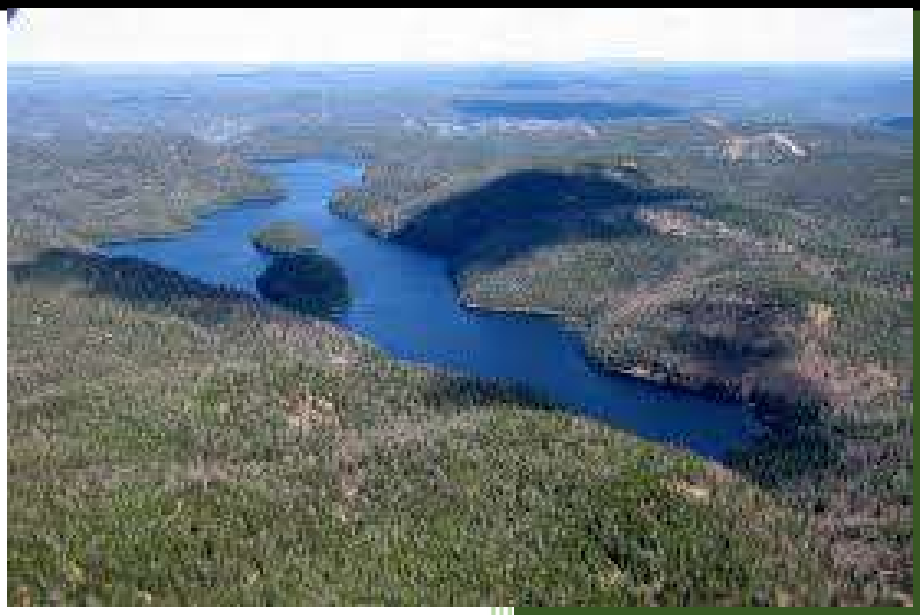
2022

NORTHWATCH COMMENT ON THE MARATHON MINE PROJECT



SUBMITTED TO THE

JOINT REVIEW PANEL

2/1/2022

1. Introduction

Northwatch is a public interest organization concerned with environmental protection and social development in northeastern Ontario. Founded in 1988 to provide a representative regional voice in environmental decision-making and to address regional concerns with respect to energy, waste, mining and forestry related activities and initiatives, we have a long term and consistent interest in the mining sequence and its social and environmental costs and benefits, including mineral exploration, mine development, operation and closure, and metals processing.

We have had an active interest in the Marathon PGM project since approximately 2001, when Northwatch first assembled an inventory of mining activities and issues in the Lake Superior basin.[1] At that time, the project was an advanced exploration project which had been under development for more than a decade as PolyMet Mining Corporation's *Marathon Palladium Project.*

More generally, Northwatch has reviewed and responded to several mining projects and has engaged in mineral policy and regulatory developments at both the provincial and federal level, including through membership in the Ontario Ministers Mining Act Advisory Committee (now disbanded) and the National Abandoned and Orphaned Mines Initiative multi-stakeholder steering committee.

Northwatch's interest in the environmental assessment of the Marathon Platinum Group Metals and Copper Mine Project relates to two of Northwatch's fundamental commitments: to support public participation in environmentally related decision-making, and to advocate for a responsible approach to mining activities in northern Ontario.

Northwatch commented jointly with Great Lakes United during Phase I of this environmental review on draft Terms of Reference, Environmental Impact Statement Guidelines, and Harmonization Order. Northwatch has collaborated with several organizations who share

[1] See "UnderMining Superior" in Appendix a

interests in the Marathon mine development throughout Phase I and the public review of the conformity of Stillwater's EIS with the EIS guidelines in Phase II, and again in this "Phase III", the restart of the review in 2021 and the review hearing in 2022.

Northwatch's objective in participating in this and other mining related assessment processes is to provide an independent review of mines as proposed, and to contribute to mine reviews in such a manner as to reduce environmental impacts and increase social benefits.

The questions Northwatch poses as a basis for mine reviews in which we engage include the following:

- Will the mine project, if in an area with past or active mines, result in or contribute to the remediation of past mining impacts?
- Will the mine project maximize economic / social benefits to local communities, especially communities who have previously been mine-dependent?
- Will the mine assessment be carried out in a way that adequately identifies the ecological values in the project area and adequately assesses the degree to and the manner in which the proposed mining-related activities imperils these values?
- Will the mining activities be carried out in a manner that avoids environmental harm?
- Will the mine project avoid adversely impacting recreational opportunities and pastimes in the mine's vicinity?
- Will the mine project be carried out in a manner that respects and preserves the rights, land uses and interests of Indigenous peoples?

2. The Project

Generation PGM Inc. (GenPGM) describes the Marathon Palladium Project (the "Project") as a "platinum group metals (PGM) and copper (Cu) mine and milling operation near the Town of Marathon, Ontario".[2]

The project was brought into the review process under the Canadian Environmental Assessment Process by Stillwater Canada in 2011 but the public hearing was suspended and at the request of Stillwater Canada Inc the environmental assessment process suspended in 2014. In the interim, the Project was acquired by GenPGM and the Panel review process to assess the potential effects of the Project was resumed in 2020.

Generation PGM describes the project as including the following components:

- Three open pits (North, Central, and South Pits)
- Ore handling facilities, including a Crusher and conveyor system
- Process Plant for the processing of ore and recovery of minerals and metal recovery
- Concentrate handling, storage and transportation
- Mine Rock Storage Area (MRSA)
- Process Solids Management Facility (PSMF)
- Water Management System, including Water Management Pond, Stormwater Management (SWM) Pond and various water pipelines
- Water Treatment Plant (WTP)
- Site Access Road and internal road network
- Electrical Transmission Line and substation
- Explosives Magazine and Site Mixed Emulsion (SME) Facility
- Aggregate Plant and Concrete Batch Plant
- Maintenance, Administration and On-Site Support Facilities
- Off-site Accommodations Complex
- Off-site Concentrate Rail Load-out facility
- Sample Prep / Assay Lab ES XIII

[2] EIS Addendum, Volume 1

In July 2020 a notice was posted on the project registry that the review was to recommence, and in November 2020 new panel members were announced. An "Environmental Impact Statement Addendum" was filed by Generation Mining in January 2021 (a set of documents that would have been more reasonably describes as a revised Environmental Impact Statement). This filing was followed by an exchange of Information Requests and responses between the Joint Review Panel and the proponent[3] and then the announcement in December 2021 of a public hearing, initially scheduled to begin in February 2022 but subsequently rescheduled to a March commencement.

3. Summary of Issues

For purposes of this summary, all references are to descriptions found in the "EIS Addendum" Volumes 1 or 2, unless otherwise noted.

Purpose for the Project

Generation Mining argues, as have other proponents, that all that is required of them in terms of a setting out of the project "purpose" is to state the business case.

We remain unpersuaded on this point, but note that despite making this argument, Generation Mining sought to bolster this argument with various descriptions of the market – and even global – need for the mine products, namely copper and palladium.

In one such instance, the document presents an argument on the case of copper, as follows:

> *Copper, another product of the Project, is a key element necessary for the expansion of electric and fuel cell vehicles and is expected by many to face critical supply shortages in the near future as that developing industry begins to expand into the mainstream. Electric cars do not use PGMs but require more copper than ICE or diesel automobiles.*

[3] See Registry postings #489,587 and 725

> *A large proportion of both PGMs and copper supply worldwide is sourced from countries with well-known geopolitical and/or developmental issues, making uninterrupted supply from these regions something that cannot be taken for granted*.[4]

In a quite different context we recently had the opposite scenario presented to us, a scenario in which there is an abundance of copper and no shortage on the medium horizon. While Generation Mining's claim of an impending shortage was not supported by evidence or reference, the party proclaiming an abundance did provide a reference, although upon investigation it was found to only partially support the claim.

Natural Resources Canada's "Copper fact sheet" describes copper as "one of the few materials that does not degrade or lose its chemical and physical properties during the recycling process. Recycling has the potential to extend the use of resources and minimize waste", further stating that the International Copper Study Group estimated that 32% of the world's copper consumption came from recycled copper in 2018 and that "Canada maintains a strong copper recycling industry. Substantial amounts of the metal are recovered in the Quebec-based smelter and refinery located in Rouyn-Noranda and Montréal, respectively".[5] There was no mention of either an impending shortage or surplus.

A quick online investigation produced directly conflicting analyst reports within the first page of hits, with Reuters predicting "moving into significant supply surplus in 2022"[6] and Bloomberg warning that of looming supply gap saying that "analysts warn of possible dearth of mine projects from 2025".[7]

[4] Vol 1, pg 1.22
[5] https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/minerals-metals-facts/copper-facts/20506
[6] https://www.reuters.com/article/us-metals-copper-ahome-idUSKBN2H31JX
[7] https://www.bloomberg.com/news/articles/2021-03-19/the-world-will-need-10-million-tons-more-copper-to-meet-demand

Whichever analysis proves to be correct – deficit, surplus or balance of copper supply in the coming years – the enduring observation in this review is that Generation Mining's claim of an impending supply crunch in copper was one of many unsupported statements, illustrating cause for a lack of confidence in the arguments being put forward in support of the project, and so by extension a lack of confidence in the project itself

Work Force Accommodations

The discussion of accommodations for the anticipated work force is problematic for a number of reasons, including that it is overly vague and indefinite, and it fails to recognize the particular threat that the establishment of work camps pose to women, and to Indigenous women in particular. More generally, the presentations by Generation Mining lack any gender analysis.

The documents variously state that the anticipated mine workforce is 375 workers while the a construction workforce estimates range from approximately 450 to 550 people. The document describes an expectation that there will be a temporary construction camp, operated by a third-party built to accommodate the workforce during the site preparation and construction phase of the project, and that "additional accommodations such as local hotels and rental accommodations may be used to house workers during this phase. The location of the construction camp has not been confirmed, but it is anticipated to be within the vicinity of the Project and the Town of Marathon"[8] and later says that "The Accommodations Complex will continue to house the portion of the workforce that is not derived from the local/regional catchment.." [9]

Later sections of the Addendum state that these "off-site support infrastructure may or may not be proposed as part of the Project. In most cases, these services or facilities will be owned and/or operated by third parties and not by GenPGM" and – different again – that "construction of an Accommodations Complex is being considered, with a proposed capacity for approximately 100 people.[10] It then goes on to describe that "the complex is anticipated as a pre-engineered, wood-

[8] Vol 1, 1.36
[9] Vol 1, 1.39
[10] 1.5.6.1 Accommodations Complex

framed two-storey structure, comprised of individual modular units, with shared bathroom, shower facilities, and common areas. A potential site for the complex has not yet been confirmed, although it is expected to be located within the general area of the Town of Marathon. It is currently envisaged that the Accommodation Complex would be operated by a third party to be available during construction and operation of the mine and would be available for continued use following the end of the Project"[11] which is a surprising amount of detail for a facility that Generation Mining seems to be ambivalent about (i.e. it may or may not happen) and have no intention of operating, but fail to describe who the imagined "third party operator" may be.

There was a significant shift in the estimates of workforce distribution between the EIS in 2013 and the Addendum in 2020, going from an estimate in 2013 of ~35% hired from local area and 65% hired from outside local area (travelling or moving into the area to work at mine site) and the 2020 estimate which assumed 80-90% of workforce will be from regional catchment. The rationale provided for the shift was "updated planning estimates" but there was no supporting discussion. [12] In addition, 10 to 20% of a construction workforce of 450 to 550 is quite an approximation to arrive at the "proposed capacity for approximately 100 people."

