CANADIAN ZINC CORPORATION

a wholly-owned subsidiary of NorZinc Ltd

POST-EA INFORMATION PACKAGE INCLUDING AN UPDATED PROJECT DESCRIPTION ALL SEASON ROAD TO PRAIRIE CREEK MINE

APPENDIX 15-1

SUBMITTED IN SUPPORT OF:

Water Licences MV/PC2014L8-0006, and
Land Use Permits MV/PC2014F0013

SUBMITTED TO:

Mackenzie Valley Land and Water Board
Yellowknife, NT X1A 2N7

Parks Canada,
Nahanni National Park Reserve
Fort Simpson, NT X0E 0N0

SUBMITTED BY:

Canadian Zinc Corporation
Vancouver, BC, V6B 4N9

February 2019

PRAIRIE CREEK ACCESS ROAD

ROAD OPERATIONS AND MAINTENANCE PLAN

FEBRUARY 2019

CANADIAN ZINC CORPORATION

Allnorth

TETRA TECH

Revision History

Revision	Description	Revised By (Initials)	Revision Date
0	Initial Version by Canadian Zinc Corporation	CZN	2012-05-01
1	Draft Version by Allnorth	Allnorth (WBM)	2015-08-24
2	Revised Version by Allnorth and Tetra Tech	Allnorth (EK), TT (TB)	2019-02-19

Review and Approval

The following signatures indicate that the undersigned have read and agreed to the contents of this document, and that they approve and accept its distribution and use.

Description	Authority	Signature	Date
Document Owner	David Harpley VP, Environment and Permitting Affairs		2019-02-19
Reviewed by: Full Name, Job Title			
Approved by: Full Name, Job Title			

Distribution List

This Plan and the most recent revisions have been distributed to:

Copy #1 –

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PLAIN LANGUAGE SUMMARY

This Road Operations and Maintenance Plan (ROMP) serves to outline the maintenance, monitoring, and response actions to be employed during operation of the Prairie Creek All-Season Road (ASR) leading to the Prairie Creek Mine (Mine). It provides management guidelines and approaches with respect to operation and maintenance activities for the Prairie Creek ASR.

The ROMP will be in effect for all personnel using the ASR following the completion of road construction until mining operations have been shut down indefinitely. It is Canadian Zinc Corporation's (CZN) policy to ensure that proper procedures are implemented and followed at all times to promote the safety of ASR users and wildlife in the area. This ROMP provides operational guidance on the following:

- Traffic Intensity along the ASR including the estimated operational life and number of trips expected per vehicle type per day.
- Liard River Trailer Transfer where loaded concentrate trailers will be swapped on either side of the river for transport onward to Fort Nelson, BC.
- Winter Operations including management of road operations during winter months where cold weather and potential avalanches are all factors to consider.
- Summer Operations including management of road operations during summer months such as barge operations, dust control, forest fires, increased wildlife, and rock falls are factors to consider.
- Barge Crossing at the Liard River during the summer months.
- Ice Bridge Crossings on the Liard River during the winter months.
- Security and Access Control to be implemented for public safety at the Liard River Crossing, including a manned checkpoint on the north side of the Liard River, motion cameras along the road alignment, and regular inspections to deter and monitor unauthorized activities.
- Road Rules and Regulations including commercial transportation use, off-highway use, speed limits, radio communication, traffic rights-of-way, vehicle inspections, and equipment requirements.
- Vehicle inspections, maintenance, and breakdowns related to ASR operations.
- Signage to identify speed limits, stop zones, kilometre markers, and special sections along the ASR including boundaries, confined watercourse crossings, wildlife crossings, down-grade sections, and hazard zones.
- Wildlife mitigations for avoiding interactions between vehicles and wildlife.
- Operation closures due to poor road conditions or unexpected hazards, poor road conditions.
- Emergency Shelters to be established at maintenance camps at KP 42, KP 87, and KP 120.
- Road Hazards including Avalanche Zones, Rock Fall Zones, and potential for Forest Fires.

Guidelines for maintenance of the ASR are also provided in this ROMP, including:

- Equipment availability and locations.
- Surface Conditioning and Updating such as road grading, snow removal, and right-of-way maintenance.

- Drainage and Watercourse Crossings maintenance for all bridges, ditches, and culverts.
- Barge Ramps including maintenance of running surfaces and repairs during low flow seasons.
- Borrow Pit maintenance per the individual Borrow Pit Management and Reclamation Plans.
- Dust Suppression, as required, during summer months when road conditions are dry.

Operational monitoring and adaptive management for the ASR also form part of this ROMP. Daily operational inspections and long-term monitoring are important for all infrastructure along the ASR, especially at watercourse crossings, rock fall zones, avalanche zones, and after hazardous events. Inspections may help to identify where additional rock fall and avalanche control mitigation is required. Operational closures of the ASR may be implemented following hazardous events, such as earthquakes or forest fires that pose increased risk to road users.

This ROMP builds on the existing CZN *Contaminant Loading Management Plan* for managing contaminant loading along the ASR. A contaminant monitoring program will be established and will include permanent soil and vegetation sampling locations adjacent to the ASR. Sampling locations will be distributed along seven transects perpendicular to the ASR, spaced at approximate intervals of 25 km. Samples will be collected annually along each transect, at offset intervals of 0 to 30 m, 100 m to 500 m, 501 m to 1,000 m, and 1,001 m to 9,000 m. Two plant species will be targeted for collection at each interval along with 1 soil sample for a total of 28 soil samples and 56 vegetation samples.

At each sampling location, a brief plant survey will be conducted to identify target vegetation species for collection. Once identified, composite samples will be collected, within a 20 m radius, consisting only of the above-ground (stems and leaves) portion of plants. Lichens will be sampled by collecting the entire thallus, while berries will simply be picked. Surface soil samples will be collected from mineral horizons to a depth of approximately 100 mm below the organic mat. The analysis of total metal concentrations in vegetation and soil will focus on a subset of the metals, chosen based on baseline metal concentrations found in soils and vegetation as well as metals found to be present in Prairie Creek ore. A comparison of data to baseline concentrations will be used to identify trends over time.

Contaminant sampling will be conducted during the summer on an annual basis for the first three years of haul operations to assess potential effects and establish contaminant trends. In subsequent years, samples will be collected from the same locations to assess changes over time. If trends over the first three years show no adverse effects from the ASR on soils and vegetation, the sampling interval may be reduced to every second year. After nine years, if adverse effects are still not recorded, the sampling interval may be reduced to every third year. Should the trend reverse, the sampling interval would revert to every year and response measures may be required to offset the adverse effects.

If an increasing trend in contaminants of concern is identified, response measures will be implemented based on three action levels. Action Level I occurs if annual concentrations are less than 20% greater than baseline concentrations and contaminant monitoring continues on an annual basis. Action Level II occurs if annual concentrations are more than 20% but less than 50% greater than baseline concentrations. The response is an internal review of concentrate handling and transport procedures resulting in corrective actions and additional mitigations to prevent further increases in concentrations. Action Level III occurs if annual concentrations are more than 50% greater than baseline concentrations and exceeds applicable guidelines. This will trigger additional sampling in the areas of concern to delineate the area of contamination both vertically and horizontally. After delineating the contamination, a response plan will be developed to review concentrate handling/transport procedures, implement new mitigation measures, increase contaminant sampling frequency, and remediate the affected area.

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ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
AHMP	Avalanche Hazard Management Plan
Allnorth	Allnorth Consultants Ltd.
ASR	All-Season Road
BC	British Columbia
BPMRP	Borrow Pit Management and Reclamation Plans
CALA	Canadian Association for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
CLMP	Contaminant Loading Management Plan
COC	Contaminants of Concern
CZN	Canadian Zinc Corporation
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
g	Grams
GNWT	Government of the Northwest Territories
JMSC	Journey Management System Coordinator
km	Kilometre
km/hr	Kilometres per Hour
KP	Kilometre Post
Mine	Prairie Creek Mine
m	Metre
mm	Millimetre
NNPR	Nahanni National Park Reserve
NT	Northwest Territories
Project	Prairie Creek Access Road
RCP	Road Construction Plan
ROM	Road Operations Manager
ROMP	Road Operations and Maintenance Plan
SCP	Spill Contingency Plan
TAC	Transportation Association of Canada
Tetra Tech	Tetra Tech Canada Inc.
WMMP	Wildlife Management and Monitoring Plan

GLOSSARY OF TERMS

Glossary of Terms	Definition
Bedrock	The consolidated rock (harder than 3 Moh's scale of hardness) underlying the Earth's surface. Bedrock can be encountered at depths ranging from the Earth's surface to hundreds of metres below, depending on the level of exposure to erosion.
Borrow Pit	Pit created to provide earth materials to be used as fill at another site.
Concentrate	Mineral concentrate containing Zinc, Lead, and Silver produced from the Prairie Creek Mine/Mill.
Cut / Fill	Construction practice in which earth materials are excavated from part of an area and used as fill in adjacent areas.
Freshet	Rapid rise in stream flow due to runoff from snowmelt during spring.
Q100	A design standard which accounts for maximum flow rates based on a 1:100-year flood scenario.
Pulaski	A special hand tool that combines an axe and an adze in one head.
Ripping	Ripping is a common practice to break up a road surface using a ripper attached to bulldozer. The ripping process helps to loosen up the road material, which is important for reclamation and revegetation processes.
Scarifying	Scarifying is the process of breaking up hard or compacted materials such as a gravel road, typically using the scarifier on a grader. Scarifying typically involves loosening up of the top 6 inches of a road surface.

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Canadian Zinc Corporation (CZN) and their agents. Allnorth Consultants Ltd. (Allnorth) and Tetra Tech Canada Inc. (Tetra Tech) do not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than CZN, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

This Road Operations and Maintenance Plan (ROMP) was prepared for Canadian Zinc Corporation (CZN) jointly by Allnorth Consultants Ltd. (Allnorth) and Tetra Tech Canada Inc. (Tetra Tech). This management plan serves to outline the operations, maintenance, monitoring, and response actions to be employed during use of the Prairie Creek All-Season Road (ASR) leading to the Prairie Creek Mine (Mine) from the Nahanni Butte Access Road, NT.

This ROMP will be updated as final road design and planning advance.

1.1 Company Name, Location, and Mailing Address

Company Name:
Canadian Zinc Corporation

Head Office:

Address:	Suite 1710 – 650 West Georgia Street, Vancouver, BC V6B-4N9
Phone:	+1.604.688.2001
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Prairie Creek Mine Site:
Iridium 9555 Satellite Phone 1 (yellow) 011.8816.315.30998
Iridium 9505A Satellite Phone 2 (black) 011.8816.315.30997
Iridium 9505A Satellite Phone 3 (orange) 011.8816.315.30996
Ground-To-Air Radio Handheld FREQ 122.800

1.2 Purpose

The purpose of this ROMP is to provide guidelines and approaches with respect to operation and maintenance activities for the ASR. It will be in effect following the completion of road construction activities until mine closure. The guidelines and procedures outlined in this ROMP are designed for all personnel using the ASR, to ensure that proper procedures are implemented and followed at all times to promote the safety of users and wildlife in the area.

This ROMP provides details on road operational and maintenance requirements, including:

- Summer and winter operations;
- Road rules and regulations;
- Signage;
- Wildlife;
- Road hazards (avalanches, rock falls, forest fires);
- Surface conditioning and updating;
- Drainage and watercourse crossings maintenance;

- Dust suppression;
- Infrastructure inspections; and
- Soil and vegetation contaminant monitoring.

This ROMP is a living document that will be updated throughout the life of the ASR to adapt and incorporate any changes to operations or conditions that may occur. Updates to this plan will also include results from ongoing engagement with the potentially-affected Indigenous groups, including the Nahanni Butte Dene Band, Liidlii Kué First Nation, and Dehcho First Nations, as well as all applicable regulators and land managers. A final ROMP will be completed after detailed design of the ASR and will be implemented prior to ASR operations.

1.3 Related Documents

This ROMP is linked to several other CZN management plans, including:

- *Health, Safety, and Emergency Response Plan;*
- *Avalanche Hazard Management Plan;*
- *Borrow Pit Management and Reclamation Plans;*
- *Explosives Management Plan;*
- *Invasive Species Management Plan;*
- *Permafrost Management Plan;*
- *Rare Plant Management Plan;*
- *Road Closure and Reclamation Plan;*
- *Road Construction Plan;*
- *Sediment and Erosion Control Plan;*
- *Spill Contingency Plan;*
- *Sundog Creek Diversion Plan;*
- *Traffic Control Mitigation and Management Plan;*
- *Waste Management Plan; and*
- *Wildlife Management and Monitoring Plan.*

Details of the ASR, including a schedule of road construction and operations, are provided in CZN's *Road Construction Plan* (RCP). A map book showing the access road is provided in Appendix A.

1.4 Regulatory Guidance

This ROMP was prepared with guidance from the following publications:

- Government of the Northwest Territories, Department of Transportation's *Guidelines for Safe Ice Construction* (GNWT 2015a);
- Government of the Northwest Territories, Department of Lands' *Northern Land Use Guidelines – Access: Roads and Trails* (GNWT 2015b);
- Government of the Northwest Territories, Department of Lands' *Northern Land Use Guidelines – Pits and Quarries* (GNWT 2015c);
- Transportation Association of Canada's *Guidelines for Development and Management of Transportation Infrastructure in Permafrost Regions* (TAC 2010);
- Government of the Northwest Territories, Department of Environment and Natural Resources' *Guideline for Dust Suppression* (GNWT 2013); and
- Canadian Council of Ministers of the Environment's *Canadian Soil Quality Guidelines for Protection of Environmental and Human Health* (CCME 1999).

2.0 PROJECT DESCRIPTION

CZN is planning to operate the Mine which is located at approximately 61° 33' north latitude and 124° 48' west longitude adjacent to Prairie Creek, a tributary of the South Nahanni River in the southwest corner of the Northwest Territories (Figure 1).

A 170 km all-season road (ASR) connecting the Mine, at Kilometre Post (KP) 0, to the Liard Highway via the Nahanni Butte access road (Figure 2) will generally follow the alignment of a previously permitted winter road, while reflecting the terrain, site characteristics, and road specifications suitable and preferred for the ASR. Approximately half of the proposed ASR (85 km between KP 17 to KP 102) is located within the Nahanni National Park Reserve (NNPR). The NNPR, a world heritage site, is known for its globally-significant karst terrain, as well as the South Nahanni River, a Canadian Heritage River. Approximately half of the access road alignment will directly overlap with the alignment of the permitted winter road. From the Nahanni Butte access road, the ASR crosses lowland terrain and the Liard River before passing through a gap in the Front Range (Grainger Gap), crossing the Silent Hills (Wolverine Pass), Fishtrap Creek, and the Tetcela River before ascending and crossing the Ram Plateau. Thereafter, the road enters the Mackenzie Mountains and follows Sundog Creek, Funeral Creek, and Prairie Creek to reach the Mine.

Construction of the ASR will take approximately three years to complete. Initially, a winter road will be built to gain access to the Mine, allow further investigation of the ASR alignment in order to complete detailed design, and to provide access for road construction. CZN's intent is to build the initial winter road along the ASR alignment as much as possible to minimize the total extent of disturbance

The ASR will cross approximately 17 major streams with clear span bridges or large diameter culverts, and 120 minor streams with culvert diameters ranging from 600 mm to 2,000 mm based on the size of the stream. Construction of the ASR will be supported by temporary camps at KP 23 (Drum), KP 42 (Cat), KP 65 (Ram), KP 87 (Tetcela), KP 120 (Grainger), KP 155 (Liard), and KP 176.5. The camps at KP 42, KP 87, and KP 120 will likely be retained in a reduced form to support on-going road maintenance.

Borrow pits have been identified all along the ASR route to provide material for the road subgrade (fill) and surfacing (gravel). Eighty-one borrow sources have been defined for use in road construction. Forty-nine are considered required, with another 32 as back-up in the event any of the 49 are subsequently found to be unsuitable. Eight of the 81 borrow sources may require blasting and/or crushing activities. Blasting may also be required along the ASR alignment at a number of locations such as KP 5, KP 23, KP 25 to KP 29, KP 32, and KP 36 to KP 37. Some of the surfacing borrow pits will be retained to support road maintenance. The remainder will be closed and reclaimed immediately after ASR construction. Most borrow sources are proximal to, or within, the road corridor while others will require short access roads.

Water sources will be utilized in winter for winter road construction and during summer for dust control. Water sources have been defined at KP 0 (the Mine), KP 39, KP 60 (Mosquito Lake), KP 70, KP 100, KP 121 (Gap Lake), KP 139, KP 141, and the Liard River. Winter water extraction from lakes will be conducted in conformance with regulatory water withdrawal protocols, limiting extraction to less than 10% of lake volume. Summer water extraction from lakes will similarly be limited to avoid significant water level drawdown and will be monitored using installed staff gauges.

2.1 Terrain Physiography and Vegetation

The proposed route of the ASR passes through a variety of natural regions including valleys, sub-alpine and alpine tundra, riparian alluvial habitat, open-forest parkland, muskeg, and mixed forest. The road alignment crosses terrain that includes discontinuous permafrost and karst, with the potential occurrence of thermokarst, sinkholes, debris flows, and thaw slumps, as well as rock fall, rock slides, and snow avalanches in mountainous terrain. The route is underlain by sedimentary rock sequences generally consisting of combinations of limestone, dolostone, siltstone, shale, and mudstone.

The road area is located primarily within the Taiga Cordillera and Taiga Plains Ecozones of the Northwest Territories and is characterized by several significant topographic features (e.g. Mackenzie Mountains, the Nahanni Range, and the Liard floodplain). This has resulted in an array of growing conditions, and consequently, numerous vegetation species assemblages. Wildfires occasionally occur in the region and have influenced forested ecosystems throughout much of the landscape.

2.2 Surface Waters

The main surface water basins crossed by the ASR alignment are, from west to east, Prairie Creek, Sundog Creek, Tetcela River, Fishtrap Creek, an unnamed creek, Grainger River, and the Liard River (Figure 2).

Seasonal hydrological characteristics of the various larger streams crossed by the ASR generally mirror the pattern of Prairie Creek, for which there is a good and lengthy record. Higher monthly flows occur in the spring and summer coincident with freshet and summer storms. The annual low flow month is typically March when flows are approximately 50 times less than in June. Peak flows observed in the area occur during intense summer rainfall events. Freeze-up usually begins in mid-October, and spring thaw in mid-April.

2.3 Fish and Wildlife

Both bull trout and mountain whitefish spawn in Prairie Creek upstream of the mine site, the former most likely in Funeral Creek. Arctic grayling is known to inhabit lower Prairie Creek and many other creeks and rivers in the area. Bull trout have not been found east of the Prairie basin. In total, there are 13 stream crossings along the ASR alignment where the presence of fish has been confirmed or is suspected.

Wildlife species at risk or maybe at risk that are potentially present along the ASR corridor include boreal woodland caribou, northern mountain woodland caribou, wood bison, grizzly bear, and collared pika. In addition, five bird species at risk occur or may potentially occur in the area including Peregrine Falcon, Short-eared Owl, Common Nighthawk, Olive-sided Flycatcher, Bank Swallow, and Canada Warbler.

Additional wildlife species that have known distributions along or near the ASR include Dall's sheep, moose, and furbearers (including grey wolf, beaver, marten, and wolverine). A number of waterfowl species, including Trumpeter Swan, frequent the area of the ASR alignment; the Project area contains habitat for breeding and/or staging for short periods during annual migration. In addition to waterfowl, raptors are expected to occur and nest near the entire ASR alignment, and documented occurrences include Golden Eagle, Bald Eagle, Peregrine Falcon, American Kestrel, Red-tailed Hawk, Northern Harrier, and Gyrfalcon.

3.0 ROAD OPERATIONS

Although the Prairie Creek ASR will be constructed as an all-season road, seasonal crossing constraints at the Liard River, combined with potential spring load restrictions on the Liard Highway (NWT Highway 7), will temporarily restrict hauling operations.

The majority of traffic on the ASR will be concentrate haul and back-haul trucks. All concentrate will be hauled in sealed containerized units, two per Super B style tractor-trailer. The concentrate haul will be split into two hauls, served by one fleet based at the Mine and another based in Fort Nelson, BC. The hauls will meet at the Liard River crossing and exchange trailers, after which the tractors will return to their home bases. The reasons for this are that the tractors are optimally set-up differently for the different roads (gearing, tires), and there are safety and job satisfaction benefits for drivers operating on one type of road and returning to their 'base' each night. There will be a check-in and check-out process. Prior to the daily haul commencing, maintenance crews and Environmental Monitors will leave in advance to confirm road conditions and advise the Journey Management System Coordinator (JMSC).

Concentrate trucks will conduct hauls in one or more convoys. Adequate space between units will be made to allow for adaptation of driving and safe travel. Scheduling of conveys will facilitate passing by on-coming traffic.

3.1 Traffic Intensity

The ASR's operational life is nominally 20 years, based on 17 years of supplies and concentrate hauling and 3 years of closure and reclamation. Table 1 below summarizes the estimated number of round trips per day by vehicle type during the normal operational period.

Table 1: Estimated Number of Vehicle Trips

Vehicle Type	Number of ASR Trips per Day
Super B Concentrate Truck	15 - 20
Conventional Tandem Tractor-Trailer	1
Fuel Tandem Tractor-Trailer	1
Light Vehicles (pickup truck)	6
Maintenance Equipment (graders, backhoes)	2
Special Deliveries	1 - 2

3.2 Liard River Trailer Transfer

The concentrate will be transported from the Mine to Fort Nelson for transfer (loading) onto rail cars. The total round-trip cycle time is anticipated to be up to 24 hours. Trailer transfer will occur at the Liard River crossing, where tractors from Fort Nelson and the Mine would switch trailers. There will be no handling of concentrate as the trailers will utilize sealed containers. Loaded concentrate trucks from the Mine would drop off loaded trailers, switch, then return to the Mine with mostly empty trailers, apart from some supplies, such as bulk diesel fuel.

