The Continuing Rehabilitation of the Kam Kotia Mine: An Acid-Generating Abandoned Tailings Area.

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Kam Kotia Mine Site:

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

WHAT IS KAM KOTIA?

- Environmental impacts are locally significant:
  - Acid drainage
  - Blowing tailings

  - Physical Mine Hazards:
  - Open Pit; Open Shafts and Raises on Surface
  - Crown Pillars
  - Ramp to underground mine workings
- Scrap Metal, Barrels, Waste Materials on site

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 Cu, Zn, Ag

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

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

HYDROLOGY

- North and East seeps, at a pH of 2.0-3.0, drain NUT, east half of NIT and north half of plant site to the Kamiskotia River in the north.
- South seep drains SUT, south half of NIT and plant site to Little Kamiskotia River in the south, at a pH 0f 3.5 to 4.0 prior to rehabilitation beginning on the site.

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BACKGROUND

- The total rehabilitation of the abandoned Kam Kotia Mine site was to be conducted as a proposed five-phase program.
- This rehabilitation plan was developed in 2000, 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 the construction of a Lime Addition Treatment Plant, as well as all of its required infrastructure, and the construction of a new NUT impoundment dam structure.
- The combined cost of the Phase "A" bids was $9.85 million.
- The funding was eventually approved and the work was completed by July 2002.

- **Realized that the combined costs of Phases "A" and "B" would approach $14 million.**

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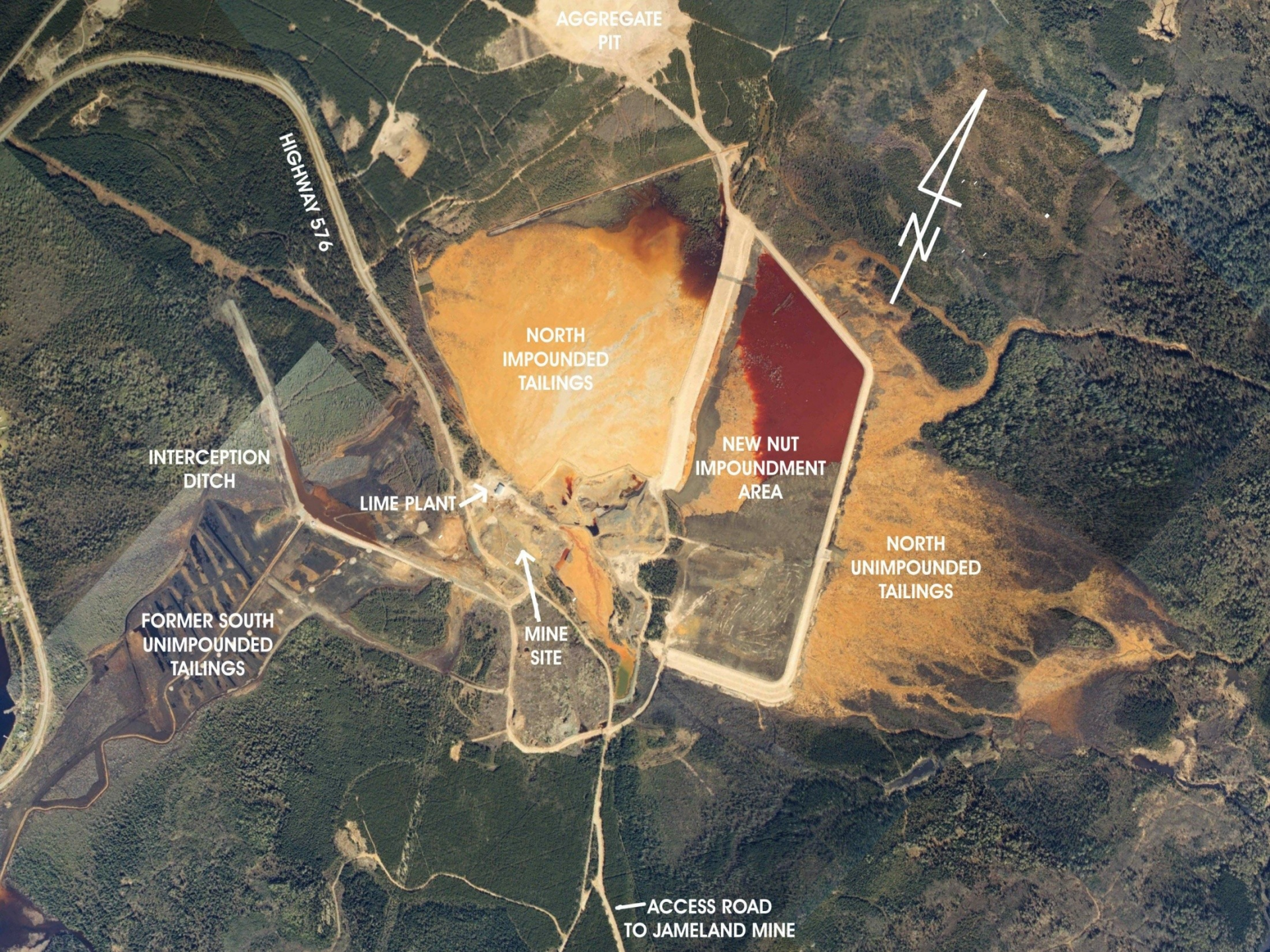
AGGREGATE PIT
HIGHWAY 576
NORTH IMPOUNDED TAILINGS
NEW NUT IMPOUNDMENT AREA
INTERCEPTION DITCH
LIME PLANT
NORTH UNIMPOUNDED TAILINGS
FORMER SOUTH UNIMPOUNDED TAILINGS
MINE SITE
ACCESS ROAD TO JAMELAND MINE
N