> *According to the MMIWG report, "the National Inquiry heard testimony and examined evidence that suggested resource extraction projects can exacerbate the problem of violence against Indigenous women and girls. Expert Witnesses told the National Inquiry that resource extraction can drive violence against Indigenous women and girls in several ways, including issues related to transient workers, harassment and assault in the workplace, rotational shift work, substance abuse/addictions, and economic insecurity. They argued that resource extraction can lead to increased violence against Indigenous*

[11] Vol 1, p 1.61
[12] Vol 1, p 1.67

women at the hands of non-Indigenous men, as well as increased violence within First Nations, Métis, and Inuit communities.[13]

As noted above, the assessment fails to recognize the particular threat that the establishment of work camps pose to women, and to Indigenous women in particular. More generally, the presentations by Generation Mining lack any gender analysis.

These failures are illustrated by women's security not being identified as a consideration under project scoping, or given any value. Similarly, we found no discussion of the pressures the project will bring to local housing stock, and the effects these pressures would have on local residents, including on housing availability and affordability.

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Cumulative Effects

The submissions made by Sara Libman and submitted on behalf of Citizens for Responsible Industry in Northwestern Ontario (CRINO) provide an excellent summary of cumulative effects in the Lake Superior watershed that should be considered as part of this assessment process. We wish to commend them to the Joint Review Panel, and seek now to supplement with two additional comments:

- Generation Mining has stated that final concentrates will be moved from the mine site to an off-site third-party facility for subsequent metal extraction and separation;[14] the impacts of that metal processing should also be considered in this review, as should the carbon impacts (and climate consequences) of the long distance haulage involved

[13] "'Man camps' may be a threat to Yukon Indigenous women and girls, say advocates", 2019 at https://www.yukon-news.com/news/man-camps-may-be-a-threat-to-yukon-indigenous-women-and-girls-say-advocates/#:~:text=Expert%20Witnesses%20told%20the%20National,%2Faddictions%2C%20and%20economic%20insecurity., See also "Indigenous Gender-based Analysis for Informing the Canadian Minerals and Metals Plan Policy Paper", Native Women's Association of Canada, 2018 at https://www.minescanada.ca/sites/default/files/indigenous-gender-based-analysis-cmmp_.pdf

[14] Vol 1, p 1.32

- Forest management including the extraction of trees and silvicultural practices including scarification (with attendant carbon loss), pesticide application, and construction and maintenance of an extensive road network are also industrial activities taking place in the Lake Superior watershed and within local and regional proximity to the project, and should also be considered in the cumulative effects study; summary maps indicating location of these activities are included in Appendix D.

As supplementary information, earlier reports produced by Northwatch on mining in the Lake Superior basin are included as Appendix A and Appendix B, and a report produced on Northwatch's behalf in an earlier stage of this review is included as Appendix C.

As additional comment on the Volume 2 Section 6.6 presentation of Generation Mining's Cumulative Effects Analysis, while we found the Table 6.6.1 listing of the many adverse effects expected from this project, and Table 6.6-2's "Summary of Projects and Activities included in Cumulative Effects Assessment" to be a reasonable listing of activities in the area, the analysis that followed these identifications was weak. For example, analysis failed to explore important thematic concerns, such as forest fragmentation, habitat loss, and the effects of those singly and in combination, cumulatively and synergistically, on various populations.

At times the analysis comes close – for example, in Section 6.6.6.6.1 "Change in Forest Cover" the Addendum acknowledges the "potential additive incremental losses of forest that is associated with the Project and the other projects/activities on PIL" and concludes that cumulative residual effect can be identified. However:

1) The analysis then goes on to conclude – without related and supporting rationale – that the "Project's contribution to the overall cumulative effect, therefore, is deemed to be negligible", seemingly on the basis that the forest industry does not utilize their full harvest allocation (which is the case in forest management units across the north, and is related to the modelling undertaken in the forest management planning process; it does not support the claim being made)
2) The analysis does not consider ecological themes, such as forest fragmentation and the effects of forest fragmentation on flora and fauna populations, including mortality, breeding and abundance effects

Climate

We found the Addendum's analysis of the contributions of the project to greenhouse gas emissions -and so to climate change - to be weak, and some statements to be questionable at best. For example, in the following statement to be problematic:

> Overall, with mitigation and environmental protection measures to be implemented, residual effects on GHG emissions are predicted to be not significant since the magnitude of the residual effect is low, the geographical extent is high (GHGs are a global phenomenon), the duration and frequency are medium, reversibility is high, and the ecological/societal value is high because of the overall importance upon which society places on GHGs and, by extension, climate change.[15]

- The conclusion that these emissions are not significant is not supported by climate science
- The statement that "reversibility is high" is perplexing at best, and could more reasonably be categorized as nonsensical
- The included observation that there is a high ecological / social value associated with the reduction of greenhouse gasses directly conflicts with the earlier dismissal of the emissions as being not significant

On a related note, through a climate lens we find the following aspects of the project to be problematic:

- The use of diesel generators when alternate sources of power are available (i.e. connection to the transmission system) to be very problematic[16]

[15] PDF page 39, Effects Assessment, Volume 2
[16] Vol 1 1.36

- The Addendum estimates 90 passenger vehicles will be entering the mine site for the day shift and 60 passenger vehicles will enter the mine site for the night shift, but also states that "the contractors or employer will provide a crew bus";[17] making the crew bus the standard mode of access to the mine site has an obvious climate benefit that should be seized

In addition to our own brief comments (above) Northwatch wishes to adopt the submissions prepared by Kerrie Blaise on behalf of Environment North with respect to climate concerns, in the brief titled "Review of Climate Impacts of the Marathon Palladium Project by Environment North to the Joint Review Panel".

Alternative Means Assessment of Power Supply

The discussion of power supply, including consideration of the option of connecting to the existing Terrace Bay-Manitouwadge transmission line (M2W Line) versus the East-West Tie illustrates a number of weaknesses which are recurring throughout the assessment documents. These include:

- The approach contemplates the installation and use of five 1 MW diesel generators on the site, when employing a different strategy could avoid option; as noted elsewhere in Northwatch's submission, this signals that Generation Mining is not committed to maximizing the reduction of their greenhouse gas emissions; this is highly problematic
- The document indicates that 'a power distribution line may be connected to the existing powerline located along the Camp 19 road to support site preparation and construction activities";[18] this lack of project definition is also problematic – does Generation Mining have a project plan, or simply a set of ideas and possibilities?

[17] Vol 1, 1.39

[18] 1.5.4.12 Power Supply and Distribution, Vol 1 1.57

- The document states that "the availability of a connection point within the existing Marathon Transformer Station (TS) (which would be required for Option 2) is unknown at this time"; more than ten years into the EA process this is an outstanding statement; how can Generating Mining believe that there project is sufficiently developed to be seeking an environmental assessment review (and possibly approval) when basic project components such as power supply have not been developed?
- Why is the availability of a connection point unknown? The lack of detail or explanation is not unique in this set of documents, but it is vexing – how can it be that this is an option for consideration, but Generating Mining doesn't know if it is available? What is the barrier to knowing if this option is available?
- The document states that "more flexibility exists for GenPGM to identify an appropriate connection location for the M2W line (Option 1) given their existing surface rights in the area than for a connection to the East-West Tie (Option 2)" [19] but provides no basis for that statement; what would the barriers be to a connection with the East-West Tie, and has Generation Mining explored them? Why is this not presented?
- The document states that "Both alternatives are considered technically feasible options (subject to confirmation by IESO / HONI) for which potential technical constraints can be overcome, albeit the ability to connect to the East-West Tie is uncertain at this time" but this is a contradictory statement:
    - Why are they considered technically feasible if it has not yet been determined that the technical constraints can be overcome?
    - Why is the ability to connect to the East-West Tie uncertain at this time?
- Generating Mining concludes that "as a result of a straighter corridor, ability to avoid potential interaction to existing infrastructure, and availability of land within the care and control of GenPGM, Option 1 is "preferred" for this criterion" but there is no indication that Generation Mining has considered all the consequences of this "straighter corridor"; for example, there is no indication of what weight or consideration has been given to the great increase in forest fragmentation that would come with Option 1 vs Option 2

[19] 3.2.3.5 Technical Factors, Volume 1 p 3.16

- The analysis fails to discuss and describe important factors that may be outside Generation Mining's control, but should be weighted into this evaluation of the two alterative electrical power supply options; these factors include line load, the effect on line stability of adding the load from the mine, and on the source stability for the mine of being connected to Option 1 vs Option 2; note that these issues of supply stability are serious considerations from a health and safety perspective, as power outages can affect workplace safety

Northwatch wishes to note that the East-west Tie was approved in March 2019[20], construction began in September 2019 and the line is expected to be complete by the end of the first quarter of 2022.[21]

We further wish to note that there was no actual cost analysis provided, only very generalized statements, and statements limited to different lengths/distances to connection points. There was also no mention of connection charges, or identification as to whether different connection costs for the Terrace Bay-Manitouwadge transmission line versus the East-West Tie might have been a factor which Generation Mining did not wish to disclose.

Acid Mine Drainage and Aquatic Impacts

Northwatch is relying on the expert review prepared by Dr. Kevin A. Morin, Ph.D., P.Geo., L.Hydrogeo of the Minesite Drainage Assessment Group on behalf of CRINO and Northwatch to communicate our review of aquatic impacts, including acid mine (rock) drainage issues. The report has been submitted by Dr. Morin in its entirety under separate cover. We provide the following points as summary for the purpose of Northwatch's own submission:

- a major concern for a proposed mine site is its capacity for on-site water contamination and, in turn, off-site water contamination caused by contaminated water leaving the site

[20] https://www.ontario.ca/page/east-west-tie-transmission-project
[21] https://www.nextbridge.ca/

- on-site water contamination is sometimes called “metal leaching and acid rock drainage (ML-ARD)” and “geochemical source terms”
- if on-site contamination is underestimated, then all off-site contamination and environmental impacts, like terrestrial vegetation and dust inhalation, are also underestimated.
- there has been an underestimation in the case for the Marathon Palladium and Copper Project
- Generation PGM and its consultants have continued to submit major new or revised information on the Marathon Project long after the EIS/EA Addendum had been submitted in 2021; this ongoing *ad hoc* approach allows the company and its consultants to revise the predicted environmental impacts at any time, based on concerns as they receive them from stakeholders.
- In the course of the upcoming hearing, concerned citizens and stakeholders will most likely continue to be rapidly exposed to major Project revisions without clear explanations of what has changed, why it has changed, and what the new implications are for the surrounding land, water, and air; this provides a strong, biased advantage to Generation PGM and its consultants to deflect or ignore valid concerns
- The review most recently submitted by Dr. Morgan is a supplementary document and it must be read in conjunction with: 1) Review of the Marathon PGM-Cu Project - Review of Environmental Geochemistry, dated October 2012 (nearly 10 years ago) and 2) Marathon Palladium Project EIS Addendum - Review of Predicted Water Contamination and ML-ARD, dated July 2021.
- Ontario Regulation 240/00 on “Mine Development and Closure under Part VII of the Act” formally states in part: *56. The objective of this Part of the Code is to determine the potential for significant metal leaching (ML) or acid rock drainage (ARD) and, if necessary, to ensure the development and implementation of effective prevention, mitigation and monitoring strategies”;* this supplementary review continues to show that the Marathon EA, EIS, Addendum, and IR responses fail, under Regulation 240/00, *“to determine the potential for significant metal leaching (ML) or acid rock drainage (ARD)”* reliably.
- This failure is due to repeated and major underestimations of ML-ARD potential of mine rock, tailings, and mine waste.

