- 700 hp ball mill
- 1000 tpd flotation cells
- Thickener tanks
- Larox filters
- To Install: Paste backfill plant & Pb Ox circuit
- Produce Pb and Zn Cons
New 1566 kw Generators (3 Units)
New Incinerator
Metallurgical Summary

Prairie Creek Mine
Process Summary Per Tonne of Mine Rock

- 50% Float Tails
- 24% DMS Reject Rock
- 26% Concentrate

Paste Backfill Flowsheet
Mine Waste Management

- Float tails and portion of DMS rock backfilled underground. All float tails fits with contingency
- Waste Rock Pile for development rock and excess DMS rock
- Conversion of original tailings pond to Water Storage Pond to allow recycle, up to 50,000 tonnes start-up float tails storage
Solid Waste Facility Layout

- Lined Cell For Oil Contaminated Waste Material
- Belts & Tires
- Incenerator Cell
- Sewage Sludge Cake Cell
- Access Road
- Perimeter Berm
- Perimeter Fence
Upgraded Mine Facilities:

1. Water Storage Pond - Cell A
2. Water Storage Pond - Cell B
3. Reagent Storage Sheds
4. Water Treatment Plant
5. Staff Accommodation Block
6. Ore Stockpile Lined Pad
7. 2nd 870 Underground Portal
8. Concentrate Storage Shed
9. DMS Plant (Attached to Mill)
10. Temporary Float Storage Pile
11. Paste Backfill Plant (Attached to Mill)
12. Waste Rock Pile
13. Acid Storage Tanks
14. Bagging Plant
15. Cement Storage Shed
Water Storage Pond

190,000 m³ of SLOPE REMOVAL

PRAIRIE CREEK MINE
FIGURE 6-17:
RECONFIGURED WATER STORAGE POND
Water Use

- Process water ‘aged’ in Water Storage Pond to degrade Mill reagents
- Mill feed is 65% process water, 35% mine water
- Process water recycle limited to 65% by long-term major ion build-up
Water Treatment for Discharge

- Mine water – lime, clarification
- Process water – pH reduction (acid), sulphide, lime, clarification
- Mine water treated and discharged year round, less in winter
- No process water treatment and discharge Feb-Mar, and substantially reduced in other winter months
Water Management Contingencies

• Available pond storage
• Short-term increase in process water recycle %
• Use of process water treatment circuit for mine water treatment
• Redundant pumps and power supply
• Emergency use of storage pond freeboard
## Predicted Mine Flows (L/sec)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<td>83</td>
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<td>181</td>
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<td>207</td>
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<td>207</td>
<td>150</td>
<td>100</td>
<td>162</td>
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flow reduced to account for limited recharge of HCAA during winter freeze-up
Prairie Creek Flows at Harrison Creek

![Graph showing the flow of Prairie Creek from January to December. The graph indicates the mean, minimum, and maximum flow rates. The highest flow occurs in July, with the lowest flow in January.](image-url)
WSP Water Balance

LOW MINE FLOWS

- Mine Drainage to Water Storage Pond
- Cell B to Water Treatment Plant
- Process Feed
- Losses to solids
- Mill Effluent to Water Storage Pond
- Cell A to Water Treatment Plant

Flow L/s

Month

Jan  Mar  May  Jul  Sep  Nov
WSP Water Balance

BEST ESTIMATE MINE FLOWS

Month

Flow L/s

- Mine Drainage to Water Storage Pond
- Cell B to Water Treatment Plant
- Process Feed
- Losses to solids
- Mill Effluent to Water Storage Pond
- Cell A to Water Treatment Plant
WSP Water Balance

HIGH MINE FLOWS

- Mine Drainage to Water Storage Pond
- Cell B to Water Treatment Plant
- Process Feed
- Losses to solids
- Mill Effluent to Water Storage Pond
- Cell A to Water Treatment Plant

Flow L/s

Month

WSP Water Balance

HIGH MINE FLOWS

- Mine Drainage to Water Storage Pond
- Cell B to Water Treatment Plant
- Process Feed
- Losses to solids
- Mill Effluent to Water Storage Pond
- Cell A to Water Treatment Plant

Flow L/s

Month
WSP Water Balance

EXTREME MINE FLOWS

- Mine Drainage to Water Storage Pond
- Cell B to Water Treatment Plant
- Process Feed
- Losses to solids
- Mill Effluent to Water Storage Pond
- Cell A to Water Treatment Plant
Water Discharge

• All flows collect in lined Catchment Pond
• Discharge via pipes with slots in exfiltration trench extending part way below Prairie Creek channel
• Rapid mixing enables small Initial Dilution Zone (IDZ, 100 m). Vast majority of mixing complete 1.6-30.6 m downstream
• Zone of fish passage maintained around trench location in all seasons
Buried Pipe Discharge
Discharge Water Quality

