The Ongoing Rehabilitation of Ontario's Kam Kotia Mine: An Abandoned Acid Generating Tailings Site

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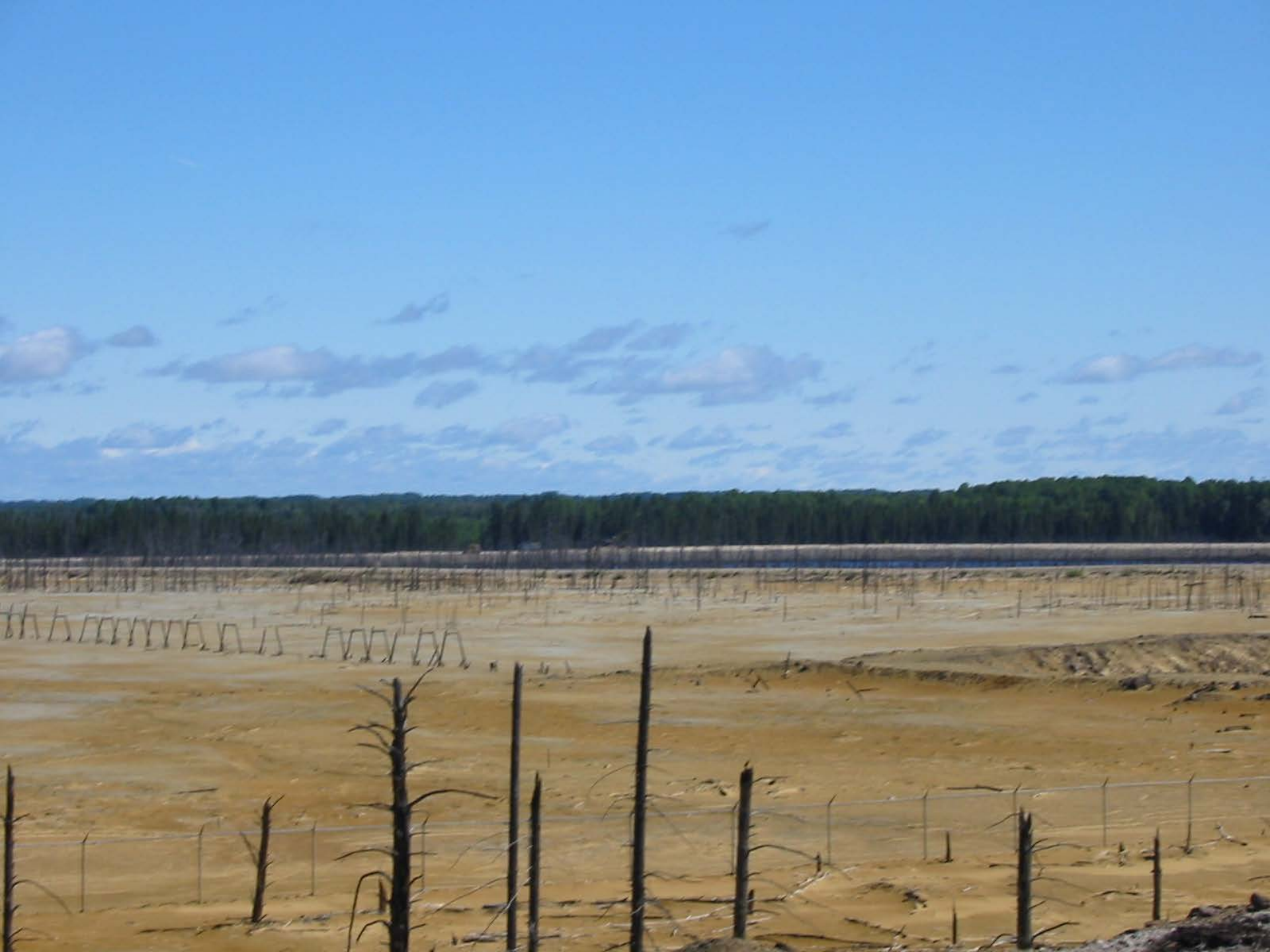
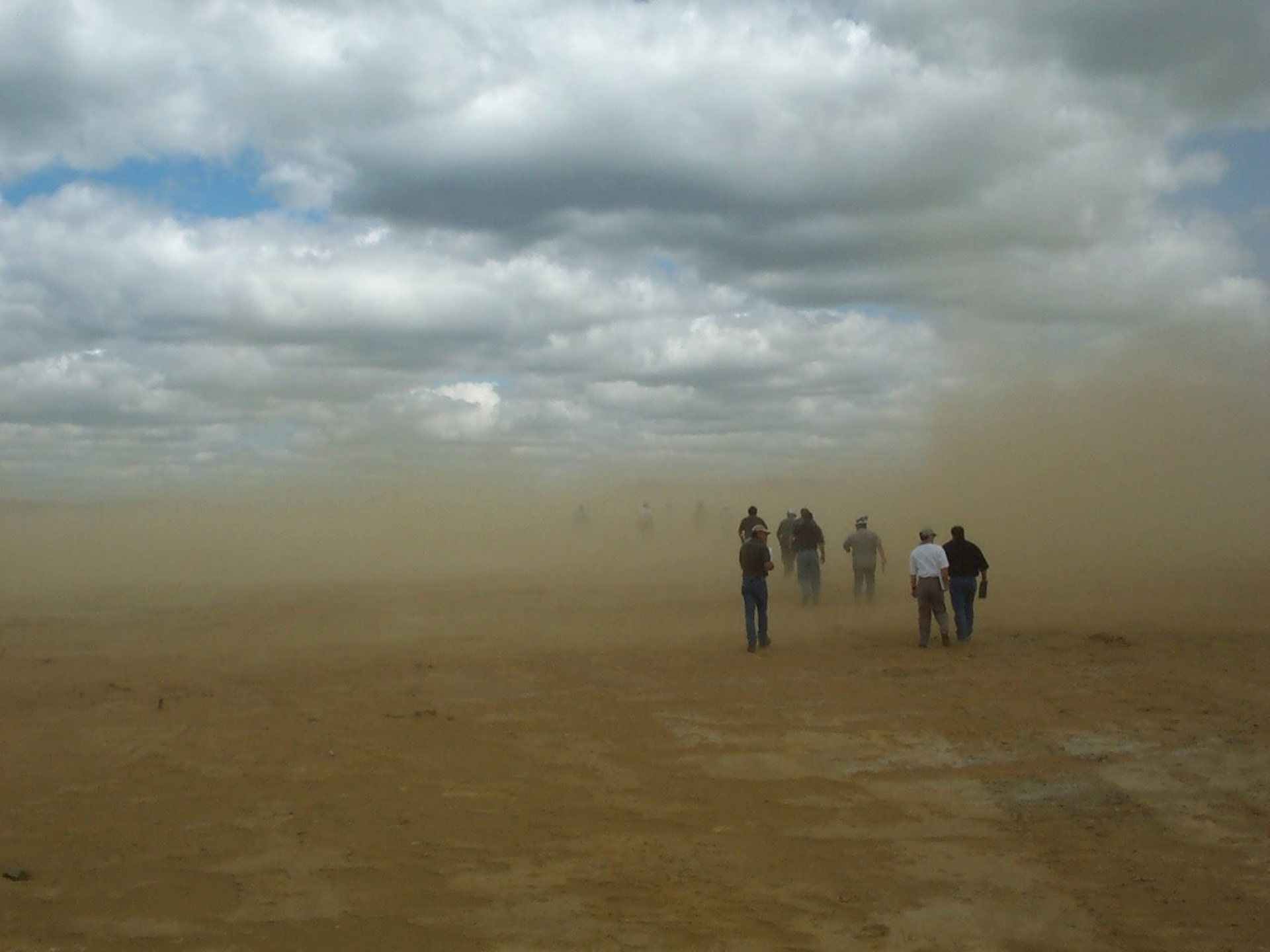
WHAT IS KAM KOTIA?

- Kam Kotia is a former Cu/Zn mine near Timmins, Ontario
- There were about 6 million tonnes of unmanaged acid generating tailings covering more than 500 ha
- Environmental impacts are locally significant
  - acidic leachate
  - dusting
  - aesthetics
  - physical safety


HIGHWAY 576
NORTH
IMPOUNDED
TAILINGS
(NIT)
NORTH
UNIMPOUNDED
TAILINGS
(NUT)
SOUTH
UNIMPOUNDED
TAILINGS
(SUT)
KAM KOTIA
PLANT SITE
ACCESS ROAD
TO JAMELAND MINE





MINING HISTORY

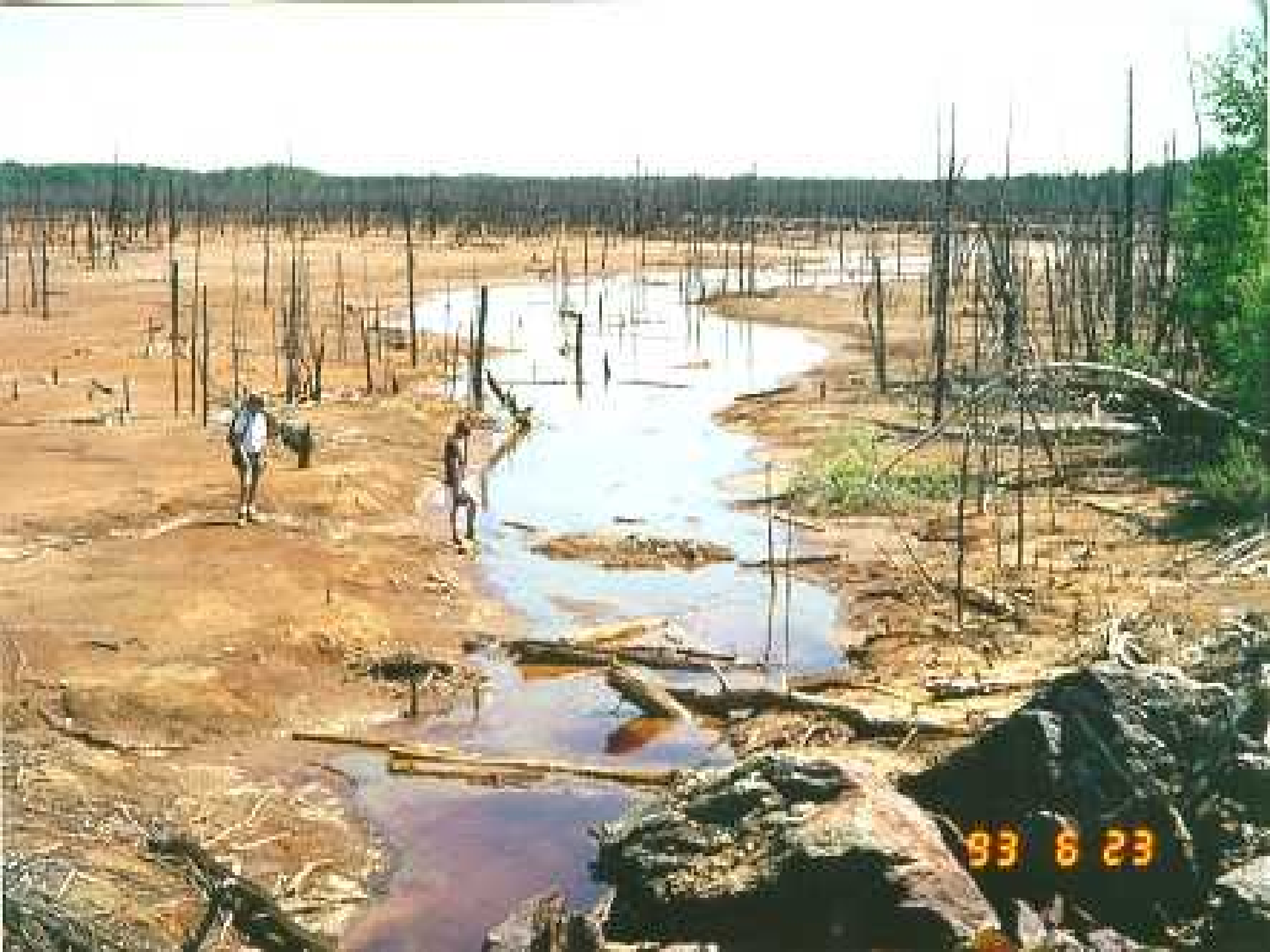
- Principle exploration 1926-1928, exploration shaft
- Mining * 1943-1944 - 169,000 tonnes open pit
- Mining 1961-1972 - 5,840,000 tonnes, mainly underground
- Production 6.6 MT @ 1.1% Cu, 1.17% Zn, 0.10 oz/Ag

* **Mining in 1943-1944 carried out on behalf of Wartime Metals Corporation, a Federal Government Agency. Cu sold to Metals Reserve Company. Washington, which paid operating costs and royalty.**

HYDROLOGY

- North and East seeps, with a pH of 2-3, drain NUT, east half of the NIT and north half of plant site to the Kamiskotia River in the north.