Trailer transfer may occur on either side of the Liard River, and the preferred side may differ by season. For example, in summer, it may be preferable for the transfer to occur on the north side so that concentrate trucks are not delayed at the barge crossing. In winter, concentrate trucks can cross the river via the ice bridge, and trailer transfer may occur on the south side.

3.3 Winter Operations

Winter operations will typically commence in early January after the Liard River ice bridge is established and will extend into early to mid-April, after which the ice bridge cannot be sustained. Considerations associated with winter operations include:

- Less daylight;
- Cold weather risks (e.g. breakdowns, unexpected road closures);
- Avalanche potential; and
- Poor traction and slippage.

3.4 Summer Operations

Summer ASR operation would commence once a barge crossing of the Liard River is established. The barge will be capable of transporting two Super B-style tractor-trailers at one time. Additional considerations associated with summer operations are:

- Barge operations;
- Potential for dust;
- Forest fire hazard;
- Road base deterioration (thaw, rainfall);
- Possible public use of the road;
- Increased wildlife activity;
- Increased level of road maintenance for required road repair; and
- Rock fall hazards in mountainous sections.

3.5 Barge Crossing

The Liard River summer crossing will be located at a section of the river which is relatively narrow. The north side has deeper water and the bank is steeper. The south side has shallow water and bank. To accommodate this, the loading ramp on the south side will extend further out to support low water barge operation. The base of the ramps will be constructed with coarse, angular rock, capped with a coarse rock surface. A prefabricated concrete mat embedded into the running surface will be considered for long term stability and traction. Barge operations will comply with the applicable Transport Canada regulations.

3.6 Winter Ice Bridge

The location of the winter ice bridge crossing will be 1.5 km downstream from the summer barge crossing. A winter-only access road will be constructed annually along the exposed riverbank parallel to the tree-line connecting the ice bridge crossings to the north and south barge ramps. The road structure will be constructed from ice and snow.

The construction and monitoring of the ice bridge will be completed under the direction of a qualified professional. A number of publications regarding the safe construction and operation of winter ice bridges are available such as the GNWT's *Guidelines for Safe Ice Construction* and Alberta Transportation's *Best Practice for Building and Working Safely on Ice Covers in Alberta*. As ice bridges are commonly used in the Northwest Territories, it is expected that local technical expertise is readily available.

Some key points in the construction and operation of an ice bridge are:

- A minimum of 480 mm thickness of "Clear / Blue / Black" type ice;
- Two methods can be used for strengthening ice: snow removal; and flooding snow cover;
- 30 m to 45 m or greater cleared width, wider to extend the operating season;
- Mark the operating edges of the road;
- Preferred operating speeds are below 8 km/hr and a maximum of 15 km/hr;
- Limit of one vehicle crossing at a given time;
- No stopping or parking on ice above water (i.e. excluding the river banks); and
- Regular use heavy commercial vehicles equipped with emergency escape hatches are recommended.

3.7 Security and Access Control

Once connected to the Nahanni Butte access road, the ASR will be a public road and access cannot legally be denied; however, access to the ASR through the Liard River crossing staging areas, which will be under lease agreements, can be legally restricted.

CZN intends to restrict public access through its leased property as a means of discouraging public traffic on the ASR. Additional measures to prevent unauthorized access and promote public safety, include:

- Liard River barge only available to authorize mine traffic;

- A manned checkpoint will be operated on the north side of the Liard River to record entry and exit of personnel utilizing the road, and to discourage public use;
- Motion cameras with alarm relays will be used to monitor the ASR when the checkpoint is not manned; and
- Road inspections and reporting by the Road Operations Manager (ROM), including any suspicious activity along the road corridor.

3.8 Road Rules and Regulations

Below is a summary of the road rules and regulations applicable to the Prairie Creek ASR:

- Obey all traffic signs and posted speed limits;
- Road users must be aware of speed reduction zones;
- Road users must follow radio call procedures;
- Operate vehicles defensively at all times;
- Road users to acknowledge and obey the vehicle type priority for right of way;
- Give wildlife the right of way and maintain safe distances until all clear;
- Report all wildlife sightings in accordance with CZN's *Wildlife Management and Monitoring Plan* (WMMP);
- Use of engine retarders for braking is discouraged but not prohibited since some road sections contain steeper portions, and drivers should retain the option to use any form of braking if necessary for safety;
- Be alert for public and other road users;
- Mandatory daily vehicle inspections;
- Vehicles to be equipped with applicable safety gear;
- Vehicles to be equipped with required fire tools and fire extinguisher;
- Report all incidents and road hazards immediately;
- Be observant for avalanches in winter and rock fall in summer;
- Mandatory chain up sections for commercial vehicles during winter operations at specified locations;
- All traffic must adhere to posted rules and follow barge crew directions;
- Only pass when lead vehicle yields at pullout and gives "all clear"; and
- Absolutely no littering or feeding wildlife.

3.8.1 Commercial Transportation Regulations

The national safety code hours of service will apply to drivers who are operating on a provincial and/or territorial highway system. Based on the expected operation, drivers operating on the provincial highway infrastructure from Fort Nelson to the ASR will be required to operate within these parameters. Identified below are the basic conditions which those operators must conform to:

- Maximum of 14 hours on duty;
- Maximum of 13 hours driving per day;
- Maximum of 70 hours on duty per week; and
- Minimum of 36 hours off every seven days (reset cycle).

The requirement of the reset on day six or seven (subject to accumulated hours) may require an additional driver per shift. This additional driver would augment the crew by covering off for the driver that is re-setting on any day. In addition, the schedule can be created to ensure that the drivers are staggered for their reset days.

3.8.2 Off-Highway Operations

The ASR is an off-highway industrial road. The National Safety Code hours of service do not apply to off-highway operations where the haul unit is not in contact with a municipal or territorial operated road system; however, CZN will operate the off-highway portion based on the National Safety Code regulations.

3.8.3 Vehicle Maintenance and Inspections

All mine-related vehicles (CZN and contractors), operating along the ASR, are required to complete daily vehicle inspections prior to operations. These inspections are to include:

- Requirements for commercial vehicles, as per the National Safety Code, and provincial and territorial Motor Vehicle Acts, which includes an up-to-date log book;
- Brake checks, lights, and tires;
- Oil and fluid levels and potential leaks. Notable oil/fluid leaks will be repaired immediately;
- Annual Commercial Vehicle Inspection/Certification;
- Required safety supplies, firefighting tools, and spill kits;
- Operations communications;
- Use of drip pans when vehicles are parked;
- Applied wheel blocks for parked heavy commercial vehicles; and
- Fueling restricted to approved fueling locations that are a minimum 100 m from water bodies, fens, and wetlands.

3.8.4 Mechanical Failures

If a vehicle experiences mechanical failure on the ASR route, the following procedures will apply:

- If possible, stop vehicle at designated pullout or other suitable location so as not to block ASR operations;
- When safe to do so, inspect/diagnose the nature of the failure;
- Communicate the location and nature of the problem with other road users, the JMSC, ROM, and maintenance crews and seek assistance;

- If possible and safe to do so, park the vehicle at a preferred location, such as a designated maintenance camp (KP 42, KP 87, or KP 120) and wait for further assistance; and
- If the vehicle experiences a fluid leak, apply measures as per CZN's Spill Contingency Plan.

3.8.5 Speed Limits

Speed limits will be posted along the ASR and enforced. Maximum speed limits will be posted for optimum driving conditions. Employees will be required to drive to road conditions and not endanger themselves or others in inclement weather or adverse driving conditions.

Table 2: Access Road Operating Speed Limits

Road	Speed
Phase 1 (Winter Road)	30 km/hr (with 20 km/hr Speed Restricted Zones)
Phase 2 (All-Season Road)	40 km/hr (with 20 km/hr to 30 km/hr Speed Restricted Zones)

3.9 Signage

Exact locations for all signage, and the nature of the signage, will be determined during detailed design and further reviewed by the ROM before traffic is cleared to use the road. Signage is expected to be applied at the following sections:

- Intersection of the Nahanni Butte Access Road, specifying "*Industrial Road Used by Heavy Vehicles – Use Road at Own Risk";* "*Road Use Restricted to Authorized Vehicles after 14 km*"; and "Entering traditional land of NDDB – No Hunting";
- Boundary of the staging area south of the Liard River "*Entering Canadian Zinc Corporation Lease Area, Road Use only by Authorized Vehicles, Access Denied to Unauthorized Users*";
- All bridge and confined watercourse crossing locations;
- Generally posted speed limits (30 km/hr or 40 km/hr) throughout;
- Speed reduced sections (20 km/hr or 30 km/hr);
- Known wildlife presence or crossing areas (once this data is available);
- Rock fall or avalanche zones, specifying "*No Stopping*";
- Any 'must call' locations;
- Long, sustained down-grade sections (e.g. gearing down between KP 11 to KP 17);
- Chain on/off stations;
- Turn around locations;
- Stop Signs – Intersection with Nahanni Butte Access Road; and

- Kilometre marker signage at 1 km intervals.

3.10 Wildlife

There is a potential for wildlife occurrence along the ASR. Minimizing the potential for collisions is clearly desirable, both between vehicles and with wildlife. All road users should be aware of the potential for wildlife presence, and to use common sense and take appropriate precautions to avoid incidents. Wildlife have priority at all times. If any Species at Risk (e.g. woodland caribou) are on the road, vehicles are to stop until the animals have moved a safe distance away or are no longer visible. The use of engine retarders is discouraged to avoid wildlife disturbance.

The following key wildlife mitigations for road operations and maintenance are defined in the WMMP:

- Wildlife advisory system to communicate and alert nearby road users that wildlife are on, or visible near, the road via radio so that extra precautions and or avoidance can be taken. Sightings of caribou, Moose, Dall's Sheep, Wolverine, Grizzly Bear, Wood Bison, Trumpeter Swan to be reported to CZN's Environmental Monitor to be recorded and road-wildlife interactions monitored for possible adaptive management.
- If Caribou, Moose, Dall's Sheep, and Wolverine reported beyond 500 m of the road footprint, traffic speeds are to be reduced to half the posted speed limit within 1 km of the sighting or as soon as the animal is sighted.
- If Caribou, Moose, Dall's Sheep, Mountain Goat, Grizzly Bear, and Wolverine reported on the road or within 500 m of the road footprint, traffic or activity will cease at least 500 m from (or at first observation of) the animal(s) and all headlights turned off until the animal moves off at least 100 m or 5 minutes after last visual. Once traffic resumes, speed reduced to half the posted speed limit within 1 km of the sighting.
- Policy giving all wildlife the right of way if crossing or attempting to cross the road, which obligates drivers to stop (when safe to do so) for all wildlife seen on or immediately adjacent to the road, giving wildlife the opportunity to move off. Headlights are to be turned off.
- All employees/contractors are to remain in their vehicle or shelter if harvested wildlife species are observed on or near the ASR.
- Reporting and evaluating wildlife sightings along the access road, and if a problem area is identified such as frequent wildlife encounters, corrective management options for traffic and road-related activities will be considered.
- Control of tree and shrub growth within the proposed right of way will be conducted using mechanical methods (such as a brush mower). Herbicides and/or other chemical means of vegetation control will not be used.
- Do not use salt for road maintenance to avoid potential wildlife attraction to the road.
- Maintain snow removal practices approved for the winter road to manage high snow banks (e.g. less than 1 m high) and create breaks in snow berms (e.g., berm breaks every 500 m), so that wildlife can readily move off the road and through breaks as vehicles approach and aircraft flyover.
- CZN's Environmental Monitor to report all big game and species-at-risk accidentally killed or seriously injured as a result of the ASR to Parks Canada or a GNWT Environment and Natural Resources Officer within 24 hours, per *Wildlife Act* Regulations.
- CZN will develop a more formal, detailed approach to identifying and communicating seasonal "wildlife caution zones". Road operations will be controlled using a JMSC. This system will include driver journey and

incident logs which are compiled, and wildlife sightings logged. Sightings will include the nature of the sighting and the location based on landmark and KP. The information will be noted by the driver at his next stop, and possibly by radio dispatch if animals are proximal to the road. Once a trend has emerged (which may occur over a few weeks), it will be discussed at pre-travel tail-gate meetings. Once an occurrence becomes common in terms of location, the road operations Supervisor will consider formalizing the caution zone with signage, although drivers will already be aware, and will have received instructions regarding caution. Road maintenance crews and environmental monitors will also be on the road, and they will also record wildlife sightings and provide the records for collation.

Additionally, the following wildlife mitigations apply for each noted species:

- Birds:
  - Right of way brushing should occur outside of the bird nesting window. Mowing is not allowed in any wetlands when conditions are dry.
  - Options such as avoiding, adapting, rescheduling, or relocating activities, will be considered and implemented if there are indications of migratory bird nests where disturbance activities that have the potential to disturb or destroy nests are proposed.
  - All disruptive activities in the nesting area will be halted if migratory bird nests containing eggs or young are discovered.
  - The absence of nesting avian species at risk (and other migratory birds) will be confirmed in borrow, sand, and gravel pits prior to commencing disruptive activities during the general nesting period (May 1 to August 20). If work commences, monitoring for the absence of nests at borrow and gravel pits will continue throughout activities.
- Pikas:
  - Should pikas occupy a proposed borrow source or portion thereof, prior to use, a replacement borrow source or an unoccupied portion of the same source (as some sources are large) will be selected for use (after confirming that no pikas occur within a sufficient buffer distance identified by a biologist).
  - Prohibit the storage of snow, including along roadside snow banks, on or within 10 m of talus habitat (within pika range).
- Trumpeter Swans:
  - Pumping water from ponds occupied by Trumpeter Swans is prohibited during nesting season.
- Wood Bison:
  - Cease barging activities if Wood Bison are observed crossing the river near the barge location.
  - If Wood Bison are reported on or near the road, traffic speeds are to be reduced to half the posted speed limit within 1 km of the sighting or as soon as the animal is sighted.

3.11 Operational Closures

The ASR corridor traverses a variety of terrain from low valleys to mountainous terrain subjected to sudden weather changes in a northern climate. Operators must:

- Report any potential road hazards or poor road conditions which can limit or restrict transportation activities;

- Be observant of weather changes and adjust plans as required;
- Short term closures up to several hours are possible when in transport. Vehicles are to stop and park at appropriate locations and hold;
- During long-term or unscheduled closures, return to base via defined turnaround locations or wait at emergency shelter locations; and
- Upon notice of road closures, all traffic at the Mine or the Liard crossing, must hold until “all clear” is confirmed.

3.12 Emergency Shelters

Temporary emergency shelters will be maintained at the maintenance camps at KP 42 (Cat), KP 87 (Tetcela), and KP 120 (Grainger). These camps will be able to accommodate up to six personnel to support maintenance crews and to act as an emergency shelter for unscheduled road closures or vehicle breakdowns. Camps will be equipped with food rations, drinking water, and restroom facilities.

3.13 Road Hazards

3.13.1 Avalanches

Sections of the winter road and ASR are in steep mountainous terrain and have been identified to be at risk from avalanches. Avalanche assessments have been carried out and an *Avalanche Hazard Management Plan* (AHMP) has been developed. The AHMP should be consulted for details, but the following key items will be implemented to safe guard road users against the effects of avalanches:

- All road operators will receive a site access orientation prior to operating vehicles on the access road in winter and early spring which will include specific reference to access through avalanche terrain;
- Personnel working in avalanche prone areas during periods of snow will receive prior advice on current risks from a member of the avalanche management team;
- “No Stopping” signs will be installed at predetermined locations during avalanche season; and
- Proper protocols will be implemented in the event of road closures due to any active avalanche management and control.

3.13.2 Rock Falls

Some portions of the ASR, between KP 0 to KP 40, are located below rock faces or at the base of talus rock slopes which have the potential for rock falls. The following approaches will be implemented:

- Annual inspections during spring of susceptible slopes with mitigation actions taken as directed by professionals;
- Review the adequacy of rock fall protection measures after completion of the ASR design and prior to road construction, notably between KP 14 to 15.5 and KP 16.5 to KP 17.0;
- “No Stopping” signage will be installed along the ASR sections that are prone to rock falls;
- Daily inspections of high-risk rock fall areas will be conducted by road maintenance staff; and

- Significant rock falls along the ASR will be immediately reported to the ROM for action.

3.13.3 Forest Fires

Forest fires can occur in summer, potentially in close proximity to the ASR. Transportation operations may be suspended accordingly. Any suspicious looking smoke or fire will be reported to the ROM.

Road users should also take care to not start forest fires (e.g. properly disposing of cigarettes). All CZN trucks will be equipped with basic fire-fighting equipment including a fire extinguisher, shovel, and Pulaski.

4.0 ROAD MAINTENANCE

4.1 Equipment and Maintenance Supplies

Personnel, graders, dump trucks, backhoes, and excavators will execute the daily road maintenance and inspections of the ASR. It is expected that graders will be located along the route to maintain the road surface to ensure efficient, safe transport of materials to and from the mine site. During winter operations, plow/sand trucks, graders with ice blades, and possibly wheel loaders or dozers will be employed to keep the ASR operational and safe.

The Prairie Creek Mine site will serve as the main base for maintenance crews and supplies. The maintenance camps at KP 42, KP 87, and KP 120 will act as support centers for ongoing maintenance. These maintenance camps will be self-contained and able to support up to six personnel. Each camp would be stocked with basic road maintenance supplies, such as:

- Hand tools, chainsaws, portable generators, and limited fuel storage;
- Firefighting tools;
- Standard erosion and sediment control materials;
- Large spill kits; and
- Culvert sections and components.

The Tetcela Camp (KP 87) will host additional heavy equipment such as a rubber-tired loader, excavator, bulldozer, and self-contained hot water/steam culvert thawing unit. In addition to the maintenance camps, a spill kit, basic hand equipment, fire tools, and heavy equipment will also be located at the Liard River Trailer Transfer.

4.2 Surface Conditioning and Updating

The frequency of routine grading and conditioning of the running surface of the road will vary based on:

- Condition of surfacing material;
- Weather, including temperature, precipitation, and season; and
- Traffic in less than optimal road conditions.

A newly constructed road can take several years or more for the fresh subgrade/surface to stabilize. It is expected that at some locations or segments, the road subgrade and/or surface may show signs of degradation, and therefore maintenance improvements may be required to maintain a safe and efficient road system.

4.2.1 Summer Program

The summer maintenance program will include:

- Grade road running surface, as required;
- Apply water to road surface for dust suppression for safety and/or grading, as required;
- Monitor all major and minor watercourse crossings to ensure full capacity;
- Monitor ditches and established drainage systems to ensure full operation and capability, including ditch restoration and cleanout;
- Maintain all major bridge crossings and approaches;
- Inspect bridge decks, rails, and safety berms for defects and repair as required;
- Ensure all proper signage is visible and maintained;
- Identification of problematic road sections requiring upgrading or improvements;
- Maintain proper line of sight which may include right of way brushing;
- Routine safety and operational inspections of the Liard River barge and the river crossing approaches;
- Monitor all erosion and sedimentation infrastructure established during the road construction process;
- Monitor and repair defective road subgrade/surfacing segments and culverts as required; and
- Monitor all potential rock fall sections (see Section 4.7 below).

4.2.2 Winter Program

The winter maintenance program would include:

- Routine snow removal, grading, and sanding of the running surface, as weather and conditions demand;
- Managing snow banks with adequate frequency breaks, allowing wildlife to readily move off and escape the roadway;
- Monitor all culvert crossings to ensure full capacity, especially prior to break-up. Ice blocked culverts to be flushed with self-contained hot water/steam culvert thawing unit;
- Monitor ditches and established drainage systems to ensure full operation and capability. This may include de-icing and clean out of culverts to ensure future capacity;
- Maintain all major bridge crossings and approaches;
- Ensure all proper signage is maintained and fully functioning;

- During questionable weather systems, an increased level of road surveillance will be applied to assess road conditions and safety implications;
- Monitor and maintain the Liard River ice bridge; and
- Monitoring of potential avalanche zones (see Section 4.8 below).

4.2.3 Non-Operational Periods

During the periods when the ASR is not operational, necessary maintenance will be applied as required to:

- Ensure all drainage crossings structures are functioning;
- Minimize risk to road structure due to weather and dysfunctional drainage within the road right of way;
- Minimize risk to environment caused by dysfunctional drainage systems leading to possible increase in siltation levels; and
- Maintain monitoring of general road conditions, road access, and the environment.

During non-operational periods of the ASR, larger upgrades and improvements can be completed to avoid disruption during operable periods (i.e. culvert replacements, bridge deck maintenance).

4.3 Drainage and Watercourse Crossings

All watercourse crossing structures, major and minor, have been designed for Q100 flows (a flooding event where maximum flow rates are a 1:100-year flood scenario). Generally, the minimum culvert size is 500 mm (600 mm for streams), with some exceptions where shallow bedrock restricts diameter sizes.

4.3.1 Major Watercourse Crossings

The ASR has 17 major watercourse crossings, including 12 bridges, 3 large multi-plate culverts, 1 open bottom arch culvert, and 1 river barge crossing at the Liard River. Routine maintenance of major watercourse crossing structures will include:

- Ongoing removal of debris naturally occurring or associated with beaver activity to ensure full functionality of structure and protect the environment;
- Replacement of defective signage and bridge delineators;
- Cleaning of bridge decks as required. Debris to be removed and disposed at appropriate location (not to be cast off bridge); and
- Inspection of bridges for deck and guard rail deficiencies, as required.

