Poirier mine: HDPE liner over the tailings, performance after four years.

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Maxine Wiber BHP-Billiton Base Metals





LOCATION AND HISTORY

- The Poirier site is located in northwestern Quebec (lat. 49° 30'), some 150 km north-east of Rouyn-Noranda
- Lies on the water divide of the Kistabiche and the Plamondon rivers
- Operated from 1965 to 1975
- Rehabilitation works from 1998 to 2000

















MINE WASTE INVENTORY

Tailings basin	46.0 ha	5,000,000 tons
North deposit	4.0	72,000
Tailings spills	24.0	216,000
Ore stockpile	0.2	20,000
Mill site	15.0	400,000
Tailings basin pond	7.0	120,000 m ³





AERIAL VIEW OF THE POIRIER SITE BEFORE REHABILITATION WORKS (1997)

TAILINGS SPILL

NORTH DEPOSIT

KISTABICHE CREEK



MILL SITE

REMOVAL OF ACID-GENERATING MATERIALS

THE ENGINEERED COVER DETAILS OF LINER ANCHORING AND SOIL COVER



AERIAL VIEW OF THE TAILINGS BASIN DURING CONSTRUCTION (SEPT. 1998)



INSTALLATION OF THE TEXTURIZED LINER ON THE 5H:1V SLOPES



PLACEMENT OF SOIL COVER OVER THE GEODRAIN



AERIAL VIEW OF THE TAILINGS BASIN, LOOKING WEST (JULY 1999)



AERIAL VIEW OF THE TAILINGS BASIN, LOOKING EAST (JULY 1999)



EXPERIENCE ACQUIRED DURING THE REHABILITATION WORKS





- NEUTRALIZING THE ACIDIC POND WATER (from pH 2,5 to pH 5,0)
- EXCAVATION OF SPILLED TAILINGS ON VERY SOFT GROUND
- DEALING WITH TREE TRUNKS BURIED IN TAILINGS BASIN
- LIQUEFACTION OF TAILINGS FROM HEAVY
 TRAFFIC





NEUTRALIZING THE ACIDIC POND WATER (from pH 2,5 to pH 5,0)





LIMING THE ACIDIC POND WATER





PORTABLE LIME PLANT AND SILO







LIMING THE POND WATER BY BLOWING HYDRATED LIME DIRECTLY FROM THE TANK TRUCK



EXCAVATION OF SPILLED TAILINGS ON VERY SOFT GROUND





EXCAVATION OF SPILLED TAILINGS WITH STOCKPILING IN WINDROWS



LOADING THE STOCKPILED TAILINGS INTO TRUCKS FOR TRANSPORT TO THE TAILINGS BASIN



DEALING WITH TREE TRUNKS BURIED IN THE TAILINGS BASIN





SURFACE PREPARATION WORKS (FINE LEVELING AND COMPACTION) EXPOSE WOOD DEBRIS







INVESTIGATION WORKS SHOW THOSE DEBRIS TO BE TREE TRUNKS BURIED AMONG TAILINGS



AERIAL VIEW OF THE MILL PLANT AND NEARBY TAILINGS BASIN (NOTE THE PRESENCE OF TREES BEING SUBMERGED IN THE UPPER RIGHT CORNER OF PICTURE)



LIQUEFACTION OF TAILINGS FROM HEAVY TRAFFIC





1. TAILINGS ARE FLOWING UP TO SURFACE AFTER PLACEMENT OF SECOND SOIL LAYER (TILL) DURING NIGHT SHIFT



2. FISSURES IN THE CLAY LAYER INDICATE A SIGNIFICANT SUBSIDENCE OF UNDERLYING MATERIALS



3. INVESTIGATION WORKS SHOW THAT EXCESSIVE FILL WAS PLACED TO COMPENSATE FOR THE DISPLACEMENT OF LIQUEFIED TAILINGS UNDERNEATH THE LINER



4. CLOSE VIEW OF LINER PUNCTURED BY A TREE STUMP. UNDERLYING LIQUEFIED TAILINGS ESCAPED TO SURFACE THROUGH THIS PUNCTURE.