- South seep drains the SUT, the west half of the NIT and the plant site to Little Kamiskotia River in the south, which had a pH of 3.5 to 4 prior to rehabilitation beginning on the site.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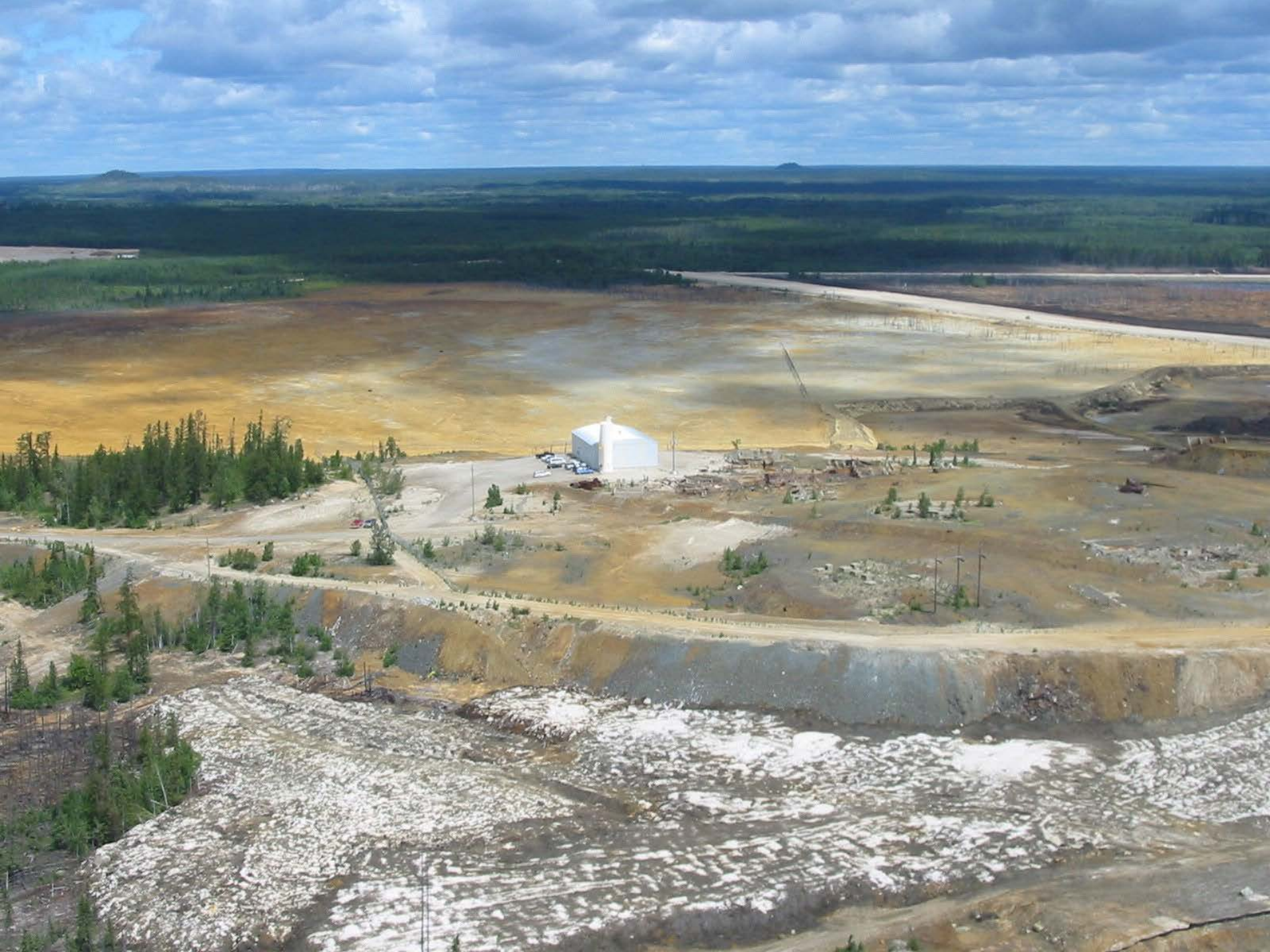
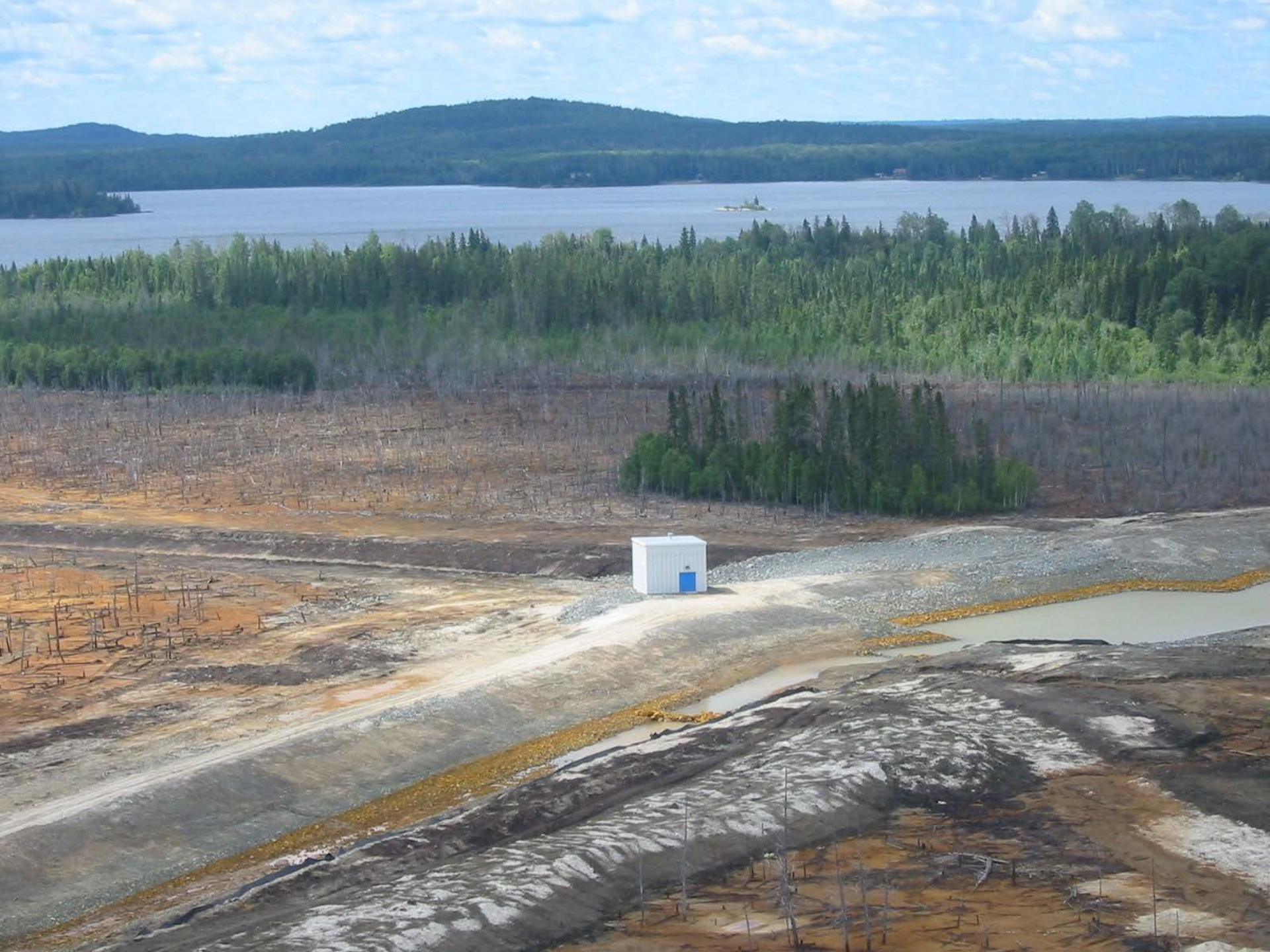
BACKGROUND

- The total rehabilitation of the abandoned Kam Kotia Mine site is to be conducted as a proposed five-phase program.
- This rehabilitation plan was developed during fiscal 2000/01, and predicted a total rehabilitation cost of more than $41 million.
- The cost estimates were as follows, including a 30% contingency:
  - Phase “A”: $4.985 million
  - Phase “B”: $3.285 million
  - Phase “C”: $8.190 million
  - Phase “D”: $3.372 million
  - Phase “E”: $11.766 million
  - Effluent treatment for 50 years: $9.698 million

PHASE “A”

- Phase “A” involved: a) the construction of a Lime Addition Treatment Plant, as well as all of its required infrastructure, and b) the construction of a new NUT impoundment dam structure.
- The combined cost of these Phase “A” bids was $9.85 million, which was almost double the price predicted in the conceptual plan.
- The Phase “A” work was completed by July 2002.





PHASE “B”

- Phase “B” involved the relocation of the SUT tailings to within the new NUT impoundment area.
- Upon completion of the work, more than 340,000 m^3 of SUT tailings had been relocated and buffered with Envirolime, at a cost of $3.4 million.
- Phase “B” work was completed by mid-March 2003.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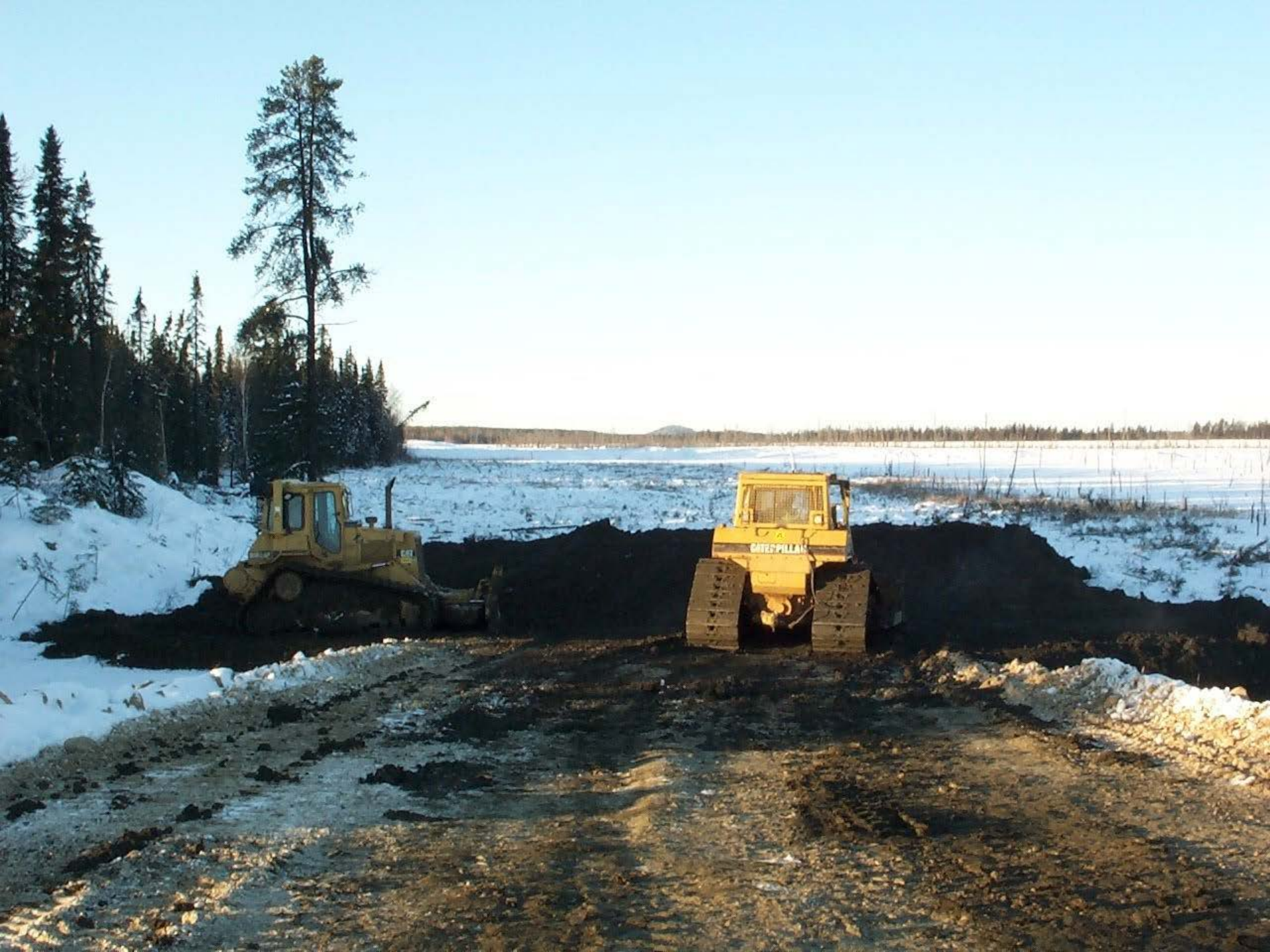
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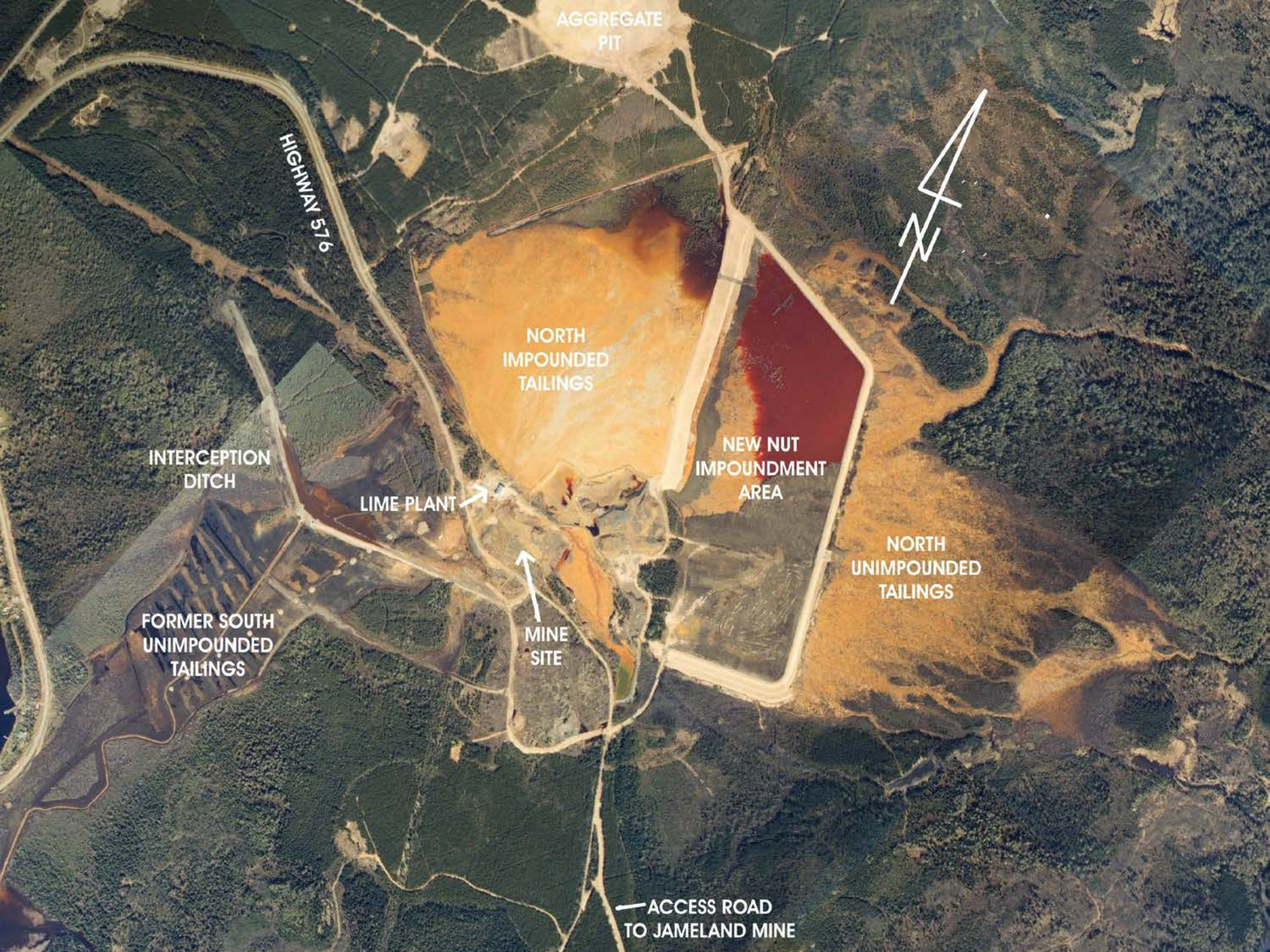
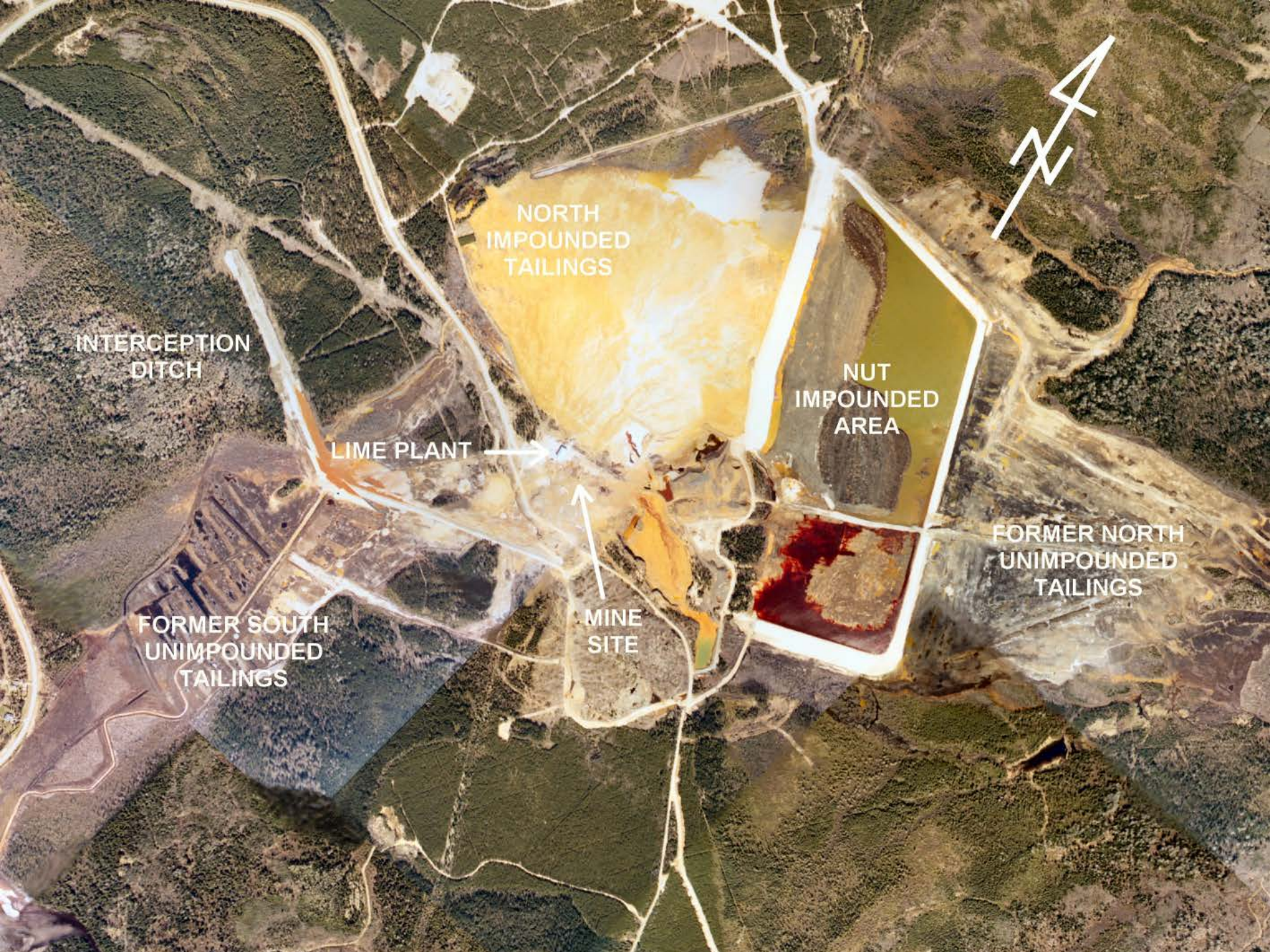

AGGREGATE PIT
HIGHWAY 576
NORTH IMPOUNDED TAILINGS
NEW NUT IMPOUNDMENT AREA
INTERCEPTION DITCH
LIME PLANT
NORTH UNIMPOUNDED TAILINGS
FORMER SOUTH UNIMPOUNDED TAILINGS
MINE SITE
ACCESS ROAD TO JAMELAND MINE

PHASE “C"

- Phase “C” involved the relocation of the NUT tailings to within the new NUT impoundment area.
- Upon completion of the work, more than 611,000 m^3 of NUT tailings had been relocated and buffered with Envirolime, at a cost of $6.9 million.
- The Phase “C” work was completed by late-March, 2004.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MINE
SITE
FORMER SOUTH
UNIMPOUNDED
TAILINGS
N

However…..