• Treated process water never >20% in discharge to minimize toxicity
• Toxicity testing confirms discharge will not be acutely toxic
• Exfiltration trench ensures rapid mixing and very small zone of chronic toxicity
Approach to Ensuring No Significant Effects (Water Quality Objectives)

• Compile reference database of upstream water quality
• Compute mean and 2 standard deviations (M+2SD) of each parameter
• If predicted concentration (for all mine flow scenarios) within M+2SD, no significant effect (and M+2SD adopted as objective)
• If predicted concentrations exceeds M+2SD, review toxicity data and select protective objective
## CZN’s Proposed Water Quality Objectives

<table>
<thead>
<tr>
<th>Analyte of Concern</th>
<th>Proposed SSWQO</th>
<th>Derivation/Rationale</th>
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<tr>
<td>Antimony (Sb)</td>
<td>20 ( \mu g/L )</td>
<td>Ontario guideline (no CCME guideline)</td>
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<tr>
<td>Arsenic (As)</td>
<td>5 ( \mu g/L )</td>
<td>CCME toxicity fact-sheet including northern species (existing guideline)</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.38 ( \mu g/L )</td>
<td>CCME toxicity fact-sheet including northern species (proposed guideline)</td>
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<tr>
<td>Copper (Cu)</td>
<td>4 ( \mu g/L )</td>
<td>Northern species toxicity data</td>
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<tr>
<td>Iron (Fe)</td>
<td>242 ( \mu g/L )</td>
<td>RCA-derived benchmark</td>
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<tr>
<td>Lead (Pb)</td>
<td>7.0 ( \mu g/L )</td>
<td>Northern species toxicity data (CCME guideline)</td>
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<tr>
<td>Mercury (Hg)</td>
<td>0.026 ( \mu g/L )</td>
<td>Northern species toxicity data (CCME guideline)</td>
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<td>Selenium (Se)</td>
<td>2.22 ( \mu g/L )</td>
<td>RCA-derived benchmark</td>
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<tr>
<td>Silver (Ag)</td>
<td>0.1 ( \mu g/L )</td>
<td>CCME (existing guideline)</td>
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<tr>
<td>Zinc (Zn)</td>
<td>35 ( \mu g/L )</td>
<td>Northern species toxicity data (proposed CCME guideline)</td>
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<tr>
<td>Ammonia (total)</td>
<td>0.409 mg/L(^1)</td>
<td>Northern species toxicity data (CCME guideline)</td>
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<td>Nitrate</td>
<td>2.9 mg/L</td>
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<tr>
<td>Total phosphorus</td>
<td>4 ( \mu g/L )</td>
<td>CCME (existing guideline for protection of ultra-oligotrophic waters)</td>
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<td>Sulphate</td>
<td>200 mg/L</td>
<td>Based on hardness-based, dose-response relationships published in Elphick et al. (2010)</td>
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<tr>
<td>TDS</td>
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Antimony Toxicity Data

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<th>Species</th>
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<tr>
<td>Ontario guideline</td>
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<tr>
<td>Rainbow Trout</td>
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<tr>
<td>Fathead Minnow</td>
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<td>Water Flea</td>
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<tr>
<td>Fathead Minnow</td>
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<td>Nile tilapia</td>
<td>1000000</td>
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<td>Water Flea</td>
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</tbody>
</table>

Rainbow Trout, Amphipod, Water Flea, Fathead Minnow, Nile tilapia.
Arsenic Toxicity Data

The graph shows the proportion of total number of species tested at various water concentrations in µg/L. Different symbols represent different species categories:

- Plant
- Intertebate
- Vertebrate
- Northern Fauna

Species tested include Arctic Grayling and Coho Salmon.
Cadmium Toxicity Data

Water concentration (µg/L) vs. Proportion of total number of species tested

- Plant
- Intebrate
- Vertebrate
- Northern fauna

Species: Bull Trout, Arctic Char, Chironomid
Lead Toxicity Data

Water concentration (µg/L)

CCME, Amphipod, Chironomid, Mayfly, Chironomid, Arctic Grayling, Chironomid, Coho Salmon
Zinc Toxicity Data

Water concentration (µg/L)

CCME
Bull Trout
Arctic Grayling
Cutthroat
Chinook Salmon
Chironomid
Ammonia Toxicity Data

Water concentration (µg/L)

CCME
Rainbow trout
Sockeye salmon
Mayfly
Spiny-gilled mayfly
Midge
Midge
Mayfly
Midge
Damselfly
Caddisfly
Water Quality Objective

Antimony

mg/L

CZN Objective
RCA Mean+2SD
Highest Predicted Concentration
Upstream Concentration
Water Quality Objective

