinc’s analysis showed that 26.5 km of the road have a high or medium probability of a spill together with a high or medium consequence if a spill occurred. As a result, adequate mitigation to ensure there is no significant adverse environmental effect is important including:

- road design and operation to minimize the risk of a spill.
- training, spill response plan and equipment to ensure response to a spill minimizes the impact.

2.1.3 Mitigation, proponent commitments and recommendations

Road design and operation to minimize the risk of a spill

March 22, 2011 Proponent commitments included:



- The erection of a physical barrier on the outer edge of the road from Km 11-16 will be evaluated to reduce the risk of spills along this section where the grade is steeper and a tributary of Funeral Creek exists below.
- Suitable locations for the construction of run-away lanes will be investigated for sections Km 11-16 and 19-22.
- Specific speed limits may be set for specific types of trucks and loads through sensitive sections.
- The road operations supervisor will place limits on hours of driving over a prescribed period.
- The road will be regularly inspected and maintained during the operating season to ensure optimal performance and minimize risks from poor road bed conditions.
- Trucks will be required to use chains from Km 0 to Km 29.

The above commitments provide some mitigations to ensure design and operation of the road minimizes the risk of a spill. Further details about the mitigations are not available, including:

- Speed limits by location and by vehicle type.
- Location and type of safety berms with reference to the type and weight of trucks and therefore the efficacy of the berms.
- Locations of runaway lanes.
- Locations of passing locations and rest stops.
- Locations where road shoulder design can minimize the risk of falling off the road.

Training, spill response plan and equipment

March 22, 2011 Proponent commitments included:

- Involve NBDB members in spill response training and inform the Band of any spills.
- A spill contingency plan for the Mine and access road will be reviewed and updated as per Appendix I of the Second Round IR Response.
- All trucks on the access road must carry spill kits, and drivers must have read the spill contingency plan and be prepared for an appropriate spill response in relations to their load. Drivers must be suitably qualified and experienced.
- The Spill Contingency Plan (SCP) will address all potentially hazardous substances used at the Mine or transported along the road. The SCP will contain information that clearly states who is responsible for spill response and clean-up.
- Portable spill response equipment will be maintained no more than 50 km from any location along the road.
- The SCP will include details of spill responses for all types of ground conditions, including frozen and non-frozen ground, and with and without snow cover. Opportunities for the rapid spread of contaminants will also be considered, such as in karst areas.
- A trained spill response team will be maintained at the Mine. Operators at the Transfer Facilities will also receive appropriate spill response training. Training will include classroom study, equipment deployment instruction and spill exercises.
- Spill exercises will be undertaken in summer (initial training) and winter (final training) conditions, and in locations representing the range of environmental conditions that will exist on the road.



- To respond to spills, an Incident Command System (ICS) will be used that is widely used by governments and industry (see Appendix I of the Second Round IR Response for details).
- A silt or other form of curtain will be stored approximately mid-point between the mine and Funeral Creek ready for deployment to reduce flow in part of Prairie Creek adjacent to a spill.
- Control points will be established at key locations, and will include material to create temporary dams, absorbents, booms, board weirs and sand bags. Control points locations will include two upstream tributaries to Funeral Creek, on Sundog Creek just above the main falls and just before the fluvial outwash plain, and downstream of the Tetcela River and Fishtrap Creek crossings.
- Spill kits will be carried on vehicles with materials appropriate for the loads (i.e. type of sorbent). Comprehensive spill kits will be maintained at the mine site, Cat Camp, the Tetcela Transfer Facility, Grainger Gap, and the Liard Transfer Facility. Custom built and stocked road trailers dedicated to spill response, containing equipment, materials and tools will be considered.

Given the high potential for spills and the high consequences of a spill, these commitments leave some concerns to be addressed. For example:

- CZN proposed that the use of trailers to mobilize spill response equipment along the road “might” be used. The volume of sorbent and neutralizing material required to manage a large fuel or sulphuric acid spill will be large and therefore the mobilization of equipment on trailers is not expected to be effective.
- “Control points” have been described by CZN to be positioned along the road to contain spill response equipment. The specific spill response materials at each control point are not defined.
- Selected spill equipment has been stated to be 50 km away at “control points”. The number of control points needed to provide an acceptable spill response time is not described. No minimum response times to spills have been determined by CZN in general to support the response design.
- The “control points” may not contain spill equipment that can manage all type and/or volumes of spills. The limitations of the “control points” in addressing spills are not described. The response times associated with these types of spills are not described.
- CZN proposes that first time drivers of the road be given an informative package. This level of effort to inform drivers of the road and spill response is likely inadequate.
- Soda ash is the primary method that is proposed by CZN to manage a spill of sulfuric acid. CZN states that soda ash “might” be stored along the road for emergency response. A firm commitment is required to ensure adequate material will be in place.
- Detailed analysis of risk and mitigation to ensure appropriate locations are chosen for all mitigation and spill clean-up materials is required.
- Consideration has not been provided for spills originating in karst landscapes including where contaminated ground water may surface and how spill response and monitoring will occur at these locations.



In addition to the above mitigations it will be critical that CZN uses any spill as an opportunity to learn and adapt plans with the goal of prevention and effective spill response. This feedback will ensure that the program of the company is continually improving. As a result, the following recommendations are made.

Recommendation 1: After each spill, the proponent be required to report on the spill including the following information: factors contributing to the cause of the spill, corrective action that will be taken to minimize a similar set of factors occurring again, effectiveness of spill response, actions that will be taken to improve spill response based on this experience.

Recommendation 2: After each spill, adequate monitoring occur to assess the impacts and effectiveness of clean-up. If the spill occurs within the karst area, monitoring should occur for an extent appropriate to the potential of impacts in the karst system.

2.2 Road construction

Numerous aspects of the winter road construction approach can result in adverse impacts to the environment in Nahanni. For example:

- Water use and consequential impacts on aquatic ecosystems
- Borrow pits and consequential impacts on terrain, vegetation and potentially aquatic ecosystems
- Permafrost degradation and consequential impacts
- Drainage alteration and potential impacts on aquatic ecosystems and terrain
- Land degradation through erosion, slumping, and decreasing geotechnical stability
- Creek crossings and potential impacts on aquatic ecosystems

2.2.1 Relevant Documents

Developers Assessment Report and Addendum

IR Round 1 Parks_Canada 12,13, Appendix D, E

Technical Sessions Undertakings 12, 17

IR Round 2 Parks_Canada_2, DFO_2-2; 2-4; 2-5; NRCan-1; Appendix B

2.2.2 Analysis

The ruling by the Mackenzie Valley Environmental Impact Review Board (Review Board) on scope stated “The Review board will not be assessing construction impacts of already built structures...The Review Board will determine to what degree certain aspects of the development ...will be considered in the scope of assessment while developing its Draft Terms of Reference”¹.