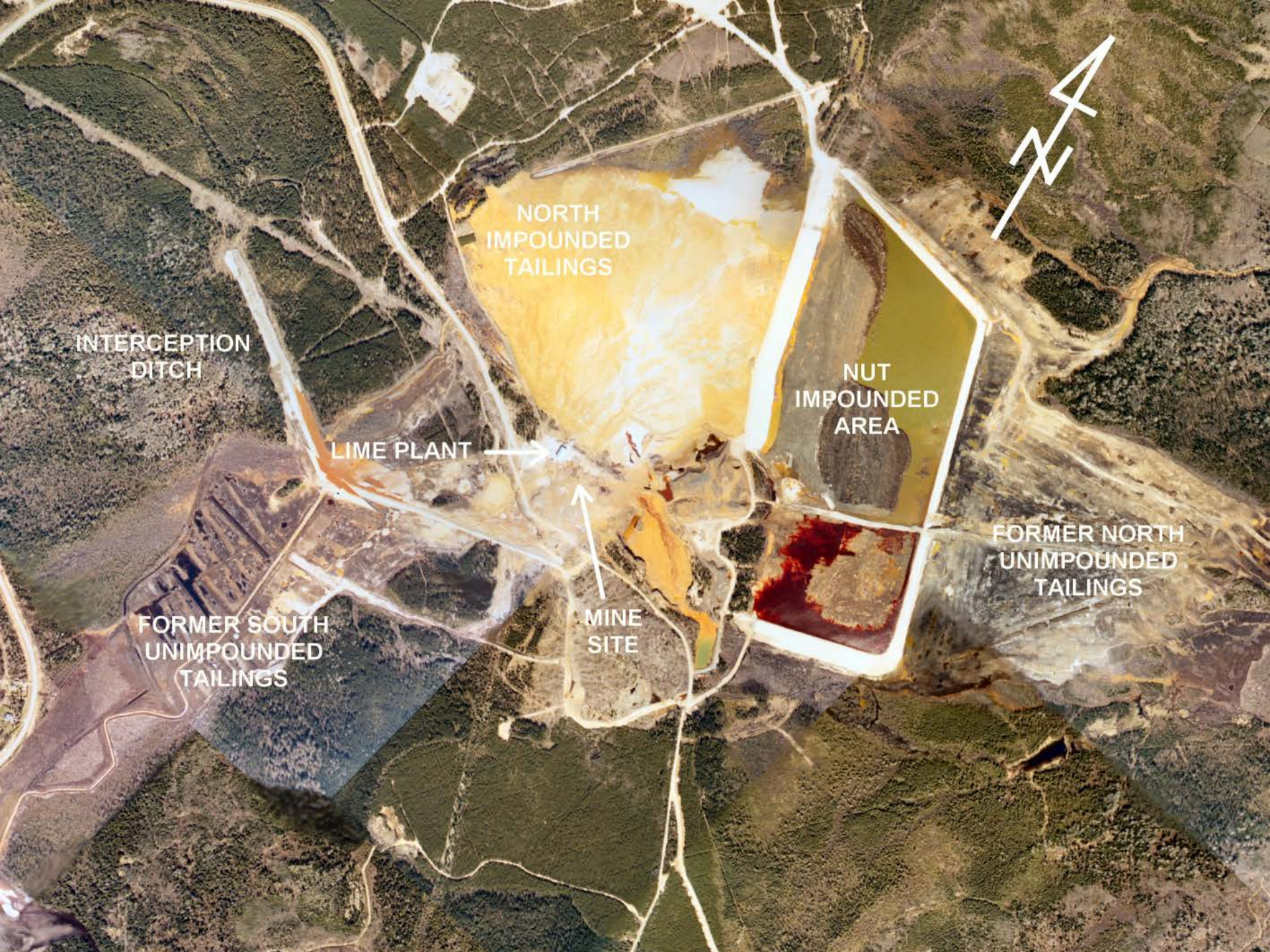
…. in abandoned mine rehabilitation,

like any construction project, ….

Things don't always go exactly as planned!

Contaminated NUT Area Water

- Timmins received two years of anomalously high precipitation.
- The NUT Impoundment Area filled with approximately 600,000 m^3 of water at a pH of about 2.8, and containing very high acidity and metals.
- In order not to delay the project, a decision was made to stack the NUT tailings in the impoundment area during Phase “C”.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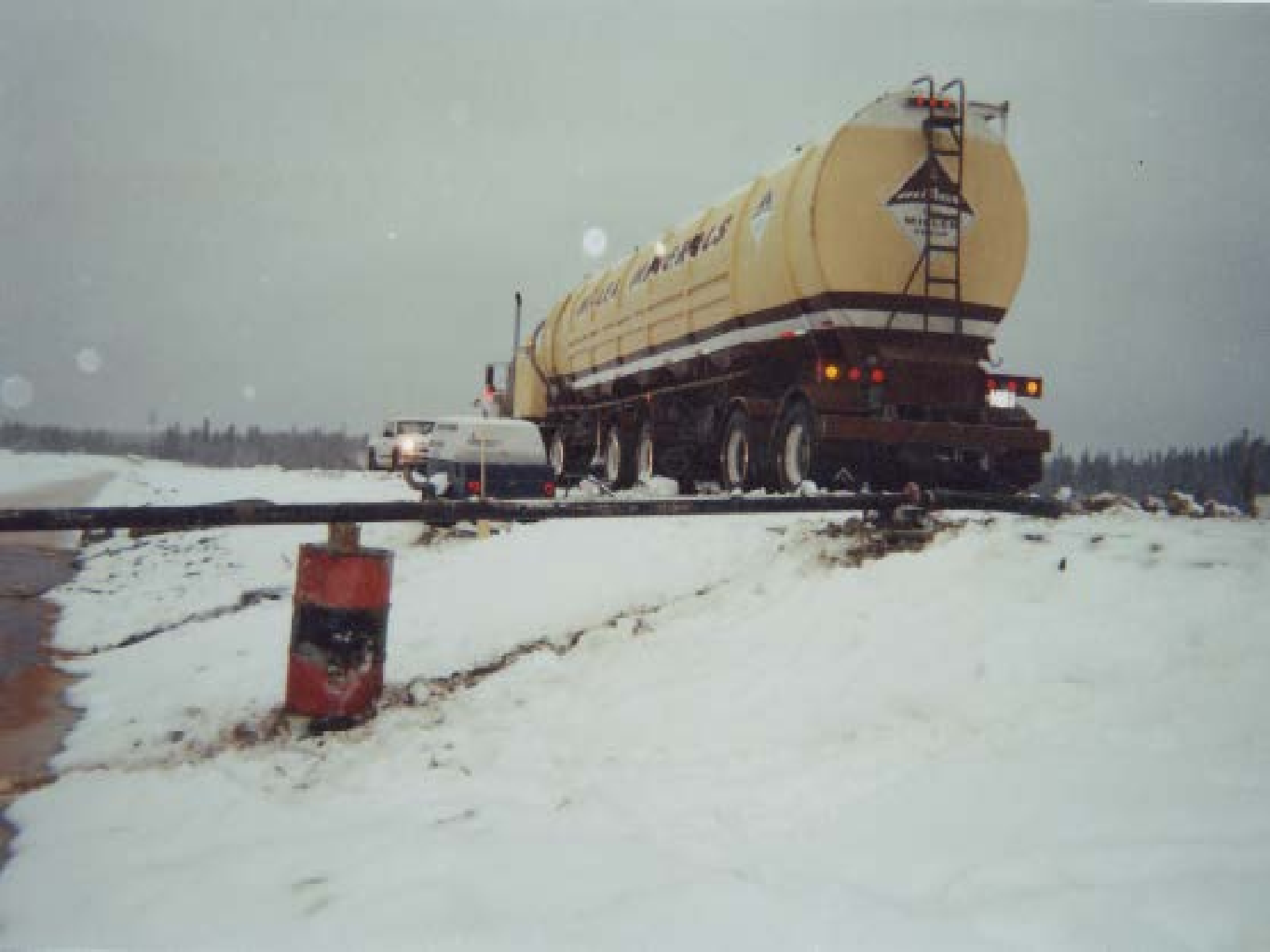
Contaminated NUT Area Water

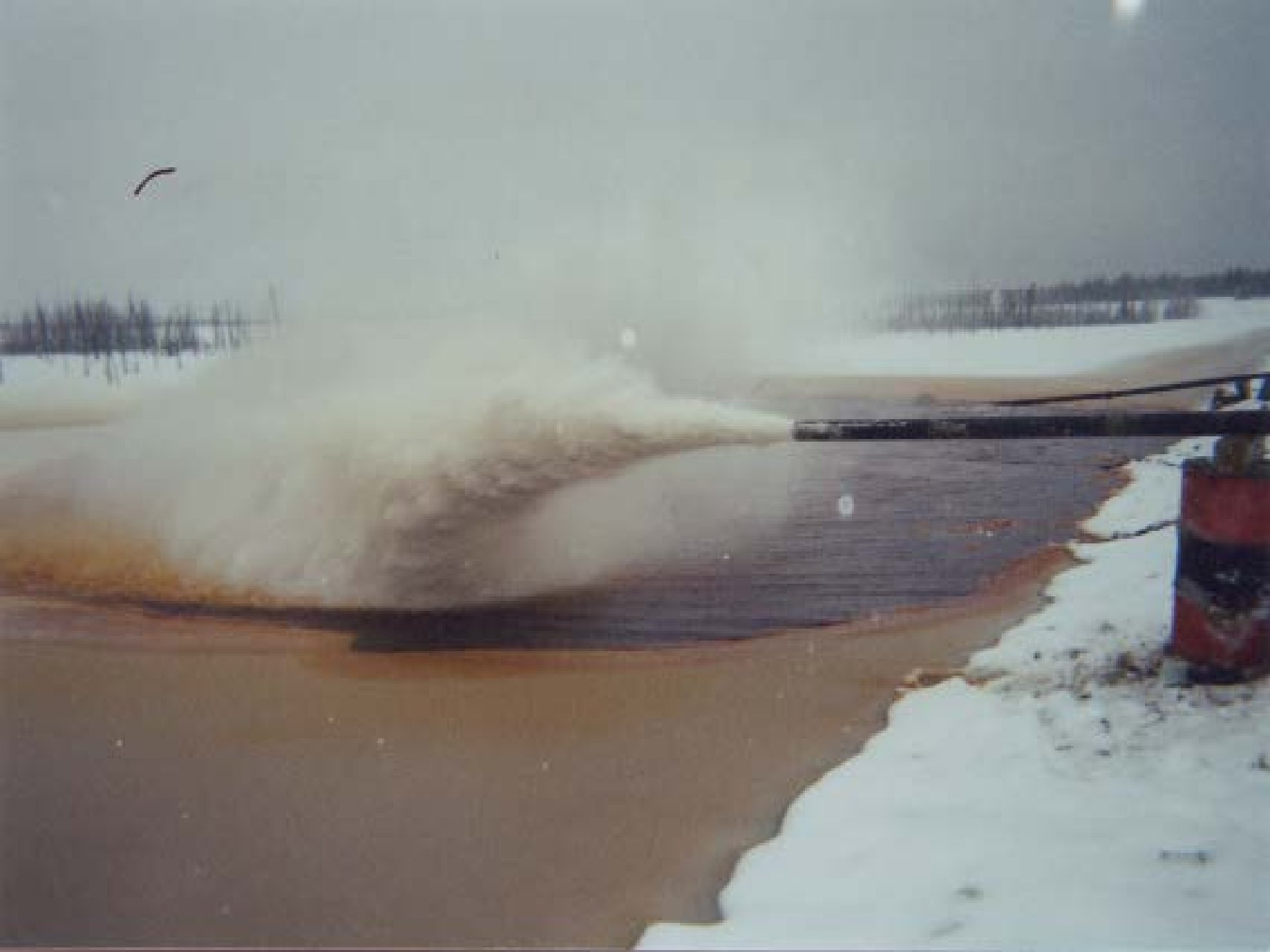
NUT Water Quality, October, 2003

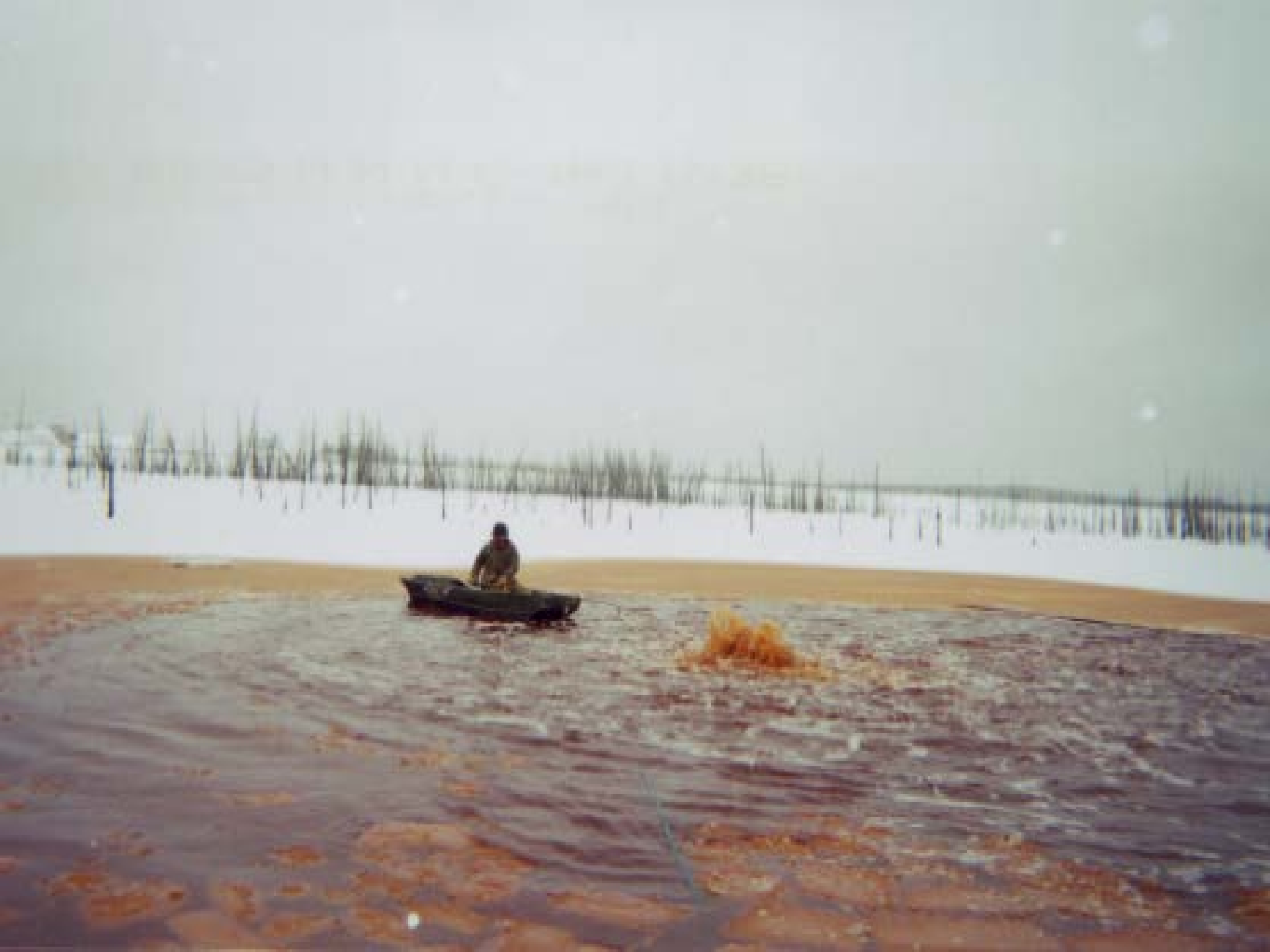
Parameter	Units	Result
pH		2.58
Acidity	mg/L as CaCO3	3980
Al	mg/L	104
As	mg/L	0.08
Co	mg/L	3.87
Cu	mg/L	25.5
Fe	mg/L	1320
Zn	mg/L	188

Contaminated NUT Area Water

- Efforts were made to conduct the “in-situ” treatment of the NUT “Pond” during the winter of 2003/04.
- After 706 tonnes of lime were added to the Pond, caustic (e.g. NaOH) was used.
- Over 2,000 tonnes of caustic were also added.
- Managed to raise the pH sufficiently to allow the discharge of the contaminated water for ~ 3 hours.
- Eventually ceased the treatment after having spent $1.8 million.