Arsenic

mg/L

0.006
0.005
0.004
0.003
0.002
0.001
0.000

CZN Objective
RCA Mean+2SD
Highest Predicted Concentration
Upstream Concentration
Water Quality Objective

Cadmium

mg/L

CZN Objective
RCA Mean+2SD
Highest Predicted Concentration
Upstream Concentration
Water Quality Objective

Copper

mg/L

- CZN Objective
- RCA Mean+2SD
- Highest Predicted Concentration
- Upstream Concentration
Water Quality Objective

Zinc

- CZN Objective
- RCA Mean+2SD
- Highest Predicted Concentration
- Upstream Concentration

mg/L

0.000 0.005 0.010 0.015 0.020 0.025 0.030 0.035 0.040
Water Quality Objective

Ammonia

- CZN Objective
- RCA Mean+2SD
- Highest Predicted Concentration
- Upstream Concentration

mg/L

0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0

0.3
0.4
0.5

0.1
Water Quality Objective

Sulphate

CZN Objective
RCA Mean+2SD
Highest Predicted Concentration
Upstream Concentration
Mercury

- Background concentration in Prairie Creek is very low
- Similarly very low concentration in mine water
- Majority of mercury in process water is sediment (dissolved is 15% of total)
- Water quality after discharge will be very close to background levels
- Mine operations will not lead to a significant increase in accumulation in fish
Water Quality Objective

Mercury

mg/L

CZN Objective
RCA Mean+2SD
Highest Predicted Concentration
Upstream Concentration
### SUMMARY OF PRAIRIE CREEK EXISTING AND PREDICTED WATER QUALITY - OPERATIONS (mg/L)

<table>
<thead>
<tr>
<th></th>
<th>Prairie Creek upstream*</th>
<th>CZN Objective</th>
<th>Treated Mine Water</th>
<th>Treated Process Water</th>
<th>Predicted In-Stream Concentrations at Harrison Creek Low to High Mine Flows</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Mean Creek Flow</td>
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<td>Ag</td>
<td>0.00074</td>
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<td>Cu</td>
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<td>0.004</td>
<td>0.0072</td>
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<td>356.7</td>
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<td>6100</td>
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* Means from existing database, non-detections for each parameter assigned a value half the lowest detection limit

** Bold = Exceeds Objective **
ID = Insufficient Data
ND = No Data
1 Ontario guideline 2 Diavik underground water 3 Factored from Diavik STP
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prairie Creek</th>
<th>RCA (Mean+2SD)*</th>
<th>CZN Objective</th>
<th>Treated Mine Water</th>
<th>Treated Process Water</th>
<th>Predicted In-Stream Concentrations at Harrison Creek</th>
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<tbody>
<tr>
<td></td>
<td>Up-stream*</td>
<td>Down-stream*</td>
<td>Value</td>
<td>%&lt;DL</td>
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<td>Low to High Mine Flows</td>
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**Mean Creek Flow**

**Low Creek Flow**

**High Creek Flow**

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</tbody>
</table>

* Means from existing database, non-detections for each parameter assigned a value half the lowest detection limit

**Bold = Exceeds RCA**

* Old NNPR boundary, means from existing EC database, non-detections for each parameter assigned a value half the lowest detection limit

ID = Insufficient Data
ND = No Data
1 Ontario guideline
2 Diavik underground water
3 Factored from Diavik STP
Effluent Quality Criteria

• Maximum grab and average limits should cap discharge concentrations so that objectives are met during higher than normal flows
• Load limits that vary according to Prairie Creek flows should be set to ensure objectives are met for all flows
• This approach ensures significant effects do not occur, but gives the operation maximum flexibility
Load Limits

- Continuous creek flow readings
- Pre-determined upstream and objective concentrations
- Compute discharge load limits
- Track discharge loads based on continuous flow readings and discharge concentrations

![Graph showing allowable zinc load vs Prairie Creek flow](attachment:image.png)
Manpower and Logistics

- 220 full-time jobs at the Mine, 110 at any one time
- 2 mine and mill shifts, 1 admin shift, per day
- 3 weeks on, 3 weeks off rotation by air, weekly flights
- Concentrates/supplies haul to/from Mine during December-April
Concentrates

• Placed in sealed 3 tonne bags, dust control, stored for winter haul
• Collected by trucks from bay with wheel wash
• Bags and contents will be frozen
• Off-load/load at transfer facilities makes bulk transport impossible
• Dust and soil monitoring to verify no losses
Proposed Transfer Facilities (Inside)
Prairie Creek Mine: Transport
Road Design/ Changes

• Re-alignments out of wetlands
• Avoid poljes & karst features
• Reduce/remove grades/turns
• Bridges over some creeks
• Curbs, run-away lanes
• Speed limit and warning signs
Bridge Concept - Sundog Creek
Access Road – Polje By-Pass
Access Road – Nahanni Range