5. EXTENT OF SUBSIDENCE DUE TO LIQUEFACTION OF TAILINGS. PREPARATION WORKS FOR REPAIRS IN PROGRESS.



RESULTS OF THE ENVIRONMENTAL MONITORING PROGRAM:

AN APPRECIATION OF THE PERFORMANCE OF THE ENGINEERED COVER





INSTRUMENTATION

- MONITORING WELLS ON TOP OF THE COVERED TAILINGS BASIN TO MONITOR THE WATER TABLE DRAWDOWN IN TAILINGS

- PIEZOMETERS AT THE TOE OF THE TAILINGS BASIN TO MONITOR THE EFFICIENCY OF THE INTERNAL DRAIN

- BENCH MARKS TO MEASURE THE SETTLEMENT OF THE WASTE PILE AT THE CENTER OF THE TAILINGS BASIN

- PROBES UNDERNEATH THE LINER TO MONITOR THE VARIATIONS OF TEMPERATURE, MOISTURE AND OXYGEN IN THE COVERED TAILINGS

-WEIRS INSTALLED AT SELECTED WATER SAMPLING STATIONS TO MEASURE FLOWS AND CHEMICAL LOADINGS





LOCATION OF INSTRUMENTATION



VARIATION OF WATER LEVELS IN MONITORING WELLS

Plot of Water Levels in Monitoring Wells



VARIATION OF WATER LEVELS IN TYPE A PIEZOMETERS

302.0 <u>م</u> ------6 >----⊗----..... 301.5 301.0 Legend and elevation <u>0</u>----of lateral screens for Elevation of lateral screen (typ. toe piezometers PZ-10 e. 300.5 Elevation (m) 300.0 4 P7-3A PZ-5A 299.5 299.0 2001 2002 2003 2004 1999 . 2000 298.5 J J A SON D J F M A M J J A SON D J F M A M J J A SON D J F M A M J J A SON D J F M A M J J A SON

Plot of Water Levels for Type A Toe Piezometers in Internal Drain

VARIATION OF WATER LEVELS IN TYPE B PIEZOMETERS



Plot of Water Levels for Type B Toe Piezometers in Lateral Drains

J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N

2002

2004

2003

2001

1999

298.5

2000

MONITORING WELLS AND M-O-T MONITORING STATIONS





VARIATIONS IN MOISTURE AT STATION LR-1



YEAR

YEAR

YEAR

YEAR



VARIATIONS IN TEMPERATURE AT STATION LR-1



MEASUREMENTS OF SETTLEMENT OF THE WASTE PILE





LOCATION OF VENT PIPES USED AS BENCH MARKS



SETTLEMENT READINGS

YEAR	VENT 1	VENT 2	VENT 3
2001	23 cm	40 cm	(?)
2002	5 cm	40 cm	47 cm
2003	5 cm	30 cm	79 cm
2004	0 cm	29 cm	33 cm
TO DATE	33 cm	139 cm	> 159 cm







TYPICAL SECTION THROUGH THE TAILINGS SPILLED IN KISTABICHE CREEK (SOUTH OF HIGHWAY)



DUMPING THE MINE WASTE ON THE FROZEN POND IN THE MIDDLE OF THE TAILINGS BASIN (GENERAL VIEW)



DUMPING THE MINE WASTE ON THE FROZEN POND IN THE MIDDLE OF THE TAILINGS BASIN (CLOSE VIEW)



DIFFERENTIAL SETTLEMENT OF THE COVERED MINE WASTE PILE



DIFFERENTIAL SETTLEMENT OF THE COVERED MINE WASTE PILE



VARIATION OF CHEMICAL LOADINGS AS MEASURED AT SELECTED STATIONS





LOCATION OF WATER SAMPLING STATIONS







SURFACE WATER SAMPLING STATION A





VARIATION OF LOADINGS AT STATION A (RUISSEAU 1 TOWARDS THE KANANEWESIG CREEK)





mmjjasondjfmamjjasondjfmamjjasondjfmamjjasondjfmamjjasondjfmamjjasond







VARIATION OF LOADINGS AT STATION B (RUISSEAU 2 TOWARDS THE KANANEWESIG CREEK)











VARIATION OF LOADINGS AT STATION C (KISTABICHE RIVER)



IN CONCLUSION...





• As a very low permeability cover, the HDPE geomembrane with protective soil layer was cheaper than compacted clay requiring a much thicker frost-protection soil layer

• HDPE geomembrane is better suited than compacted clay to maintain integrity when subjected to highly differential settlement





AERIAL VIEW OF THE TAILINGS BASIN PRIOR TO THE REHABILITATION WORKS (1997)



AERIAL VIEW OF THE TAILINGS BASIN AFTER THE REHABILITATION WORKS (2002)



SNC-Lavalin wishes to thank BHP Billiton for authorizing the presentation of the results obtained to date from their long-term environmental monitoring program