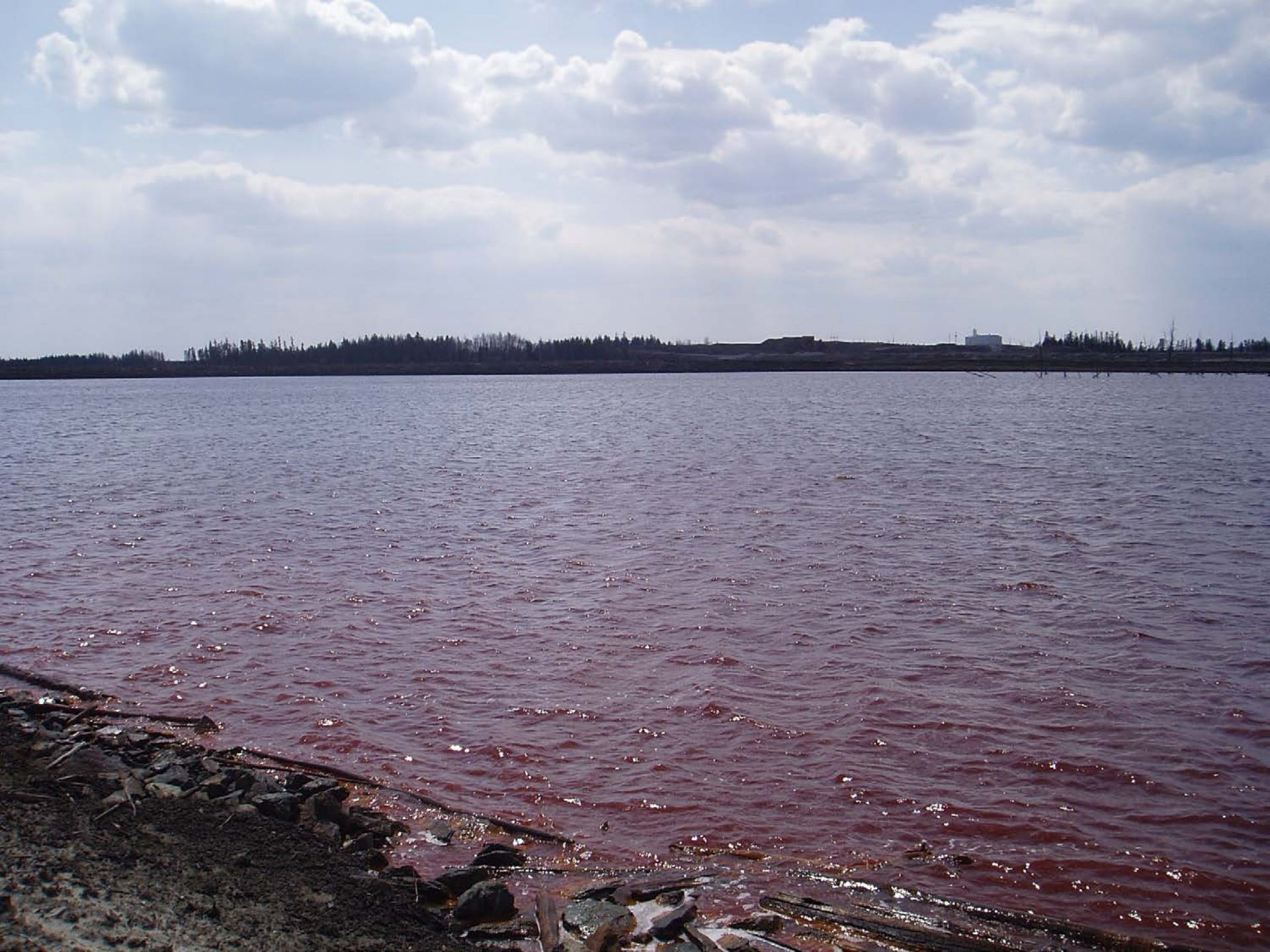


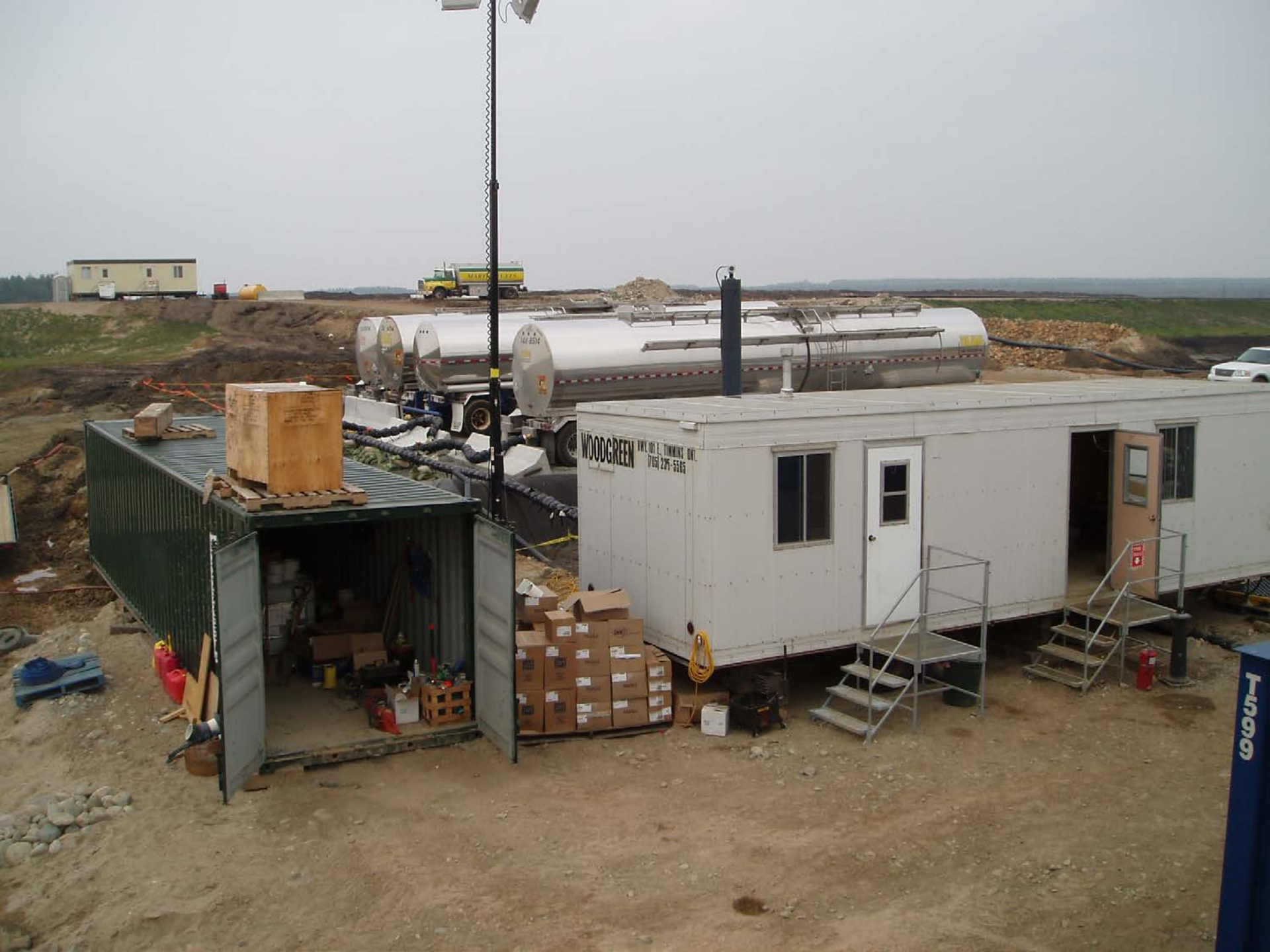
Contaminated NUT Area Water

- The in-situ efforts to neutralize the NUT area water ceased in the spring of 2004.
- A consultant was subsequently hired to recommend how the NUT area water could best be treated and released.
- Recommended method involved neutralization with caustic and subsequent filtration using geotextile bags.

Contaminated NUT Area Water

- A contract was awarded in the spring of 2005 to conduct the treatment and discharge of the contaminated NUT water and to place the stacked NUT tailings into their proper location.
- The work was completed successfully.
  - the NUT impoundment area was emptied by the end of the fall of 2005.
  - the tailings in the NUT were leveled by the end of the winter of 2005/06.
- The final cost of this contract was $9.4 million.