¹ Page 30 “Mackenzie Valley Environmental Impact Review Board’s ruling on scope of development issues related to the Prairie Creek Mine environmental assessment” March 5, 2008



The “Terms of Reference for the Environmental Assessment of Canadian Zinc Corporation’s Prairie Creek Mine EA 0809 – 002 June 26, 2009” specifically includes (which the Review Board indicated was the final word):

- Initial upgrading (as necessary) and annual construction activities associated with the winter access road from the mine to the Territorial Highway 7 (Liard Highway), including vehicle traffic, water use and water crossings;
- Development and use of borrow sources for aggregate production at the mine site or along the winter access road.

Parks Canada and other parties have submitted information requests relevant to these matters. Specifically IR Round 1 Parks_Canada 12,13, IR Round 2 Parks_Canada_2, DFO_2-2; 2-4; 2-5; NRCan-1. In general these information requests were similar in both rounds and asked questions about construction techniques, water withdrawals, aggregate needs, permafrost and other risks associated with construction.

Responses by the proponent to information requests on the topics discussed above were general with little detail. Furthermore, when answers were provided, they were sometimes limited to a portion of the road. Canadian Zinc Corporation in the Response to PC-2_1 indicated that answers to questions about construction techniques, impacts to permafrost, etc., would focus on alterations to the existing route. Also Canadian Zinc Corporation did not provide the total aggregate required for the whole route. If no new bridges or cut and fills were required along the existing route, we would not expect any information on this matter. However, on May 6, 2011 the proponent indicated there will be a new bridge at a Sundog Tributary and there may be fill requirements associated with constructing this bridge. Fill has also been proposed as a technique to insulate permafrost, for cut and fill repairs, and upgrading on other locations along the existing route of the road². In addition water use is an annual construction activity that is included in the terms of reference. The following are outstanding information requirements and issues with respect to road construction.

Water use

Water use was estimated in Appendix B of IR Round 2 Response “Preliminary Estimate of Water Consumption for the Construction & Maintenance of the Prairie Creek Mine Access Road” prepared by Paul Davidson, Kleido Construction Ltd. The volume of water needed for kilometres 0-84, which includes a portion in Nahanni, was not provided in Appendix B of IR Round 2 and therefore the total volume of water needed for road operation is unknown. Appendix B of IR Round 2 identified three water sources: the mine, Mosquito Lake and the Liard River. In the main reply answer to PC-2_1, four sources were identified: mine site well, Mosquito Lake, Gap Lake and Liard River with the possibility of other sources being used in the future. Although the main sites for water use are identified, there remains some uncertainty about other sites that will be used.

² Page 6 “Prairie Creek Mine responses to second round information requests” March 2011.



No analysis has been done on these water sources. For example, the quality of well water at the mine site needs to be assessed to ensure it is appropriate to spread on the road. The only estimate for the water volume in Mosquito Lake, which is located in Nahanni, is based on surface area. Between the coarse estimate and missing water volume estimates, we are uncertain whether the lake has sufficient volume of water to allow withdrawal of the required water without causing impacts on the aquatic ecosystem.

Aggregate use

The DAR Addendum provided estimates of the aggregate requirements for each of the transfer station (totaling 13,500 m³) but did not include estimates for the road. In response to PC-2_1, a volume of 50,000m³ was estimated for a portion of the road; however, this volume is an estimate for cut and fills along new alignments, not for the entire route and therefore is not a complete estimate. Furthermore, it is not clear if this estimate includes a consideration of using aggregate to mitigate impacts on permafrost as suggested by Canadian Zinc³. As a result, we do not know the total volume of aggregate required for the winter road. The locations of gravel extraction were provided on maps in Appendix C of the response to Information Request 2, which showed two areas approximately 1.5 km long within Nahanni, rather than specific locations. No information was included about the specific ground conditions in these locations, potential impacts or mitigations (for construction, operation, closure and post closure). No information was provided on access requirements to the aggregate source, and therefore potential impacts or mitigations are unknown for construction, operation, closure and post closure.

Permafrost, drainage, erosion, slope stability, avalanches

Limited details have been provided on the design of the road and those that have been provided were only provided for the new alignments (half of the approximately 180 km road) (IR Round 2 Parks_Canada_2). The road design details were not tailored to site specific conditions, but rather simplified schematics for selected typical road sub-grade and topographic conditions. Limited description of drainage control structures and sediment and erosion control have been described. Design details in areas of slopes that require cuts/fill to ensure slope stability were limited in description. Therefore, impacts to permafrost and landscape features and consequential impacts along most of the road are difficult to predict. The road traverses tight mountain valleys and passes that may pose risk from snow avalanches, yet this risk has not been assessed nor have design or mitigation considerations been identified.

Stream crossings

Details around the bridges in the Nahanni have been few, with general schematic design for Polje Creek provided in IR Round 2 Parks_Canada_2 and a general picture of Sundog Tributary bridge provided on May 6, 2011.

Although standard mitigation techniques are known to exist for road activities such as these, if the right ones are not chosen and applied initially, potentially significant environmental effects could occur. In addition, some mitigations may conflict or create additional impacts that have not been considered.

³ Page 6 “Prairie Creek Mine responses to second round information requests” March 2011.



2.2.3 Mitigation, Proponent Commitments and Recommendations

Recommendations to mitigate any potential significant adverse environmental impacts could not be identified without the following additional information to understand the project and mitigations.

- Fine scale mapping of the entire road identifying risks for erosion, sedimentation, permafrost, spills, slope stability, drainage control and other environmental impacts.
- Design details for all high risk areas, including creek crossings, as identified above.
- Soil/gravel requirements, quarry locations and resource evaluations, site assessment, quarry management to mitigate environmental impacts, quarry monitoring and quarry restoration.
- Water withdrawals locations and distribution, water quality from wells and distribution, design of water withdrawal mechanisms.
- Monitoring plans for geotechnical road condition during construction, operation, closure and post closure.

2.3 Karst Landscape

With many outstanding examples of karst formations and some unique features found nowhere else in the world, the Nahanni North Karst area is an internationally outstanding example of karst landscape⁴. Parks Canada's scoping submission identified the ecological management outcomes that need to be maintained at relevant ecological scales. It is expected that the ecological integrity of Nahanni North Karst will be maintained when the following conditions are maintained:

- Hydrological processes remain within the natural range of variation. Note: Hydrological processes include surface water and ground water flow regimes, water physical and chemical processes and their spatial patterns.
- Landform structure, processes and spatial patterns are unaltered by human activity.
- Vegetation composition and structure are characteristic of the natural region.
- All species persist in naturally occurring populations and habitats.

2.3.1 Relevant Documents

DAR 9.4.2 page 295, Appendix 16

IR Round 1 Parks Canada 6-10, NRCAN 9; Appendix D

2.3.2 Analysis

The current winter road route is immediately adjacent to a number of karst landscape features, including a sinkhole and two poljes. Karst terrain is geologically less stable and may be vulnerable to collapse or

⁴ Ford, D.C. 2001. *Postscript to the McMaster University 1974 Report on the Nahanni North Karst*. McMaster University.



significant erosion with construction on the surface. The vulnerability of karst landscapes, even after past use, has been demonstrated by the sudden collapse of rock under highways, bridges, buildings, vehicles and other structures⁵.