- Due to incomplete descriptions of "water treatment" the Marathon EA, EIS, Addendum, and IR responses also fail to *"ensure the development and implementation of effective prevention, mitigation and monitoring strategies"* reliably under Regulation 240/00.
- There is a large and currently underestimated environmental risk that the Marathon Project poses to surrounding water quality and sediment quality which can lead to disastrous problems for water quality and the surrounding environment and can lead to expensive liability for the Government and people of Ontario.
- the Marathon Project should be halted until reasonable and realistic estimates are made of MLARD and of costs for dissolved-contaminant water treatment.
- If the project is not halted until Regulation 240/00 is met for ML-ARD under Regulation 240/00, the initial financial security could be grossly underestimated by many tens of millions, to hundreds of millions, of dollars; this could lead to another major provincial environmental liability

4. Review Challenges

A mining project of the size and complexity that Generation Mining is proposing can be expected to pose some challenges in its review, particularly for members of the public and for public interest organizations. However, this review has posed special and /or additional challenges, which we wish to note for the Panel's consideration.

Extended Time Frame

The long period of time for this review, including and particularly between the filing of the first EIS in xx and this hearing in 2022, pose particular challenges. Reviews undertaken a decade ago must be redone or reconsidered, and conclusions reached in the first EIS review may or may remain as applicable as they first were, but the impressions of the first EIS and the first EIS review may persist, making commentary on the current EIS more challenging.

At least one other review participant asked the Panel whose fault it was that the review had been extended over such a lengthy period of time, and others have implied or suggested that the length of the review is the failing of the process.

It should be clear to all: environmental assessment processes are extended when a proponent required long periods of time to provide required information, and when project proponents change, project proponents request hearing suspensions after the hearing has already been announced, and when proponents seek to restart projects under the same review process many years after the review has been suspended. Those all apply in this instance and are not failings of the process or the result of public participation. Rather, they are the direct result of decisions made by project proponents at various points in the project development and review process.

In Northwatch's case, we planned our workload around the 2012-2014 review process; when the process was suspended and then reinitiated in 2020 commitments had already been made to other projects and other areas of work, and the review of this project was added to that workload. This has had a negative consequence on both our other work commitments and our opportunity to invest the necessary time and effort into this review.

Revised Version of Environmental Impact Statement, Co-relating EIS, Addendum and IRs

Initially referred to as "Addendums"[22] to the Environmental Impact Statement, we were pleased to see the Joint Review Panel clarify with their January 11th 2021 announcement[23] that the documents are in fact revisions to the 2012 EIS, rather than addendums the 2012 EIS.

We did not find the proponent's decision to "stagger" the release of the revised Environmental Impact Statement to be helpful to review participants. We did generally agree with the proponent's characterization that review participants must now "refamiliarize themselves with the Project and read new material",[24] and that there is a large amount of information to be managed and reviewed, including information filed during the 2010 to 2014 period and information now being filed by Generation Mining.

[22] See CEAR #726 Letter from Generation PGM Inc. to the Impact Assessment Agency of Canada re: Update on submission of Volume 1 of EIS Addendum
[23] See CEAR #729 News Release – Environmental Impact Statement Received from Generation PGM Inc. for Marathon Palladium Project Environmental Assessment
[24] See CEAR #726 Letter from Generation PGM Inc. to the Impact Assessment Agency of Canada re: Update on submission of Volume 1 of EIS Addendum

Many review participants invested considerable time and effort in reviewing proponent filings in the 2010 to 2014 period as well as engaging technical experts in this review. After the filing of the revised EIS were confronted with a similar volume of filings by the newest proponent, but with no tool to readily and reliably identify those areas where the information has changed versus those areas where the proposal remains unchanged.

Our assessment is that the proponent or Agency staff should have prepared and provided a table of concordance showing a comparative accounting of those areas in which the project proposal has been changed, and those areas where the project proposal remains unchanged from 2012. The concordance table would not have had to detail the changes, but rather provide a very brief summary description and identify where the information is located in both the original and revised EIS documents. Additionally, the same concordance table could have shown which section(s) in the EIS each Information Request and response related.

The Agency did helpfully provided a compilation of Key Documents for the Marathon Palladium Project[25], as posted on the registry on January 8, 2021, and included in the compilation was a listing of the 31 support information documents filed by the (then) proponent in July 2012, plus seven additional technical documents filed by Stillwater between 2012 and 2014. It would have been helpful to have these documents also included in a concordance table, as described above.

Environmental Registry Function

The current form of the Impact Assessment Agency's environmental registry functions poorly, and this poor functioning is an obstacle to effective public participation, largely due to inefficiencies and challenges in identifying and location relevant information. These are issues which are perhaps beyond the control of the Joint Review Panel, but which do have an adverse impact on public participation. Every hour a review participant – or potential participant – must

[25] See CEAR #728, Compilation of Key Documents for the Marathon Palladium Project (Note: Updated January 19, 2021)

spend dealing with the mechanics of the registry is an hour that is not spent considering and comment on the project itself.

5. Conclusions

As Northwatch and other review participants have identified there are information gaps and missing information items and analysis. Further, there are numerous examples of where statements in the Addendum (revised Environmental Impact Statement) are unsupported by references, evidence, or even rationale.

At this point in time it is our assessment that Generation Mining has not presented a case which the Joint Review Panel can approve.

Throughout the course of the hearing, Northwatch intends to monitor the proceedings to the greatest degree possible and will review our current assessment and communicate it to the Joint Review Panel in our final submission at the hearing's conclusion.

Appendices

Appendix A	Undermining Superior – A report on Mining in the Lake Superior Basin, Northwatch, 2001
Appendix B	Undermining Superior – Field Notes, 2001
Appendix C	The Hard Way: A Report on Mining in the Lake Superior Basin, 2011
Appendix D	Big Pic Forest Management Plan Summary Map

under MINING SUPERIOR




A Report on Mining Activities and Impacts in the Lake Superior Basin

Northwatch Summer 2001

MINES IN THE LAKE SUPERIOR BASIN
Field and Briefing Notes
July 2001

The following provides information on mines in the Lake Superior Basin, those that are operating, under care and maintenance, in the process of closure, or abandoned with tailings. The information forms the basis for a tabloid produced by Northwatch and the Lake Superior Alliance entitled Undermining Superior.

The briefing notes consist of a list of issues of concern at each mine, field notes that were gathered by Northwatch on a tour in June, 2001, as well as background research. For example, sources include: minesite visits, water samples, meetings with mine representatives, government, First Nations and the public, mine closure plans, mine environmental assessments, abandoned mines inventory system (AMIS), and various related reports.

There are many, many more abandoned mines in the Lake Superior Basin (e.g. with shafts and waste rock piles) than are listed here. It is estimated that there are approximately 6000 abandoned mines in Ontario. Only those with tailings were researched, in order to limit the scope of work while hopefully catching most of the major abandoned mines.

Some of the information in the briefing notes, particularly on abandoned mines, may be erroneous. This is due to the fact that different reports give different information e.g. on dates of operation, contaminant potential, etc. In addition, the list may not be comprehensive.

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Issues:

The expansion of the mine that is presently under construction has not been assessed under the *Canadian Environmental Assessment Act*. The expansion is from 2,400 t/d to 15,000 t/d. The mine contacted the DFO prior to undergoing its expansion, and DFO advised the mine, in order to avoid triggering an Environmental Assessment.

- Acid Rock Drainage / Metal Leaching (ARD/ML) characterization of mine waste is inadequate. ML characterization of tailings material has been carried out on a total of 11 tailings samples according to Ontario Regulations 309 and 347. These regulations are likely inadequate for determining metal leaching potential since they are not specific to mine waste. Only five samples of tailings have been assessed for ARD potential. Given the massive scale of the operation, the numbers of samples gathered seems far too small. Furthermore, only tailings have been sampled where the *Mine Rehabilitation Code of Ontario* requires that all materials remaining on site be sampled for ARD/ML e.g. waste rock, pit walls, drill core.
- The massive scale of the mine is creating a major impact on the area's aesthetics and terrestrial productivity. The south rock pile will be 80 m in height, approximately 40 m above the highest natural feature. Revegetation of the minesite following closure will have limited success because of the rocky substrate that will remain over much of the site.
- No evidence of post operational water quality assessments at site was found. The mine has been operating for 8 years.
- What is the rationale for addition of peat to the tailings impoundment pond at closure?

Field Notes:

Northwatch requested a tour of the mine. This was refused because the mine is undergoing a major expansion. A tour of the mine may be available as early as September. Northwatch went to the mine gate on June 22, 2001 and requested to meet with the mine's Environmental Coordinator at the gate. This was refused.

MOE Non-Compliance:

1998 Exceeded the total phosphorus limit; facility revised operational process and facility is under investigation.
1997 Failed toxicity test in October.

Research Notes:

The mine is owned by Lac Des Iles Mine Ltd. of North American Palladium Ltd. and is located 85 air km north-northwest of Thunder Bay (49°10N, 89°37W). Access is via HWY 527 and then along a 20 km stretch of gravel road. Platinum group mineralization was discovered in the area in the 1960's. Products from the mine are palladium, platinum, gold, copper and nickel. It is the only developed mine in the area, which is otherwise used mainly for logging, trapping and some recreation. Expected mine life as of 2001 is 11 years.

Palladium is used in autocatalysts to reduce hydrocarbon emissions from gasoline engines, as well as in electronics, dental work and jewelry.

Mine production began in 1993 and is currently 2,400 tonnes per day (6/10/2000). Concentrate from the mine is trucked to Sudbury for smelting and refining. The size of the property is currently 8014 ha and landholdings total 15,000 ha. The mining method is open pit. An expansion of the site is planned to 15,000 tonnes per day. The expansion is expected to provide for 5% of the world's annual palladium supply by 2002. Between 1993-2000, 7,627,055 tonnes of ore and 23,448,980 tonnes of waste were mined. Projected mining for 2001-2011 is 70,901,400 tonnes of ore and 154,483,000 tonnes of waste. Exploration is currently underway to the east of the main Roby pit.

Mine development rock generally has 2% sulphides and 80% of these sulphides are removed from tailings during the milling process. Five samples were assessed for ARD potential using acid base accounting and were found to

have a strong net neutralizing potential. One leach test was performed on a single tailings sample (using a method in Ontario Regulation 309), and from this one sample it was determined that the tailings mass is not leachate toxic waste. Further leach testing on ten tailings samples (according to O. Reg 347) has supported this assumption (note Pb concentration in TMF 7 elevated relative to other samples at 0.0030 mg/L).