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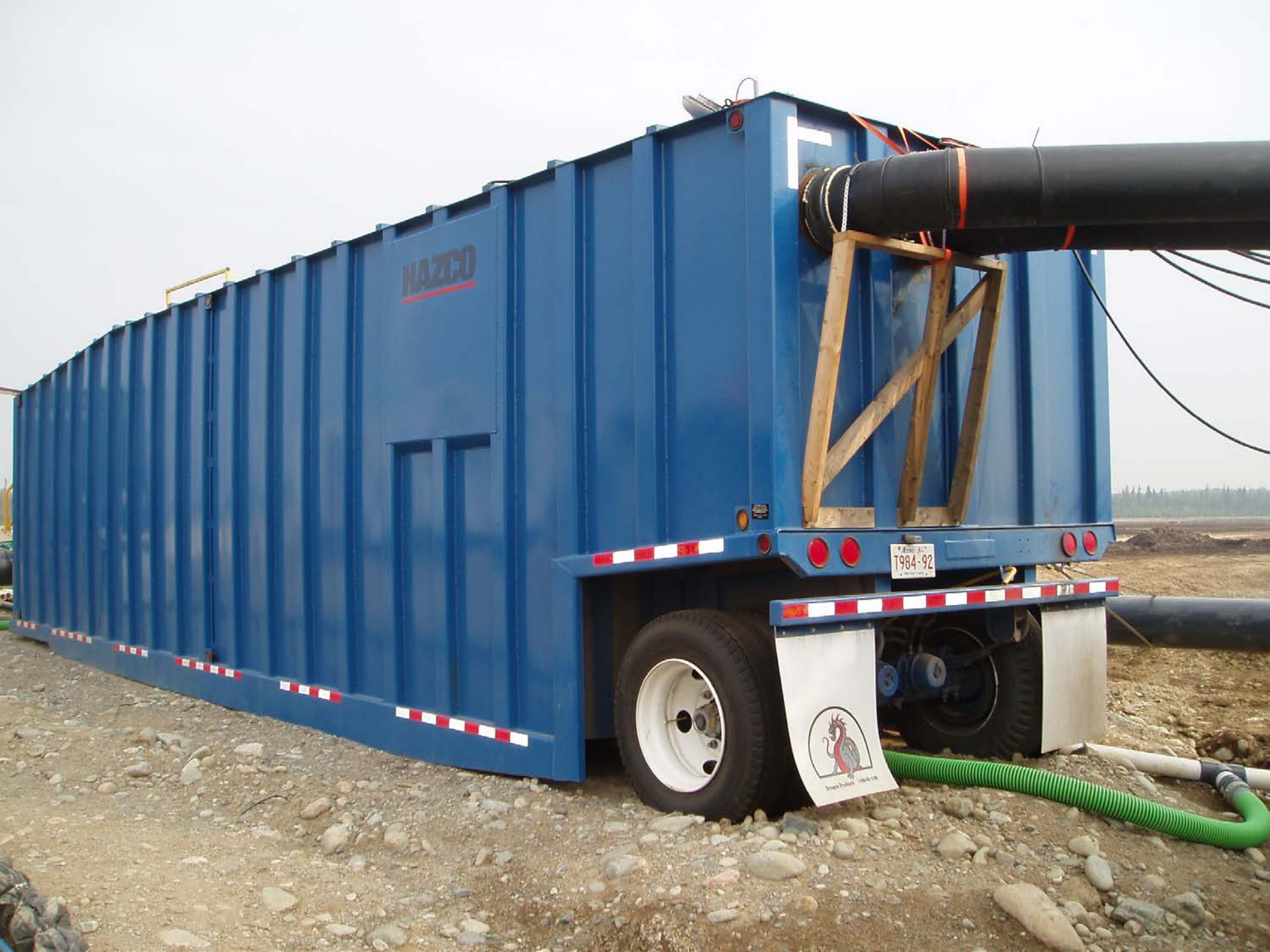
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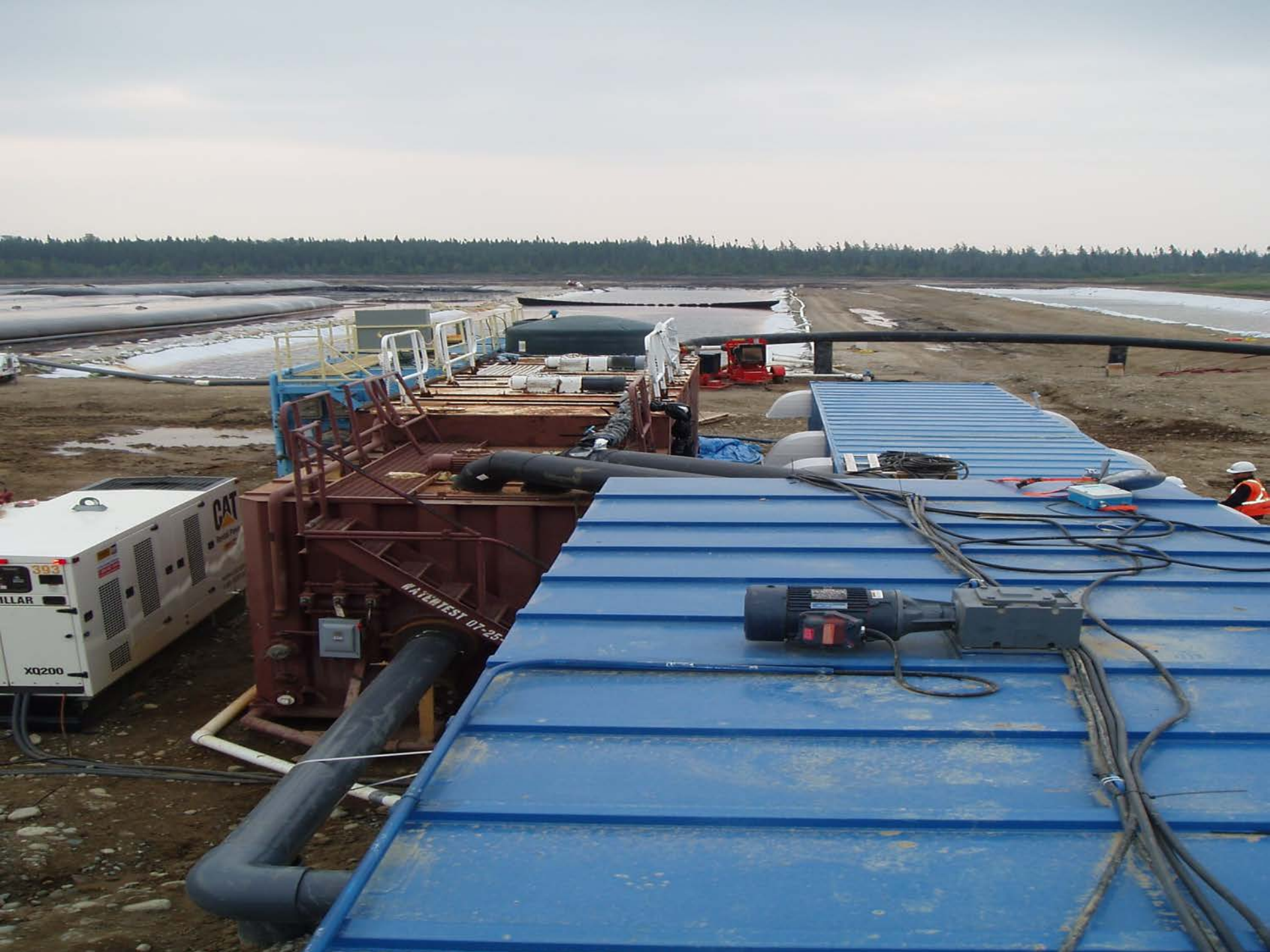
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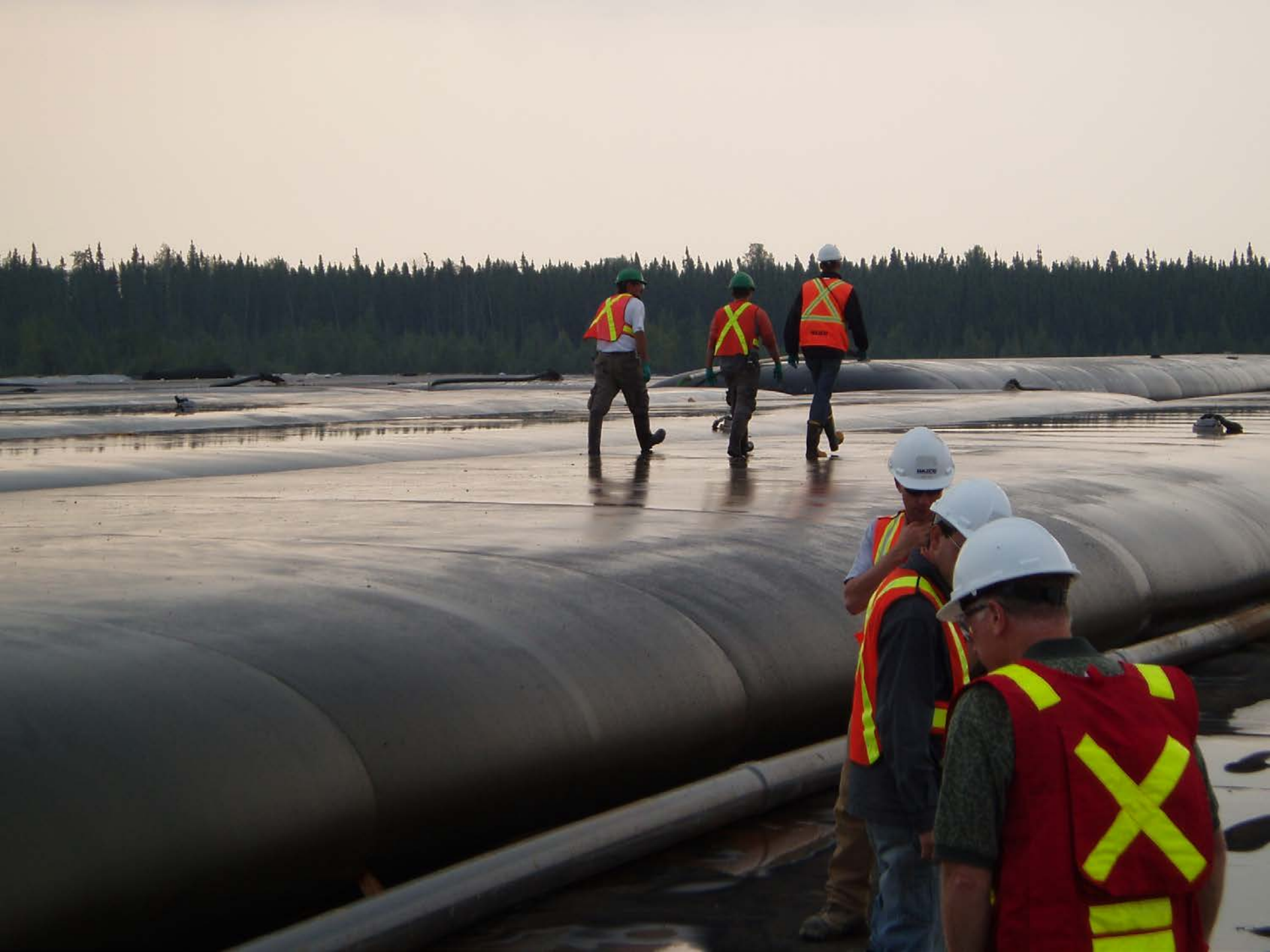
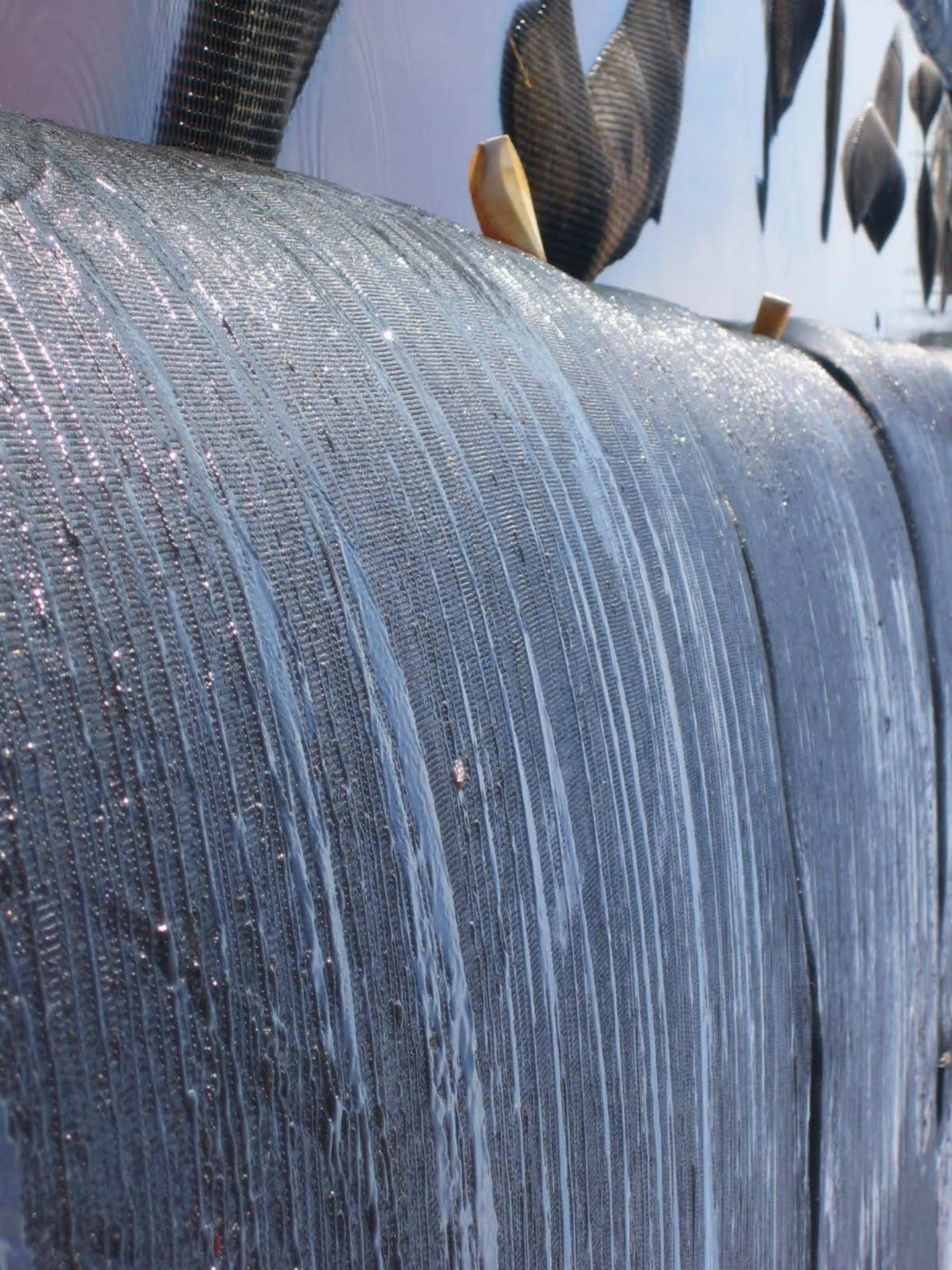
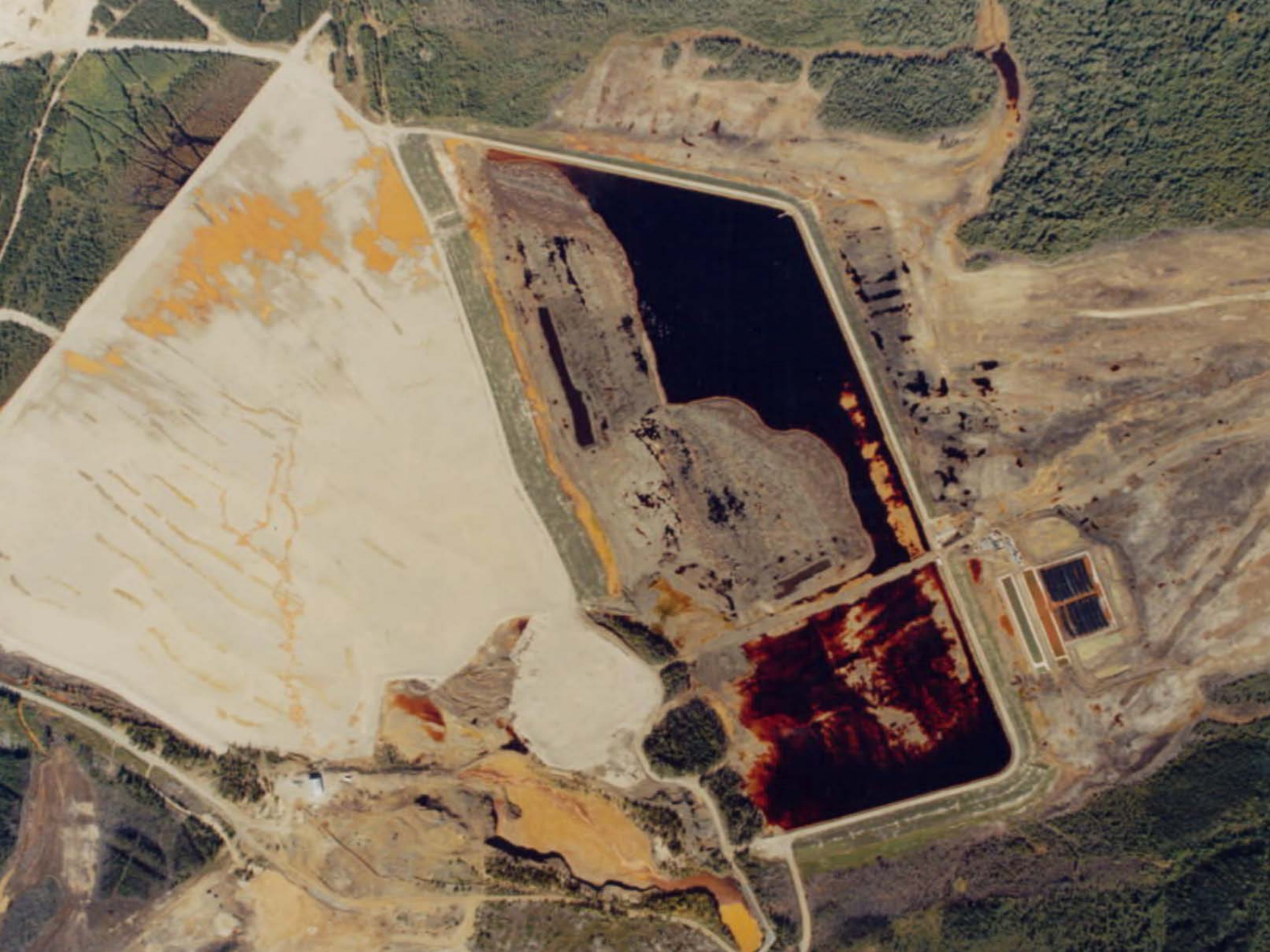
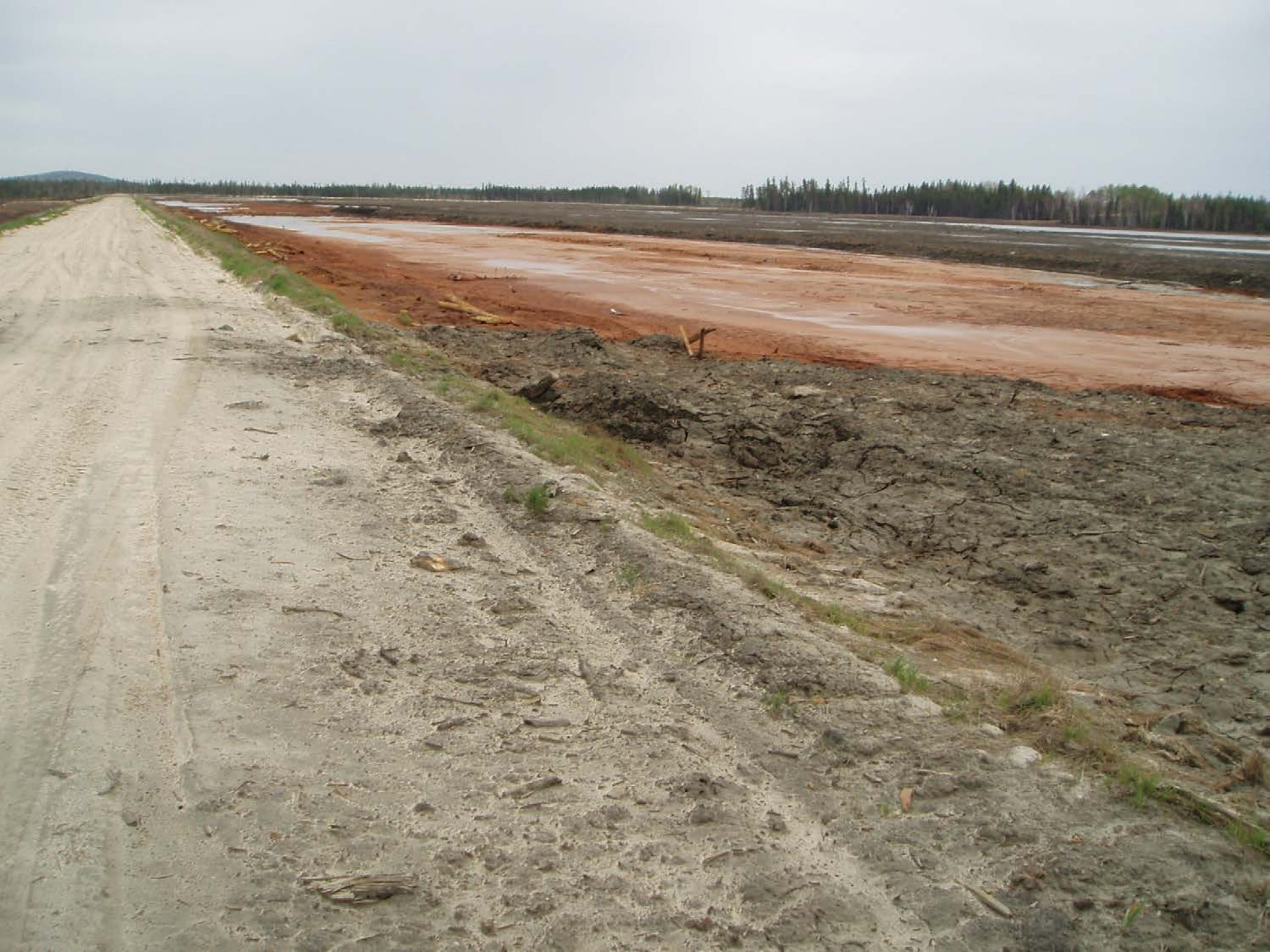