Canadian Zinc has proposed to realign the previous winter road in the area of the karst landscape, specifically between km 48 and km 59, called the Polje By-Pass. Evidence to support the benefits of the new route stated by the proponent are:

- “Where the [historic] access route crosses through the valley that contains the intense karst land (near Km 56) many sink holes and faulted land exists adjacent to and probably under the route.” (DAR Appendix 16 s. 10.2, p. II-10)
- “Briefly, the proposed by-pass route avoids the intense karst land (the poljes) and is downstream of surface and subsurface drainage from the polje area. Another benefit of the by-pass, not directly related to the karst features is that it also avoids areas of historic landslide movement and recent rotational landslides and flow slides” (Response to IR Round 1 Parks_Canada 7)
- “The zone of intense karst formation near km 56 probably appears to be governed by a fault or fracture zone. It is likely that the proposed route re-alignment crosses the northern extension of this fault or fracture zone, however, this crossing is believed to be a more beneficial choice than the existing access route through the poljes since it is lower down in the stratigraphic sequence and may indeed be below the Nahanni Formation.” (Response to IR Round 1 NRCAN 9.3)

In this section, we are particularly evaluating whether there would be an impact to ecological integrity as defined above as “land form structure, processes and spatial patterns are unaltered by human activity.” Given the importance of this area and the irreversibility of an effect to landform structure, more detailed information to support a conclusion on the best route is sought. It is Parks Canada’s view that a route can be found in this area.

2.3.3 Mitigation, Proponent Commitments and Recommendations

Geotechnical investigations

In IR Round 1 Parks_Canada 8, the Proponent indicated that they would be conducting a third phase of geotechnical investigations. Additional geotechnical investigations are required in order to allow further refinement of construction details and concepts, and a better understanding of site conditions to determine the best route. Without the understanding of physical conditions and characteristics, it is not possible, or will be very difficult, to assess the potential impacts caused by the road re-alignment. Additional work required includes:

- Intrusive investigations to confirm assumptions made in the preliminary design process. Investigation should include sampling, testing, and visual reconnaissance of geotechnical characteristics.

⁵ Ford, D.C., and P. Williams. 2007. *Karst hydrogeology and geomorphology*. John Wiley & Sons, Ltd., West Sussex, England.



- Site investigations and assessment of the existence of ice-rich permafrost areas, liquefiable soils, characteristics of borrow materials, groundwater characteristics, and evaluation of the potential impacts as defined in section 2.3 above (e.g., permafrost degradation and environment).

Monitoring

March 22, 2011 Proponent commitments included:

Potentially unstable areas and karst features along the access road will be inspected at a frequency dependent on observed conditions and changes or lack thereof of those conditions.

This commitment does not provide sufficient detail for monitoring karst. The following approach is recommended for monitoring the approximate 10 km of road adjacent to the intense karst landscape centered near Polje Creek.

Recommendation 3: Monitoring of the approximately 10 km of road through the intense karst landscape will include the following:

- ***Initial recording of sinkhole features and other closed depressions would consist of specifically identifying, briefly characterizing and photographing each feature within a zone at least the maximum diameter of karst subsidence features in the area. Each feature would be mapped onto ortho-corrected, high resolution satellite imagery and given a unique identifier. The attributes of each feature, along with associated photos and other related data (date, category of sink hole, etc.) would be handled within a geographic information system. (Response to IR Round 1 Parks_Canada 9.3).***
- ***Monitoring of sinkhole features and other closed depressions be carried out within a zone width that is at least the maximum diameter of karst subsidence features, by re-photographing the corridor and making an image comparison with the original image. (IR Round 1 Parks_Canada 9.3) Monitoring of formation and development of new sinkholes and caves by visual inspection, and monitoring of settlement within the karst area to assess if road operations are impacting the karst. Minimum frequency of visual monitoring should be twice yearly during times of limited to no snow cover.***
- ***Monitoring of surface water flow patterns (and potentially quantity) in the intense karst region adjacent to the road to assess if road operations are altering the natural drainage patterns.***
- ***Monitoring of surface water quality in the intense karst region to assess if road operations are altering the quality of water.***
- ***Monitoring of groundwater originating or passing under the intense karst region to assess if road operations are altering groundwater levels and background groundwater quality.***



2.4 Vegetation

While impacts to vegetation are not expected to be pervasive, impacts to rare species or communities could be important and could impact the ecological integrity of Nahanni through alterations to community composition, structure and prevalence. Furthermore, movement of vehicles along the road may introduce and establish non-native species. Finally, when the road or burrow pits are no longer in use, vegetation should be restored appropriately.

2.4.1 Relevant Documents

DAR Section 4.10, 9.4.1, 10.6, Appendix 13, 17

IR Round 2 Parks_Canada_1, 2, Appendix B

Reclamation Assessment, Invasive and Rare Plant Survey 2010, Prairie Creek Mine Access Road, April 2011

2.4.2 Analysis

In response to Parks Canada's information requests, Canadian Zinc conducted field work that demonstrated rare plants and communities are not likely to be impacted by the project. Furthermore their field work demonstrated that non-native species were likely not present, suggesting that previous use of the road did not result in the introduction of non-native species. Evidence of re-vegetation on the previously used road way was also presented. Based on this evidence, there is a low potential for significant adverse environmental effects on vegetation along the road.

2.4.3 Mitigation, Proponent Commitments and Recommendations

While additional mitigation is not required, monitoring for non-native vegetation will be important as the introduction of non-native vegetation could have significant impacts on native vegetation and wildlife species. Invasive species are becoming a management problem at a global scale. Documentation of invasive plant species have been made along all major highways in the NWT⁶. Canadian Zinc will be using the road far more often and over a longer period than it was used originally. Monitoring of the road bed and other disturbed areas should occur based on the biological attributes of the potential invading species to provide early warning and action should invasive species become present along the route.

Recommendation 4: Monitoring for invasive species should occur along the road corridor and any associated footprint of the development. The extent and design of this monitoring should be based on the biological attributes of potential invading species.

On October 7 2010 the proponent committed to initiating a study collaboratively with Parks Canada prior to road operations to improve the effectiveness of revegetation and reclamation. Immediate, effective revegetation of disturbed landscapes is important in preventing landscape change (e.g., permafrost degradation, sedimentation and erosion, and mass wasting), decreasing the likelihood of invasive species

⁶ Oldham, M.J. 2007. 2006 survey of exotic plants along northwest territories highways. Prepared for the Government of the Northwest Territories.



establishing, and in maintaining vegetation in a state typifying the surrounding landscape. In addition, reclamation planning for quarries and the road will require accurate information to ensure correct prescriptions are made to restore landscapes post-closure or after other disturbances (e.g., damage to lands from spill recovery operations).

Recommendation 5: Post-closure, abandonment, and reclamation planning should incorporate findings of research on revegetation and reclamation conducted in the project area.