The tailings impoundment is located in a shallow valley south of the mill underlain by bedrock. Planned close-out of the impoundment will involve dewatering of tailings, flattening the downstream toes of dams and revegetating. Approximately 20 ha of the impoundment will be covered by a pond about 15 cm in depth at close-out. Peat will be added on the surface of the impoundment (in the pond?) in order to improve effluent objectives

Baseline water quality assessment was completed but no post-operations monitoring was evident from the closure plan. A Fish Habitat Compensation Agreement negotiated between the mine and government required that the mine enhance a walleye spawning site at Lac des Iles Mines Road bridge at Vandenbrooks Lake by expanding available habitat. The mine takes about 1000 m^3/day of freshwater from Lac des Iles but expects to reduce this demand by half by using a larger reclaim pump.

Typically, clarification is the only treatment needed at the effluent treatment plant. Clarification removes suspended solids, which are proportional to elevated aluminum, iron and nickel concentrations. A filter within tailings dams also helps remove suspended solids in seepage from the impoundment. Discharges from the tailings at DAM 4A and from the water treatment plant south of the mill drain to Second Pond. A third discharge point is to be established at DAM 2 of the tailings and will flow via Camp Creek and via surface drainage into Hasson Lake. Hasson Lake receives mine effluent from the mine via Second Pond and these two waterbodies act as the "mixing zone", so that the outflow of the Hasson Lake should meet Provinicial Water Quality Objectives (PWQOs) or conform to background concentrations.

There are two pits on site: Czone and Roby. The Roby pit is the only active pit at the mine and contains a shear zone. The shear zone is the only geological system identified with the potential to conduct significant amounts of groundwater. Any seepage losses via the shear zone are expected to decrease as the pit floods at closure, the water table rises and the hydraulic gradient decreases. Excess water from the tailings will be pumped to the Roby Pit for a period at closure. The pits are expected to flood (to a final elevation between 466 m, which is that of Lac Des Iles, and 496 m, which is the outflow elevation). At closure, overflow from the pits will be directed to Lac des Iles. Boulder fences are to be installed for the entire perimeter of the pit and waste rock will be end dumped on portions of the top pit bench when no further expansion is planned, in order to decrease safety hazards.

Bedrock on site has limited permeability and shallow groundwater flow occurs mainly through porous soils. Soils in the area are typically shallow tills, less than 3 m in depth with weak organic development. The mine does not expect any significant long term change to the water table or groundwater flow.

Significant waste rock piles will be generated on site. The south rock pile will be 80 m in height, approximately 40 m above the highest natural feature. In addition north and central rock piles will be generated. Piles will be sloped at 2:1 horizontal to vertical and accumulations of fine material on the piles will be revegetated where possible.

The total cost of closure is estimated at $2,400,000 (as of 1999 before major expansion).

The company certifies that it has carried out reasonable and good faith consultations with the appropriate representatives of all aboriginal peoples affected by the project. No inhabited or uninhabited reserves are located in the same watershed. The nearest inhabited aboriginal community is the Gull Bay First Nation reserve 80 km north of the mine site. The company's Environmental Coordinator made a presentation to the Spruce River Local Citizens Committee regarding mine operation and closure in November 2000 and the minutes of the meeting were circulated to all members (including Gull Bay First Nation which was absent from the meeting). The company has entered consultation with the Gull Bay First Nation regarding mine related employment and business opportunities.

Sources 1) website: www.palladium.ca
2) March 1999, Lac Des Iles Mines Ltd., Mine Site Closure Plan,

3) March 2001, Lac Des Iles Mines Ltd., Closure Plan Amendment, Volume 1, Technical Report

RIVER GOLD MINES LTD. - EAGLE RIVER MINE and EDWARDS PROJECT

River Gold Mines Ltd. owns two mines north of Wawa, the Eagle River Mine and the Edwards Project. Ore from the Edwards Project is shipped to the Eagle River Mine for processing.

Issues:

At start up of the Eagle River Mine, the Michipicoten First Nation was told that the appropriation of their traditional territory for mining would mean that they would benefit through employment. No one from the Michipicoten First Nation community is working at the mine and there is no Impact Benefit Agreement between the mine and the First Nation on record.

- Sources of ore processed at the Eagle River Mine include the Eagle River Mine, the Edwards Project, the Magnacon Mine and in future possibly the Mishi pit. Characterization of Acid Rock Drainage / Metal Leaching (ARD/ML) of materials from these sources is inadequate. Sampling for ARD is minimal and not necessarily representative. There has been no testing of mine wastes for ML. A record is required for the sources, quantities and characteristics of ore processed and the pattern of disposal of different tailings in the tailings impoundment.
- Present closure planning for the tailings impoundment assumes that tailings will not generate ARD/ML. Closure costs for the tailings impoundment and all other structures on site assume that there will be no generation of ARD/ML.
- The Eagle River mine plans to conduct a post-operational aquatic assessment this fall (2001).

Field Notes:

Tour of the Eagle River Mine June 24th, 2001 with Mike Frost, Head of Safety, Don Bridges, Mill Metallurgist, and Colin Kirkpatrick, Mill Superintendent

The development of the Mishi pit will only provide about two months of mill feed, or 30,00-40,000 tonnes of ore. There are 5 years of reserves remaining at the Eagle River Mine and ore generally contains from trace to 2% sulphides, averaging about 1%. Reserves at the Edwards Project are low.

An aquatic assessment at the Eagle River Mine is scheduled for this fall, however the mine is waiting for the MMLER (Metal Mining Sector Liquid Effluent Requirements) Environmental Effects Monitoring Guidelines before planning their own study.

The mine uses the Merrill-Crowe process for recovery of gold, which is an older process, as opposed to the more recent carbon-in-pulp (CIP) process. The CIP process allows for better recovery of gold. The Merrill-Crowe process is more environmentally friendly because water is recirculated and much less is used. In addition, the effluent is filtered in the Merrill-Crowe process so that contaminant loadings are reduced by approximately an order of magnitude in comparison with the CIP process.

Seepage from waste rock piles at the portal for the Eagle River Mine discharges to pond C7. No elevated metal concentrations have been noted in discharge. There is a MISA (Municipal Industrial Strategy for Abatement) monitoring point at the outflow of pond C7.

The MISA monitoring point for the Eagle River Mine tailings impoundment is at the outflow of the polishing pond and the limits in the Certificate of Approval are the same as those for MISA. In 1998, exceedances of cyanide in discharge from the polishing pond were due to the presence of ice slowing cyanide breakdown. As a result, discharges from the polishing pond are now stopped earlier in the fall and there is no discharge during the winter season. In 1997, exceedances of total suspended solids in discharge from the polishing pond were due to problems in settling out slimes. During a 6 week drought in 1997, water was scooped out of the polishing pond for toxicity testing since there was no discharge, and this more concentrated solution caused the failure of the toxicity test. The ratio of flow in Ellen Creek to discharge from the polishing pond must not be lower than 45:1. Usually the ratio is much larger. The retention time of the polishing pond varies and is approximately 10 days.

The mine is not unionized.

Meeting with Chief John Swan Peterson of the Michipicoten First Nation June 18th, 2001

At start up of the Eagle River Mine, the First Nation was told that the appropriation of their traditional territory for mining would mean that they would benefit from mining through employment. No one from the Michipicoten First

Nation community is working at the mine and there is no Impact Benefit Agreement between the mine and the First Nation on record.

Meeting with John Woods, Reeve of Michipicoten Township on June 19th, 2001
The "Mishi pit" that will be developed at the Eagle River Mine is on a small hill with no nearby water sources. It is low-grade ore than can be mined using open pit to a certain depth and then the deposit may be mined from underneath as it is situated over the Magnacon mine workings.

EAGLE RIVER MINE (formerly Magnacon Mill)

MOE Non-Compliance:
1998 Eagle River exceeded total suspended solids, WAD cyanide, iron, total cyanide and cyanide limits; company implemented equipment improvements. Exceeded total suspended solids, unionized ammonia, pH, oil and grease limits; facility revised operational process.
1997 Failed toxicity test for Daphnia in September. The limit of 0.2 mg/L for copper was exceeded on June 11 at 0.46 mg/L, June 20 at 0.48 mg/L, August 20 at 0.5 mg/L, August 27 at 0.53 mg/L, September 5 at 0.41 mg/L, September 10 at 0.25 mg/L, September 17 at 0.24 mg/L, September 24 at 0.26 mg/L, September 29 at 0.23 mg/L, October 29 at 0.4 mg/L, November 12 at 0.25 mg/L. The limit of 6.0 - 8.5 pH was exceeded on June 23 at 8.92. The limit of 0.2 mg/L for cyanide was exceeded on October 29 at 0.32 mg/L.

Correspondence Northwatch - MNDM :
Catherine Daniel, Northwatch, wrote to Leslie Cooper, Mine Rehabilitation Inspector, MNDM on March 19, 2001 and received a written reply of March 29, 2001. Correspondence was subsequent to the mine's closure plan amendment for mill expansion and concerned ARD/ML characterization of mine waste (specifically tailings) and its implications on closure of the tailings area.

Research Notes:

The mine is located 48 km northwest of Wawa with access via Paint Lake Road (47°59N; 85°28W). It is divided by two separate owners. River Gold Mines Ltd. owns the mill operation, tailings facility and associated infrastructure. Muscocho Exploration Ltd. owns some surface rights and continues to hold the mineral rights and infrastructure associated with the previous mining operation. The mine originally opened in 1986 and then shut down in 1990, with the mill being reopened again in 1995. When the mill was reopened in 1995, low grade ore stockpiles were used for upgrading roads and for mill feed.

All drainage from the mine flows to Lake Superior via three watersheds: Macassa Creek, Feather River, and Ellen-Eaglet University River. The Feather River watershed is sensitive as it contains Mishibishu, Mishi, Katzenbach and Augusta Lakes, which supply the brood stock for MNR lake trout stocking programs. The goal of final closure is to achieve pre-development background water quality conditions (Addendum 1,I)[1].

The mill employs cyanide leach / Merrill Crow zinc precipitation process for the extraction of gold. The Closure Plan Amendment of January 2001 pertains to 2 expansions completed in 1999 and 2000 to the mill building to allow for an increase in mill production (from 800 tonnes per day to 1,200 tonnes per day as approved by the MOE in August 1999). Ore is supplied to the mill from River Gold's Eagle River Mine and the Edwards Project.

The tailings impoundment previously discharged to Mishibishu Lake but discharge has been redirected to the Ellen-Eaglet University River via Miron Creek to Ellen Creek to Eaglet Lake. The tailings impoundment is located in what was previously Magnacon Pond and covers 0.65 km^2. The main tailings dam is built with granular fill and has an upstream polyethylene liner for water retention. The seepage collection and diversion dams are built with granular fill and are unlined. The closure plan for the tailings currently involves a 10-15 cm cover of overburden and subsequent revegetation.

The Magnacon Mill operated from June 1989 to October 1990 processing ore from the Magnacon Mine, during

which time 256,000 tons of tailings were produced. The average net neutralizing potential (NNP) for the five tailings samples analyzed was -20.7 kg CaC03/ton. Based on this information the tailings had an NNP greater than 20 or -20 and were considered to be non-acid generating. Since the opening of the Eagle River Mine in 1995, an estimated 1,460,000 tons of tailings have been added to the tailings pond. The neutralizing potential ratio (NPR) for four tailings samples ranged from 4.8:1 to 17.5:1 with very low total sulphur content (0.04-0.09%). [Information on ARD/ML in Closure Plan later clarified by Leslie Cooper, Mine Rehabilitation Inspector, MNDM.]