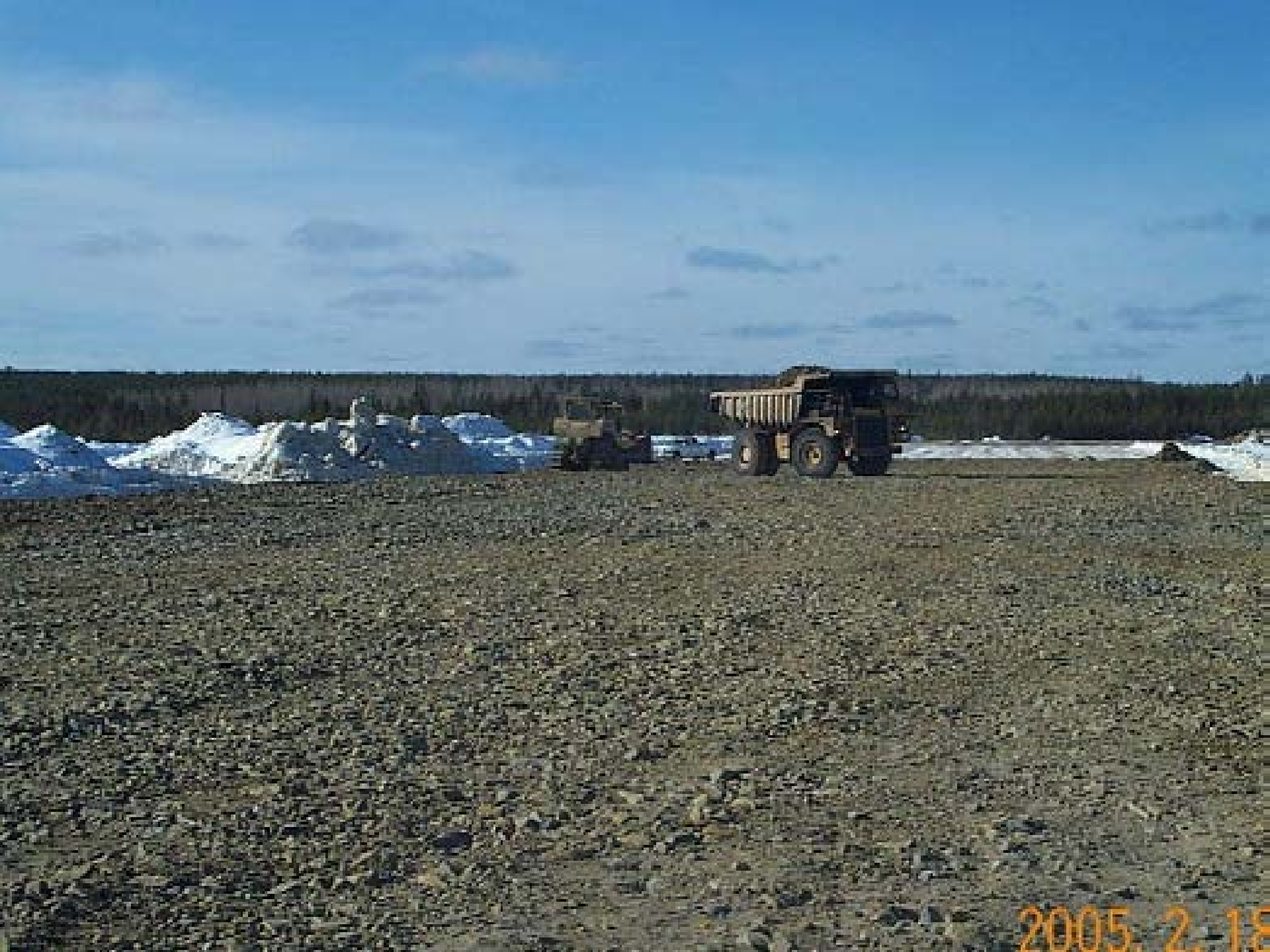






NIT Area Cover

- The construction of the NIT area engineered “dry” cover is part of the Phase “E” rehabilitation requirements.
- In order for the KKM rehabilitation work to continue until the contaminated water was dealt with, the first two layers of that cover – the capillary break – were constructed during the winter of 2004/05, at a cost of $3.4 million.
- The NIT area cover completion project is now nearing completion, at an additional cost of $12.6 million.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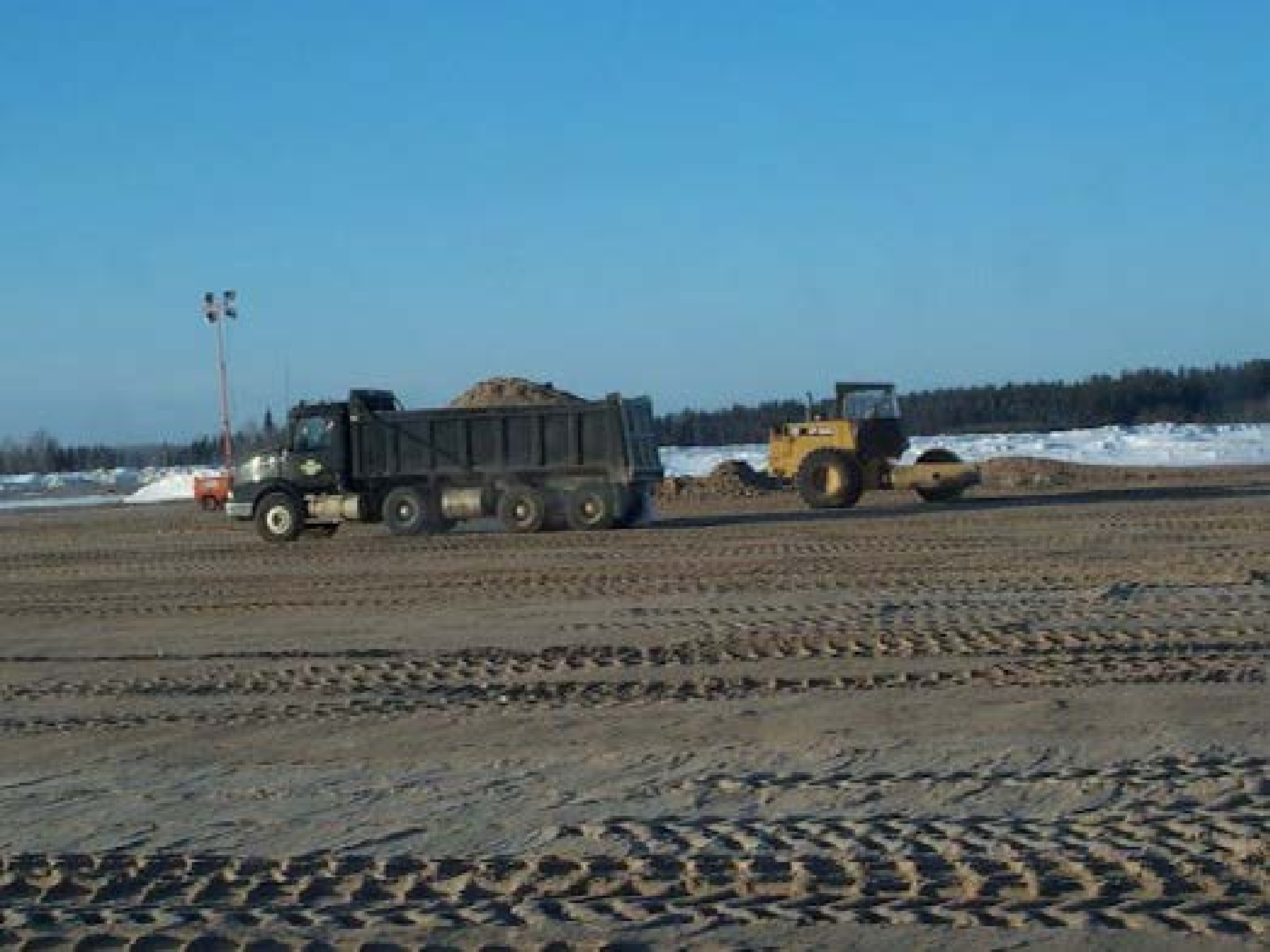