4.3.2 Minor Watercourse Crossings

Over time and during heavy spring freshet conditions, culverts can be subject to debris and material loading, especially in the early years of operation. Routine maintenance of minor watercourse crossing structures will include:

- Monitoring of general road drainage, ditches, water drainage, and culverts;

- All culverts will be cleaned out as required depending on the debris flows seen each year, to maintain functional drainage;
- Annual clean-out of inlets of culverts may be required in low flow periods (late summer, fall) to ensure full capacity;
- Replace malfunctioning or damaged culverts, when safe to do so;
- Install additional cross drainage culverts as necessary to minimize unnecessary ponding of water along roadside and maintain natural drainage patterns; and
- Ongoing removal of debris naturally occurring or associated with beaver activity.

4.3.3 Fish Bearing Stream Crossings

Maintenance crews will apply additional attention to crossing structures on fish bearing streams. The approach will include:

- Regular inspections;
- Removal of debris from within the right of way which might otherwise be carried into the stream and may impede fish passage through the crossing structure; and
- Consider future site improvements at problematic crossings.

4.4 Liard River Barge Ramps

It is expected that the barge ramps will take several years for the settlement of the rock bases to stabilize. Additional material will need to be placed on the structures over this period. The following maintenance will also be completed on the barge ramps:

- Routine inspections of the running surface for wear and durability and structural integrity;
- Completion of necessary repairs when safe and opportune; and
- Completion of any more significant repairs or improvements during low flow seasons (fall/winter), with suitable weather conditions, to minimize operations and siltation issues.

4.5 Borrow Pits

A number of the borrow sites will be maintained through the life of the project as supplies of aggregate for maintenance and repairs to the road system and road sanding in winter. The selection of these sources will be subject to the geotechnical investigations and logistics considerations. Borrow Pit Management and Reclamation Plans (BPMRP) will be completed for each borrow pit. The BPMRPs will conform to the GNWT's *Northern Land Use Guidelines – Pits and Quarries* guidebook and standard best practices. The borrow sources and access roads that will no longer be needed after construction will be progressively reclaimed in accordance with each BPMRP.

The following approach will be applied for active borrows:

- Follow the borrow BPMRP;

- Borrows must be excavated to deflect surface water drainage away from natural bodies of water, into natural, environmentally neutral locations which allow settling and filtering of sediment;
- Borrows will be developed to avoid surface water ponding, unless previously approved in the BPMRP;
- Employ industry standard best practices to minimize airborne dust. All water will be extracted from approved sumps and sources to support dust management;
- Avoid deflecting surface water to areas influenced by permafrost;
- Ensure cut and fill slope angles are stable and safe, adhering to the BPMRP;
- A sign will be posted at entrance warning of risks;
- Follow safe work practices when working in and around the borrow area, as per the BPMRP; and
- Any borrow pits incorporating tall cut slopes, or those adjacent to environmentally sensitive areas, will be monitored for any evidence of slope instability during excavation operations. If any evidence of slope instability becomes apparent (tension cracking, sinkholes, sloughs etc.), operations will cease until the slope's stability and safety can be further assessed. If any slope is deemed to be unstable, a mitigation plan to resolve the issue will be developed.

4.6 Dust Suppression

During dry periods, increased levels of dust may occur. Dust suppression for the ASR will be conducted in conformance with the GNWT's *Guideline for Dust Suppression* (GNWT 2013), which is included in Appendix B. Maintenance crews will operate water trucks as required to suppress dust when unacceptable conditions prevail. Dust suppression agents (calcium chloride) may be used at specific problem locations or constrained road sections (approaches to bridges). Water for dust suppression will be extracted from approved locations as per Water Licenses.

4.7 Rock Falls

The access road traverses through some steep mountainous terrain with isolated sections subject to rock fall hazard. The following maintenance approach will be applied at rock fall sections:

- Continually grade off rock fall debris immediately;
- Avoid stopping within rock fall sections;
- Ensure signage is in place;
- Report any suspect problematic sections immediately;
- When safe to do so, under proper direction, clean out debris loadings from rock fall mitigation locations; and
- When safe to do so, under proper direction by a designated professional, apply proactive measures if necessary.

4.8 Avalanches

Sections of the road are in steep mountainous terrain and have been identified to be at risk from avalanches. Avalanche assessments have been carried out and the AHMP should be consulted for details on avalanche management. The following strategy will be implemented for road operations within avalanche zones:

- Following an avalanche event, immediately shut down ASR operations and follow specified procedures outlined in the AHMP.
- Pending an avalanche risk assessment, a wildlife sweep will be conducted prior to any avalanche control being implemented. A qualified individual will conduct the sweep.
- If a large mammal (e.g., caribou, sheep, moose) is observed within 3 km of the control area, the avalanche control will be put on hold (maximum 24 hours) until the animal or group of animals have vacated the area. The location of the animal(s) may be periodically reassessed throughout the 24-hour hold period at the discretion of the qualified individual conducting the sweep.
- When safe to do so, remove avalanche debris with equipment, as required.
- Clean out all ditches and ensure culverts and ditches are free to permit future water drainage.
- Ensure all signage is in place.

5.0 ROAD MONITORING AND REPORTING

5.1 Daily Operational Inspections

Prior to commencement of the daily concentrate hauls, an inspection of the road will be completed to ensure the road is safe for operation. The ROM will direct maintenance efforts at specific problem locations. Following the first five years of road operation, it is anticipated that the road prism and right of way characteristics will have stabilized, and a reduced maintenance effort focussing on road ditches, culverts, and cross drainages would be sufficient. This would be a natural progression of the road maintenance program and will be evaluated on an ongoing basis.

5.2 Infrastructure Inspections

5.2.1 Road Conditions

Maintenance crews will regularly inspect the road surface for defects and problem areas. Appropriate maintenance actions will be directed to mitigate any deficiencies. Ongoing problematic sections will be targeted for higher level road improvements as described in Section 5.3.

5.2.2 Post-Seismic Events

Following a significant seismic event, the following will occur:

- Road operations will stop until inspections are complete and the “all clear” is given;
- Inspections of all major structural components of the road, bridges, and culverts will be completed; and

- If significant defects are identified, the road will remain closed until a qualified individual has completed an inspection, determined a remedy, and the remedy has been implemented.

5.2.3 Watercourse Crossings

The ASR will be monitored for areas that exhibit drainage issues which may affect the integrity of the infrastructure or pose increased risk to the environment. Problem areas will be assessed, and an appropriate action plan implemented to mitigate/correct the issue. Maintenance records will be maintained for all corrective actions applied at stream and cross drainage structures as a means to track and apply a corrective, proactive action at problematic crossings.

5.2.3.1 Major Watercourse Crossings

The following monitoring will be completed at all 17 major watercourse crossings:

- On a regular basis, minimum once per year, CZN will complete visual inspections of each major crossing structure.
- Every three years, under direction of a Professional Engineer, all major crossing structures will undergo a detailed inspection complete with a written report. In addition, potential stream channel changes and the potential impacts will be reviewed.
- Following a major weather event, visual inspection of all major structures for problems or defects will be completed.
- Where possible, a catchment area or sump will be established at the inlet end of culverts for streams prone to debris loading from displaced rocks, gravel, and sediment. These catchment areas will be cleaned out as required depending on debris accumulation.

5.2.3.2 Minor Watercourse Crossings

All minor stream crossing culverts and cross drainage culverts will be monitored for deficiencies impacting natural flows and road infrastructure. Ongoing problematic culverts will be targeted for higher level road improvements as described in Section 5.3. The following monitoring will be completed at all minor stream and cross drainage culvert crossings:

- Inspected annually. Records will be compiled describing completed works and upgrades required.
- Following a major weather event, visual inspection of road and identified problematic culverts and drainage patterns will be completed.

5.2.3.3 Liard River Crossing – Summer Barge Crossing

Ongoing monitoring will be completed by the barge crew for deficiencies and potential deterioration of ramp structures. It is expected that the ramps will require ongoing maintenance and upgrading.

5.2.4 Rock Fall Zones

Rock fall monitoring and adaptive management will include:

- Annual inspections (spring season) of susceptible slopes and defined mitigation actions, as directed by professionals;

- Ensure proper signage is in place ("No Stopping");
- Daily inspections of slopes and conditions by maintenance crews;
- Immediate reporting of rock fall hazards and immediate follow up;
- Inspect mitigation structures for accumulation of rock debris and clean out as required;
- Apply temporary road closure if an elevated and significant risk is identified; and
- Apply mitigation procedures or methods to reduce risk as necessary.

5.2.5 Avalanche Zones

The following monitoring strategy will be implemented to safe guard equipment, infrastructure, and road users against the effects of avalanches:

- Personnel working in avalanche prone areas during the avalanche season will receive prior advice on current risks from a member the avalanche management team. Weather and snow conditions will be monitored;
- Check-in procedures and radio communication procedures will be monitored for all users;
- "No Stopping" signs will be checked during avalanche season; and
- In the event of road closures due to active avalanche management and/or control, conditions and road use will be monitored.

5.3 Long-Term Monitoring and Improvements

In addition to an ongoing daily monitoring and maintenance program, it is expected that problematic road sections will be identified after a period of ASR operations. These sections will be targeted for improvement beyond the conventional maintenance program, including:

- Additional culvert installation;
- Subgrade reconstruction;
- Additional road surfacing; and
- Upgrading problematic stream crossings.

These long-term improvements will be considered and defined as ASR operations proceed and problem locations are identified.

5.4 Wildlife Caution Zones

In addition to the key wildlife mitigations for road operations and maintenance identified in Section 3.10 of this ROMP and the WMMP, it is expected that, after initial operations and the accumulation of observations of wildlife proximal to the road, specific wildlife crossing, or wildlife presence locations may be identified. If this occurs, road signage will be adjusted to notify drivers of caution zones for wildlife, with speed adjustments as necessary. Such caution zones cannot presently be identified since studies to date have not defined specific locations of wildlife crossing or regular presence.

6.0 POTENTIAL CONTAMINANT LOADING

The ASR will be used to transport lead and zinc concentrates from ore processing at the Mine to market. Testing has indicated that concentrates may leach sulphate, cadmium, lead, and zinc, and to a lesser extent mercury, copper, nickel, and silver, at neutral pH. During EA0809-02 for the Mine and winter road, there was concern regarding the potential for concentrate loss in transit. At that time, concentrate was to be shipped either in bags or in bulk in trailer boxes with tarpaulin tops. A *Contaminant Loading Management Plan* (CLMP) was developed describing controls to be put in place to mitigate contaminant loading, as well as a road bed soil monitoring plan (Golder 2012). Since that time, and as explained in EA1415-01 for the ASR, the form of concentrate haul has been modified to consist of shipping in sealed 20 tonne containers. Hence, the risk of concentrate loss in transit is now much lower.

Concentrates; however, are not the only potential source of contaminant loading. Traffic can also result in the suspension and dispersal of road dust. CZN has committed to a soil sampling program, and Suggestion 11-3 of the EA1415-01 REA discusses the collection of baseline data to characterize vegetation contaminant levels. The sections below draw on the existing CLMP and describe activities for soil and vegetation monitoring. CZN plans to revise the CLMP to be specific to the Mine site only.

In addition to concentrates and dust, there is a potential for spills (i.e. diesel fuel, sulphuric acid) that could introduce contaminants along the road corridor. CZN's *Spill Contingency Plan* (SCP) addresses potential spills along the ASR, including spill response and remediation. As such, spills are not considered further here.

6.1 Soils

Sampling of soils adjacent to the road will be carried out for trace element (metals) analysis to establish baseline concentrations and to provide a means of monitoring trends in soil metals over time. Soil samples will be collected from areas that are within the influence of the ASR, as well as from areas that are representative of background concentrations. Soil grain size will also be considered when assessing potential effects. The top 100 mm of soil will be sampled as this is the primary rooting zone for many northern plant species.

Canadian Council of Ministers of the Environment's *Canadian Soil Quality Guidelines for Protection of Environmental and Human Health* (CCME 1999) provides generic guidelines for metals that are pertinent to the Prairie Creek ASR. The applicable land use definition for the Prairie Creek ASR will be residential/parkland. Sampling of soils will occur in a number of locations, both before and during haul operations.

6.2 Vegetation

Similar to the monitoring of soils, sampling of terrestrial vegetation will be carried out for trace element (metals) analysis to establish baseline concentrations and to provide a way to monitor trends over time. Vegetation sampling will focus on addressing two potential issues: the deposition of dust onto vegetation and the potential uptake of metals by vegetation from soils potentially affected by the road. Plants can absorb trace amounts of heavy metals from soil and water, and dust can also negatively affect plants by sitting on surfaces and plugging photosynthetic structures. Some rock formations in the Northwest Territories are naturally high in metals such as arsenic; soil is the main source of arsenic in plants; however, historic mining activities are also a known contributor in some locations.

As with the soils sampling program, plant tissue samples that are to be representative of background concentrations will also be collected from areas that are considered beyond the influence of the ASR. Plant

species targeted for collection will include a wildlife browse species and a berry species; lichen may also be sampled, depending on the amount of material available for collection.

6.3 Sampling Program

6.3.1 Sampling Locations

The contaminant sampling program will establish permanent soil and vegetation sampling locations adjacent to the ASR. Sampling locations will be distributed along seven transects perpendicular to the ASR, spaced at approximate intervals of 25 km. Transect locations will be established based on vegetation cover type (e.g. ideally the full length of the transect would be located in one vegetation type). Samples will be collected annually along each transect, at these offset intervals:

- 0 to 30 m
- 100 m to 500 m
- 501 m to 1,000 m
- 1,001 m to 9,000 m

At each sampling interval, 2 plant species will be targeted for collection along with 1 soil sample for a total of 28 soil samples and 56 vegetation samples. The first two sampling intervals of the transect up to 500 m represent the anticipated zone of influence of dust, with the latter portion of the transect representing less affected areas.

6.3.2 Sampling Methods

A brief plant survey will be conducted at each sampling location to identify target vegetation species for collection. Once identified, composite samples will be collected from an area localized enough to be considered an individual location (e.g. within a radius of 20 m from the centre of the soil sampling locations). Vegetation samples will consist only of the above-ground (stems and leaves) portion of plants, as they are the most likely to be consumed by wildlife should grazing occur. For woody plants, only the current year's growth will be sampled, where possible. Lichen samples will involve collecting the entire thallus. Berries will simply be picked. A minimum of 10 g of vegetative material will be collected per sample.

Surface soil samples will be collected from mineral horizons at each sampling location to a depth of approximately 100 mm below the organic mat. Samples will be collected using hand equipment such as a pick, shovel, or hand-operated auger.

Samples will be placed into pre-labelled paper bags and chilled (not frozen) prior to being shipped to a Canadian Association for Laboratory Accreditation (CALA) accredited laboratory for analysis, ideally within 48 hours of collection (if possible). All sampling locations will be documented using a hand-held Global Positioning System (GPS) unit.

6.3.3 Sampling Frequency

Contaminant sampling will be conducted initially on an annual basis for the first three years of haul operations to establish a preliminary trend. If the trend over the first three years is showing no adverse effect of the ASR on soils and vegetation, the sampling interval may be reduced to every second year (e.g. next sampling event would be in year five). After year nine, if adverse effects are still not recorded, the sampling interval may be reduced to every third year. The sampling interval (e.g. every two or three years) would continue provided the trend is consistently showing no adverse effects. Should the trend reverse (e.g. adverse effects become apparent), the

sampling interval would revert to every year and response measures (adaptive management) presented below for road operations may be required to offset the adverse effects.

Soil and vegetation samples will be collected during the summer of each year. Late summer sampling may be required to capture berries. In subsequent years, samples will be collected from the same locations to assess changes over time.

6.3.4 Data Analysis

The analytical results from each sampling event will be assessed in comparison to baseline concentrations and other previous analytical results for the same location. Metals analysis will be conducted using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and results will be reported as both wet and dry weights. The analysis of total metal concentrations in vegetation and soil will focus on a subset of the metals referred to as contaminants of concern (COC), chosen based on the following considerations:

- Baseline metal concentrations in soils and vegetation;
- Metals found to be present in Prairie Creek ore including cadmium, lead, and zinc, as well to a lesser extent mercury, copper, nickel, and silver (MESH 2008); and
- Potential metals in road embankment materials and road-generated dust.

This comparison of data will be used to identify potential trends that may indicate an increase in concentrations of COC over time. If an increasing trend in concentrations of any COC is identified, the response measures outlined in Section 6.4 will be implemented. Data from locations where multiple samples are taken will be assessed collectively, by calculating an average concentration and identifying a range of concentrations for each location.

6.4 Triggers and Adaptive Management

If elevated metals concentrations occur, a series of pre-determined action levels will apply, as described in the sections below.

6.4.1 Action Level I

Triggers

Action Level I Triggers include:

- Annual concentrations below applicable CCME Quality Guidelines and territorial criteria; or
- Annual concentrations less than 20% greater than baseline concentrations; or
- Annual concentrations demonstrating less than 10% increase year to year.

Response

If annual concentrations meet the Action Level I criteria, soil and vegetation quality monitoring will continue on an annual basis. No further investigation, contamination management, or additional mitigation measures are warranted at this action level.

6.4.2 Action Level II

Triggers

Action Level II Triggers include:

- Annual concentrations below applicable CCME Quality Guidelines and territorial quality criteria; or
- Annual concentrations more than 20%, but less than 50%, greater than baseline concentrations; or
- Annual concentrations demonstrating more than 10%, but less than 30%, increase year to year.

Response

If annual concentrations trigger an Action Level II response, an internal review of concentrate handling and transport procedures will be conducted to identify potential deficiencies. Corrective actions and additional mitigation strategies will be developed and implemented in a timely manner to prevent further increases in concentrations.

If concentrations continue to increase, an Action Level III response will be considered.

6.4.3 Action Level III

Triggers

Action Level III Triggers include:

- Annual concentrations exceeding CCME Quality Guidelines or territorial quality criteria; or
- Annual concentrations more than 50% greater than baseline concentrations; or
- Annual concentrations demonstrating more than 30% increase year to year for two or more consecutive years.

Response

If annual concentrations trigger an Action Level III response, the concentrations will first be confirmed by conducting additional sampling in the areas of concern where the triggering concentrations were identified.

If the concentrations are confirmed, further sampling will be carried out to delineate the area of contamination both vertically and laterally. Additional investigation may also include sampling of other media, as appropriate, in the vicinity of the contamination.

As previously described, the sampling locations along the ASR will primarily be locations where the road crosses or is in close proximity to surface water bodies. If contamination triggering an Action Level III response is identified at a location of concern along the ASR, surface water and sediment sampling of the corresponding surface water body would be considered.

Based on the results of the delineation of contamination and sampling of other media, a response plan will be developed. The response plan may include, but is not limited to, the following options:

- Review of concentrate handling and transport procedures;
- Implement additional contaminant loading mitigation measures;

- Increase the frequency of soil and vegetation monitoring; and
- Remediate soil, vegetation, and other affected media.

7.0 ANNUAL REPORTING

The ROM will ensure an annual report is provided to regulators which will include the following:

- ROMP updates;
- List specific maintenance challenges and accomplishments;
- List problematic road sections or stream crossings, and planned mitigations;
- Results of stream crossing inspections; and
- Potential contaminant loading sampling results.