Average annual water quality of tailings pond during shutdown 1991-1994

	1991	1994
As	0.796	0.234
Cu	1.074	0.043
Ni	0.169	<0.011
Zn	0.072	<0.096
pH	8.01	7.45

"Post operational data (90-94) on discharge water quality from the Magnacon mill site indicate that there will be no concerns with regard to water quality following closure of the mine[1]."

Pre-development background water quality:
pH 6.14-6.96; slightly elevated zinc in Macassa Creek and Magnacon Pond (0.016-0.021); As<0.001; Cd<0.002; Cu<0.005; Pb<0.02; Mn<0.02; Hg<0.0002; Ni<0.005.

As of 1993, the cost of closure of the portion of the Eagle River Mine owned by River Gold Mines Ltd. was estimated at $293,760.

Sources 1) River Gold Mines Ltd. Magnacon Mill Closure Plan (for mill and associated infrastructure), 1993 and 1996
2) Closure Plan Amendment, River Gold Mines Ltd., Eagle River (formerly Magnacon Mill), January 2001

EDWARDS PROJECT

MOE Non-Compliance:
1999 Total suspended solids (Clean Water Regulations); assessment complete, no further action required

Research Notes:

The gold mine opened in 1997, 20 km east of Dubreuilville (48°19N, 84°21W). The minesite includes a shop, camp, office, stockpiles of ore and waste rock and mine water treatment ponds. There is no mill on site. A wetland (14 ha in size) is located near the mine and acts as a polishing pond for mine drainage which then runs into Spirit Lake (10 ha in size). Ore from the Edwards Project is shipped to Eagle River Mine for processing (predicted rate of 200 tonnes per day of ore and a total of 60,000 tonnes to waste rock to be removed).

Acid-base accounting on waste rock samples determined that they were non acid generating with a net neutralization potential ranging 100-200. No metal leaching characterization was completed.

As of 1996, two sedimentation ponds and an exfiltration ditch were planned for use on site for treatment of excess water pumped to surface from underground. The ponds were predicted to provide between 2 and 8 days retention time for the removal of suspended solids, dissolved metals and ammonia, with the wetland providing additional polishing. The closure plan states that "it is not expected that the Project will have any effect on the local aquatic plant and animal life."

Source 1) Proposed Closure Plan, River Gold Mines Ltd., Edwards Project, prepared by Kirtec Resources Ltd., December 1996

THE HEMLO MINES - WILLIAMS, DAVID BELL and GOLDEN GIANT

Issues:

The public holds significant liability for close-out of the Hemlo mines because the closure costs and the associated financial securities posted by the mining companies are much lower than real costs. Closure costs do not account for appropriate disposal or treatment of acid generating/leachate toxic waste rock, nor do they reflect the risk of groundwater contamination to the area.

- Contamination of groundwater may occur primarily from the underground workings and the tailings. Groundwater data provided for the Williams-David Bell tailings area showed copper, molybdenum and zinc elevated above Provincial Water Quality Objectives. Groundwater quality has reportedly been affected at the Golden Giant tailings area. The issue of groundwater contamination has not been acknowledged in closure planning for the mine. Furthermore, the mines have not been provided by the MOE with standards for groundwater monitoring.
- The underground workings are acid generating and leachate toxic and closure planning has not addressed this problem. Hydrology of the mine workings has not been examined. Future planning of pit development above the underground workings will have a major impact on their hydrology. It is necessary to plan for close-out of the workings.
- Closure planning at the Hemlo mines involves the maintenance of flooded tailings impoundments in perpetuity. Climate change has not been taken into consideration in planning for maintenance of the water cover.
- The Hemlo mines use the Carbon-in-Pulp (CIP) process. Relative to the Merrill-Crowe process, CIP requires much greater quantities freshwater and results in much higher metal loadings in effluent. Ideally, a hybrid of the Merrill-Crowe and CIP processes would be favourable in reducing mining impacts.
- Golden Giant and David Bell discharged effluent into Lim Lake. The original plans for mine operations expected changes to the water quality of Lim Lake from mining. Water quality changes have also occurred further downstream. David Bell no longer discharges to Lim Lake. Golden Giant continues to discharge and intends that water quality at the confluence of Hayward Creek and the White River should meet PWQO's for the protection of aquatic life, over 20 km downstream from the point of discharge in Lim Lake. Similarly, there has been an impairment of water quality in the Frank Lake watershed from Williams mine effluent discharges.
- The Pic River First Nation has no Impact Benefit Agreement with the Hemlo mines and has not received details of closure planning for the mines.

Field Notes:

<u>Tour of the Hemlo Mines with Adele Faubert, Environmental Coordinator for Williams and David Bell, and Laszlo Gotz, Environmental Coordinator for Golden Giant on June 20th, 2001</u>

Predicted closures: David Bell: 2006
Golden Giant: 2005
Williams: 2012

Battle Mountain Gold has been taken over by Newmont Mining.

The Pic Mobert First Nation has an agreement with the Hemlo mines for a labour pool that is brought in periodically, especially at year-end. There is potential for further hiring from the labour pool for full-time work at the mine.

The Hemlo mine sites are located in the Black River watershed, excluding the tailings impoundment for Williams and David Bell and the piped effluent discharges for all mines, which report to the White River watershed.

Effluent treatment may continue post-closure for an indefinite period of time. Effluent is discharged only seasonally from the mines, since discharge in winter would entail a need to treat for cyanide. Cyanide breaks down more quickly in warmer weather and the mines do not treat for cyanide in their effluent. At Williams and David Bell, approximately 8,000 m^3 of effluent treatment sludge is disposed of in the tailings impoundment each year, along with more than one million tonnes of tailings. The disposal location of the sludge and the tailings is moved around the impoundment regularly. A new type of treatment for Golden Giant mine effluent being investigated is silica micro encapsulation, which is being promoted by a company named Keeco.

A significant amount of manganese is discharged from the Hemlo mines (see NPRI data) and this is due to

its presence in grinding media.

The original Certificate of Approval for ammonia at Williams was 10 mg/L, and now the limit is 20 mg/L with a target of 12 mg/L. Switching to an emulsion based ammonia, at Golden Giant and at the open pit at Williams, should reduce levels of ammonia in discharge and result in less wastage of explosive materials.

The tailings management facility for David Bell and Williams contains approximately 43 million tonnes of tailings. Having two settling ponds for the facility is helpful in allowing for more dilution and settling time. Originally closure planning for the Williams and David Bell tailings impoundment assumed non-acid generating tailings. A changeover in thinking occurred in 1992, when the mines discovered tailings were acid generating and started planning to flood them. At Williams, standards being used for comparison with groundwater seepage from the tailings impoundment are *The MOE Guidelines for Use at Contaminated Sites in Ontario, 1996*. The objectives in these Guidelines depend on end land use. Groundwater seepage currently meets most of the objectives for potable water.

At Golden Giant, groundwater seepage from the tailings impoundment is collected via ditching and a seepage collection pond. Therefore, the possibility exists to construct a facility to mitigate any contamination of seepage water. At closure overflow from the Golden Giant tailings impoundment will spill to Cedar Creek. Sampling of overflow will be 1) on Cedar Creek just prior to its confluence with Philips Creek and 2) on the Black River at HWY 17. In the early 1990's Golden Giant mine was taken to court when their tailings line ruptured spilling tailings into the Black River via Cedar Creek. Further measures have been taken at the point where the tailings line crosses Cedar Creek to prevent the incident from reoccuring.

For all of the Hemlo mines, the downstream component of tailings dams was constructed by quarrying non-acid generating rock.

A natural spring that is located near the Williams mill enables the monitoring of seepage from waste rock piles at Williams mine. Waste rock may be removed to the pits at closure at Williams mine; collection and treatment for the stockpiles has not yet been considered. Waste rock at Golden Giant may be removed to the flooded backfill quarry, or to the underground and will be sampled prior to making these decisions.

At Williams mine, the initial open pit (A zone) was excavated to process low grade ore and obtain backfill for the underground workings. The Sceptre pit was originally mined for non acid generating material for the Interlake tailings dams at Golden Giant and the pit is being traded to Williams from Golden Giant. The C zone and Sceptre pits may eventually be mined as one massive open pit and this may be mined out to the underground workings. Currently, the C zone pit is the main open pit for Williams.

Groundwater flow from the underground workings has not been studied. Predictions of flooding times and groundwater movement patterns have not been carried out. The workings are fairly dry. A major source of seepage into the workings occurs through the A zone pit. Mining plans include mining out the bottom of the A zone pit and this will increase seepage to the underground workings. Water from the A zone pit seeps to the underground and is pumped out by Williams before it reaches the Golden Giant workings.

Williams and David Bell mines have posted 75% of financial assurances and by next year they will have posted 100%. Closure costs at the mine do not account for any possibility of groundwater contamination. Closure costs for waste rock only account for sloping and revegetation. Closure costs for underground account only for the removal of hazardous waste, the capping of openings to surface and the removal of a ramp.

Herrick and Hayward Lakes meet PWQO for all parameters except molybdenum and antimony.

A bat cage will be installed in a ramp portal at the Williams mine.

<u>Meeting with Byron LeClair, Councillor for Economic Development, Pic River First Nation, June 20th, 2001</u>

Due to Golden Giant's tailings spill into Cedar Creek and the Black River in 1990, the water supply at the Pic River First Nation (taken from the Black River) was shutdown for 45 days and the Golden Giant mine brought in a trucking company to fill a water reservoir for the First Nation during this time. The water supply for the Pic River First Nation was subsequently moved out to the shore of Lake Superior and this was paid for by the federal government due to their concerns with high levels of aluminum in the original source of water from the Black River.

The First Nation has no Impact Benefit Agreement with the Hemlo mines and has not received details of closure planning for the mines.

Newmont has been recruiting First Nations to work in Montana as a cheaper labour pool.

<u>Round table with Northwatch members in the town of Marathon, June 20th, 2001</u>

Municipal taxes are paid by the Hemlo mines to both the towns of Marathon and Manitouwadge.

Meeting with Mose Shepherd, United Steelworkers Association (USWA), Marathon, June 21st, 2001
Golden Giant and David Bell are both USWA but Williams is not unionized. The miners are at risk of silicosis and some have contracted the disease. This problem is not being taken seriously by the Ministry of Labour or by the mine. Silicosis is a broader term for a disease which may be categorized by other more specific names. The Ministry of Labour is not keeping adequate records on the group of diseases. This obstructs analysis of the problem, by making it impossible to properly track the incidence of the disease in miners.

Research Notes:

The Hemlo gold mines are located 40 km east of Marathon in the township of Bomby. Gold mineralization was discovered in the Hemlo area in the late 1920's and exploration has been ongoing since[3]. The three mines opened in the mid eighties. Silver, molybdenum, barite, mercury and antimony are also produced.

The three mines are connected underground with Golden Giant in the middle of Williams and David Bell[3]. There is agreement between the three mines for the maintenance of the workings. The closed mines will not flood and will minimize inflow while any mine is in operation. A mine drainage plan is to be agreed upon closure and water balance is to be done annually by each mine.