2.5 Wildlife

Woodland caribou (Boreal and Northern Mountain ecotypes) have been indicated as a species listed under Schedule 1 of the Species at Risk Act (SARA) that uses habitat within the EA Study Area. Additionally, wolverine and grizzly bear occur throughout the EA Study Area and are considered Special Concern by the Committee on the Status of Endangered Wildlife in Canada. Finally, moose, Dall's sheep, and beaver have been indicated as key harvested species by the Terms of Reference that should be given special consideration.

2.5.1 Relevant Documents

IR Round 1 Replies Parks Canada 1_3,1_4, 1_5, Appendix C

IR Round 2 Replies Parks Canada 2_6,2_7,2_8, Appendix H, K

Wildlife survey of Prairie Creek Mine and access road conducted December 2010.

Wildlife survey of Prairie Creek Mine and access road conducted in February 2011 including figures.

Letter to Chuck Hubert from David Harpley, Environmental Assessment EA0809-002, Prairie Creek Mine Commitments to Provide Information, April 12 Technical Meeting PROGRESS REPORT. May 6, 2011

2.5.2 Analysis

The DAR's information and analysis on wildlife had significant deficiencies. Wildlife work from the early 1980's is relied upon extensively. Surveys are limited and out of date. Wildlife communities, populations, and behaviour are more susceptible to change than vegetation communities and vary within and among years. Consequently, the baseline data from 1980 and 1981 are of limited use except as a historic point of comparison for current and future conditions. A 1994 RES report is cited but little information is provided on the nature of the survey. Prior to the winter of 2010-2011, the past 15 years of wildlife survey work conducted by the proponent in the area had consisted of a one day road survey in June 2006; a one day aerial reconnaissance in April 2007; and a two day survey in 2009 during which the mine site and access road vegetation and wildlife were evaluated from either helicopter or all-terrain vehicle. As such, only one survey (April 2007) had captured the winter period when road use is proposed to occur, and the consultant's report suggests results from that survey only captured tracks made between April 3-7 due to wind conditions and snow drift. The survey conducted in June occurred at the peak of calving and lambing which for most ungulate species coincides with the hiding phase, thus making observations difficult. The last survey described in Appendix 13



(July 2009) was not designed to detect wildlife species and can be best described as incidental observations of wildlife sign (e.g., vegetation browse, feces, or tracks) encountered at several vegetation plots and transects.

Northern Mountain Caribou

Of particular importance, the impact of the proposed alternative and existing routes on at-risk or key harvested species has not been considered. Specifically, Woodland Caribou (Boreal and Northern Mountain ecotypes) are a species listed under Schedule 1 of the SARA that use habitat within the EA Study Area. As stipulated in 3.3.6 of the Terms of Reference, any species listed under Schedule 1 of the SARA must be identified and any adverse impacts of the development on them thoroughly assessed and mitigated, regardless of whether the impact(s) are deemed “significant”. This stipulation is to meet legislated requirements and to ensure that the species is minimally impacted. In particular, SARA requires that an assessment:

- a) identify the adverse effects of the project on the listed wildlife species and its critical habitat and,
- b) if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them.

The data gaps and problems identified above apply to caribou as well. However, additional field work was conducted over the 2010-2011 winter with the goal of mapping caribou pattern of occurrence probabilities. The analysis shows several areas along the road, including the mine site, where there is a high probability of caribou occurrence. No updated analysis of the potential effects, mitigation measures and monitoring accompanied this map based on knowledge acquired on caribou occupancy. Although previous answers to information requests and a wildlife management plan identified some impacts and potential mitigations, the mitigation was not developed based on the most recent data, nor is it specific to the areas identified as a high probability of caribou occupancy. Appendix 1 presents a conceptual model of some potential effects as they relate to key determinants of population size. Several mitigation measures and monitoring options are presented for caribou. The recommendations presented below relate to this model.

2.5.3 Mitigation, Proponent Commitments and Recommendations

Recommendation 6: Management of traffic when wildlife are on/near the road will be detailed in the wildlife management plan, but will include:

- ***Stopping traffic when wildlife are within 50m to allow them to cross.***
- ***Only hazing when there is a danger to people or wildlife.***
- ***Hazing only carried out by specific trained staff.***

Recommendation 7: Monitoring of wildlife will include:

- ***Measures of Mountain Woodland Caribou distribution (e.g., site occupancy) and population vital rates (e.g., pregnancy rates) in the Prairie Creek watershed and along the road.***
- ***Wildlife interactions, observations, hazing etc.***
- ***Measures of moose distribution (e.g., site occupancy) along the road corridor east of Cat Camp in Nahanni National Park Reserve.***



- *Wildlife attractant inspections including all storage facilities.*
- *Track surveys and incidental observations for predators of caribou along the road and at the mine site.*

The following details will need to be planned or require greater detail particularly with respect to the locations along the road.

- Mapping of expected key areas of habitat or movement for wildlife related to the road.
- How wildlife movement is facilitated in bridge and/or barrier designs, where applicable.
- Management of ungulate attractants (e.g., soda ash).
- Management of snow banks and brush to provide escape areas for wildlife movement along road.
- Speed limits by vehicle type and location.
- Vehicle management and use of convoys.
- Signage to alert drivers to risks at key locations.

2.6 Conclusions for the Winter Road

In general the road has been designed at a conceptual level and there is potential for there to be conflicts between mitigation commitments. As described above, there are a number of areas where sufficient details about the project description and mitigations are still required. Those identified above are:

- Speed limits by location and by vehicle type.
- Location and type of safety berms with reference to the type and weight of trucks and therefore the efficacy of the berms.
- Locations of runaway lanes.
- Locations of passing locations and rest stops.
- Locations where road shoulder design can minimize the risk of falling off the road.
- Locations of control points, response times from control points, and materials to be stored at controlled points and other locations.
- Fine scale mapping of the entire road identifying risks for erosion, sedimentation, permafrost degradation, spills, slope stability, drainage control and other environmental impacts.
- Design details for all at risk areas, including creek crossings, identified above.
- Soil/gravel requirements, quarry locations and resource evaluations, site assessment, quarry management to mitigate environmental impacts, quarry monitoring and quarry restoration.
- The location and extent of areas that will have fill as compared to organic beds including possible impacts caused by fills, mitigation of environmental impacts, seasonal monitoring requirements and restoration requirements.
- Water withdrawals locations and distribution, water quality from well and distribution, design of water withdrawal mechanisms.
- Monitoring geotechnical road condition during construction, operation, closure and post closure.



- Intrusive investigations to confirm assumptions made in the preliminary design process. Investigation should include sampling, testing, and visual reconnaissance of geotechnical characteristics.
- Site investigations and assessment of the existence of ice-rich permafrost areas, liquefiable soils, characteristics of borrow materials, groundwater characteristics and evaluation of the potential impacts (e.g., permafrost degradation and environment).
- Mapping of expected key areas of habitat or movement for wildlife related to the road.
- How wildlife movement is facilitated in bridge and/or barrier designs, where applicable.
- Management of ungulate attractants.
- Management of snow banks and brush to provide escape areas for wildlife movement along road.
- Speed limits by vehicle type and location.
- Vehicle management and use of convoys.
- Signage to alert drivers to risks at key locations.