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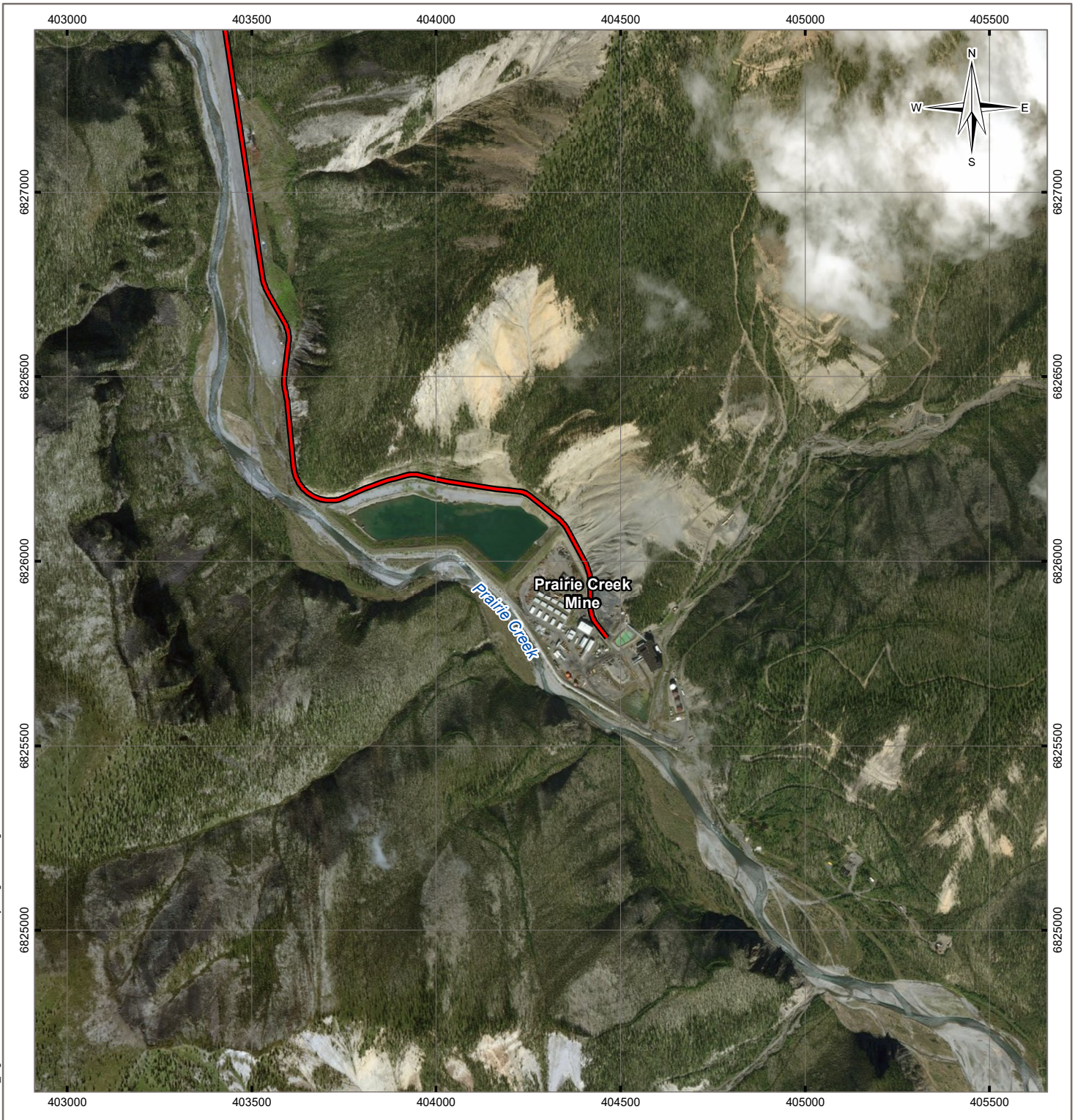
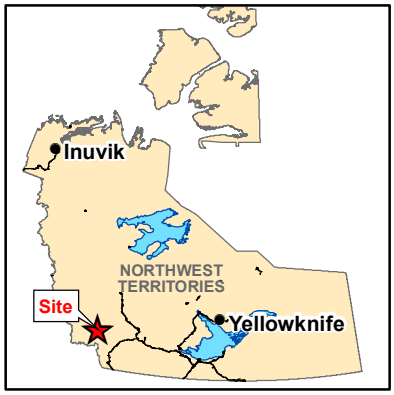
FIGURES



LEGEND

Proposed Prairie Creek Access Road



PRAIRIE CREEK ACCESS ROAD

Prairie Creek Mine Overview

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NWT Lambert	NAD83	CANADIAN ZINC CORPORATION

Scale: 1:15,000

200 100 0 200

Metres

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Tt-VANC	SL	BB	RH	0
DATE	**PROJECT NO.**			
January 16, 2019	ENG.EARC03145-01			

TETRA TECH

Figure 1

NOTES
Base data source:
Imagery from ESRI; DigitalGlobe (2016).

STATUS
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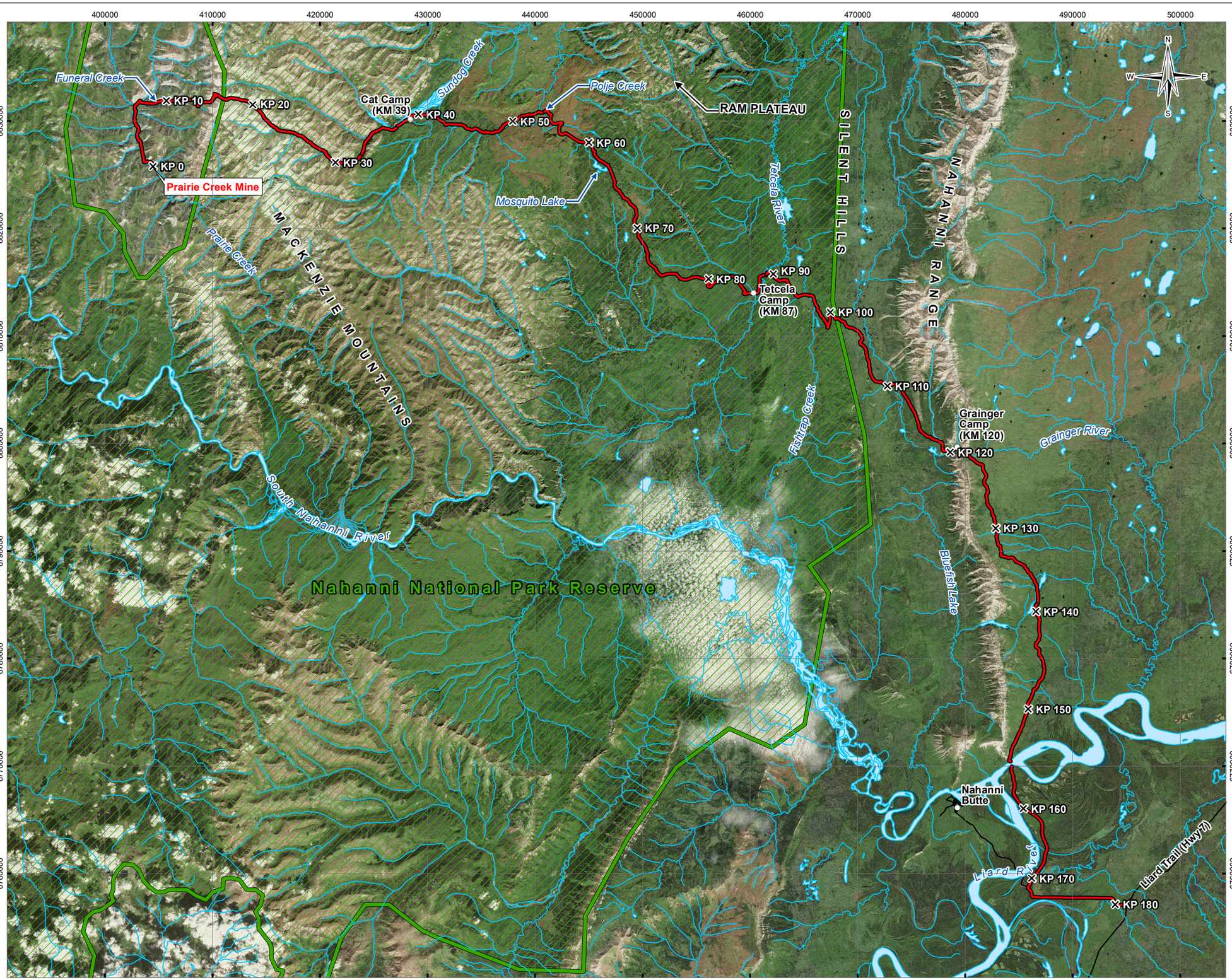

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LEGEND

- Access Road Kilometre Marker
- Proposed Prairie Creek Access Road
- Existing Road
- Nahanni National Park Reserve Boundary
- Watercourse
- Waterbody

NOTES
Base data source:
Road alignment provided by Allnorth (December 2018)
Kilometre markers provided by Allnorth (November 2018)
Existing roads from CanVec (1:50,000)
Watercourses from CanVec (1:250,000)

STATUS
ISSUED FOR USE

PRAIRIE CREEK ACCESS ROAD

Proposed Access Road Alignment

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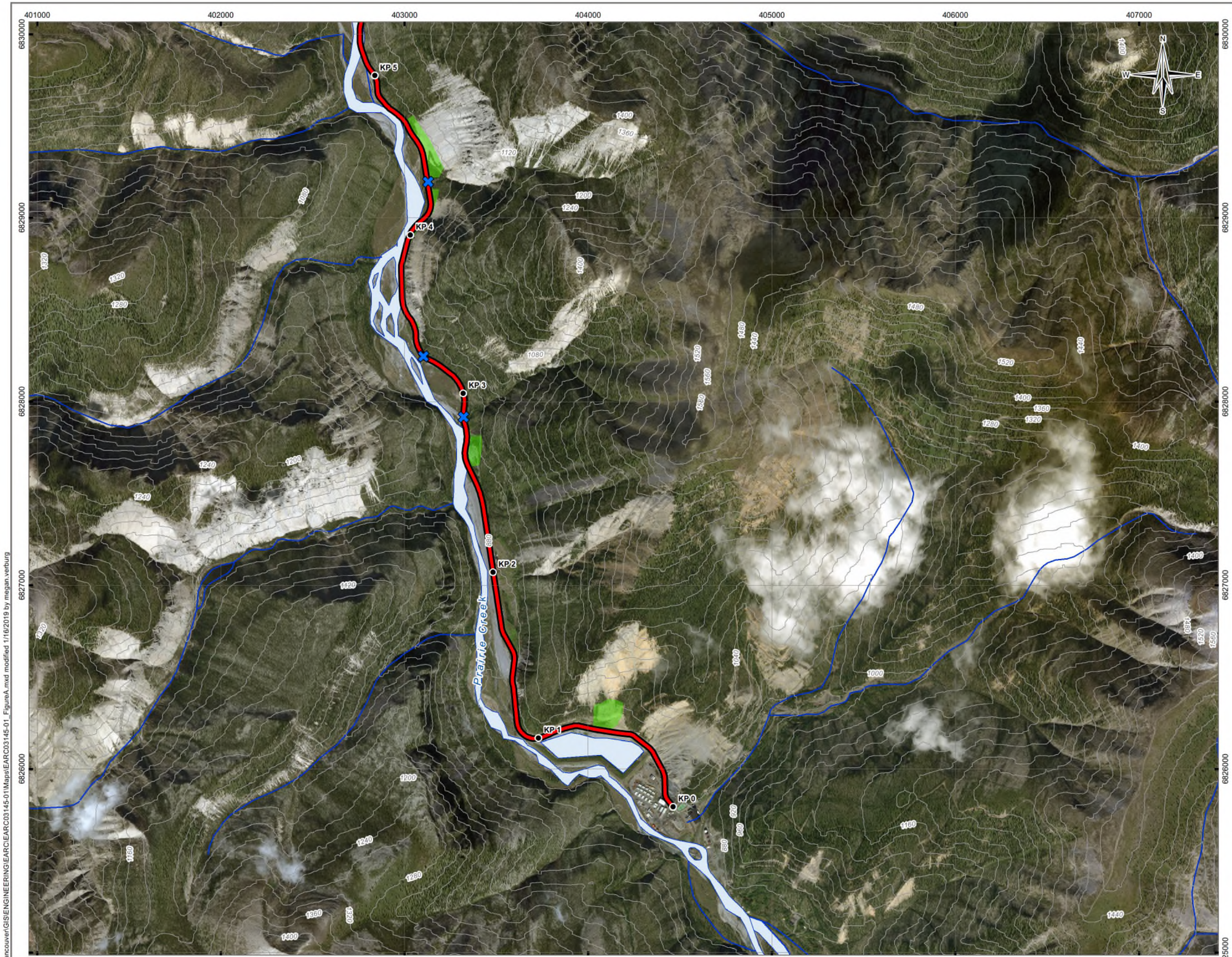
DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01			**Figure 2**

APPENDIX A

ACCESS ROAD MAP BOOK



LEGEND

- Access Road Kilometre Marker
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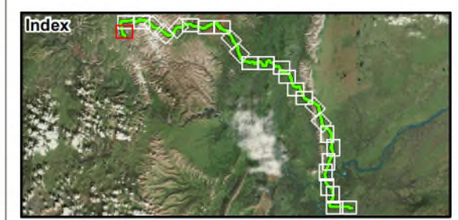
- Camp/Laydown
- Watercourse Crossing
- Prairie Creek Access Road (December 2018)
- Potential Permafrost Section
- Nahanni National Park Reserve Boundary
- Potential Borrow Source
- Contour (40 m)
- Watercourse
- Waterbody



NOTES
Base data source: CanVec; GeoBase.
Base imagery source: DigitalGlobe, 2016

STATUS
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PRAIRIE CREEK ACCESS ROAD

Map Book

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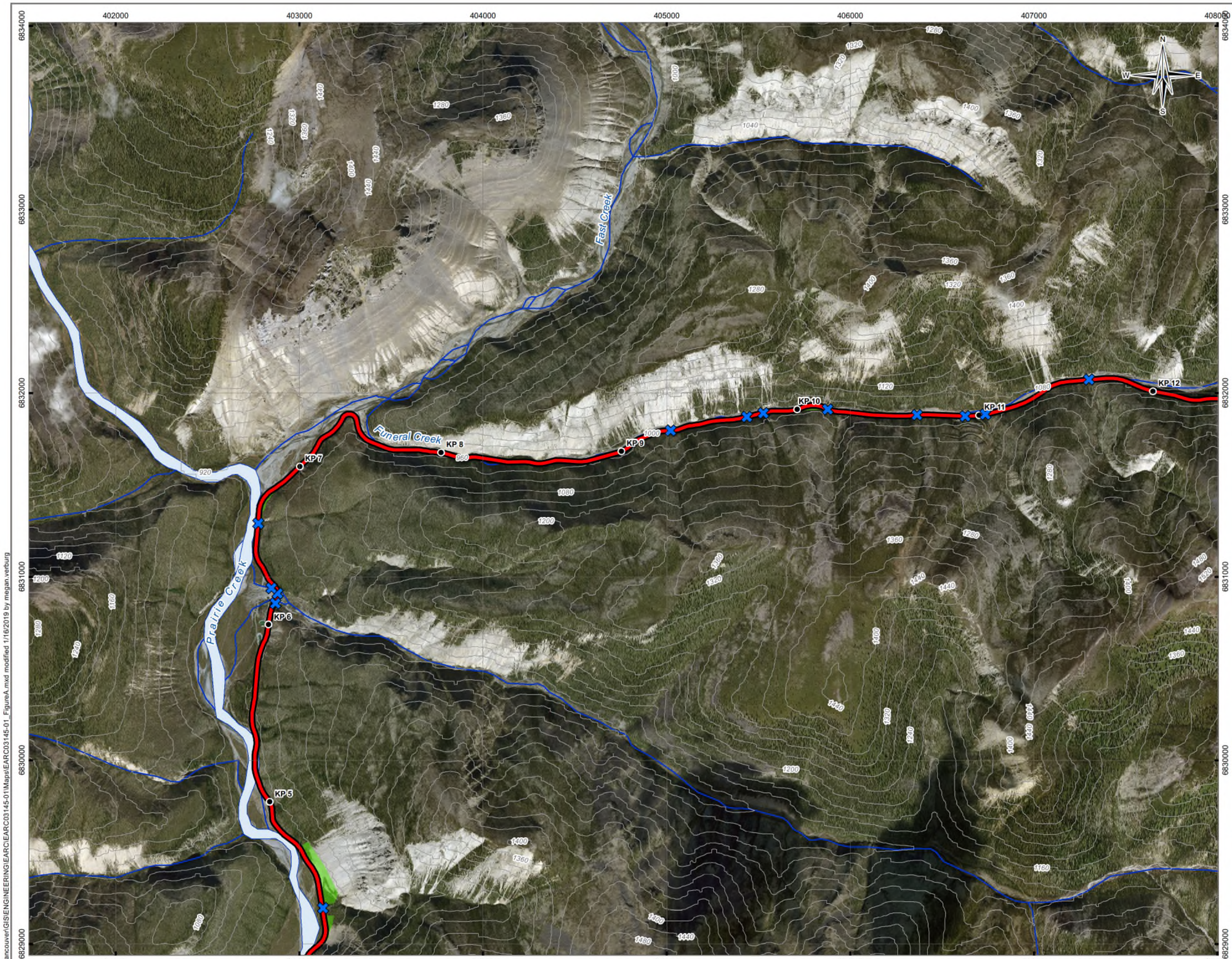

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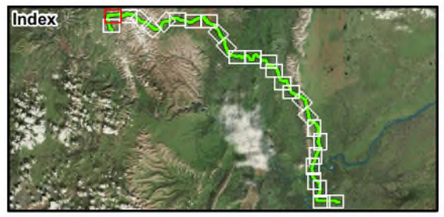

NOTES
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Base imagery source: DigitalGlobe, 2016

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

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Metres

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TI-VANC	MRV	SL	TB	4

DATE
January 16, 2019

PROJECT NO.
ENG.EARC03145-01

TETRA TECH

A2

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LEGEND

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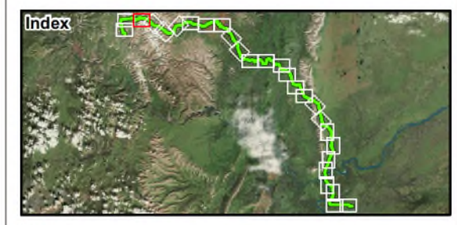

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: DigitalGlobe, 2016

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

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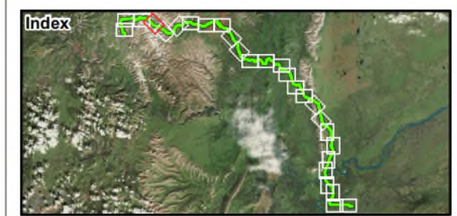

NOTES
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PRAIRIE CREEK ACCESS ROAD

Map Book

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- Watercourse
- Waterbody

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: DigitalGlobe, 2016

STATUS
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PRAIRIE CREEK ACCESS ROAD

Map Book

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STATUS
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PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION	DATUM	CLIENT
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Metres

TETRA TECH

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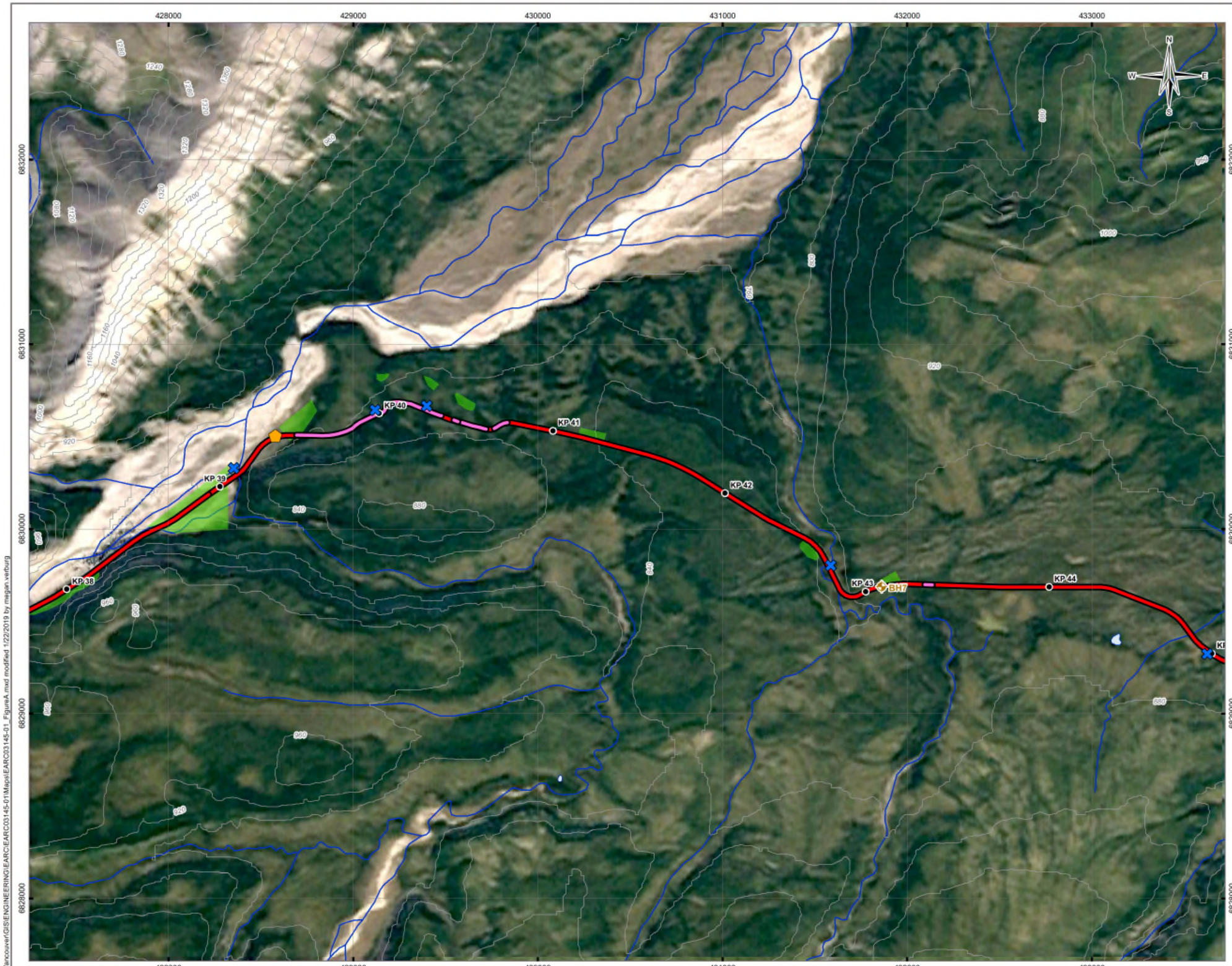

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NOTES
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STATUS
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PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	CANADIAN ZINC CORPORATION