The fresh water supply for the mines is jointly operated and maintained through a system of dams to manage supply from Cedar Creek for both process and potable water, with consumptive withdrawals to a maximum of 0.29m3/s[3]. The Cedar Creek Water Management Committee includes the mines, government and the Cottagers Associations of Wabikoka and Little Cedar Lakes. The final disposition of water control dams will be settled at closure of the last remaining Hemlo Area Mine. All water diversion dams for Cedar Creek and Theresa Lake will be converted to low maintenance structures at closure with the level control mechanisms removed. The coffer dam at Wabikoka Lake is maintenance free and will be kept as is. Water flows from Theresa Lake to Wabikoka Lake to Wabikoka Creek and then to Cedar Creek.

DAVID BELL MINE

Location: 48°696N, 85°883W. The mine is owned by Homestake Canada Inc. and Teck-Corona Operating Corp.

All samples of tailings and ore have acid generation potential well in excess of acid consuming values[3]. The waste rock stockpile at David Bell Mine is located on high ground and is removed to the Golden Giant Mine over the summer [3]. The determination of acid generation potential of remaining waste rock on site at closure will be tested before being sent to Williams Mine[2].

Since 1992, the tailings basins of the David Bell Mine and the Williams Mine have been managed as one[1]. The basin is located in what was Molson Lake, which lies at the top of the White River watershed. The tailings area measures 50 ha with runoff from 490 ha entering the basin[3]. The David Bell Mine tailings basin is used as a polishing pond and the Williams basin as the primary tailings basin. Tailings capacity is now 60 million tonnes and maximum design elevation will allow for a capacity of 80 million tonnes[1]. The Molson tailings basin will be flooded with runoff subsequent to the closure of Williams Mine to create a perpetual water cover. A spillway beside DAM A will likely spill continuously to Lee Lake following closure[2]. Water chemistry tests of tailings conclude that surface water quality will remain stable with little or no effect from interstitial water[3]. Some mixing of interstitial water may occur during cooling in the fall, however, this will likely be minimal due to low hydraulic conductivity. Runoff will improve water quality in tailings supernatant over time and there are low oxygen concentrations in interstitial water[3]. In 1999, the mill at David Bell was closed and ore is now being sent to Williams Mine[1]. Mill tailings from Williams Mine are pumped to the David Bell Mine for backfilling as required.

Most groundwater movement occurs in the top 10 meters of bedrock along foliation plane and gently south dipping joint sets. Traverse dykes cut across predominant east-west foliation and tend to channel groundwater flow.

WILLIAMS MINE

Location: 48°688N, 85°916W. The mine is owned by Williams Operating Corp., which is equally owned by Teck-Corona Operating Corp. and Homestake Canada Inc.

Milling capacity has been increased to 8,200 tonnes/day to accommodate ore from David Bell[5].

Estimated cost of closure of the mine is $3,956,000[9]. Screening plant reject is hauled to a stockpile used for padding work, roads, and random fill for construction of the upstream shell of the tailings dam[9]. Polishing pond on site for runoff from ore and waste stockpiles and effluent is discharged to Cedar Creek or used in preparation of backfill. The effluent treatment plant is located at Dam A and discharges to Frank Lake in the White River watershed (or can be recycled to tailings pond). The treatment plant will function after closure as required. The A and C zone pits will be flooded at closure. (There is also seepage at the "north rim" to the Black River via Cedar Creek).

In the 1993 closure plan[9], ARD static tests conducted on tailings, underground and surface waste samples showed a net acid producing capacity for all samples except for the C zone (the B zone was only slightly net acid producing). As of 1993, stockpiles on site included A zone (43,000 tonnes), B zone (413,000 tonnes) and C zone (357,0000 tonnes).
Bzone waste has been recategorized as potentially acid generating and will be redirected underground as backfill or placed in the Azone pit (pit to be filled to crest with waste rock, covered with clay and revegetated)[4]. Metal leaching from waste rock stockpiles is being investigated (copper, lead, molybdenum and zinc concentrations exceed PWQOs in leachate from stockpile but do not exceed MMLER limits)[6]. Sulphate shows a significant trend towards increasing in some areas of the stockpile perimeter (no low pH as yet)[6]. Antimony, arsenic and iron are elevated in leachate, but do not exceed guidelines[6].

103 samples (plus replicates for QA/QC) were analysed for acid generation potential for four rock types. [according to BC ARD guidelines (1997) NP/AP<1 is PAG and >4 is NPAG]. Molydbdenum and arsenic can be leached at neutral pH and there is a moderate to high potential for leaching of these metals. Rock type is a better descriptor than zone in terms of acid-base accounting. Samples of intermediate volcanic and metasediments are NPAG. Samples of quartz eye porphyry and quartz eye muscovite schist are PAG or uncertain[6]. Additional acid-base accounting and metal leaching testwork will be completed based on waste rock types[4].

A characterization of tailings from Williams Mine was undertaken in 1992 and was based on one wet tailings sample sent to the research facility in a 45 gallon drum[7]. It was estimated that the tailings were net acid producing and that all of the acid consuming constituents in the tailings would be depleted in 182 weeks, with acid production beginning prior to depletion. Contamination of groundwater with molybdenum and antimony from seepage of interstitial water may be a problem depending on the underlying hydraulic conductivity[7]. Treatment may be required unless the water can be diverted back to the tailings pond. A subaqueous column test was completed over 68 weeks on a tailings subsample in an attempt to mimick the disposal of tailings underwater. Molybdenum concentrations in water at the bottom of the column were higher than at the top, and peaked at 5.80 mg/L on week 25 and levelled off at 3.30 mg/L. The study concluded that higher molybdenum concentrations in bottom water could be expected in the field due to higher pH, since the solubility of molybdenum sulphide's oxidation product, molybdic acid, increases with increasing pH. Antimony concentrations were also high in the column ranging up to 4.2mg/L in surface and 4.4 mg/L in bottom waters. The test also showed that oxygen diffusion was low and this would mitigate sulphide oxidation. An aerial disposal test saw the decline of concentrations of molybdenum and antimony in the first 12 weeks, likely due to the solubilisation of stored salts. Concentrations of antimony stabilised at 0.2mg/L, while molydenum concentrations increased from week 34 to a maximum of 2.9 mg/L at the end of the test on week 74. The increase in molybdenum was probably due to increasing molybdenite as the leach progressed[7].

The mine is currently monitoring groundwater around the Williams Mine and reports that constituents are currently

meeting government requirements for potable water[8].

Regarding the tailings impoundment, see David Bell Mine

GOLDEN GIANT MINE

Location: 48°698N, 85°905W. The mine is owned by Battle Mountain Canada Ltd. (50% Noranda and 50% Homestake). Access is via the Yellow Brick Road turnoff just east of the David Bell Mine.

Estimated closure cost covered as a letter of credit is $3,743,870[10]. Start up in 1985. Mill capacity is 3000 tonnes/day of which approximately 47% is recycled as underground backfill. The mine has 350 permanent employees. Waste rock is stored on site temporarily and used as backfill in the workings during the summer months. Acid-base accounting has confirmed the potential for acid generation for the ore and tailings, with a moderate to high acid consumption potential for the waste material and Sceptre Pit ore[10].

Previous to the construction of tailings basin for Golden Giant, the area was a broad, shallow, poorly drained valley, with several shallow bogs drained by a small intermittent stream[10]. The tailings dams for the Interlake Tailings Basin at Golden Giant Mine were constructed in four phases. For phases 1, 2, and 3, raises were constructed with a plastic liner on the upstream side of the dam, backed with a layer of till. Phase 4 involved a till plug, with the liner keyed into the base of this raise (12). The closure plan for the tailings involves a 1 m water cover (under typical runoff conditions). The total capacity for the tailings basin is 15 million tonnes[12].

The tailings basin is operated as a closed system, in the sense that there is no discharge of untreated water to the environment, except for a small fraction of seepage[13]. The downstream receivers of drainage from the tailings basin are Cedar Creek, Black River, Pinegrove Creek and Unnamed Creek[13]. A seepage collection facility is located downstream of the main dam and includes a ditch, dyke and pond, with a pump station and return water pipeline[13]. Average pumped inflow from the seepage collection pond is 1,188m3/day, which includes intercepted seepage and average runoff from the area between the main dam and the seepage collection pond[13]. The total seepage leaving the tailings basin towards Cedar Creek is estimated at 581 m3/day and towards the Black River watershed is 394 m3/day.

There is only about 30 years of actual field experience with geomembranes[11]. It is predicted that the HDPE liner on the upstream side of the tailings dam will perform satisfactorily for 100 to 200 years before commencement of deterioration. This is described as a conservative prediction. It is intended that an organic cover/wetland will be developed within this timeframe and this will act as a barrier to oxygen in the long run. A 2-3% deterioration in the liner would lead to the loss of the water cover in the tailings impoundment. Dam stability will not be affected by the loss of the liner[11].

The design criteria for the tailings expansion (phase 4B) included the following[13]: Under a 1 in 100 dry year conditions, a minimum water cover of 0.3 m will be maintained over the tailings surface, although criteria may be relaxed based on detailed design considerations. Post-closure, the mine proposes that water quality for the discharge of tailings supernatant to the Black River be sampled 23 km downstream of the actual discharge point. This is because the junction of Highway 17 and the Black River (the sampling point) allows for ease of access with approximately 25 years of monthly water quality data available at this site[10]. Golden Giant intends that the sampling point at Highway 17 should meet PWQO's for the protection of aquatic life[10]. The sampling point is to be determined at a later date through permitting, since no discharge of tailings supernatant currently takes place.

Groundwater monitoring wells are drilled near the base of each of the 4 tailings dams with water quality being monitored 4 times/year. Groundwater quality has been affected at the tailings area, but the levels of contamination are 2 orders of magnitude below levels that were predicted. There has been minimal impact to groundwater downstream of the seepage collection facility, and no measured impact to Cedar Creek or to the Black River[10]. Benthic invertebrates sampled in Cedar Creek and in the Black River in 1993 showed that pollution sensitive organisms were no longer abundant in Cedar Creek and that pollution tolerant organisms dominated also dominated

samples in the Black River[10]. However, these effects may have been due to very high waters during the study and high levels of suspended solids in the Black River.

MOE Non-Compliance:
1996 Exceeded the monthly limit for total suspended solids six times and final pH limits on three occasions - the company has scheduled construction of a treatment facility with flocculent addition and use of carbon dioxide at treatment plant for pH control.

AQUATIC EFFECTS OF THE HEMLO MINES

Both Golden Giant and David Bell Mines discharged effluent to Lim Lake. David Bell Mine ceased discharges to Lim Lake in 1999. Effluent is treated for cyanide and metals before being discharged. Precipitates from treatment are removed to the tailings. Golden Giant intends that water quality at the confluence of Hayward Creek and the White River should meet PWQO's for the protection of aquatic life[10], over 20 km from the point of discharge in Lim Lake.
Lim Lake is less than 40 ha in size and flows to Lee Lake, which is slightly smaller. Lee Lake flows into Molson Creek at about 5 km from mine discharges and from there water flows about 10 km, to Herrick Lake and then Hayward Lake, both of which are about 500 ha in size, before running into Hayward Creek and out to the White River.
None of Lim, Lee, Herrick or Hayward Lakes are chemically stratified[14].