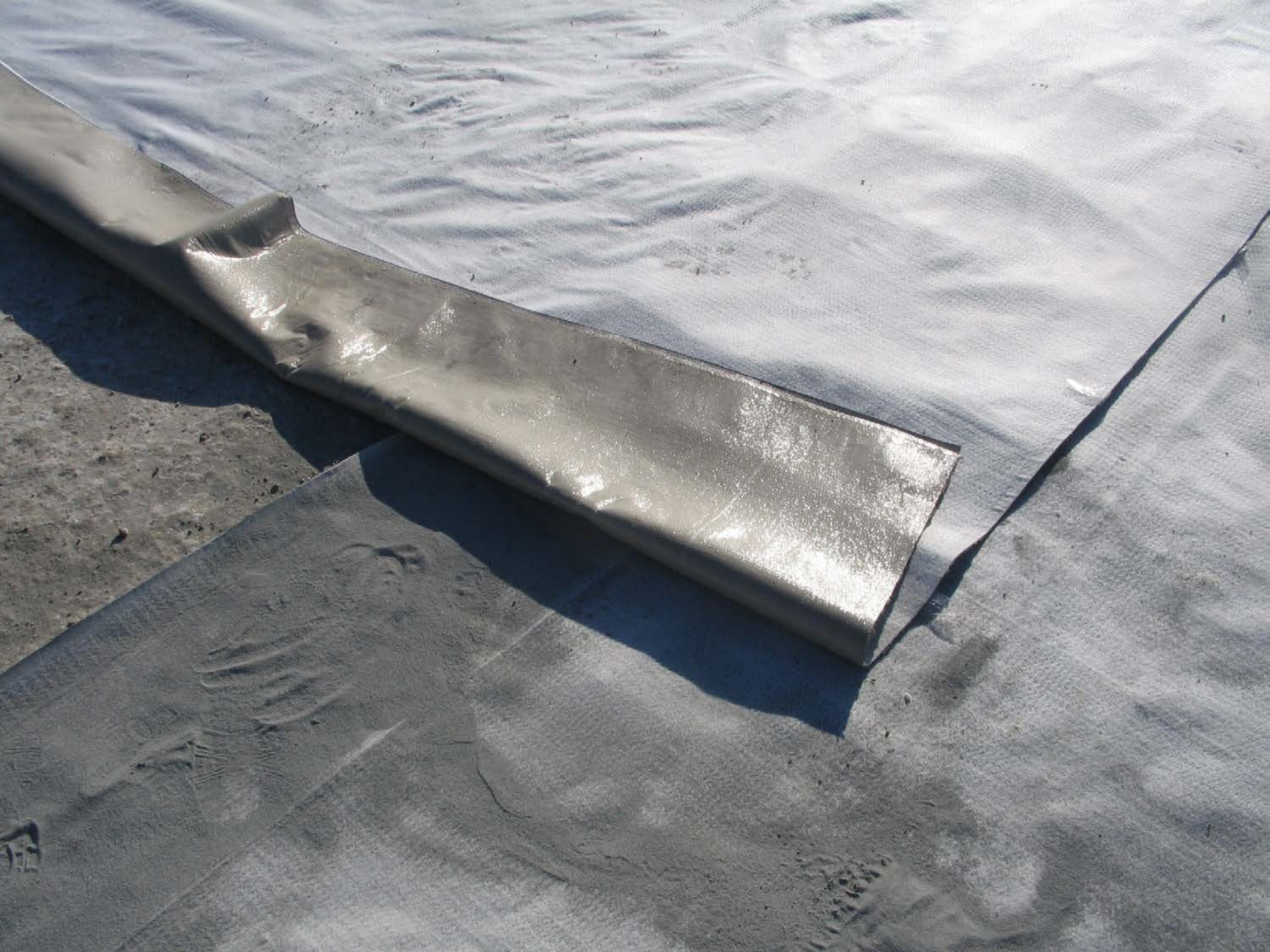

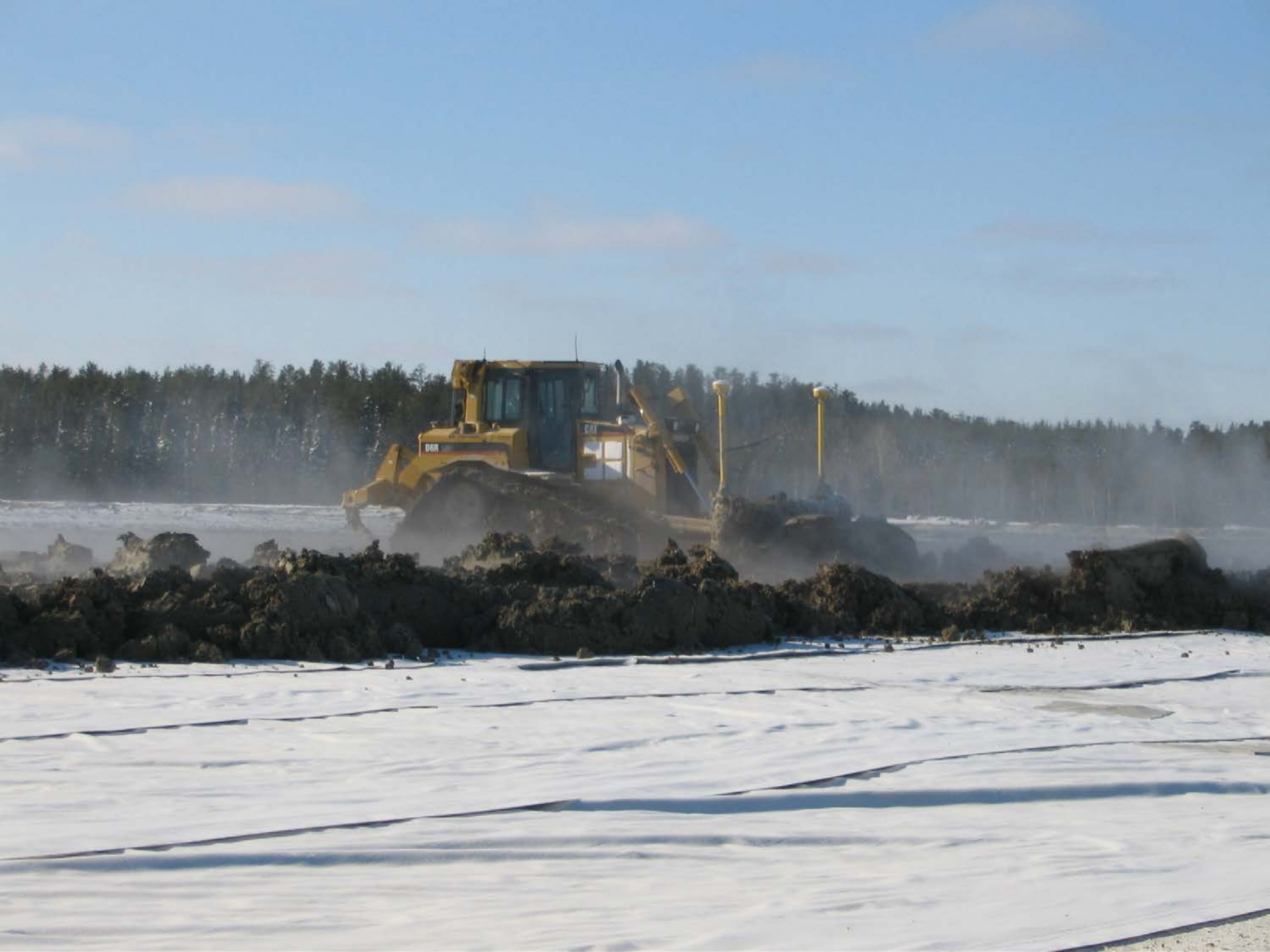
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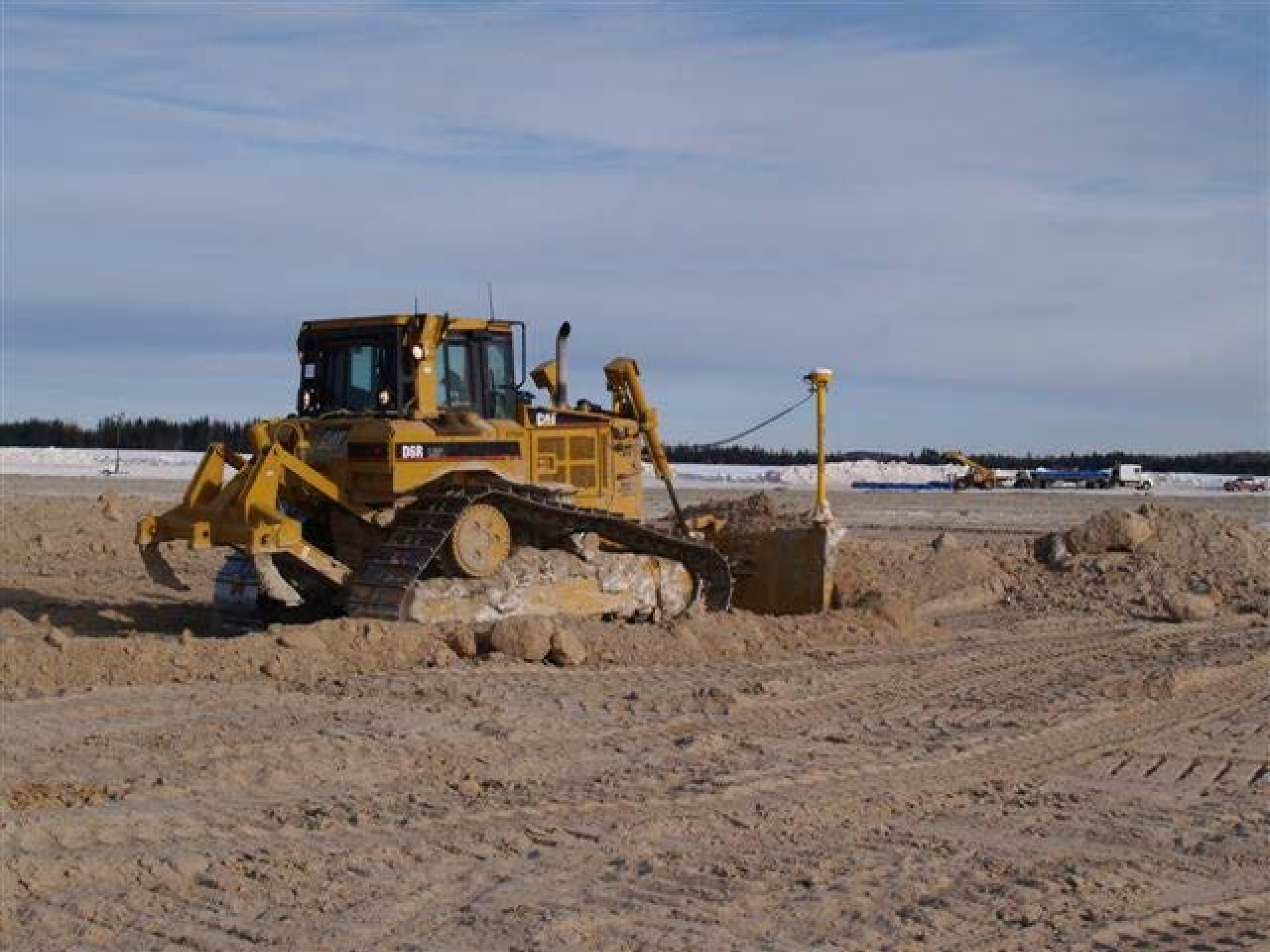
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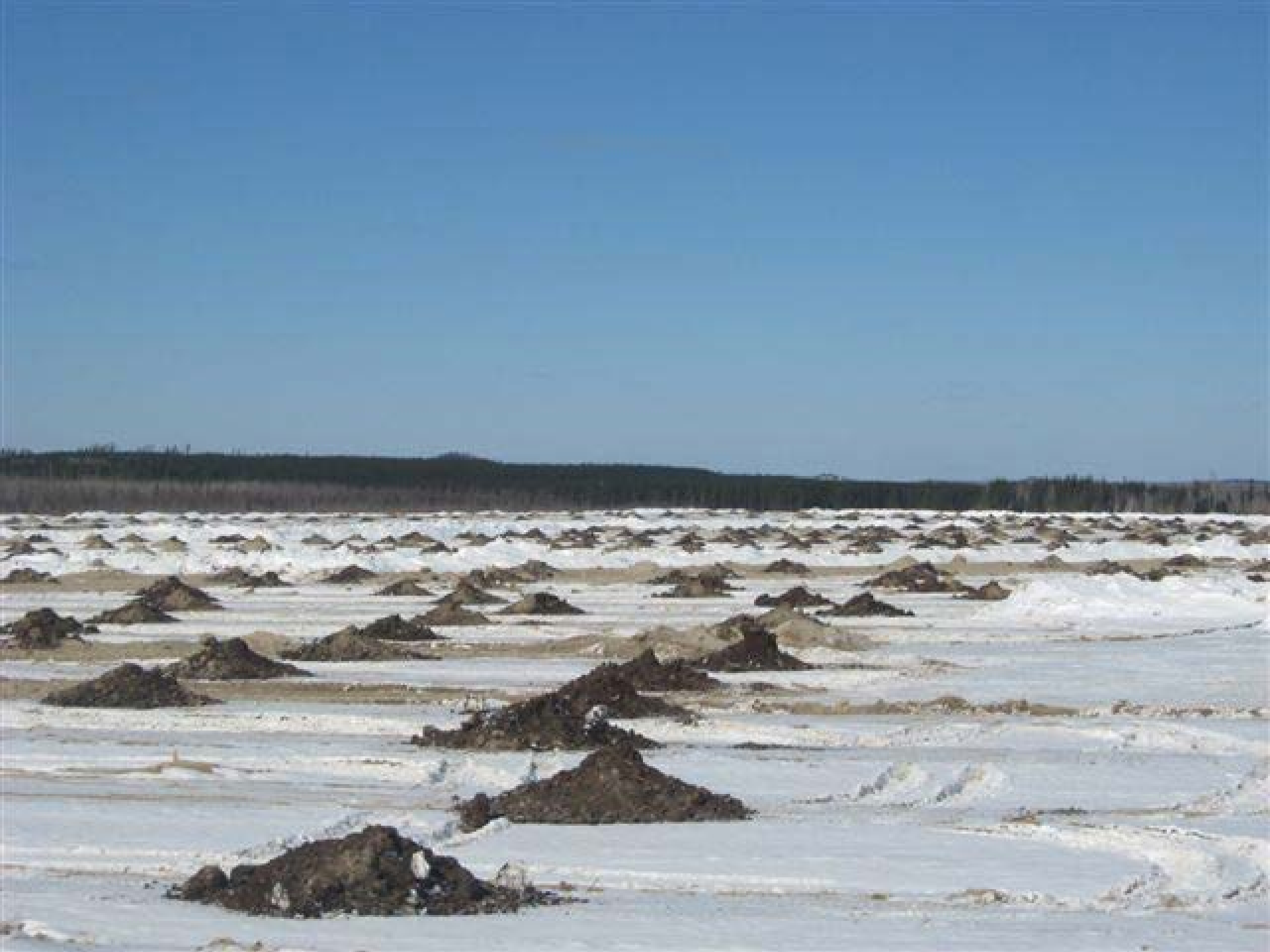


Miscellaneous Rehabilitation

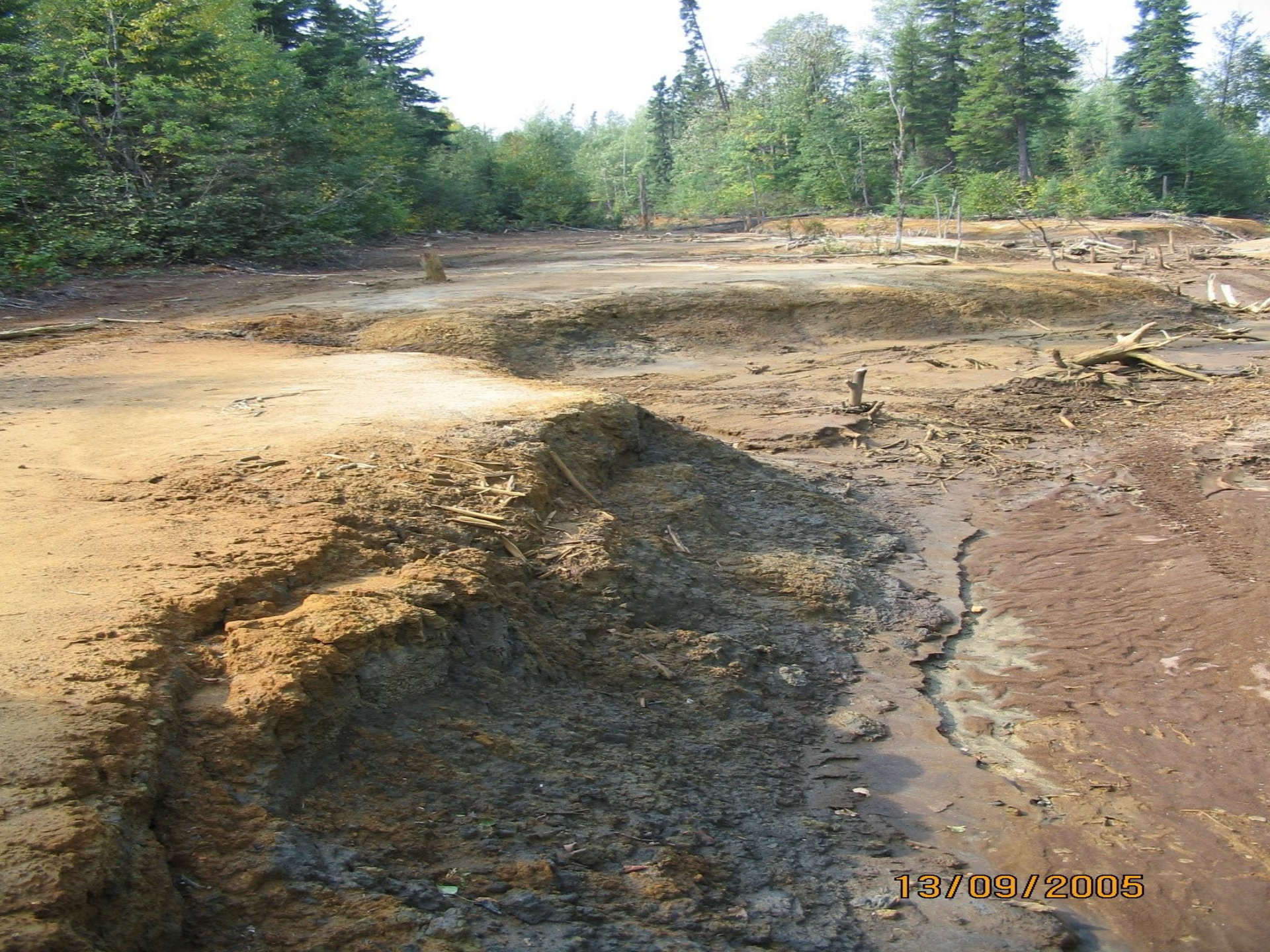
- The first partnership project between MNDM and the OMA (the Ontario Mining Association) was conducted on the Kam Kotia Mine site during the fall of 2003.
- The project involved the vegetation of the NUT impoundment dam structures, which had been deleted as a cost saving measure during Phase “A”.
- The project cost of $276,000 was shared equally between the two partners.

Miscellaneous Rehabilitation

- The second partnership project between MNDM and the OMA was conducted on the Kam Kotia Mine site during the late winter of 2007/08.
- The project involved the expansion of the forebay pond, which captures the contaminated water that is treated by the on-site Lime Treatment Plant.
- The project cost of approximately $750,000 was again shared between the two partners.

Rehabilitation Yet To Be Done ...

- Complete the NIT cover – this work is scheduled to be completed by the end of the fall, 2008.
- Collect the remainder of the unimpounded tailings – planned for the winter of 2007/08.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Rehabilitation Yet To Be Done ...

- Conduct Phase “D”, which involves the construction of the “moist” cover over the NUT impoundment area – currently planned for the winter of 2008/09.
- Conduct the remainder of Phase “E”, which will include the rehabilitation of all of the physical hazards on the site, such as the main shaft, the open pit and the thin crown pillar – expected to be completed by December 2009.

The final cost for the rehabilitation of the Kam Kotia Mine site is now expected to be in the range of…..

$60 million

What have we learned?

(aka – What would I have done differently?)

If you are planning on undertaking an abandoned mine rehabilitation project of a similar size and scope:

1. Try to diversify your funding sources by involving other governments, agencies or partnerships.
    - MNDM was unsuccessful when it approached the Federal government for assistance.
    - The OMA partnered with MNDM on the revegetation of the NUT impoundment dams.

What have we learned?

2. Build a “contingency” allowance into your bids so that you can deal with the unforeseen – a 50% cost increase is not unusual.
    - The latest RFTs have had a contingency allowance of as much as $250,000 built into the bid forms.
    - The bidders each show what their mark-up percentage will be on that contingency allowance.
    - The cost of that contingency [e.g. contingency + (contingency x mark-up)] becomes part of the contractor’s total bid price.

What have we learned?

3. Once you start a rehabilitation project it's hard to "back off". Be prepared to stay the course.
    - The five-phased approach at Kam Kotia was to have allowed MNDM to end or pause the project after any phase, with no loss of the benefits already achieved.
    - In reality, discontinuing rehabilitation on an environmental project like Kam Kotia will probably draw the negative attention of the environmental regulators, environmental NGOs, and/or the public.

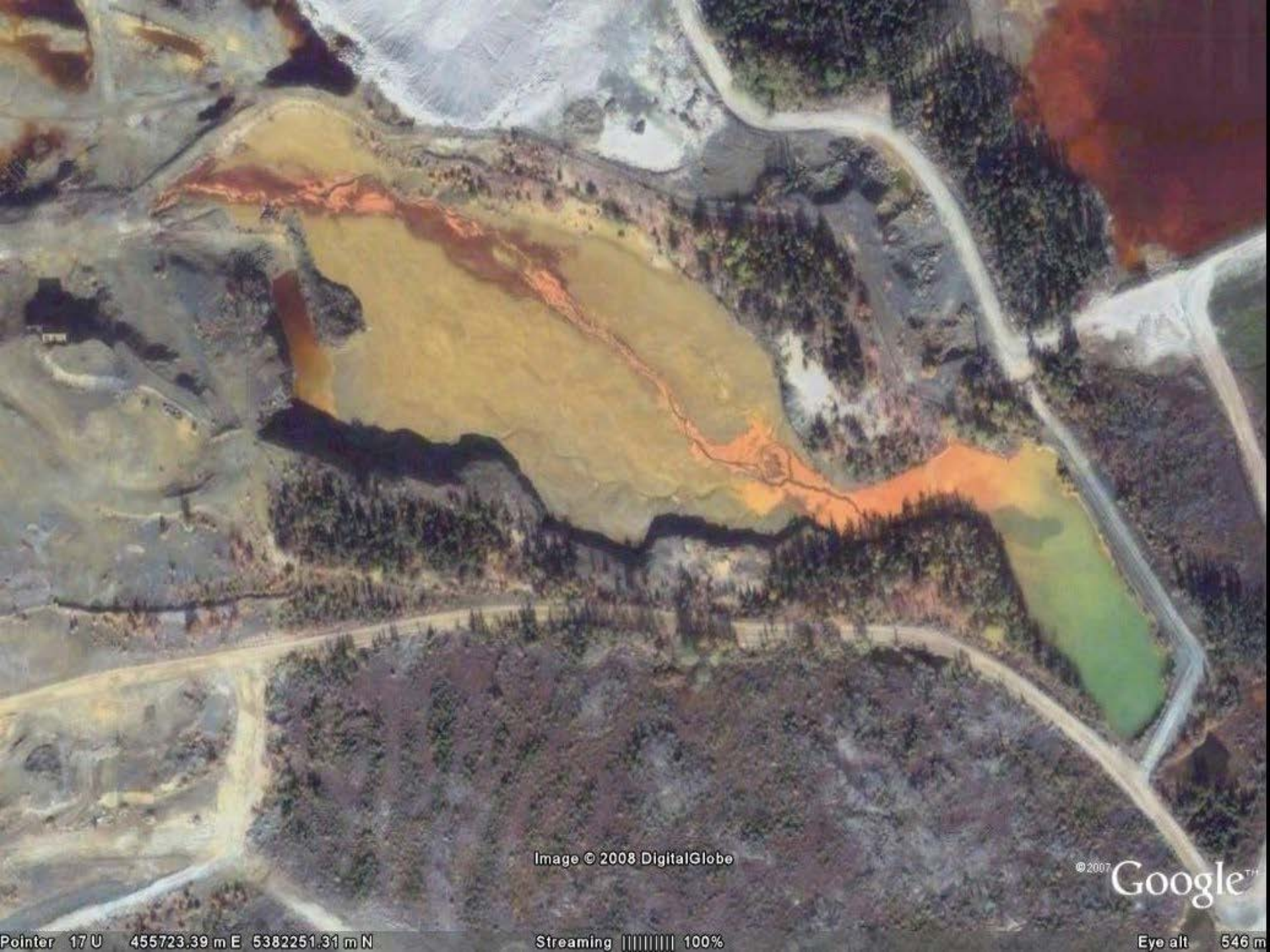
What have we learned?