Scale: 1:20,000
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TETRA TECH

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DATE
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PROJECT NO.
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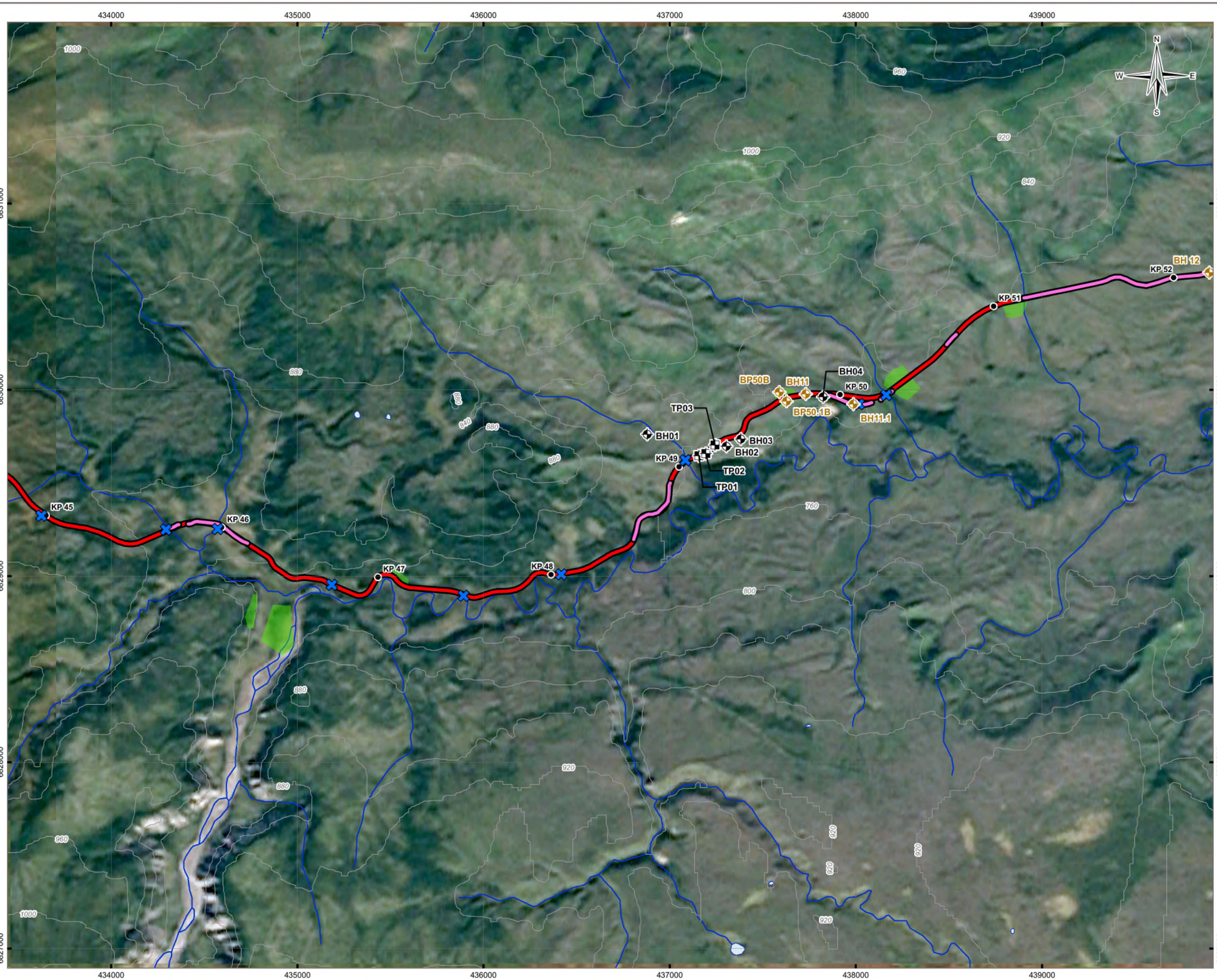

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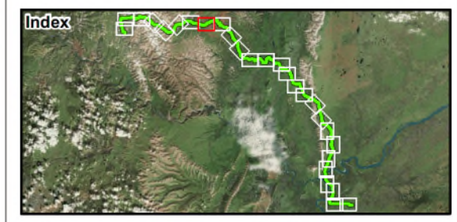

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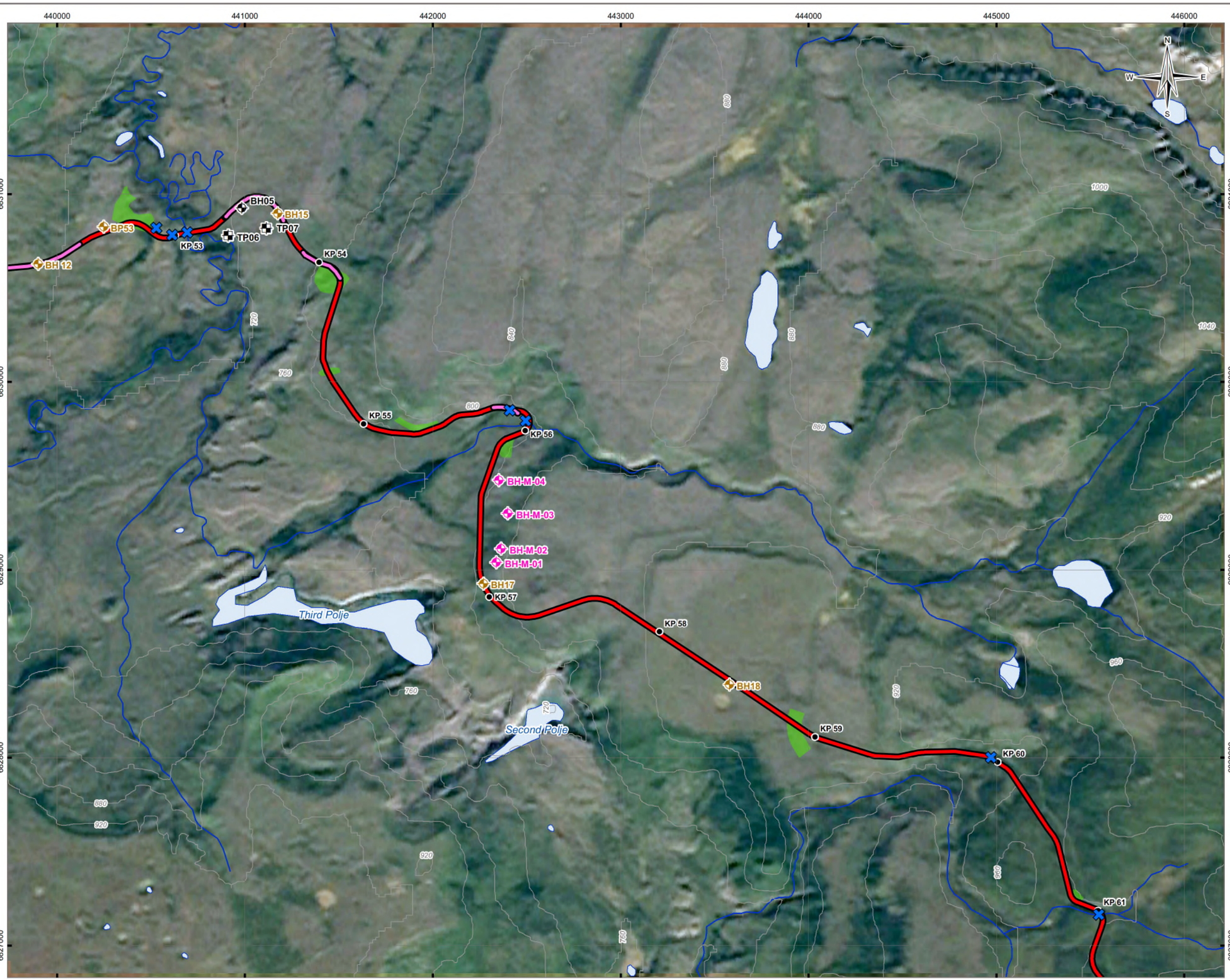

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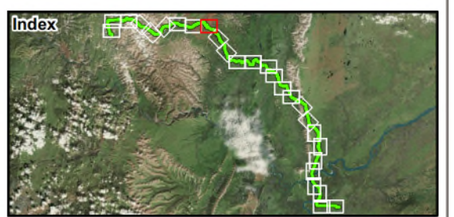

NOTES
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STATUS
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PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	CANADIAN ZINC CORPORATION

Scale: 1:20,000
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TETRA TECH

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Tt-VANC	MRV	SL	TB	4

DATE
January 16, 2019

PROJECT NO.
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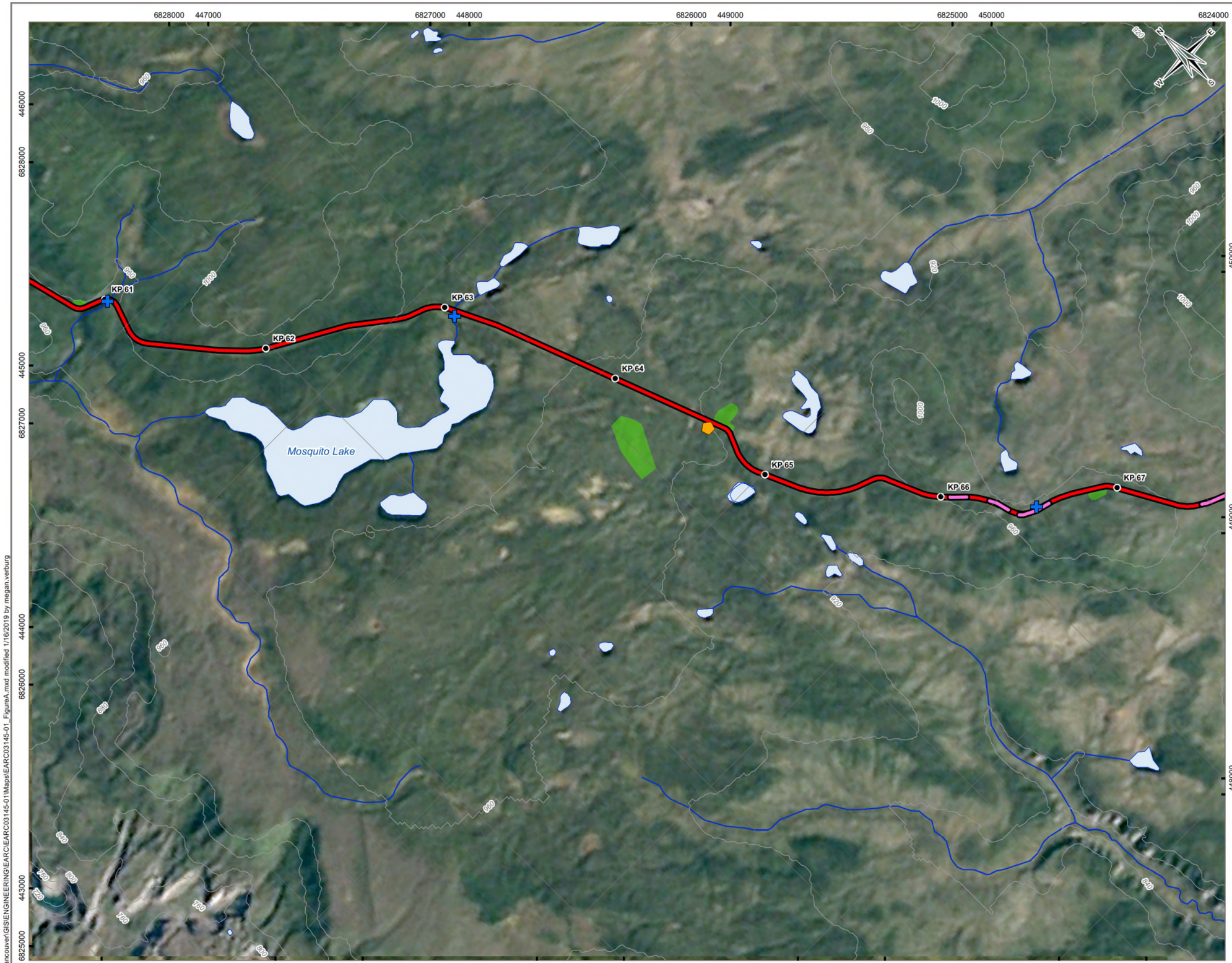

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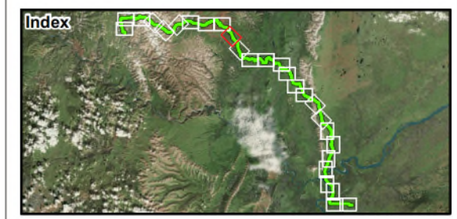

NOTES
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STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

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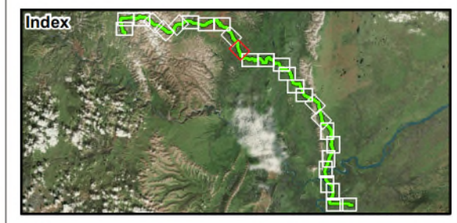
- Watercourse
- Waterbody



NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2016

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10		**DATUM** NAD83			**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 400 200 0 400 Metres					TETRA TECH
FILE NO. EARC03145-01_FigureA.mxd					
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DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01				

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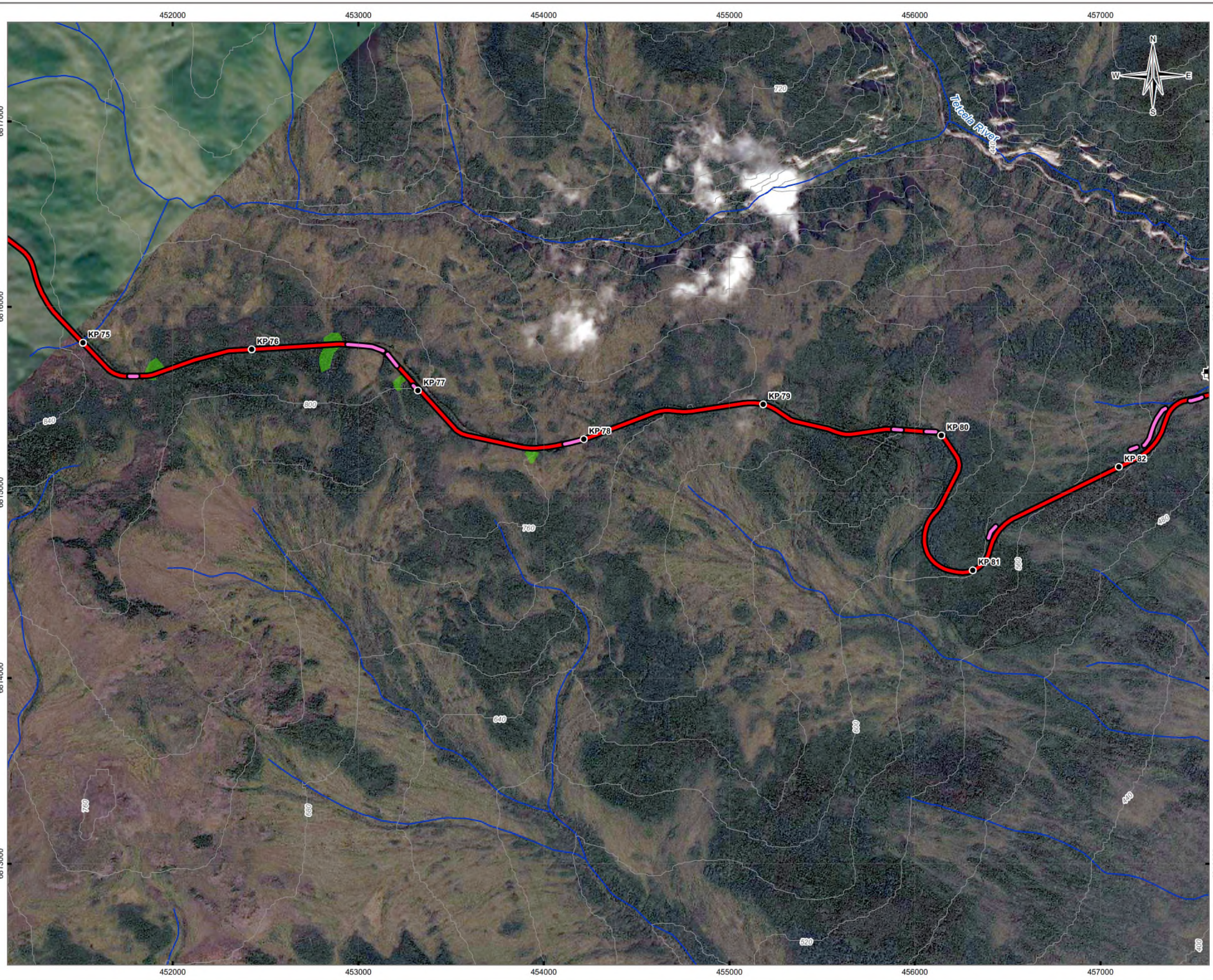

LEGEND

- Access Road Kilometre Marker
- 2018 Borehole (Tetra Tech, 2018)
- 2014 Borehole (Tetra Tech EBA, 2014)
- 2012 Borehole (SNC-Lavalin, 2012)
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- Watercourse Crossing
- Prairie Creek Access Road (December 2018)
- Potential Permafrost Section
- Nahanni National Park Reserve Boundary
- Potential Borrow Source
- Contour (40 m)
- Watercourse
- Waterbody

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Bing Maps Aerial

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	CANADIAN ZINC CORPORATION

Scale: 1:20,000
400 200 0 400
Metres

TETRA TECH

FILE NO.
EARC03145-01_FigureA.mxd

OFFICE	DWN	CKD	APVD	REV
TI-VANC	MRV	SL	TB	4

DATE
January 16, 2019

PROJECT NO.
ENG.EARC03145-01

A12

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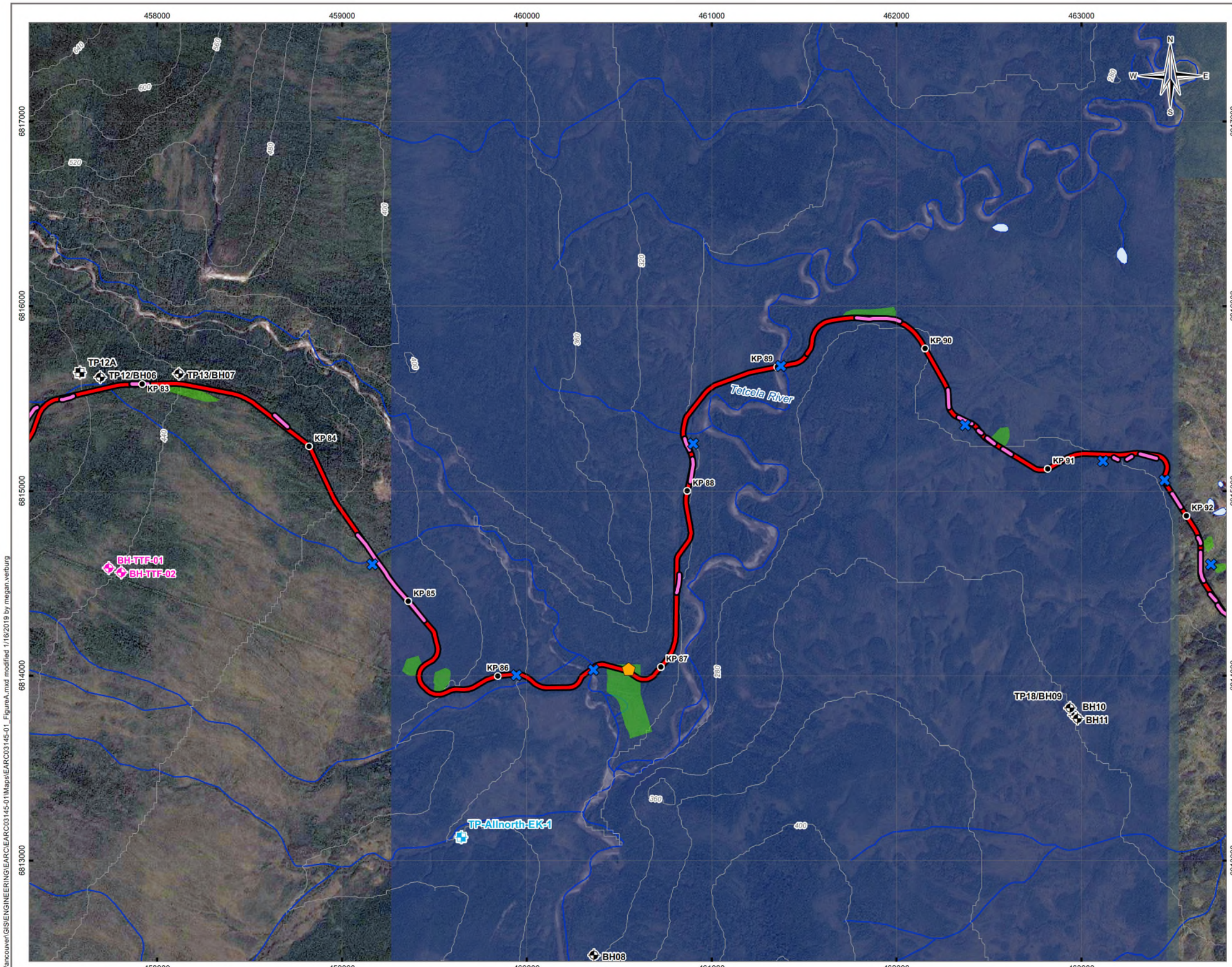

LEGEND

- Access Road Kilometre Marker
- 2018 Borehole (Tetra Tech, 2018)
- 2014 Borehole (Tetra Tech EBA, 2014)
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- Contour (40 m)
- Watercourse
- Waterbody

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Bing Maps Aerial

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10		**DATUM** NAD83			**CLIENT** CANADIAN ZINC CORPORATION
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DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01				

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BH12 BH33 BH14 BH13 BH96.6 BH36 BP97 BH-SWI-03 BH-SWI-05 BH-SWI-04 BH-SWI-02 BH-SWI-96-500 BH-SWI-01 BH-SWI-CUT-A BH-SWI-99-100 BH-SWI-CUT-E BH37 BP102 BH38 BP103.1 BP103.2

Nahanni National Park Reserve - Eastern Extent

Fishtrap Creek

N W E S

LEGEND

- Access Road Kilometre Marker
- 2018 Borehole (Tetra Tech, 2018)
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- Potential Borrow Source
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- Watercourse
- Waterbody