In addition, there has been no synthesis of the information between subjects. For example, where will the barriers be for spills and will they create barriers for wildlife in important wildlife areas? Will soda ash be stored for spill mitigation and if so will it be stored in a manner to prevent wildlife access? Will the bridges need to be designed to facilitate wildlife movement? Where will avalanche control be necessary and will the control affect wildlife and road design? It is therefore difficult to be sure that the mitigations for one issue are not creating an impact for another aspect of the environment.

We have identified the following recommendations that are not dependent on additional information/detail.

Recommendation 1: After each spill, the proponent be required to report on the spill including the following information: factors contributing to the cause of the spill, corrective action that will be taken to minimize a similar set of factors occurring again, effectiveness of spill response, actions that will be taken to improve spill response based on this experience.

Recommendation 2: After each spill, adequate monitoring occur to assess the impacts and effectiveness of clean-up. If the spill occurs within the karst area, monitoring should occur for an extent appropriate to the potential of impacts in the karst system.

Recommendation 3: Monitoring of the approximately 10 km of road through the intense karst landscape will include the following:

- ***Initial recording of sinkhole features and other closed depressions would consist of specifically identifying, briefly characterizing and photographing each feature within a zone at least the maximum diameter of karst subsidence features in the area. Each feature would be mapped onto ortho-corrected, high resolution satellite imagery and given a unique identifier. The attributes of each feature, along with associated photos and other related data (date, category of sink hole, etc.) would be handled within a geographic information system. (Response to IR Round 1 Parks_Canada 9.3).***



- **Monitoring of sinkhole features and other closed depressions be carried out within a zone width that is at least the maximum diameter of karst subsidence features, by re-photographing the corridor and making an image comparison with the original image. (IR Round 1 Parks_Canada 9.3) Monitoring of formation and development of new sinkholes and caves by visual inspection, and monitoring of settlement within the karst area to assess if road operations are impacting the karst. Minimum frequency of visual monitoring should be twice yearly during times of limited to no snow cover.**
- **Monitoring of surface water flow patterns (and potentially quantity) in the intense karst region adjacent to the road to assess if road operations are altering the natural drainage patterns.**
- **Monitoring of surface water quality in the intense karst region to assess if road operations are altering the quality of water.**
- **Monitoring of groundwater originating or passing under the intense karst region to assess if road operations are altering groundwater levels and background groundwater quality.**

Recommendation 4: Monitoring for invasive species should occur along the road corridor and any associated footprint of the development. The extent and design of this monitoring should be based on the biological attributes of potential invading species.

Recommendation 5: Post-closure, abandonment, and reclamation planning should incorporate findings of research on revegetation and reclamation conducted in the project area.

Recommendation 6: Management of traffic when wildlife are on/near the road will be detailed in the wildlife management plan, but will include:

- **Stopping traffic when wildlife are within 50m to allow them to cross.**
- **Only hazing when there is a danger to people or wildlife.**
- **Hazing only carried out by specific trained staff.**

Recommendation 7: Monitoring of wildlife will include:

- **Measures of Mountain Woodland Caribou distribution (e.g., site occupancy) and population vital rates (e.g., pregnancy rates) in the Prairie Creek watershed and along the road.**
- **Wildlife interactions, observations, hazing etc.**
- **Measures of moose distribution (e.g., site occupancy) along the road corridor east of Cat Camp in Nahanni National Park Reserve.**
- **Wildlife attractant inspections including all storage facilities.**



- ***Track surveys and incidental observations for predators of caribou along the road and at the mine site.***

3 Mine Site

While the mine site is not in Nahanni, water from the mine site will flow into the park, approximately 6.7 km downstream and remain in the park for the following 115 km.

3.1 Prairie Creek Aquatic Ecosystem

In Parks Canada’s scoping submission, we discussed the goal of protecting the ecological integrity of Nahanni and provided an operational description of ecological integrity for the Prairie Creek Watershed aquatic ecosystems (Appendix 2 of this report). The components of this description that have the greatest probability of being impacted by this project are the second and third:

- 2. In the park, physical processes that influence aquatic ecosystems will operate within the natural range of variation.**

Note: Physical processes include water flow, channel morphology, temperature and chemical processes and regimes.

- 3. Aquatic invertebrate and algal communities inside the park are characteristic of the natural region.**

Note: Community structures that are characteristic of the natural region would also provide quality habitat for other species (for example fish).

3.1.1 Analysis

We have separated our analysis of the impacts to Prairie Creek Aquatic Ecosystem in Nahanni into those impacts during the mine operation and in post-closure.

During Mine Operation

Predicting effluent quality and the potential impacts to Prairie Creek aquatic ecosystem is critical for Parks Canada to be able to assess if there could be impacts to the ecological integrity of Nahanni and the significance of any impacts.

The ecological integrity of the Prairie Creek aquatic ecosystem would be maintained if, in the park, physical processes that influence aquatic ecosystems remain within the natural range of variation. Canadian Zinc proposed Site-specific Water Quality Objectives (SSWQO)⁷ for Prairie Creek downstream of the mine based on

⁷ Appendix D. Table 10. Hatfield Consultants Memo, May 11, 2011 Subject: Prairie Creek Mine – Water Quality Objectives (Memo 1).



the reference condition approach (RCA), current and proposed Canadian Council of Ministers of the Environment guidelines and other guidelines. Choosing SSWQOs that are based on RCA will provide objectives consistent with Nahanni’s ecological integrity goals.

Two issues remain that make it difficult to determine if impacts to aquatic life in Nahanni are expected: toxicity and impacts of exceeding SSWQOs in the park.

Toxicity

The Nautilus Environmental⁸ Report identified that sub-acute chronic toxicity was present however the cause of the toxicity could not be quantified. The Nautilus report stated “*C. dubia* displayed a substantial reduction in reproduction ... These results suggest that the toxicity observed to cladocerans was from the Mill Water sample... This conclusion is supported by the fact that the full-strength Mine Water did not have any adverse effect on *D. magna*.”⁹ Further explanation was provided:

results to date have indicated that treated process (mill) effluent, rather than treated mine water (i.e., seepage from within the mine, which will comprise the majority of total effluent discharged) is the source of toxicity. Results also suggest that metals are not the primary source of observed toxicity in any samples, given effluent from which divalent metals have been removed using an EDTA column showed similar toxicity to waterfleas as effluent containing these metals. Currently, the laboratory suspects that the effect may be due to sulphate (which exhibits concentrations in undiluted effluent above thresholds known to affect waterfleas), or flocculants used during treatment (both were elevated in the simulated effluent). The elevated concentrations of sulphate and flocculant may be a result of insufficient aging of the pre-treated mine and mill process effluent (see Appendix F, Addendum F3), which is not representative of actual mine operations. Sufficient retention time for aging of pre-treated mine and mill process effluent in the Water Storage Pond will not be an issue once the mill is operational.¹⁰

These tests were repeated¹¹ and outstanding questions remain about the results:

- New treated water was used in these tests. The report states: “The new treated process water and treated mine water samples were prepared to be representative of operational mine treatment conditions.” What makes these samples more representative? How does the water quality of the new treated water relate to the previous treated water and how does that impact the predictions for water quality in Prairie Creek?
- The report indicates “During periods of low winter flows final effluent will consist only of treated mine water, which caused no effect on *C. dubia* at even 100% treated mine water.” Yet, Table 3 indicates treated mine water will be a part of the effluent for all months when effluent is released.¹²

⁸ April 6, 2011 “Toxicity Testing on Synthetic Effluent Samples: Final Toxicity Test Report” Nautilus Environmental. Vancouver BC.