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 $ 13.4 million.
- The Phase “C” work was completed by late-March, 2004.

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NORTH IMPOUNDED TAILINGS
INTERCEPTION DITCH
NUT IMPOUNDED AREA
LIME PLANT
FORMER NORTH UNIMPOUNDED TAILINGS
MINE SITE
FORMER SOUTH UNIMPOUNDED TAILINGS

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 2.8, and containing high concentrations of 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. Sodium Hydroxide) 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

- A consultant was hired and recommended neutralization with caustic (Sodium Hydroxide)
- Followed with filtration using geotextile bags or "socks"

Contaminated NUT Area Water

- In 2005 a contract was awarded to conduct the treatment and and level the stacked NUT tailings
- The work was completed successfully by winter 2005/2006
- The final cost of this contract was $9.4 million.

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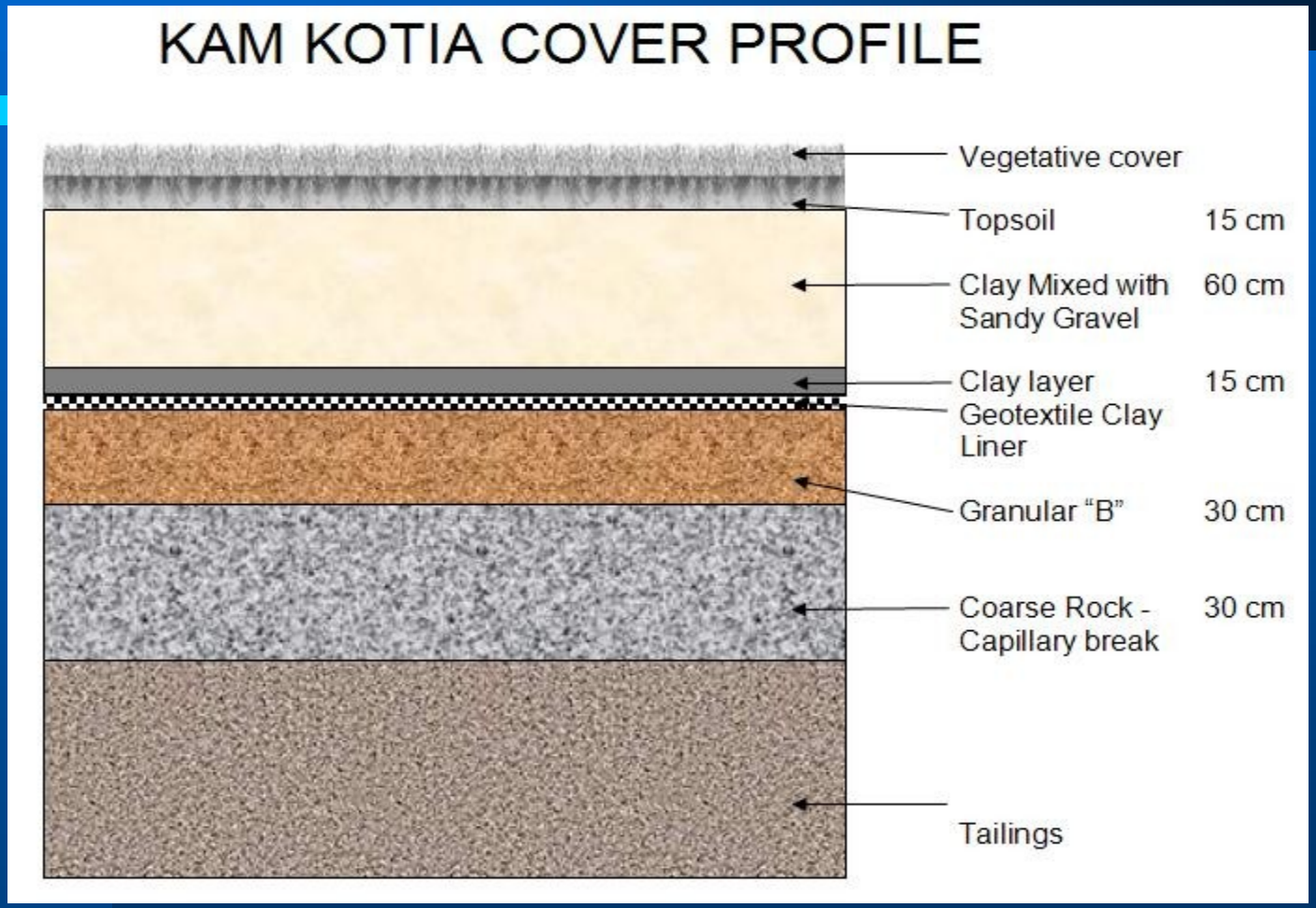
NIT Area Cover