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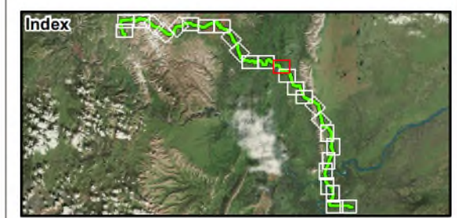

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Bing Maps Aerial

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	CANADIAN ZINC CORPORATION

Scale: 1:20,000
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Metres

TETRA TECH

FILE NO.				
EARC03145-01_FigureA.mxd				
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TI-VANC	MRV	SL	TB	4
DATE	**PROJECT NO.**			
January 16, 2019	ENG.EARC03145-01			

A14

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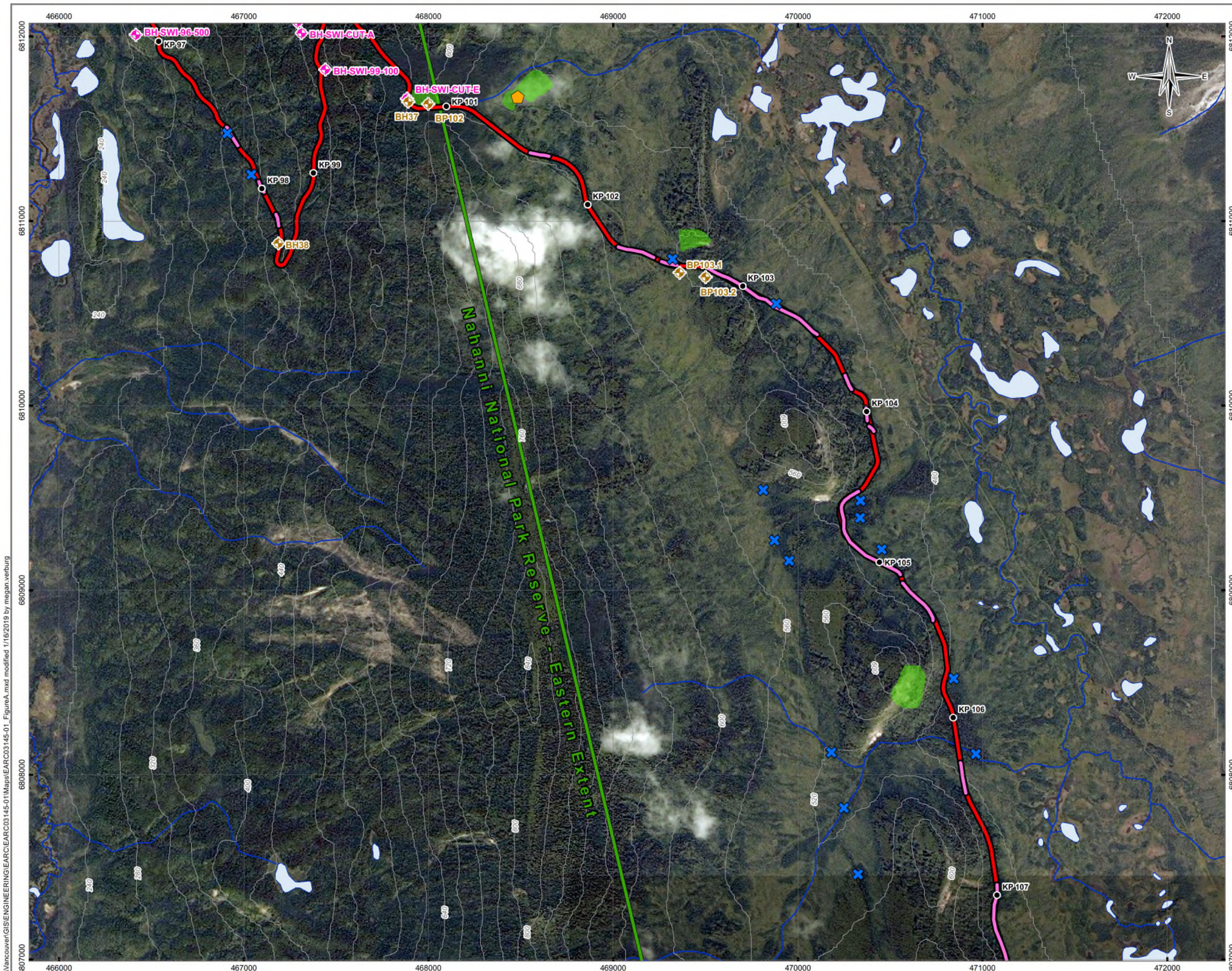

LEGEND

- Access Road Kilometre Marker
- 2018 Borehole (Tetra Tech, 2018)
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- Watercourse
- Waterbody

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Bing Maps Aerial

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10	**DATUM** NAD83		**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 (400 200 0 400 Metres)			TETRA TECH
FILE NO. EARC03145-01_FigureA.mxd			
OFFICE TI-VANC	**DWN** MRV / **CKD** SL / **APVD** TB / **REV** 4		**A15**
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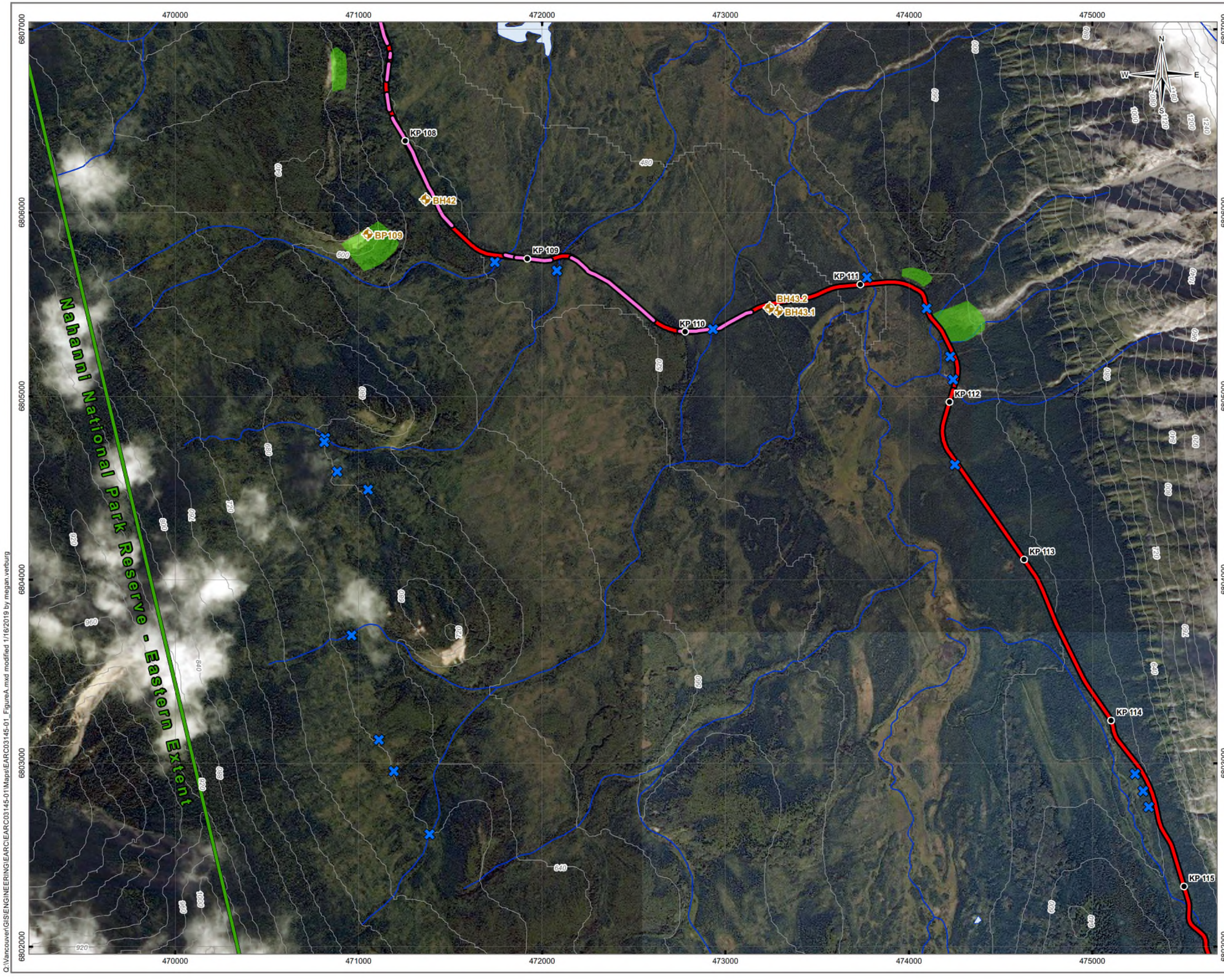

LEGEND

- Access Road Kilometre Marker
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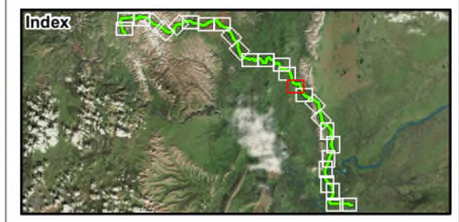

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Bing Maps Aerial

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10				**DATUM** NAD83	**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 — 400 200 0 400 Metres					TETRA TECH
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DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01				

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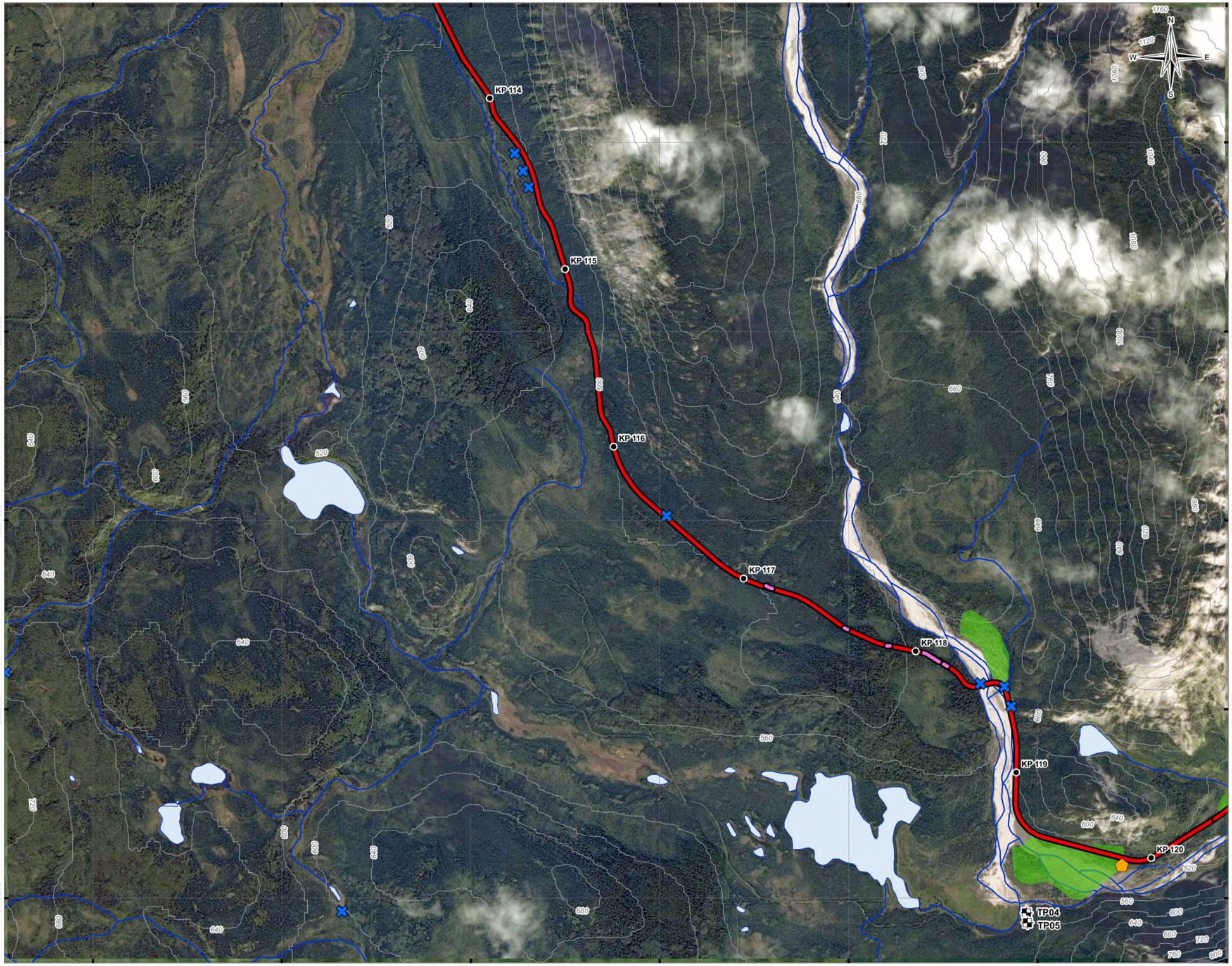

LEGEND

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- 2012 Borehole (SNC-Lavalin, 2012)
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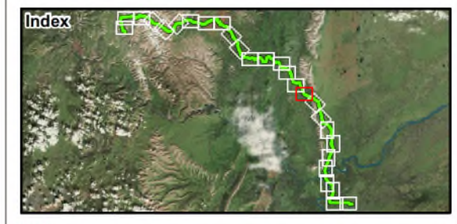

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Bing Maps Aerial

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10	**DATUM** NAD83		**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 — 400 200 0 400 Metres			TETRA TECH
FILE NO. EARC03145-01_FigureA.mxd			
OFFICE Tt-VANC	**DWN** MRV / **CKD** SL / **APVD** TB / **REV** 4		A17
DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01		

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6801000 479000 6800000 478000 6799000 477000 6798000

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KP 120 KP 121 KP 122 KP 123 KP 124 KP 125 KP 126 KP 127

BH49.2 BH49.1 BH15 BH16

TP15 TP25 TP17 TP16 TP04 TP05

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LEGEND

- Access Road Kilometre Marker
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NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2007

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10	**DATUM** NAD83		**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 — 400 200 0 400 Metres			TETRA TECH
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OFFICE Tt-VANC	**DWN** MRV / **CKD** SL / **APVD** TB / **REV** 4		A18
DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01		

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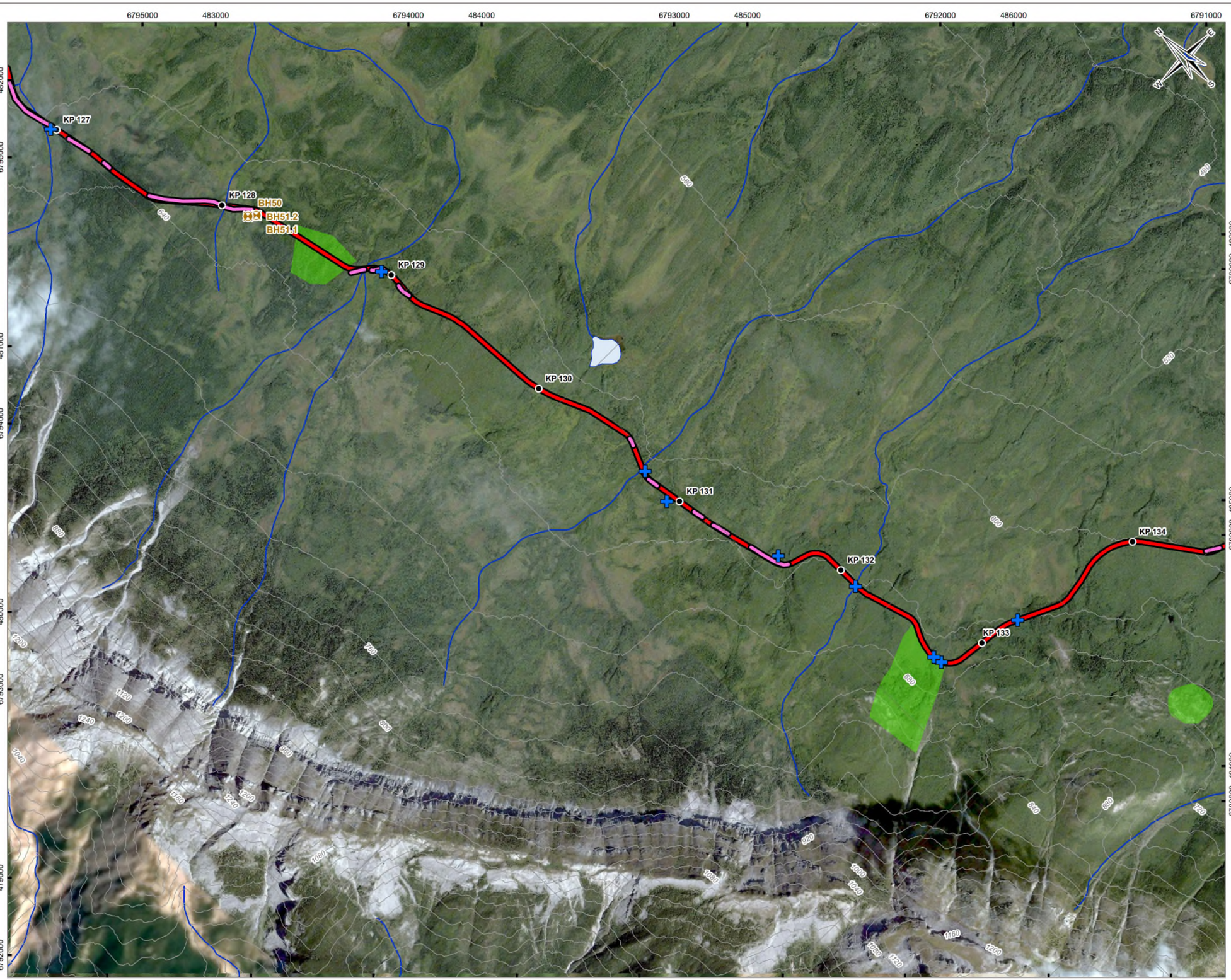

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LEGEND

- Access Road Kilometre Marker
- 2018 Borehole (Tetra Tech, 2018)
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NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2007

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10		**DATUM** NAD83		**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 — 400 200 0 400 Metres				TETRA TECH
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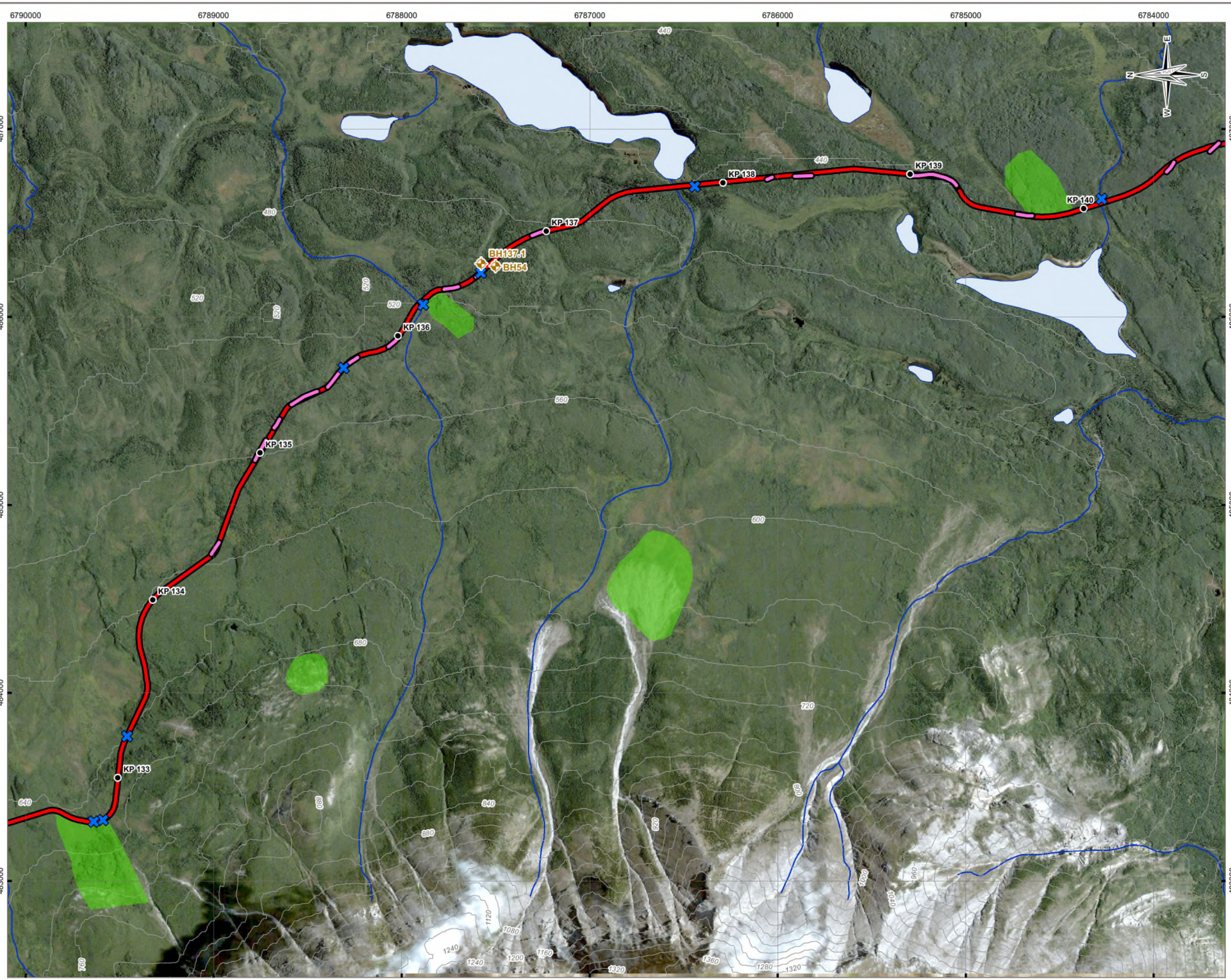
DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01			**A19**