⁹ April 6, 2011 “Toxicity Testing on Synthetic Effluent Samples: Final Toxicity Test Report” Nautilus Environmental. Vancouver BC. Page 8.

¹⁰ Page 5. Hatfield Consultants Memo, March 2, 2011 Subject: Prairie Creek Mine – Water Quality Benchmarks and Assessment of Potential Aquatic Effects.

¹¹ Hatfield Consultants Memo, May 11, 2011 Subject: Prairie Creek Mine – Supplementary whole effluent toxicity testing (Memo 7). Appendix J

¹² Appendix C: Water Balance, Water Quality And Regulatory Proposals. May 12, 2011.



The proponent compared the predicted Initial Dilution Zone (IDZ) with factors identified by the Canadian Council of Ministers of Environment (CCME) for consideration. One of these factors is “Conditions within the IDZ should not cause acute or short-term chronic toxicity to aquatic organisms”¹³. The proponent indicated the IDZ for Prairie Creek met this initial dilution zone criteria stating “Acute toxicity testing using simulated final effluent indicates no acute toxicity to *Daphnia magna* or rainbow trout at full effluent concentrations”¹⁴. However, in Appendix J, the proponent states “In conclusion, the compiled toxicity testing results indicate that the treated Prairie Creek mine effluent (process and mine water) will not result in any acute mortality within the IDZ and no sub-lethal effects outside the IDZ.” It is noted that chronic toxicity in the IDZ is not consistent with CCME guidelines. These results also create additional uncertainties regarding effluent toxicity and potential downstream effects on Nahanni.

Impacts of exceeding SSWQOs in the park

In the latest “best estimate” water quality predictions¹⁵, Canadian Zinc predicted water quality in Prairie Creek within Nahanni would have levels of cadmium, lead, selenium, zinc, mercury, ammonia, nitrate and sulphate exceeding SSWQOs based on the RCA approach. Below is a detailed analysis of the results with respect to mercury, which is predicted to exceed SSWQOs at low and average flows.

Mercury is one element of particular concern. A peer reviewed scientific article¹⁶ documented elevated levels of mercury in slimy sculpin body tissues immediately downstream of the Prairie Creek mine. The data reflected a 2.4 and 2.8 fold increases in mercury levels in fish tissues between the upstream reference site and downstream exposed sites. Analyses of these data showed that statistical differences in concentrations of mercury in sculpin at the upstream (non-exposed site) compared to the downstream near-field site and the far-field downstream site are close to being statistically significant ($p = 0.07$) but not statistically significant at probability of 0.05. Given low sample sizes inherent to the study by Spencer et al (2008), the lack of a statistical difference in concentrations of mercury in sculpin tissues among the upstream site, and the two downstream sites exposed to mining effluent from the Prairie Creek mine, is not surprising and likely reflects a sampling design used by Spencer et al (2008) that was not statistically powerful. Nevertheless, differences in levels of mercury in sculpin among these 3 sites is statistically significant at a probability of 0.10, which in many studies is used to assess statistical significance if a study design is known to be only moderately powerful. Moreover, the lack of statistical significance does not change the fact that average levels of mercury downstream of the mine were between 2.4 and 2.8 times higher than that above the mine, and does not preclude the possibility that these elevated levels are biologically significant, and are of potential concern as the mine transitions to full operation.

¹³CCME (2003). Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives. Page 38

¹⁴ Appendix E. Post Technical Meeting Responses. Hatfield Consultants Memo, May 9, 2011 Subject: Prairie Creek Mine – Initial Dilution Zone Characteristics (Memo 2)

¹⁵ Tables 49,53, and 57. Appendix C: Water Balance, Water Quality And Regulatory Proposals. May 12, 2011.

¹⁶ Spencer et al. (2008) (Integrated Environmental Assessment and Management, 4: 327-343)



Based on potential concerns related to mercury contamination of Prairie Creek due to the discharge of mercury from the Prairie Creek Mine, Parks Canada requested in the first round of information requests (Parks_Canada_33) that CZN clarify why details of their assessment of contaminant loads did not include an evaluation of a potential increase in loadings of mercury, and an evaluation of their potential environmental effects on biological communities in this system. The reply from CZN did not address this concern and reiterated that differences in mean levels of mercury among the three sites were not “statistically significant” at a probability of 0.05. This response did not address Parks Canada’s key concern, which centered on an evaluation of potential increases in mercury loadings and an evaluation of their potential environmental effects on biological communities in this system.

In the second round of information requests, further information on the impacts of mercury were requested, given that existing data has shown that slimy sculpin downstream of the Prairie Creek contain elevated average levels of mercury in their tissues compared to an upstream site, and that full mining operations are projected to increase loadings of mercury to Prairie Creek. CZN indicated in their response “that mercury in the receiving environment will be within the range of natural variability (i.e., less than the RCA-derived water quality objectives) therefore should not result in an incremental risk”¹⁷. However, mercury within the park predicted in Table 8¹⁸ is above RCA SSWQO for most low flows and average flows in October. New estimates were then provided after the technical meeting in April 2011 in Appendix C provided on May 12, 2011¹⁹, however mercury was once again predicted to be above SSWQOs for 7 months of the year at average flows and 9 months of the year at low flows. This includes a scenario where no process water is released into Prairie Creek in February and March.

Increases in levels of mercury discharged to Prairie Creek due to mining activities by Canadian Zinc could translate into increased rates of bioaccumulation of mercury in the Prairie Creek food web. It is requested that Canadian Zinc evaluate and assess this potential risk by completing an empirical model of this potential impact. Empirical modelling is a powerful tool that can be used to assess how changes in concentrations of mercury in water and sediments may influence rates of bio-accumulation in aquatic food webs. Empirical models are commonly used in scientific literature to explain variance in mercury levels in tissue of invertebrates and fish and other components of food webs based on physical characteristics of water and sediments and food web architecture. These modelling approaches include a diversity of simple regression and multivariate approaches or blends of the two, and provide opportunities to derive scenario models where insights on how changes in levels of mercury in water and sediment are projected to influence levels of mercury in stream life. An empirical model would provide a more scientific approach based on evidence than the qualitative description was provided by Hatfield Consultants²⁰ which summarized their opinions on the: i) Factors mediating bioavailability of mercury, ii) Mercury concentrations in Prairie Creek and mine effluent, and iii) Potential for increased bioaccumulation in Prairie Creek. Without a quantitative analysis, possible concerns related to increases in mercury levels in the Prairie Creek stream food web, including those related to

¹⁷ Page 3. Hatfield Consultants Memo, February 28, 2011 Subject: Hatfield Responses to Information Requests.