The original plans for mine operations expected changes to the water quality of Lim Lake. It is apparent that water quality changes have also occurred further downstream[3]. There has been an impairment of water quality in the upper reaches of the Lim Lake watershed from mine discharges. According to an aquatic assessment completed in 2001, ammonia, nitrite, antimony, cadmium, cobalt, copper, molybdenum, nickel, selenium and zinc are all above water quality guidelines in Lim and Lee lakes and also in some instances in Molson Creek[14].

Concentrations of most parameters for water quality were similar to those reported over the last five years, though some improvement has occured. Water from Lim Lake has an inhibitory effect on plant growth and invertebrate reproduction, though no inhibitory effect on survival and growth of fathead minnows was measured. Since mining, populations of northern pike and perch have been lost from Lim Lake, with only white sucker remaining. In comparison with reference populations, the growth, energy storage and reproduction of white suckers in Lim Lake is inhibited. This may be linked to the poor food supply in the lake, though elevated arsenic and selenium concentrations in tissues of fish from Lim and Lee lakes shows a high degree of exposure to these metals and subsequent uptake[14].

Lim Lake benthos reflect naturally low productivity and deep flocculant sediments that do not support a diverse community. There has been no change in benthos in Lim Lake since mining, however, benthic surveys in Molson Creek and Herrick Creek suggest reduced diversity since the mines[3].

Copper and nickel both exceeded the Severe Effect Level for toxicity in Lim Lake sediments and copper was 10 times pre-operational concentrations, though toxicity testing of these sediments suggested the potential for adverse ecological effects was low when compared to reference sediments[14]. A potential concern for water quality in the Hayward Lake sub-watershed is the decomposition of sediments in Lim Lake[10]. Lim Lake sediments appear stable under normal pH range over short and medium terms, but long term stability has not been asssessed[10]. Sediment removal from Lim Lake may be possible, but might create a larger disturbance.

In Hayward Lake, water quality is essentially equivalent to pre-operational conditions[14].

The Williams Mine discharges treated effluent to the west end of Frank Lake seasonally from May to October. Water flows approximately 5 km from Frank Lake, through Frank Creek and an unnamed lake to the White River. There has been an impairment of water quality in the Frank Lake watershed from mine discharges[15]. Many of the same contaminants that are present in Lim Lake water are also elevated in Frank Lake. Water quality in Frank Lake has improved in recent years following improvements in effluent quality in 1996. The water in Frank Lake

has an inhibitory effect on plant growth and invertebrate reproduction, though not on fathead minnows[15]. The growth and reproduction of the fish in Frank Lake are inhibited relative to reference populations, but no significant elevated metal concentrations are present in tissues sampled from the fish. The benthos in Frank Lake appears relatively unchanged from studies undertaken before mining operations. No baseline benthic studies were undertaken in Frank Creek, though diversity and abundance of benthos are presently low in this water body.

Sources 1. 1999 Annual Mine Closure Plan Report

2. Letter of September 14, 1994 to MNDM from David Bell Mine regarding the Closure Plan Review
3. David Bell Mine Closure Plan, 1993
4. May 16, 2000 - Response to Comments on 1999 Annual Closure Update for Williams Operating Corp.
5. 1999 Annual Update on Closure Plan
6. Characterization of Waste Rock and Seepage in the Stockpile Area, by Beak International Inc. for Williams Mine Operating Corp., August, 1999
7. Final Report on Characterization and Prevention of AMD from Williams Mine Tailing, by BC Research Inc., September 1993.
8. Personal communication, Leslie Cooper
9. September 1993, Closure Plan for Williams Operating Corp., Hemlo, ON
10. Closure Plan, Battle Mountain Gold Canada Ltd. Golden Giant Mine, February 1997
11. Golden Giant Mine: Response to the Closure Plan Review, Appendix C - Impact of Liner Deterioration, by Kilborn Inc., Geocon Department, February 1997.
12. 1998 Minutes of Pre-Submission Consultation Meeting, Interlake Tailings Facility Expansion
13. Phase 4B, Interlake Tailings Basin Expansion - Design Report, by AGRA
14. Lim Lake System Aquatic Environmental Assessment, Beak International for Battle Mountain Canada Ltd. and Teck-Corona Operating Corporation, April 2000
15. Frank Lake System Aquatic Environmental Assessment, Beak International for Teck-Corona Operating Corporation, April 2000

GOUDREAU MINES - MAGINO and KREMZAR

Research Notes:

These mines are located approximately 10 km southeast of Dubreuilville in Finan Township (48°17`N, 84°27'W), and northeast of the town of Goudreau, most of which is abandoned. The Magino Mine is located 2 km west of the Kremzar mine. The Kremzar mine is now also known as Patricia. Land use in the area is dominated by mining and logging, and mineral exploration has been ongoing since 1916.

The Magino Mine is presently owned by Golden Goose Resources Inc. (formerly Muscocho Explorations Ltd.) and under the management of this company the mine opened in 1988 and produced approximately 400 tonnes/day until it went under care and maintenance in September 1992[1]. The Kremzar Mine was opened in 1988 and operated until October 1990 when it was placed under care and maintenance. The mine processed 337,966 tonnes of ore during this period. It is owned by Canada Tungsten Inc. (formerly Canamax Resources Inc. and Amax Exploration)[3].

The mine and mill at Magino Mine drain to Webb and Goudreau Lakes, while surface drainage from the Kremzar Mine enters Maskinonge and Goudreau Lakes. From Goudreau Lake, water flows via Goudreau Creek to Manitovik Lake and the Michipicoten River. There is also historical mining activity in this drainage system and some effects on water quality were noted during sampling in 1985 and 1986. Algoma Summit Mines and Magino Gold Mines operated from 1934-1942 with tailings being discharged to the west end of Goudreau Lake. Data indicate that despite the presence of these tailings, the water quality in the upper basin of Goudreau Lake is "quite good"[3]. As well, 250,000 tons of pyrite was mined in open pit during WWI and runoff from the pit enters Goudreau Lake via Teare Lake. Water and sediment quality in Goudreau Lake downstream of the inflow of Teare Lake shows some effects of run-off from this pit from elevated lead, iron and copper[3]. Significant fishing occurs on Goudreau Lake and Maskinonge Lake for northern pike and white sucker.

The present tailings impoundment for Magino Mine is located in a separate system that discharges into a secondary pond and then to Lovell Lake to Spring Lake to McVeigh Creek and ultimately to the Michipicoten River via Hawk Lake. There is also historical mining activity in the area of Lovell Lake[1].

Water sampling of Goudreau, Webb, Lovell and Spring Lakes was conducted in the 1980s and results were generally below PWQO with exceptions for certain parameters at certain times of year. It was concluded that these exceptions were atypical and that PWQOs were normally achieved[1].

_PRIVATE __MAGINO MINE_tc \l 1 "MAGINO MINE"_

The mine has had two exceedances of its Certificate of Approval for discharge from the secondary tailings pond - for iron in May 1992 and for copper in October 1991[2]. Benthos and sediment sampling was conducted in 1995 downstream of the tailings impoundment and the results of this sampling have been considered to be representative of pre-operational conditions at the mine, where previously no baseline data was available. Sampling included Lovell Lake, Spring Lake and Tower Lake (a control) and the accompanying study concluded that the results of water, sediment and benthos sampling in Lovell Lake were comparable to Spring and Tower Lakes[2].

The mine employs cyanide leach and Merrill-Crowe zinc precipitation process[1]. A low-grade stockpile on site is 10-12 m in height with 20,000m3 of material and this will be contoured to a 3:1 slope at closure[1]. Waste rock has been incorporated into construction e.g. roads, ramp, helicopter pad and has been disposed sporadically in Webb Lake. The tailings impoundment is located in a basin of open and forested muskeg and alder swamp and has a potential capacity for 1,300,000m3 with a secondary polishing pond 4.8 ha in size[1]. At closure the tailings will be revegetated and the centre and west dams will be breached. The east dam will remain intact with a beach of 50 - 150 m. Natural runoff flow to the west will be chanelled via spillways to Lovell Lake[1].

Based on composite samples (1 of each), net acid generation potentials for mine waste are: low-grade ore –53.3;

waste rock –69.1; and tailings –69.5. Based on these results, the owner is not concerned about the water quality of any seepage at closure[1].

The estimated cost of closure as of 1993 is $490,500[1]. Under the present care and maintenance program, sampling the secondary pond is to be reduced to no less than a monthly basis[1].

_PRIVATE __KREMZAR MINE_tc \l 1 "KREMZAR MINE"_

The mine is accessed via a 14 km all weather road from Dubreuilville. It is gated, the workings are flooded and mine entrances are secured. The milling process at the mine is similar to that at Magino Mine. A waste rock pile on site contains approximately 300,000 tonnes of material covering 2 ha, up to 11 m in height[3]. The tailings are located in what was formerly Miller Lake and the impoundment includes two earth and rock-fill dams that are both constructed on gravelly, sandy till. The tailings pond has a maximum capacity for 30 ha surface area, with a secondary polishing pond located downstream[3].

Surface water quality since mill start up and cessation indicate that drainage from Kremzar Mine has had no discernible impact on the regional watershed[3]. Toxicity tests of the secondary pond on trout and *Daphnia magna* in May of 1992 displayed zero mortality. The owner has concluded that waste materials on site are not acid generating based on a ratio of acid consumption potential:acid generation potential that exceeds 2:1 both for the waste rock (1 sample) and the tailings (3 samples)[3].

Sources 1) Muscocho Explorations Ltd., Magino Mine Closure Plan, Revised 1993, by HBT AGRA Ltd. With Addendums to Closure Plan: Addendum I (no date); Addendum II, May 1994; Addendum III, August 1995.

2) Golden Goose Resources Inc., Magino Mine, Environmental Studies Report – Benthos and Sediment Sampling, By AGRA Earth and Environmental Ltd., March 1997.

3) Canada Tungsten Inc., Kremzar Mine Closure Plan, September 1993.

ALGOMA ORE DIVISION, MACLEOD MINE

Issues:

The mine, which is closed, does not have an approved or accepted closure plan. This shows lack of oversight by government and makes any public assessment of the mine very limited. Algoma Steel Inc. plans to submit a closure plan by the end of 2001. Apparently Algoma Ore Division was not required to post financial assurances for mine closure because the parent company, Algoma Steel Inc., was still operating.

- The township is pursuing a $50 million class-action lawsuit against Algoma Steel Inc. regarding arsenic contamination in the area. The studies on arsenic contamination in Wawa to date have determined risk of exposure. Children aged seven months to four years in the zone close to the sintering plant have levels of exposure that exceeded the provinicial allowable maximums. This September, urinalysis will be completed on toddlers to determine effects from exposure.
- Much of the reserve lands for the Michipicoten First Nation were appropriated by Algoma Ore Division for the mine. There is no Impact Benefit Agreement between the mine and the First Nation on record. The First Nation may buy land from Algoma "around the harbour" and then receive compensation from the federal government via a settlement. Michipicoten First Nation took up mining claims around "Sandy Beach" and "Tremblay Flats" in order to prevent other mining development in this area.
- It is estimated that 83 fish populations were lost from 16 lakes due to acid deposition stress from air emissions from the mine sintering plant.
- Some materials from iron mining in the Wawa area are acid generating. It is predicted that the underground workings will be flooded by 2011 and that water will start draining from the site and will have to be treated for pH. According to Algoma Ore Division, a water treatment plant is the last item of closure remaining to be completed. The tailings are reportedly not contaminated. A review of documents at MNDM could find no comprehensive assessment of acid rock drainage and metal leaching at Macleod Mine.