LEGEND

- Access Road Kilometre Marker
- 2018 Borehole (Tetra Tech, 2018)
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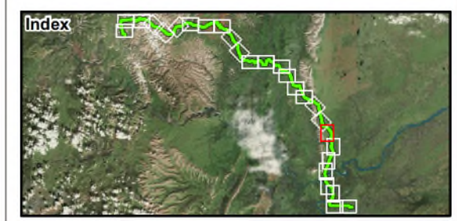

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2007

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

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Scale: 1:20,000 (400 200 0 400 Metres)					TETRA TECH
FILE NO.: EARC03145-01_FigureA.mxd					
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DATE: January 16, 2019	PROJECT NO.: ENG.EARC03145-01				

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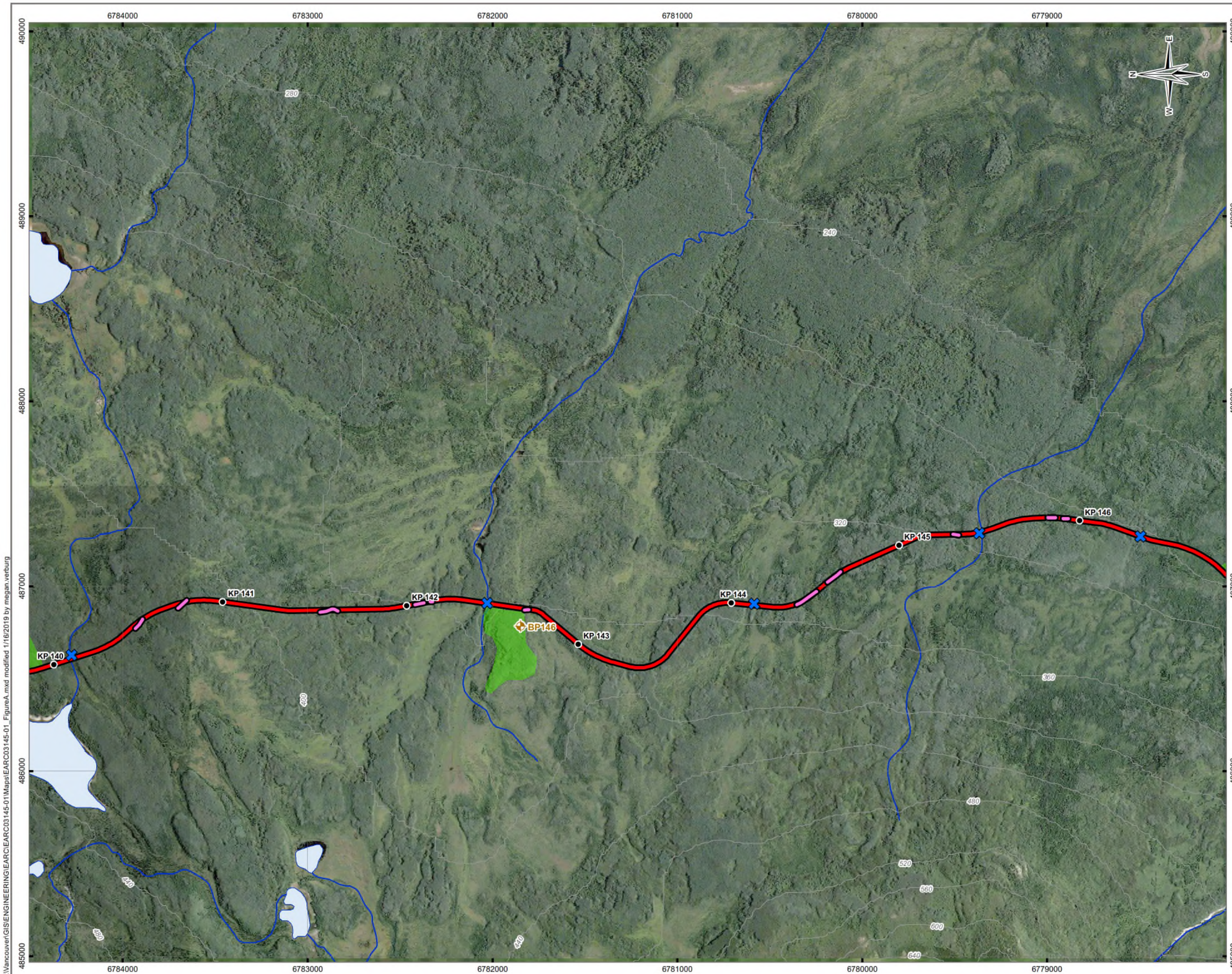

LEGEND

- Access Road Kilometre Marker
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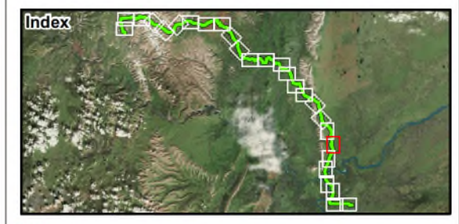

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2007

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10				**DATUM** NAD83	**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 — 400 200 0 400 Metres					TETRA TECH
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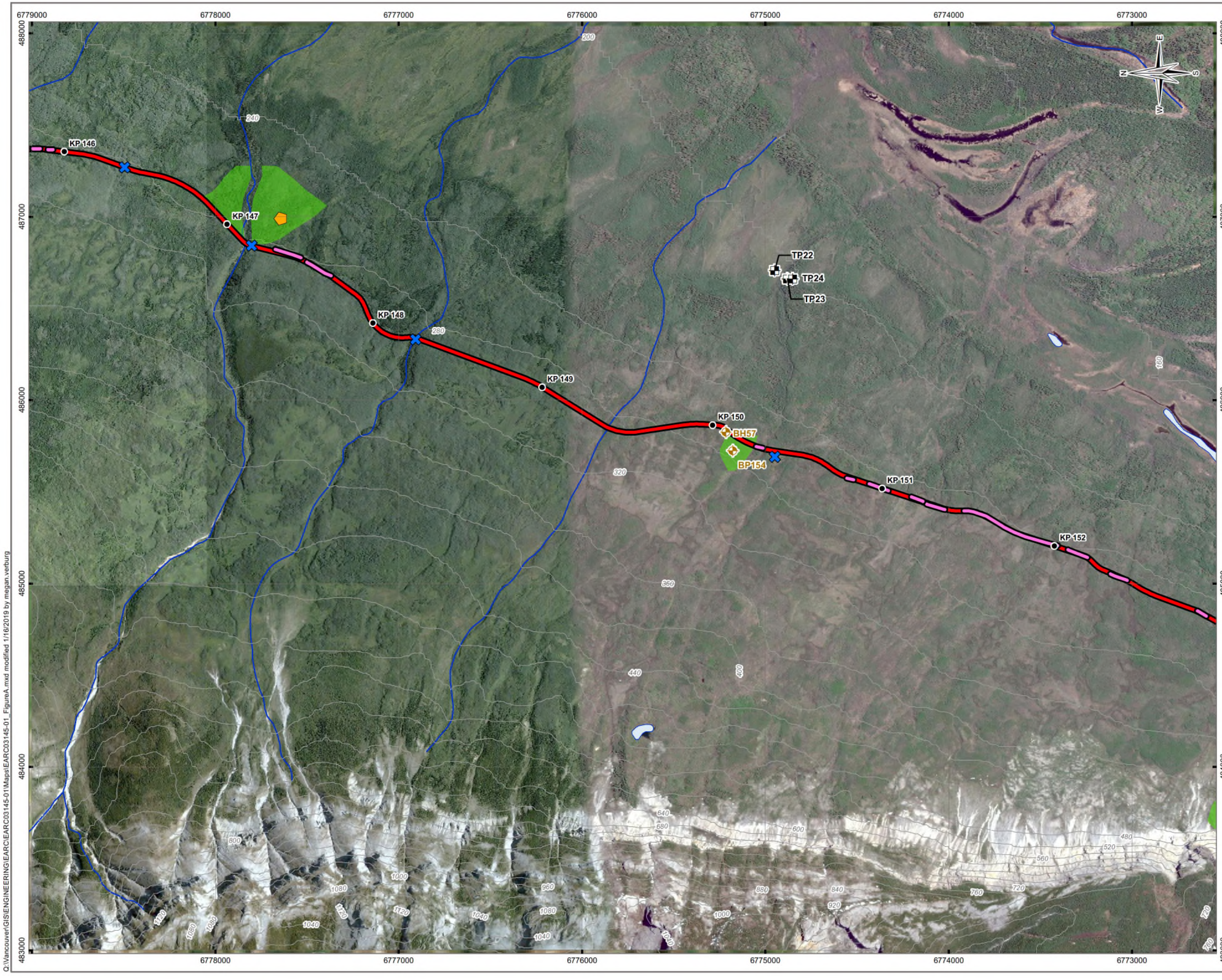

LEGEND

- Access Road Kilometre Marker
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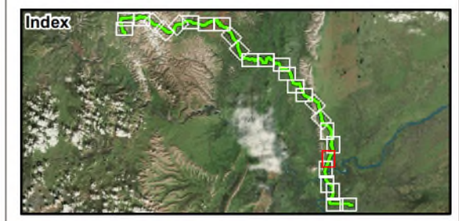

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2007-2015

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10		**DATUM** NAD83			**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 (400 200 0 400 Metres)					TETRA TECH
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DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01				

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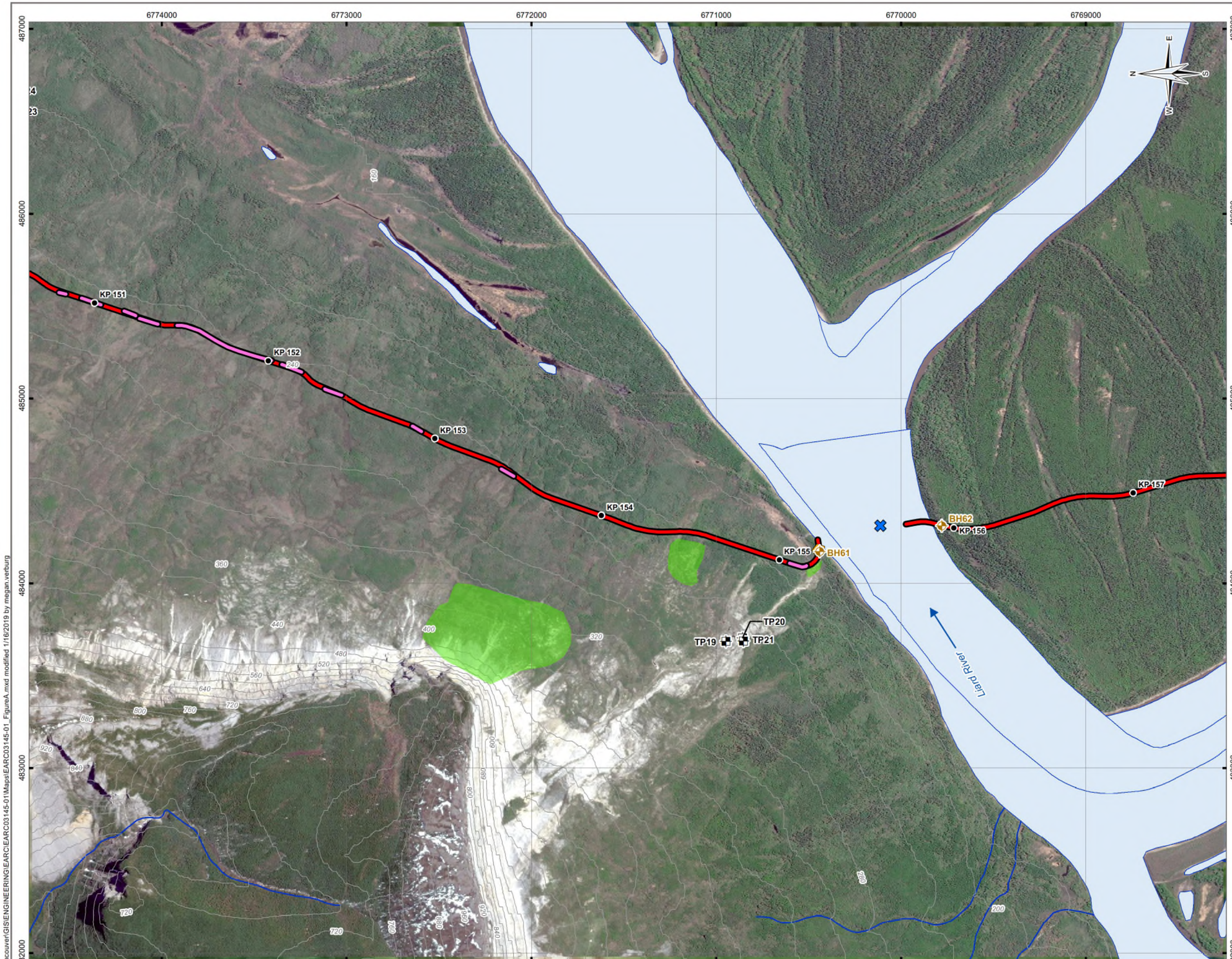

LEGEND

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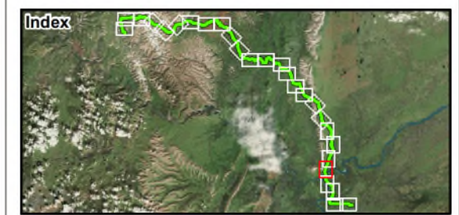

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2015

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10		**DATUM** NAD83		**CLIENT** CANADIAN ZINC CORPORATION
Scale: 1:20,000 — 400 200 0 400 Metres				TETRA TECH
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DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01			A23

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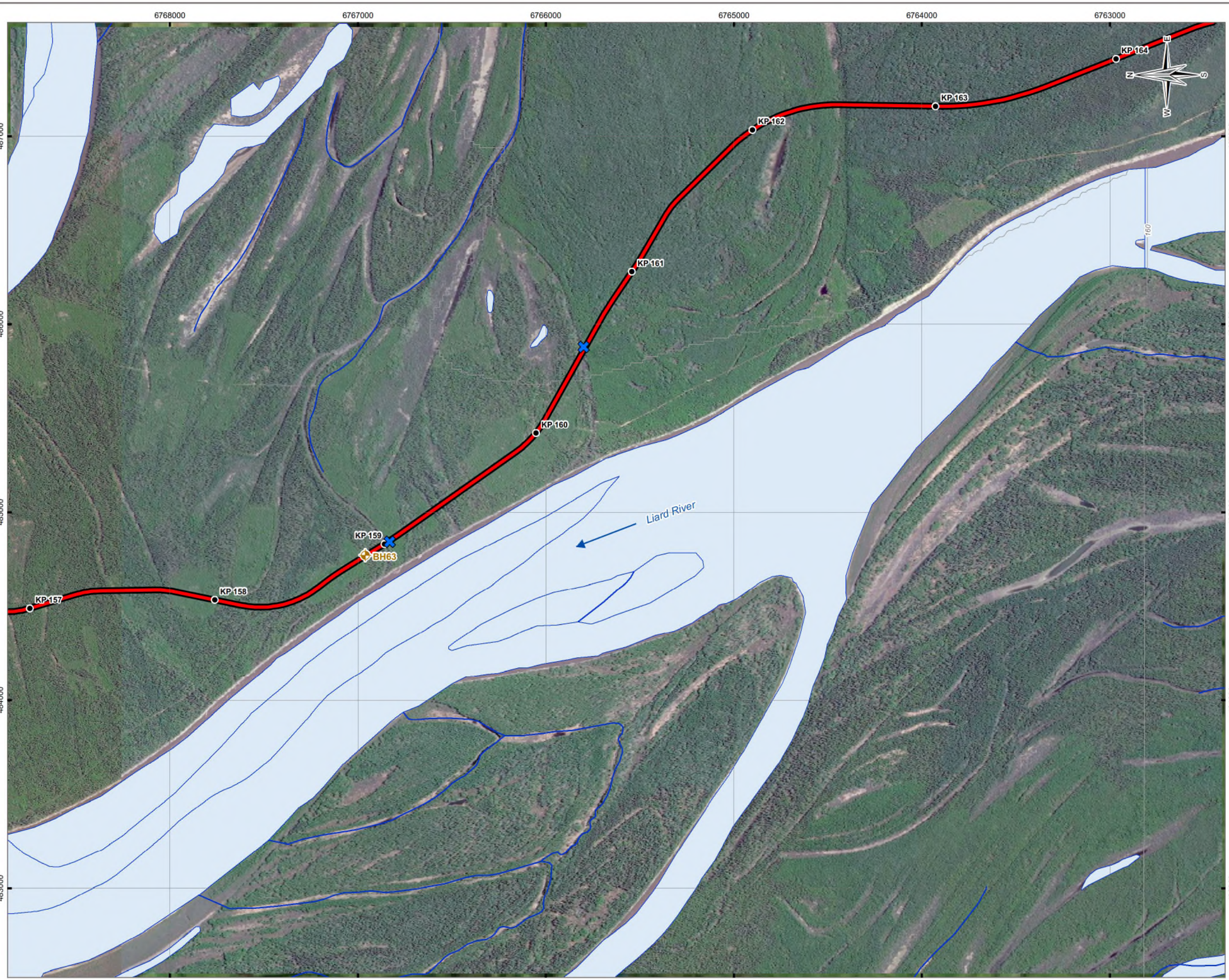

LEGEND

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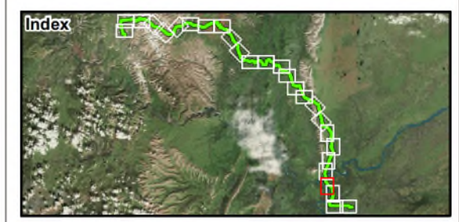

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2015

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	CANADIAN ZINC CORPORATION

Scale: 1:20,000
400 200 0 400
Metres

TETRA TECH

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OFFICE	DWN	CKD	APVD	REV
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DATE
January 16, 2019

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ENG.EARC03145-01

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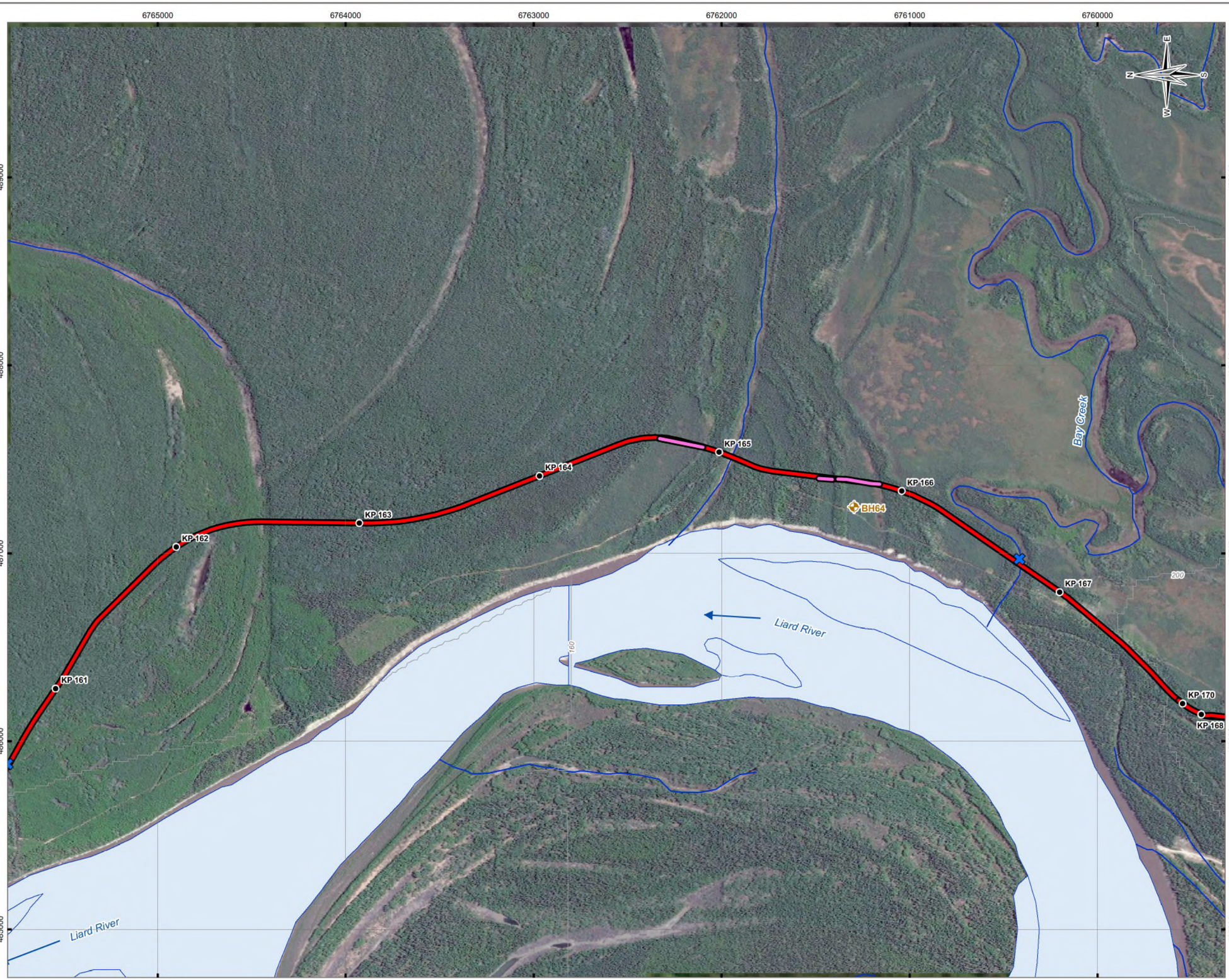
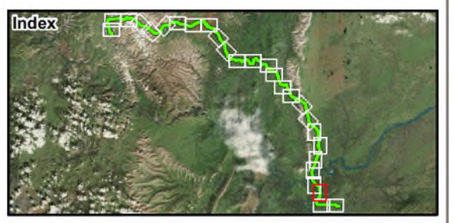