4. Be prepared to “think outside of the box”.
    - Sometimes the conventional method works.
    - Sometimes you have to improvise.
5. We live in Canada! Weather will probably have a negative impact on your project at some point!!
6. Don’t be discouraged.
    - Unforeseen things WILL happen!

Speaking of Unforeseen…

On Thursday afternoon, May 29, 2008, the Ministry of the Environment (MOE) reported that sludge from the Lime Plant was spilling out of the Kam Kotia open pit.

- The open pit has been selected as the storage location for the sludge until a more permanent solution is determined during the Phase “E” engineering study.
- While clear, supernatant water has previously spilled from the pit during peak flow times, this is the first time that we have lost sludge as well.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Streaming 100%
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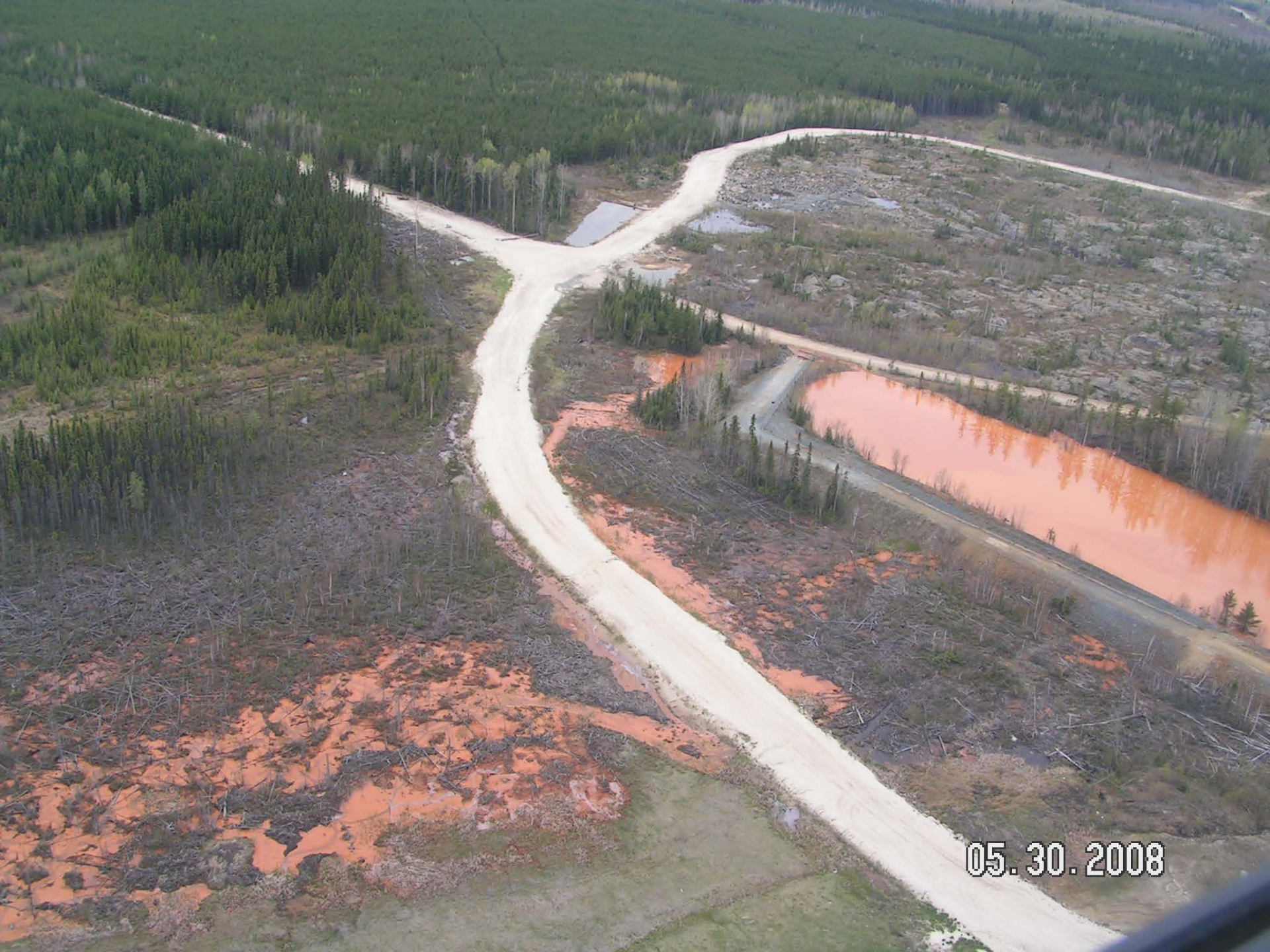
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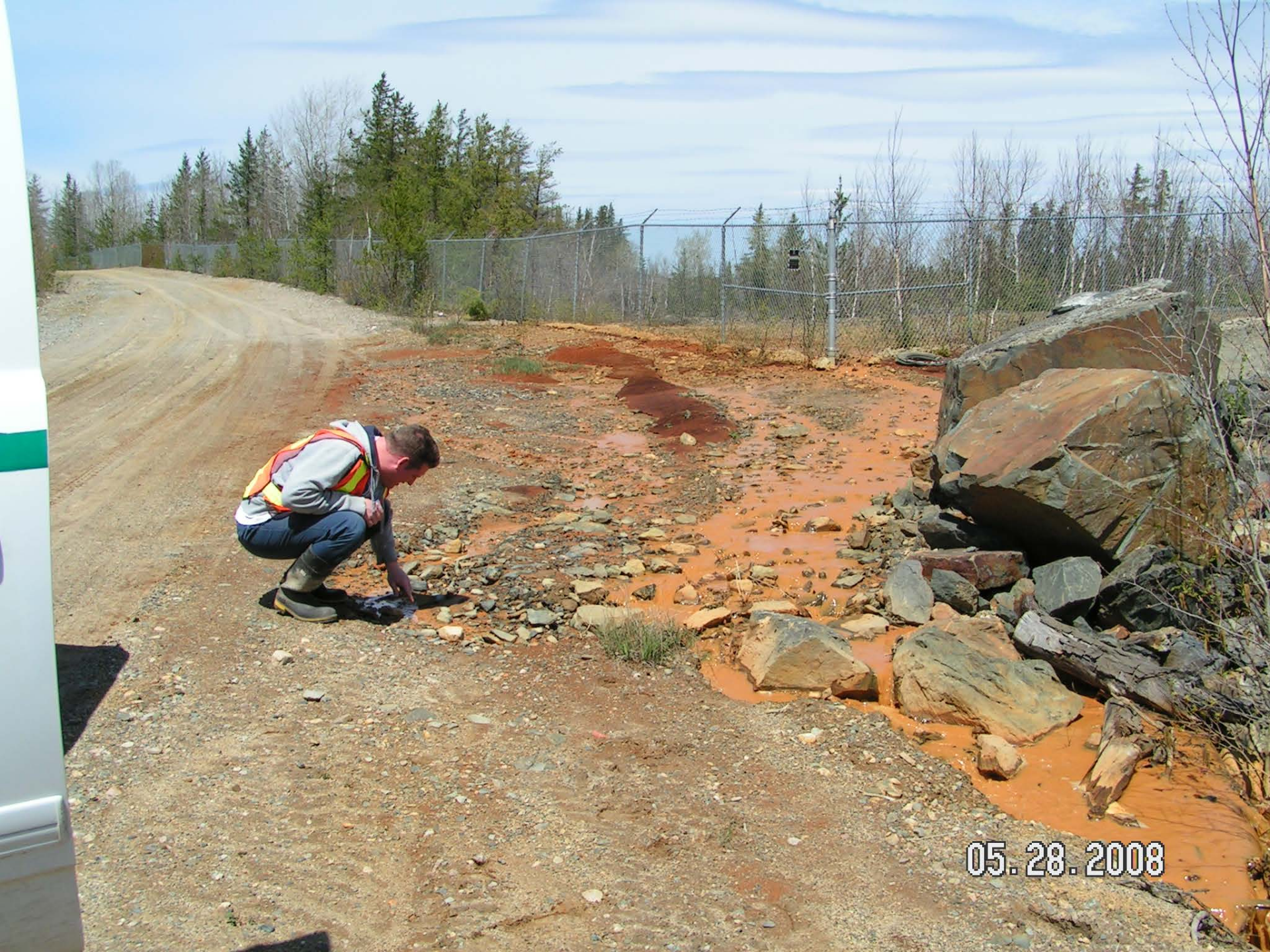
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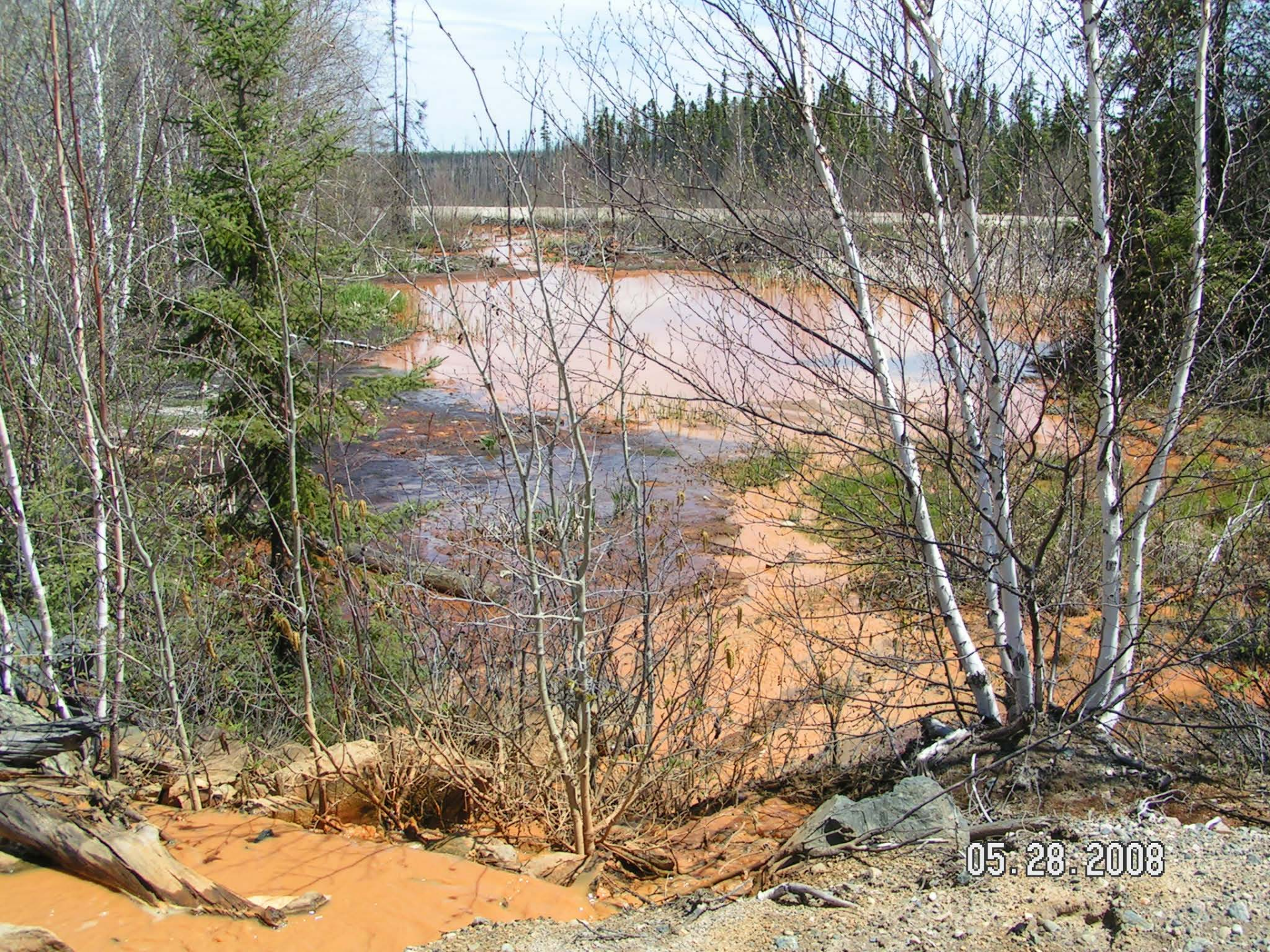
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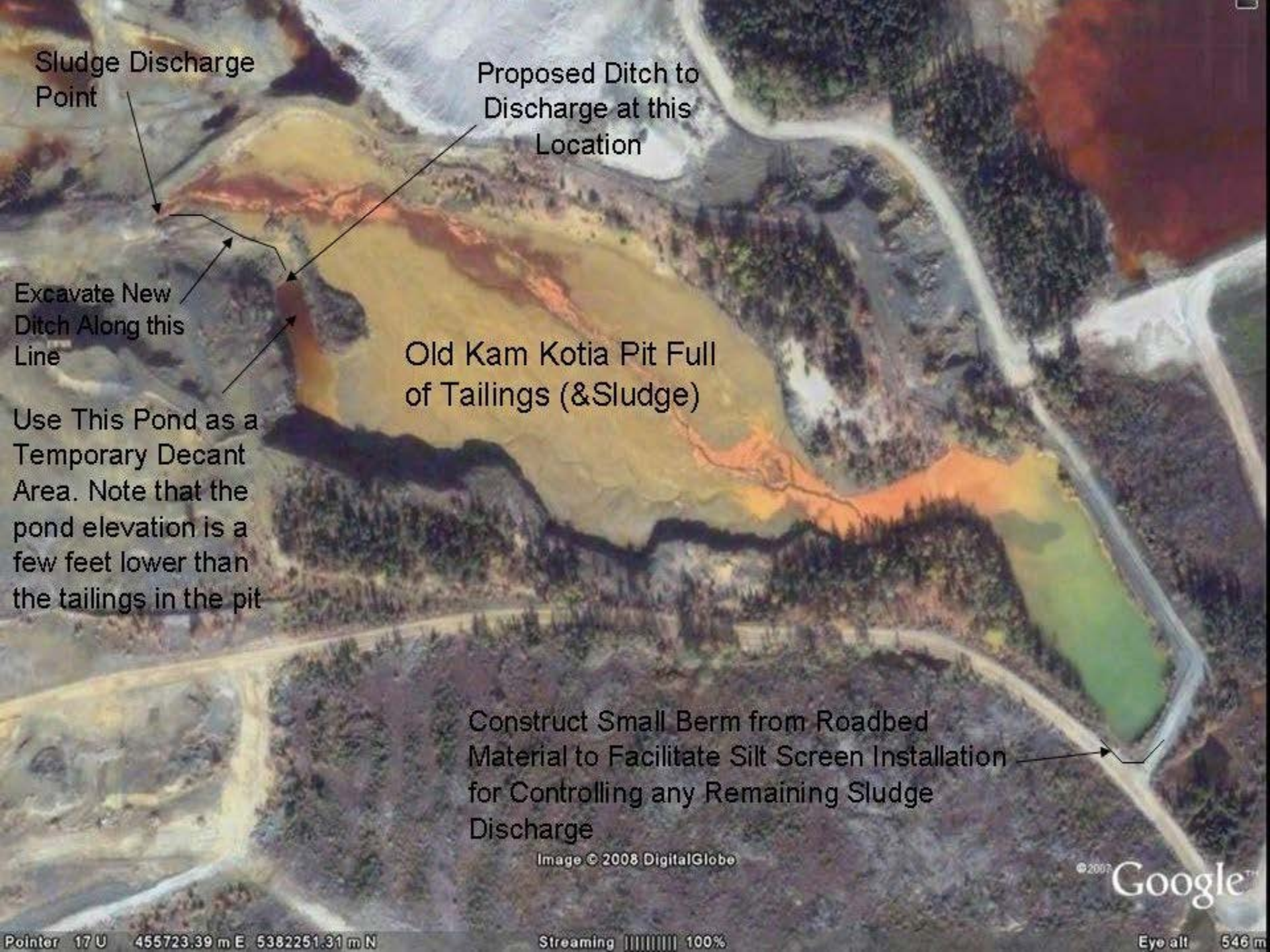
Sludge Discharge Point
Proposed Ditch to Discharge at this Location
Excavate New Ditch Along this Line
Old Kam Kotia Pit Full of Tailings (&Sludge)
Use This Pond as a Temporary Decant Area. Note that the pond elevation is a few feet lower than the tailings in the pit
Construct Small Berm from Roadbed Material to Facilitate Silt Screen Installation for Controlling any Remaining Sludge Discharge
Image © 2008 DigitalGlobe
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Pointer 17 U 455723.39 m E 5382251.31 m N
Streaming 100%
Eye alt 546 m

Thank You.

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