¹⁸ Page 26. Hatfield Consultants Memo, March 2, 2011 Subject: Prairie Creek Mine – Water Quality Benchmarks and Assessment of Potential Aquatic Effects.

¹⁹ Table 53, Appendix C: Water Balance, Water Quality And Regulatory Proposals. May 12, 2011.

²⁰ Appendix D Hatfield Consultants Memo, May 9, 2011 Subject: Prairie Creek Mine – Bioaccumulation of Mercury and Selenium in Fish (Memo 4)



possible human health issues due to consumption of fish from Prairie Creek are not adequately addressed. Therefore, issues related to potential effects of increased loadings of mercury due to mining activities in the Prairie Creek remain unanswered. As a result, it is not possible to determine if ecological integrity could be impacted; specifically, it is not possible to determine if the aquatic invertebrate and algal communities inside the park are predicted to be affected by the development and if they would remain characteristic of the natural region. Furthermore, as visitors to the park and Aboriginal people harvest fish downstream, it is not possible to determine if there would be impacts to this fishery and human health.

The number of parameters that do not meet SSWQO's based on the RCA approach at low and average flows of Prairie Creek and the lack of analysis of the impacts of those exceedances indicates that there is a potential for significant impacts to the ecological integrity of Nahanni.

Monitoring

Parks Canada believes that as part of the aquatic monitoring program, sites within the park should be monitored to assess the impacts of the development on the park.

Recommendation 8: Locations for monitoring aquatic effects include sites within the park. In addition we recommend a decision response system be established with thresholds.

Post-closure

Parks Canada has relied on the expertise of Indian and Northern Affairs Canada and Natural Resources Canada to assess the potential impacts of the paste backfill. We wish to highlight two issues from their conclusions.

1. Indian and Northern Affairs Canada identified a possibility that all tailings may not fit into the mine at closure, if conditions are not ideal. Two aspects of this finding are of concern to Parks Canada. First, planning for a best case scenario during operation results in a probability that unexpected scenarios will occur. Planning for a greater range of possibilities (as for example CZN does for water quality predictions downstream), would result in greater confidence in contingencies. Second, if predictions are wrong, the consequences are high, as no gradual additional mitigations can be put in place. In contrast, if predictions are expanded to include the possibility that additional waste rock is created, the pile could be easily expanded. In the case of placing tailings in the mine, if the predictions are wrong, there are no plans that address how to manage tailings outside the mine after closure. Given that alternative tailings storage options have not been identified and we do not know where all the tailings will be placed, the significance of the potential long term impacts of leachate from the mine on Prairie Creek and impact on the physical processes that influence aquatic ecosystems including aquatic invertebrate and algal communities (i.e., ecological integrity of Nahanni) cannot be predicted. Since Parks Canada's mandate extends from current to future generations, any ongoing leachate quality issues are a concern for the park.
2. Natural Resources Canada has identified that additional testing is needed to provide confidence in the predictions of water quality draining from the mine after closure. Given that once the paste backfill is placed in the mine, there are no mitigative measures that can be taken if predictions prove incorrect, additional testing is warranted. This gap in information does not allow for a prediction of the



significance of potential long term impacts of leachate from the Prairie Creek mine on the physical processes that influence aquatic ecosystems including aquatic invertebrate and algal communities (i.e., ecological integrity of Nahanni).

3.1.2 Conclusions

Questions and concerns remain about the impacts of the proposed mine on Prairie Creek and the ecological integrity of Nahanni as it relates to impacts on the physical processes that influence aquatic ecosystems including aquatic invertebrate and algal communities. Potential toxicity remains unexplained and unmitigated. The potential ecological impacts of mercury levels consistently higher than SSWQOs within Nahanni have not been described. Other elements will regularly exceed SSWQOs in Prairie Creek²¹. It is not known where all the leachate from the mine will come from after the mine is closed because of optimistic inputs to paste backfill models that describe paste quantities and low confidence in predictions of water quality draining from the mine post-closure.

Based on the information provided by the proponent, there is not confidence in the proposed approach to mitigate any potential significant adverse impacts to Prairie Creek's aquatic ecosystem and therefore the ecological integrity of Nahanni. Due to our concerns and uncertainty regarding the potential for significant adverse impacts, Parks Canada is unable to provide advice in relation to this to the Review Board.

4 Summary of Recommendations

Recommendation 1: After each spill, the proponent be required to report on the spill including the following information: factors contributing to the cause of the spill, corrective action that will be taken to minimize a similar set of factors occurring again, effectiveness of spill response, actions that will be taken to improve spill response based on this experience.

Recommendation 2: After each spill, adequate monitoring occur to assess the impacts and effectiveness of clean-up. If the spill occurs within the karst area, monitoring should occur for an extent appropriate to the potential of impacts in the karst system.

Recommendation 3: Monitoring of the approximately 10 km of road through the intense karst landscape will include the following:

- ***Initial recording of sinkhole features and other closed depressions would consist of specifically identifying, briefly characterizing and photographing each feature within***

²¹ Appendix A. Response to Commitments – Letter to David Harpley from Northwest Hydraulic Consultants. April 28, 2011.



a zone at least the maximum diameter of karst subsidence features in the area. Each feature would be mapped onto ortho-corrected, high resolution satellite imagery and given a unique identifier. The attributes of each feature, along with associated photos and other related data (date, category of sink hole, etc.) would be handled within a geographic information system. (Response to IR Round 1 Parks_Canada 9.3).

- ***Monitoring of sinkhole features and other closed depressions be carried out within a zone width that is at least the maximum diameter of karst subsidence features, by re-photographing the corridor and making an image comparison with the original image. (IR Round 1 Parks_Canada 9.3) Monitoring of formation and development of new sinkholes and caves by visual inspection, and monitoring of settlement within the karst area to assess if road operations are impacting the karst. Minimum frequency of visual monitoring should be twice yearly during times of limited to no snow cover.***
- ***Monitoring of surface water flow patterns (and potentially quantity) in the intense karst region adjacent to the road to assess if road operations are altering the natural drainage patterns.***
- ***Monitoring of surface water quality in the intense karst region to assess if road operations are altering the quality of water.***
- ***Monitoring of groundwater originating or passing under the intense karst region to assess if road operations are altering groundwater levels and background groundwater quality.***

Recommendation 4: Monitoring for invasive species should occur along the road corridor and any associated footprint of the development. The extent and design of this monitoring should be based on the biological attributes of potential invading species.

Recommendation 5: Post-closure, abandonment, and reclamation planning should incorporate findings of research on revegetation and reclamation conducted in the project area.