LEGEND

- Access Road Kilometre Marker
- 2018 Borehole (Tetra Tech, 2018)
- 2014 Borehole (Tetra Tech EBA, 2014)
- 2012 Borehole (SNC-Lavalin, 2012)
- 2014 Testpit (Tetra Tech EBA, 2014)
- 2014 Testpit (Allnorth, 2014)
- Camp/Laydown
- Watercourse Crossing
- Prairie Creek Access Road (December 2018)
- Potential Permafrost Section
- Nahanni National Park Reserve Boundary
- Potential Borrow Source
- Contour (40 m)
- Watercourse
- Waterbody



NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2015

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION: UTM Zone 10	DATUM: NAD83			CLIENT: CANADIAN ZINC CORPORATION
Scale: 1:20,000 (400 200 0 400 Metres)				TETRA TECH
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DATE: January 16, 2019	PROJECT NO.: ENG.EARC03145-01			A25

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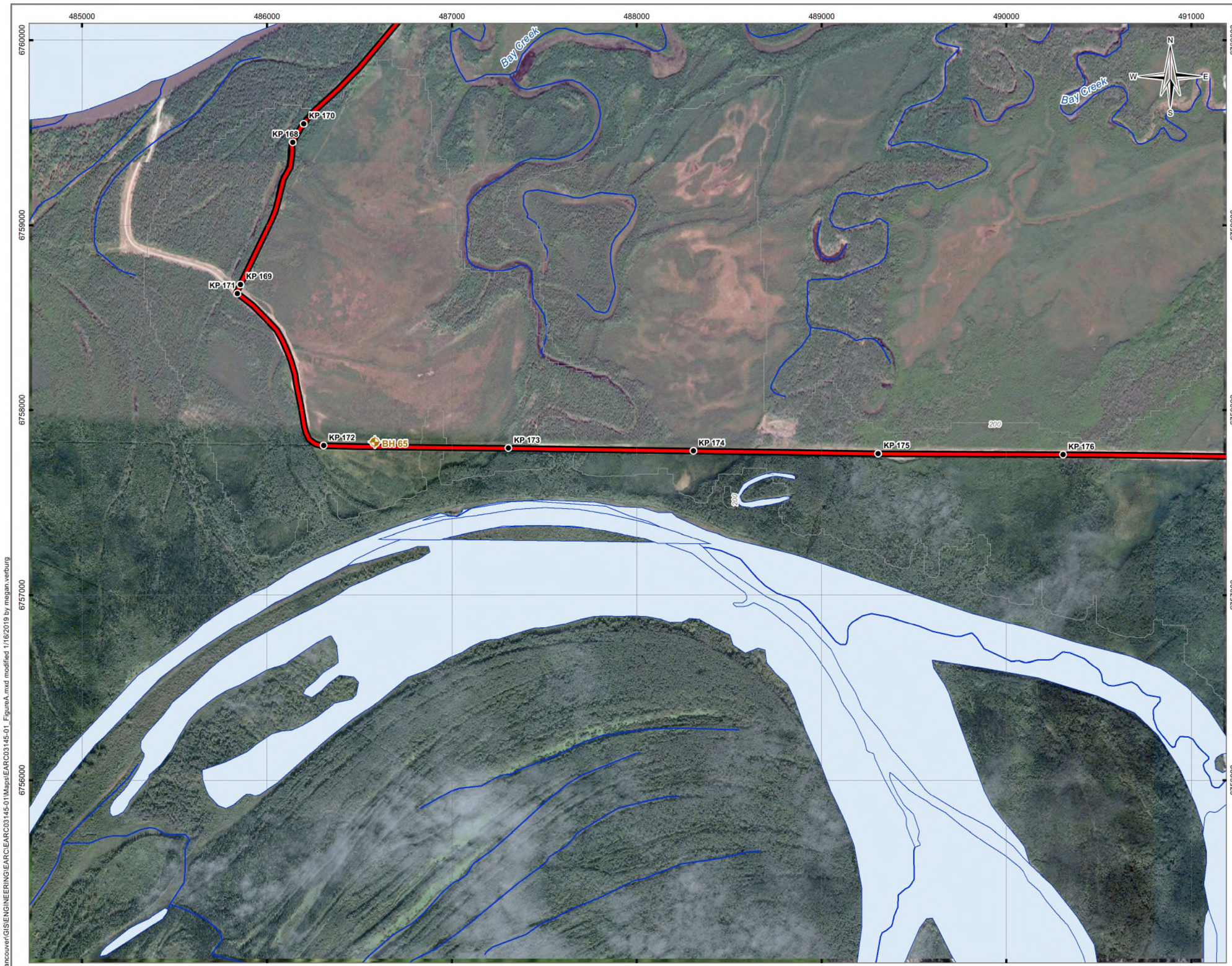

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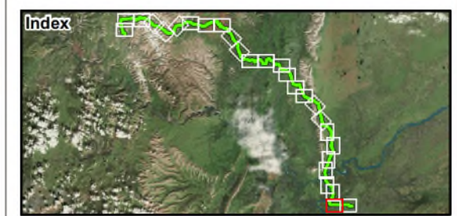

NOTES
Base data source: CanVec; GeoBase.
Base imagery source: Google Earth, 2007-2015

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION UTM Zone 10		**DATUM** NAD83			**CLIENT** CANADIAN ZINC CORPORATION
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DATE January 16, 2019	**PROJECT NO.** ENG.EARC03145-01				

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LEGEND

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- 2018 Borehole (Tetra Tech, 2018)
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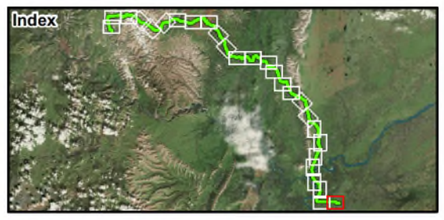

NOTES
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Base imagery source: Bing Maps Aerial

STATUS
ISSUED FOR REVIEW

PRAIRIE CREEK ACCESS ROAD

Map Book

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	CANADIAN ZINC CORPORATION

Scale: 1:20,000
400 200 0 400
Metres

TETRA TECH

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APPENDIX B

GNWT GUIDELINE FOR DUST SUPPRESSION

Guideline for Dust Suppression

June 2013

Guideline for Dust Suppression

1 Introduction

The purpose of this guideline is to make you aware of the procedures you must follow before applying a dust suppressant in the Northwest Territories. The Environment Division (ED) of the Department of Environment and Natural Resources (ENR) has currently approved three dust suppressants for use on Commissioner's Land in the NWT. This publication provides guidance for applying these products and a process for approving other dust suppression products.

Section 2.2 of the *Environmental Protection Act* gives the Minister of Environment and Natural Resources the authority to develop, coordinate and administer these guidelines (see Appendix A).

1.1 Definitions

Approved Product	A product approved by ED for dust suppression.
Commissioner's lands	Lands in the NWT that have been transferred by Order-in-Council to the Government of the Northwest Territories. This includes highways, block land transfers and most lands within municipalities.
Leachate Test	Leachate Extraction Procedure - Canadian General Standards Board (CGSB) #164-GP-1-MP (or as amended) or equivalent.
PCB	Polychlorinated biphenyl.
Roadway	The traveled surface of a road, from shoulder to shoulder; it does not include the side slopes or ditches.
Set	The point at which the product becomes stable, according to the manufacturer's specifications.
Used Oil	Any oil from an industrial or non-industrial source that has become unsuitable for its intended purpose due to the presence of impurities or the loss of original properties.

1.2 Why are Dust Suppressants Used?

Reasons for using dust suppressants include:

Safety	Untreated roads may lead to more accidents. Accident potential is increased due to loss of visibility.
Health	Dust particles may become a health hazard when they become trapped in the lungs.
Vegetation	Large amounts of dust may induce changes in vegetation due to increased heat absorption and decreased transpiration.
Aquatic Resources	High levels of dustfall into aquatic systems may adversely affect aquatic plants and fish that are not adapted to high levels of sedimentation.
Road Maintenance Costs	Treated roads can lower road maintenance costs by reducing gravel loss and blading time.
Aesthetics	Dust produces an immediate visual impact that may affect residents who live near dust prone roads.

An Ambient Air Quality Guideline established under the *Environmental Protection Act* sets standards respecting the maximum desirable levels of dust in ambient air in the NWT. Measured as total suspended particulate (TSP), the standards for dust over 24 hours are 120 micrograms per cubic metre ($\mu g/m^3$) and averaged over a year are 60 $\mu g/m^3$. These standards apply to the whole of the NWT. They define the long term goal for air quality to protect unpolluted parts of the Territory and for the continuing development of control options in polluted areas.

1.3 Roles and Responsibilities

Although the *Environmental Protection Act* does not require permits for the application of dust suppressants in the NWT, all suppressants must first be approved by ED. While general conditions are provided for approved dust suppressants, additional conditions may be required on a case by case basis.

The responsible party, being the landowner, road authority or municipal authority, must make provisions to notify the public and contact ENR before applying suppressants. The responsible party must also verify that the products are approved for use and properly applied by the applicator. If the product migrates from the roadway and is deemed to violate the *Environmental Protection Act*, the person(s) responsible must be prepared to take appropriate remedial measures.

Applicators are also accountable for their actions. Applicators are responsible for ensuring that the product is approved for use in the NWT, is correctly applied to the designated area and does not migrate off the site. Applicators, manufacturers and retailers must provide information about new products to ED for approval before their use in the NWT (section 3).

> ***It is important to remember that the responsible party (the landowner, road authority or municipal authority) is liable for any activity they authorize. Contamination of the environment and subsequent remediation of the site is ultimately their responsibility (see Appendix A).***

2 General Dust Suppression Guidelines

There are many aspects to consider before you apply a dust suppressant in the NWT. The following are general guidelines to be followed:

2.1 Notification for Use of Approved Products

The following parties must be notified:

Property Owner	Any application of a dust suppressant should be conducted according to an agreement between the applicator and the responsible road authority or property owner. A written agreement is recommended.
ENR	Before any application, provide the local Renewable Resource Officer with the following information: the location of the site, the product(s) used and a timetable for the work.
Public	Notify the affected public before any application. This can be through signs, public notices or media announcements.

2.2 Approved Products

Calcium chloride and DL10 are currently the only approved dust suppressants in the NWT. Appendix B contains a list of approved products and information regarding the application of these products.

Other products cannot be used in the NWT until they have been approved by ED.

Used oil cannot be used as a dust suppression/road stabilizing product or added to other dust suppression products.

2.3 Application Procedures

Directions	Follow the manufacturer's specifications or other tested and approved procedures.
Roadway	The application shall be limited to the roadway, driveway or parking lot.
Rate	Carefully monitor the application rate to ensure adequate coverage without pooling or runoff of products. The amount of dust suppressant applied should not exceed the minimum amount required to effectively suppress dust.

Incorporation	Products must be bladed or incorporated into the road immediately upon application, to ensure the product does not migrate off the roadway.
Surplus	There should be no evidence of excess product on the roadway.
Migration	The material must not migrate or run off the traveled portion of the roadway.

2.4 Environmental Concerns

2.4.1 General

Contaminants	Dust suppressants must conform with the manufacturer's specifications and must not contain concentrations of contaminants that would not normally be found in the suppressant.
PCB Concentration	Materials that contain more than 2 parts per million (ppm) of PCB are considered unacceptable and shall not be applied as a dust suppressant.

2.4.2 Water

Proximity to Water	Ensure that dust suppressants do not enter and contaminate waterbodies, including surface and groundwater. Do not allow the product to leave the roadway.
Sensitive Environments	Application rates near sensitive environments, (e.g. marshes), must be closely monitored. Remember, environmental restoration is the responsibility of the landowner, road authority or municipal authority.
Flooding	Do not apply products to areas of roads that are subject to flooding.
Imminent Precipitation	Do not apply products if precipitation is occurring, or forecast to occur before the product sets or cures.

2.5 Spill Contingency Plan

Provide EPS with a contingency plan, if required by the *Spill Contingency Planning and Reporting Regulations*, under the *Environmental Protection Act*.

Be prepared to respond to spills, including any product that migrates off the roadway.

3 New Products

Products that have not been approved by ED must undergo an assessment before being approved for use as a dust suppressant. The following information is required before such an assessment can be done:

Manufacturer's Information	Manufacturer's specifications and application procedures.
Laboratory Analysis	All new products must be characterized by an accredited laboratory.
Material Safety Data Sheets (MSDS)	Complete Workplace Hazardous Material Information System (WHMIS) data sheets.
Toxicity Tests	Toxicity tests should be provided for LC-50 and LD-50.
Leachate Tests	(see section 3.1)
Other Requirements	Provide a proposed schedule of field tests to confirm product efficiency and appropriate application rates. Provide any other materials, tests or analysis carried out on the substance. Provide copies of approvals from other jurisdictions. Laboratory or testing costs are the responsibility of the person(s) applying for approval.

3.1 Leachate Toxicity Testing

New, non-approved dust suppressant products may be required to undergo the leachate extraction procedure to determine toxicity of the product. Testing should be carried out on a sample consisting of the material, at the standard application

rate, and on a representative sample of road material. Such a leachate toxicity test can be undertaken by a variety of reputable commercial laboratories. Leachate extraction procedure CGSB #164-GP-1-MP, or an acceptable equivalent, must be used (see Appendix C).

4 Conclusion

This is a brief introduction to dust suppressant application in the NWT.

For more information, please contact:

Environment Division
Environment and Natural Resources
600, 5102-50 Avenue
Yellowknife, NT, X1A 3S8
phone (867) 873-7654 fax (867) 873-0221

Remember that this document is to inform you of the procedures you must follow before applying dust suppressants in the NWT. If you have any questions or comments, contact the Environment Division before beginning a dust control program.

5 Bibliography

Community Dust Control Program - Technical Services Division. Calcium Chloride as a Dust Suppressant. Department of Government Services and Public Works, Yellowknife, N.W.T., (1992).

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Techman Engineering Ltd. Road Dust Suppression in Northern and Western Canada- Manual or Recommended Procedures, Calgary, Alberta: Environment Canada, (1982).

Thompson, N. Use of Entac Dust Suppressant, Yellowknife, N.W.T.: Environmental Protection Division, Renewable Resources Department, (1990).

Appendix A

Environmental Protection Act

The following is a subset of the *Environmental Protection Act*. The complete act can be obtained from the Environmental Protection Service, Department of Resources, Wildlife and Economic Development.

1. In this Act,

"contaminant" means any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment,

(a) endangers the health, safety or welfare of persons,
(b) interferes or is likely to interfere with normal enjoyment of life or property,
(c) endangers the health of animal life, or
(d) causes or is likely to cause damage to plant life or to property;

"discharge" includes, but not so as to limit the meaning, any pumping, pouring, throwing, dumping, emitting, burning, spraying, spreading, leaking, spilling, or escaping;

"environment" means the components of the Earth and includes

(a) air, land and water,
(b) all layers of the atmosphere,
(c) all organic and inorganic matter and living organisms, and
(d) the interacting natural systems that include components referred to in paragraphs (a) to (c).

2.2. The Minister may

(a) establish, operate and maintain stations to monitor the quality of the environment in the Territories;
(b) conduct research studies, conferences and training programs relating to contaminants and to the preservation, protection or enhancement of the environment;
(c) develop, co-ordinate and administer policies, standards, guidelines and codes of practice relating to the preservation, protection or enhancement of the environment.

5. (1) Subject to subsection (3), no person shall discharge or permit the discharge of a contaminant into the environment.

(2) **REPEALED.** R.S.N.W.T. 1988,c.117(Supp.),s.8.

(3) Subsections (1) does not apply where the person who discharged the contaminant or permitted the discharge of the contaminant establishes that

(a) the discharge is authorized by this Act or the regulations or by an order issued under this Act or the regulations;
(b) the contaminant has been used solely for domestic purposes and was discharged from within a dwelling-house;
(c) the contaminant was discharged from the exhaust system of a vehicle;
(d) the discharge of the contaminant resulted from the burning of leaves, foliage, wood, crops or stubble for domestic or agricultural purposes;
(e) the discharge of the contaminant resulted from burning for land clearing or land grading;
(f) the discharge of the contaminant resulted from a fire set by a public official for habitat management of silviculture purposes;

(g) the contaminant was discharged for the purposes of combating a forest fire;
(h) the contaminant is a soil particle or grit discharged in the course of agriculture or horticulture; or
(I) the contaminant is a pesticide classified and labeled as “domestic” under the *Pest Control Products Regulations* (Canada).

(4) The exceptions set out in subsection (3) do not apply where a person discharges a contaminant that the inspector has reasonable grounds to believe is not usually associated with a discharge from the excepted activity. R.S.N.W.T. 1988,c.75(Supp.),s.5;c.117(Supp.),s.8.

5.1 Where a discharge of a contaminant into the environment in contravention of this Act or the regulations or the provisions of a permit or licence issued under this Act or the regulations occurs or a reasonable likelihood of such a discharge exists, every person causing or contributing to the discharge or increasing the likelihood of such a discharge, and the owner or the person in charge, management or control of the contaminant before its discharge or likely discharge, shall immediately

(a) subject to any regulations, report the discharge or likely discharge to the person or office designated by the regulations;
(b) take all reasonable measures consistent with public safety to stop the discharge, repair any damage caused by the discharge and prevent or eliminate any danger to life, health, property or the environment that results or may be reasonably expected to result from the discharge or likely discharge; and
(c) make a reasonable effort to notify every member of the public who may be adversely affected by the discharge or likely discharge. R.S.N.W.T. 1988,c.75(Supp.),s.5; c.117(Supp.),s.9.

6. (1) Where an inspector believes on reasonable grounds that a discharge of a contaminant in contravention of this Act or the regulations or a provision of a permit or licence issued under this Act or the regulations has occurred or is occurring, the inspector may issue an order requiring any person causing or contributing to the discharge or the owner or the person in charge, management or control of the contaminant to stop the discharge by the date named in the order.

7. (1) Notwithstanding section 6, where a person discharges or permits the discharge of a contaminant into the environment, an inspector may order that person to repair or remedy any injury or damage to the environment that results from the discharge.

(2) Where a person fails or neglects to repair or remedy any injury or damage to the environment in accordance with an order made under subsection (1) or where immediate remedial measures are required to protect the environment, the Chief Environmental Protection Officer may cause to be carried out the measures that he or she considers necessary to repair or remedy an injury or damage to the environment that results from any discharge.

Appendix B

Approved Dust Suppression Products and Application Information

Calcium Chloride

This is a commonly used product in the NWT. It is available in granular and liquid form. Because it is hygroscopic and deliquescent, it draws moisture from the air and will control dust if applied frequently enough.

Road surface conditions and traffic volume dictate the amount, timing and frequency of calcium chloride application. With normal application procedures and concentrations, it is generally non-toxic with rapid dissolution in the environment. However, calcium chloride can wash away in heavy rain. For more information read: *Calcium Chloride as a Dust Suppressant,* (see section 5).

Toxicity to Plants	Calcium chloride is toxic to some plants. Keep the product on the roadway.
Application Rate	Apply minimum amounts as it can cause roads to become slippery.
Applicator Competence	Ensure application personnel are informed of corrosive nature of the product (can be harmful to eyes and skin with direct contact).
General Guidelines	Follow all other general dust suppressant guidelines listed in section 2.

Appendix B (cont'd.)

DL10

DL10 is an asphalt product that is mixed with water and a soap solution. DL10 should be applied to one side of the road at a time, and then allowed to set for approximately three hours. Braking may be difficult on freshly treated road, so a pilot car may be necessary to direct traffic during the application. Vehicles should travel no faster than 20 km/hr through areas where the application has not set.

Fresh DL10 can be washed off using soap and water. If it is allowed to dry, a solvent may be required.

General Guidelines Follow all general dust suppressant guidelines listed in section 2.

Appendix C

Leachate Extraction Procedure Test and Equivalents (see bibliography section for complete documentation).

The Environment Division may require new products to undergo the following test:

> CGSB #164-GP-1-MP Leachate Extraction Procedure Canadian General Standards Board (or as amended).

Or one of these equivalent tests:

> Schedules III and IV - Environmental Quality Act - Hazardous Waste Regulation- Gazette officielle du Quebec.
>
> Schedule 4 - British Columbia Waste Management Act - Special Waste Regulation, Government of British Columbia.
>
> Schedule 4 - Regulation 347 (formerly Reg. 309), Government of Ontario.

If you would like to be placed on a mailing list to receive guideline amendments or for public consultation on Environment Division legislation please fill this out and mail or fax to:

Environment Division
Department of Environment and Natural Resources
Government of the Northwest Territories
600, 5102 - 50th Avenue
Yellowknife, NT, X1A 3S8
Fax: (867) 873-0221

Mailing List for Environmental Protection Service Information

Name: _____

Title: _____

Address:_____

_____

_____

Phone/Fax Number_____

PRAIRIE CREEK ACCESS ROAD

CANADIAN ZINC CORPORATION

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