- The construction of the NIT area engineered "dry" cover is part of the Phase "E" for the rehabilitation plan
- The KKM rehabilitation work continued for the NIT cover until the contaminated water was dealt with
- The first two layers of that cover: the capillary break and Granular "B" were constructed during the winter of 2004/05, at a cost of $3.4 million.
- The NIT area cover project is now nearing completion, at an additional cost of $12.6 million.

NIT Area Cover



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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.

Miscellaneous Rehabilitation

- Finish seeding the NIT cover
- Seeding was completed by September 2008
- Grasses growing by October 2008

Miscellaneous Rehabilitation

- Collect the remainder of the unimpounded tailings – planned for the winter of 2007/08.
- However, not started until November 15, 2009
- More than 50,000 m3 tailings picked up and relocated to the NUT
- Tailings distributed “all over” in the various creek channels

Miscellaneous Rehabilitation

- More tailings found by Ministry of the Environment
- South side of the property, adjacent to creek draining to Kam Kotia Lake
- Removed in 2009 as a priority

13/09/2005

Rehabilitation Yet To Be Done ...

- Conduct Phase "D", which involves the construction of the "moist" cover over the NUT impoundment area was planned for the winter of 2009-10
- But delayed until 2011/12 because increased volume of tailings were found during "Seeps and Creeks" clean up
- As more tailings were found to place in NUT impoundment, therefore, had to delay the closure of the NUT

On-Going Rehabilitation

- Collect the remainder of the unimpounded tailings – previously planned for the winter of 2007/08.
- However, not started until November 2009
- More than 50,000 m3 tailings picked up and relocated to the NUT in winter 2010
- Tailings distributed “all over” in the various creek channels

Future Rehabilitation

- Conduct the remainder of Phase “E”
- Physical hazards on the site:
- main shaft
- open pit
- thin crown pillar
- To be completed 2011 - 2013

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

$75 million

What have we learned?

(aka – What would MNDMF 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.

What have we learned?

3. The project has to continue:
   - 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.
   - Various phases are inter-connected and impact timing of each project

What have we learned?

4. Overseeing a project with various phases is difficult to implement and continuity with contractors would enhance efficiencies, and improve the project management on the ground.

4. Be prepared to “think outside of the box”.
   - Sometimes you have to improvise.

05.30.2008

05. 28. 2008

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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Streaming 100%
Eye alt 546 m

Thank You.

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