Recommendation 6: Management of traffic when wildlife are on/near the road will be detailed in the wildlife management plan, but will include:

- ***Stopping traffic when wildlife are within 50m to allow them to cross.***
- ***Only hazing when there is a danger to people or wildlife.***
- ***Hazing only carried out by specific trained staff.***

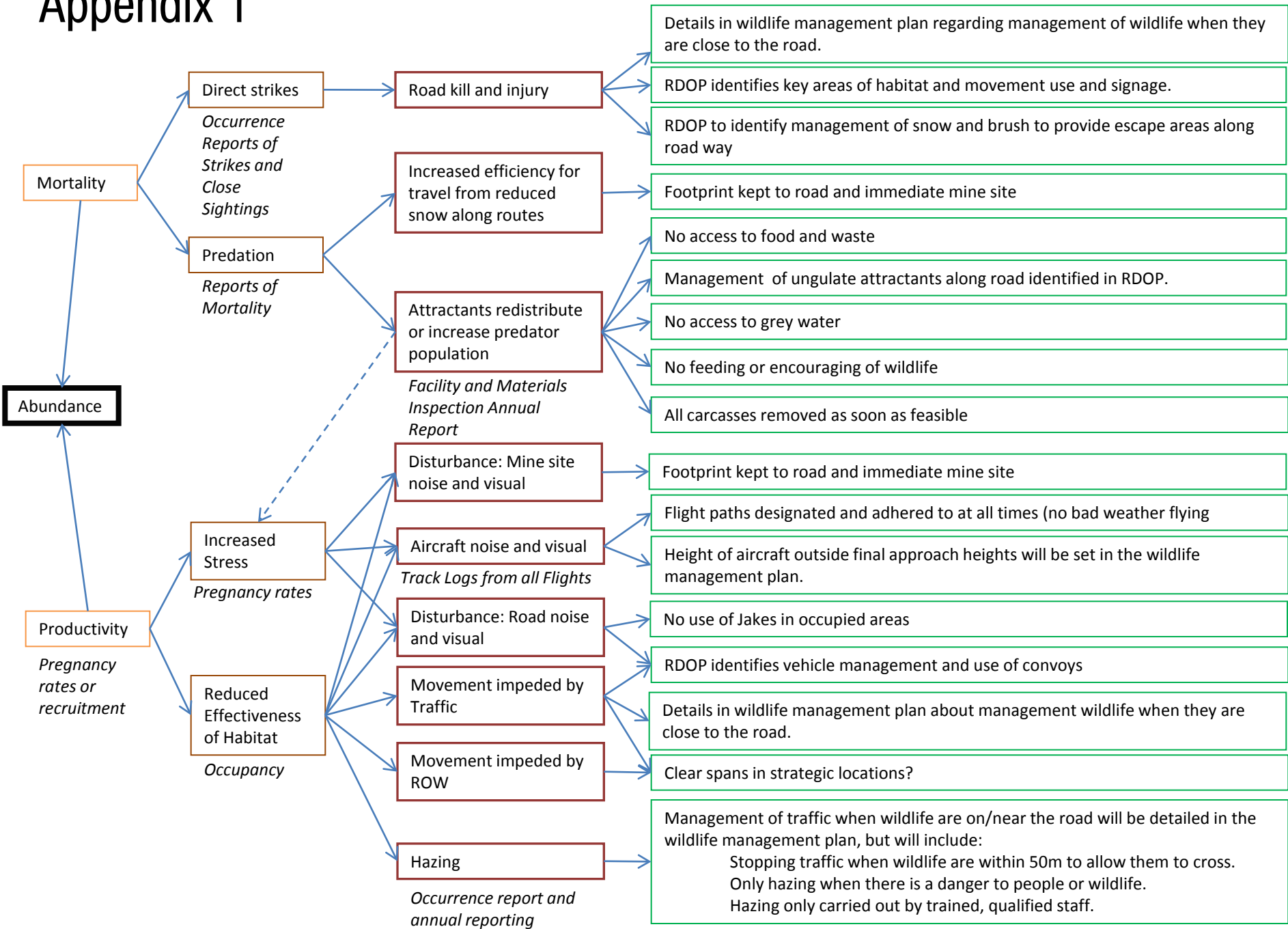
Recommendation 7: Monitoring of wildlife will include:



- ***Measures of Mountain Woodland Caribou distribution (e.g., site occupancy) and population vital rates (e.g., pregnancy rates) in the Prairie Creek watershed and along the road.***
- ***Wildlife interactions, observations, hazing etc.***
- ***Measures of moose distribution (e.g., site occupancy) along the road corridor east of Cat Camp in Nahanni National Park Reserve.***
- ***Wildlife attractant inspections including all storage facilities.***
- ***Track surveys and incidental observations for predators of caribou along the road and at the mine site.***

Recommendation 8: Locations for monitoring aquatic effects include sites within the park. In addition we recommend a decision response system be established with thresholds

Appendix 1



Appendix 2

Ecological integrity is defined in the *Canada National Parks Act* as follows:

"ecological integrity" means, with respect to a park, a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes.

In order to apply this definition within a given ecosystem, the abiotic components, native species and communities, and supporting processes need to be identified.

Prairie Creek Watershed

Aquatic ecosystems

It is expected that ecological integrity of aquatic ecosystems in the Prairie Creek watershed will be maintained when the following ecological management outcomes are realized at relevant ecological scales:

2. Non-native aquatic species are not introduced or allowed to persist in the park.

Note: This means that the ecological integrity of aquatic ecosystems in the Prairie Creek watershed will be maintained when mining and recreational activities do not result in the intentional or unintentional introduction of non-native species. If non-native species are introduced, management actions will be taken to remove them.

3. In the park, physical processes that influence aquatic ecosystems will operate within the natural range of variation.

Note: Physical processes include water flow, channel morphology, temperature and chemical processes and regimes.

4. Aquatic invertebrate and algal communities inside the park are characteristic of the natural region.

Note: Community structures that are characteristic of the natural region would also provide quality habitat for other species.

5. Habitat alteration, disruption and destruction inside or outside of the park in the Prairie Creek Watershed will not result in a permanent loss of habitat for bull trout, Arctic grayling and mountain whitefish.

Note: These fish species are highlighted because they are likely to move between areas in the Prairie Creek Watershed that are in and outside the park. Furthermore, their populations are likely to function across the whole Prairie Creek Watershed. Therefore, in order for the populations of these species in the park to remain healthy, their habitat must be protected both inside and outside of the park.

6. Fish population structures inside the park are within natural variation of the Greater Nahanni Ecosystem

Note: For example, human activities outside of the park, but within the Prairie Creek Watershed, will not affect the structure of bull trout, Arctic grayling and mountain whitefish populations within the park. These species are highlighted because they are likely to move between the park and the non-park areas. Furthermore, their populations are likely to function across the whole Prairie Creek Watershed. Metrics defining population structure include estimates of abundance and size distribution.

7. Important ecological functions and structure of riparian vegetation are unimpaired in the park.

Note: Riparian vegetation functions include providing shade, organic matter and woody matter to the stream. Riparian vegetation also maintains stable stream banks