[Map of Nahanni Range access road with labels and distances]

- Road Distances:
  - LIT to Fort Nelson (BC) - 308 km
  - LIT to BC Border - 121 km
  - LIT to Enterprise - 436 km
The Nahanni Route Re-alignment and Liard Crossing: Location of Ice Bridge during winter operations.
Road Construction & Maintenance

• Start from the Mine, November
• Use of frozen ground, snow/ice
• Inspect for cultural resources
• Water from Mine well or Mosquito Lake
• Protect stream banks
• Granular fill use, insulate permafrost
• Inspections/maintenance/closure
Road Use Schedule

- Dec 1 to Jan 15 – Mine to Tetcela - Concentrates to Tetcela Transfer Facility (TTF)
- Jan 15 to Mar 31 – Mine and TTF to Liard - Concentrates to Liard Transfer Facility, Supplies in to Mine
- Jan 15 to fall – Liard Transfer Facility to Fort Nelson - Concentrates to railhead
- All dates subject to weather
Road Management

• Verify driver experience
• Speed limits
• Radio contact and control
• Journey management and checkpoints
• Supervision and monitoring
Spill Contingency

- Response plans and response team
- Response training
- Response equipment and control points
- Driver training relevant to cargo
- Rapid response and notifications
- Complete spill clean-up verified by investigation
Access Control

- Nahanni checkpoint to deter unauthorized use
- Information and signs re high traffic road, use at own risk
- Monitoring of use (monitors and truckers)
- Barriers when road not in use
Expected Liard Facility Transfer Traffic

<table>
<thead>
<tr>
<th>From</th>
<th>Trips per Day</th>
<th>Period From</th>
<th>To</th>
</tr>
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<tbody>
<tr>
<td>Mine</td>
<td>58</td>
<td>January 15</td>
<td>March 6</td>
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<tr>
<td>Mine</td>
<td>37</td>
<td>March 6</td>
<td>April 15</td>
</tr>
<tr>
<td>Fort Nelson</td>
<td>14</td>
<td>January 15</td>
<td>October 15</td>
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</table>

Dates subject to weather
Wildlife

Figure 4-11: Seasonal Wildlife Ranges Along and Adjacent to the Prairie Creek Mine Site and Access Road
Residual effects:

• Potential for effects on Dall’s sheep lambing activity during the spring (May-June) with air traffic;

• Potential for collisions with Dall’s sheep, woodland caribou and wood bison associated on access road; and,

• Potential for grizzly bear-human encounters at the Mine site.
Wildlife Mitigation

- Wildlife Management and Monitoring Plan
- Flight Impact Management Plan
- Specific monitoring proposal for Dall’s sheep
- Speed limits, warning signs for potential collision zones. Traffic stops when wildlife near roadway
- Minimize attractants to bears. Warning and encounter management.
- No hunting/fishing by employees.
Mine Closure

- Completely fill Mine to stop portal drainage
- Cover Waste Rock Pile, limit seepage
- Treat/Monitor groundwater until quality stable and groundwater discharge will not have significant impacts
- Remove buildings and infrastructure
- Restore natural floodplain
Post-Closure Water Quality

• >99% of groundwater predicted to flow around the backfill
• Fault structure groundwater discharge occurred pre-mine
• Zinc concentrations in Prairie Creek predicted to be lower than pre-mine
• Other metal concentrations predicted to attenuate and be less than objectives
• Monitoring to verify, groundwater treatment as contingency
### SUMMARY OF PRAIRIE CREEK EXISTING AND PREDICTED WATER QUALITY POST-CLOSURE (mg/L)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prairie Creek</th>
<th>RCA (Mean+2SD)*</th>
<th>CZN Objective</th>
<th>Predicted In-Stream Concentrations at Harrison Creek</th>
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**Notes:** Silver and mercury predictions used a background value of 0.00002.

Predicted zinc and sulphate concentrations were higher pre-mine.

* Means from existing database, non-detections for each parameter assigned a value half the lowest detection limit

# Old NNPR boundary, means from existing EC database, non-detections for each parameter assigned a value half the lowest detection limit

**Bold = Exceeds Objective**

1 Ontario guideline  
ND = No Data
Mine Closure

- Fill in underground mine
- Cover for Waste Rock Pile
- Remove buildings and infrastructure
- Restore natural floodplain
Economic Benefits

- Priority hiring
- Priority on Contracts
- Percentage of Project's Profits
- Education & Training Funds
- LKFN Trust Fund
- Capacity Building Contribution
- Anchor Tenant in Band Office
- Ongoing Annual Community Events
Social Issues Programs

- Money Management
- Health Awareness
- Coordinating Family Assistance
- Ongoing Community Event Sponsorship
- Youth Workshops
- Traditional Harvesting
- Assistance with accessing Gov’t Programs
Mahsi Cho