Field Notes:

Meeting with Ron Dorscht and Rod Stewart, MOE, Sault Ste. Marie, June 25th, 2001

High concentrations of arsenic in the Wawa soils are in the upper 5 cm. The impacts of arsenic from fumes from the sintering plant are both recent and historic. The arsenic is insoluble and will migrate only if soils are moved, e.g. via blowing dust or gardening.

The studies on arsenic contamination in Wawa to date have determined a theoretical risk. Additional follow-up will determine whether there is an actual effect. This September the follow-up on the study of arsenic in urine will be completed by focusing sampling on toddlers. The MOE will be collecting soil samples at those houses where urinalysis is completed on toddlers. In addition, bioassay tests will be completed to examine how plants, worms and microorganisms grow in the Wawa soils, and the results of these tests will help determine need for remediation. Data regarding arsenic levels in Wawa has previously been collected for drinking water, hare, grouse, birch, blueberries and some other components.

The MOE could have done a better job in notifying the township of the problem of arsenic contamination. Sampling for arsenic in the vicinity of residential properties was first completed in 1998 and this was shared with the township. Prior to 1998, sulphur dioxide was the main contaminant of concern to the MOE and any information provided to the township regarding measurements of arsenic would have been ancillary. The Guidelines for Use at Contaminated Sites in Ontario was published in 1996, and previous to this time there were no standards set for arsenic contamination in soils. These guidelines are not meant for fume impacted sites.

In 1984-85, the town was concerned about contaminants in drinking water and a study was completed that resulted in redirecting runoff from storm sewers away from Wawa Lake. The town of Wawa is currently taking unfiltered water from Wawa Lake and will have to start filtering it in the future. This will require major expenditure. Levels of contaminants in the sediments of Wawa Lake are similar to those in the surrounding soils.

The Michipicoten First Nation may have struck an arsenopyrite vein in their well water on the reserve. Arsenic levels were elevated in the water. Only total arsenic was measured, not speciated forms. The water source for the First Nation was moved to Lake Superior.

Some materials from iron mining in the Wawa area are acid generating. The Rand pit belongs to Algome

Ore Division and produced some acid mine drainage. It has been reclaimed by backfilling with high carbonate waste.

Meeting with Chief John Swan Peterson of the Michipicoten First Nation on June 18th, 2001

The Chief indicated that much of the reserve lands for the Michipicoten First Nation were appropriated by Algoma Ore Division for the mine. There is no Impact Benefit Agreement between the mine and the First Nation on record. The First Nation has not participated in the class action lawsuit launched by the town of Wawa against Algoma Steel Inc. The First Nation may buy land from Algoma "around the harbour" and then receive compensation from the federal government via a settlement. Michipicoten First Nation took up mining claims around "Sandy Beach" and "Tremblay Flats" in order to prevent other mining development in this area.

The water for the First Nation was previously drawn from wells on site and then the water supply was switched to a line going out to Lake Superior. This was due to high arsenic concentrations being found in the well water. The Chief indicated that to his knowledge the wells were located in sandy substrates that are common on the reserve.

Meeting with John Woods, Reeve, Michipicoten Township on June 19th, 2001

Apparently Algoma Ore Division was not required to post financial assurances for mine closure because the parent company, Algoma Steel Inc., is still operating. Algoma Steel Inc. is highly invested in the Tilden property in Wisconsin and this ore has lower sulphur content than that in Wawa.

In the 1951, Algoma turned over their ownership of the town, and the township of Michipicoten was created. In the 1950's there were approximately 1200 jobs at the mine and when the mine closed in 1998 there were 220 jobs, even though more iron sinter was being produced than in the 1950's.

Regarding the class action lawsuit, the Reeve is of the opinion that the MOE and MNDM are to blame since they never officially notified the township of the high concentrations of arsenic in soils. The township has spent $320,000 on studies regarding arsenic contamination. The Reeve stated that scientifically there is no health hazard due to arsenic contamination, however the township launched the lawsuit (previous to his involvement) in order to protect themselves from other individuals that might sue the township for damages. The process of studying arsenic contamination has been very confusing since many different studies have been done and these have been referred to scientists who have had differing opinions and a wide range of comments .

There is a cave-in area on the Macleod Mine property.

Tour with Howard Whent, local historian of Wawa, June 19th, 2001

Much of early mining was for gold deposits that were discovered along the southern shore of Wawa Lake in 1897.

Iron mining began in 1899 at the Helen pit. Other deposits in the area include Magpie, Josephine, Ruth and Lucy, Sir James Dunn and Macleod. Mining methods were both open pit and underground. In total, 110 million tonnes of iron ore were mined in the Wawa area and half of this quantity came from the Macleod deposit. When the mine closed in 1998, there were still plentiful reserves remaining. Both siderite and haematite ores were mined for iron. Of these two minerals, siderite is harder to process than haematite.

The Wawa kill zone was ravaged by fires and was unable to reestablish itself following pollution from the sintering plant.

MOE Non-Compliance:

1998 Exceeded total suspended solids limit; facility permanently shut down operations.
1997 The limit of 30 mg/L for residual particulates was exceeded on October 20 at 46.3 mg/L, October 22 at 45.4 mg/L. The monthly limit of 15 mg/L for total suspended solids was exceeded in October at 16.98 mg/L.

Research Notes:

The mine is the main reason that Wawa came into existence. It is located on a high ridge of hills just 5 km north-northwest of Wawa in the township of Chabanel (48°025N; 84°738W). Iron mining began in the area in 1899 and so there is little information on the pre-mine environment e.g. baseline water quality[1].

The mine is owned by Algoma Ore Division of Algoma Steel Inc., which is going to be submitting an updated closure plan. The sinter plant site and various facilities and buildings have been sold to Buchanan Forest Products[2]. As of October 2000, Algoma reports that the majority of rehabilitation has been completed with revegetation being 95% complete[2].

The township is pursuing a $50 million class-action lawsuit against Algoma Steel Inc. regarding arsenic contamination in the area[3]. A report published June 16 found that arsenic levels were almost uniformly below danger levels however this report also outlined concerns e.g. for residents closer to the sintering plant and for those who used sintering plant residue for driveway aggregate material. Children aged seven months to four years in the zone close to the sintering plant had levels of exposure that exceeded the provinicial allowable maximums[3]. In addition further tests are needed due to conflicting results between studies and possible errors in testing methods[3].

The mine has both open pits and underground workings. It is predicted that the underground workings will be flooded by 2011 and that water will start draining from the site and will have to be treated[2]. A water treatment plant is the last item of the closure plan remaining to be completed.

The tailings are reportedly not contaminated[2].

The property is contained within three major watersheds: Soulier Creek, Magpie River and Wawa Lake. Soulier Creek discharges to the Magpie River 2 miles downstream of the Macleod Mine. It is estimated that 83 fish populations were lost from 16 lakes due to acid deposition stress from air emissions[1]. There are three lakes within the property that have no fish. These are Little Soulier, Otter and Talbot Lakes where pH ranges from 3.1-3.3; aluminum >3.09 mg/L; manganese >3.7 mg/L and sulphate >187.0 mg/L[1]. The results of monitoring well water sampling for the year 2000, show that Walbank Lake (#94-01) is the only location where arsenic levels were elevated: 0.014 mg/L in May and 0.035 mg/L in October of 2000[2].

Sources: 1) Algoma Ore Division, Macleod Mine (Wawa), Closure Report, September 1996
2) Algoma Ore Division, Macleod Mine, Closure Plan Progress Review, 2000
3) Wawa arsenic below danger limit: report (published June 16) by Matthew Oleynik, Sault Star, June 17, 2000

INMET MINING CORP. - WINSTON LAKE and ZENMAC/ZENITH

Issues:

Untreated, high pH effluent from the Winston Lake tailings facility is being sent underground to flood the workings. The effluent is contaminated (zinc concentrations between 0.2 and 1 mg/L) and water in the workings may become further contaminated by acid generating/metal leaching materials underground. Water in the workings will flow outwards into the groundwater through bedrock fractures into the Whitesand River watershed, though where exactly is uncertain. The pH of flood water is expected to decline in the workings over time due to the neutralization of acidity and the dissolution of carbon dioxide from the air. No monitoring of water quality in the workings and in surrounding groundwaters has been done and none is planned. While flooding the workings with high pH water has the potential to be beneficial by limiting acid generation underground, the company is proceeding irresponsibly and may cause further widespread contamination of the aquifer.

- The Whitesand River watershed has been contaminated by the Winston Lake Mine and also by the older Zenmac or Zenith Mine, which is located on the same property and is also the responsibility of Inmet Mining Corp.
- In 1989, water from the Zenmac mine at the confluence of Kenabic Creek with the Whitesand River contained concentrations of zinc at approximately 5 mg/L. In 1999, concentrations were down at between 1-2 mg/L (outflow over time did not vary greatly). The Zenmac Mine was a property of Mr. Sheridan, who is well-known in mining in Ontario. Reclamation of the mine was not properly completed at the time that it closed in 1970. Abatement of zinc concentrations in outflow from the mine was partly due to reclamation work by Inmet and partly to the fact that the workings naturally flooded and contaminants in discharge declined.
- The tailings at Winston Lake Mine are potentially acid generating and are being flooded to a depth of 1.5 m for closure to prevent acid mine drainage and metal leaching. The depth of water cover over the tailings was determined by modelling a 1 in 100 year dry event. Northwatch previously questioned the effectiveness of this safety factor given predicted reductions in precipitation in the Lake Superior basin due to climate change. In response to Northwatch, MNDM stated "If, in the future, it is determined that climatic changes are negatively impacting the water cover adjustments may have to be made. However, given the long time frames involved, the technological advances or actual changes in the site conditions that may take place, it is impossible to speculate what those adjustments may involve." Inmet Mining Corp. plans to walkaway from the site via an exit ticket in approximately 10 years.
- Inmet Mining Corp. provided the option for miners to have their homes bought back at closure of the Winston Lake Mine. Approximately 75 homes were bought back at closure and have been placed on the market by the company at very low prices. This lowers the value of real estate for area residents.
- Two of the crown pillars at the Zenmac mine may fail in the long term. A risk assessment determined low risk due to lack of human access to the area and this is currently under interministerial review.

Field Notes:

Meeting with Matt Bliss, Site Manager, Winston Lake Division, Inmet Mining Corp., June 21st, 2001

The Winston Lake deposit was discovered in 1982 at 250 - 700 m below surface. In 1994, a drift over 1 km in length was extended from the Winston Lake to the Pick Lake deposit. The Pick Lake deposit turned out to be too small and flat to mine economically. The Winston Lake deposit is now completely depleted. At the time of mine closure in 1998, the mine was losing $1 million a month in mining, with 180 full-time employees plus contractors. The cost of paying severance and buying back homes from miners was $8-10 million. Inmet provided the option for miners to have their homes bought back at closure and also provided a second mortgage. Approximately 75 homes were bought back at closure. The mine paid taxes to the school board and is still paying these taxes as well as property tax.

The Rainbow Falls Provincial Park is located at the base of the Whitesand River watershed and there is a cottage community around Whitesand Lake. The MISA (Municipal and Industrial Strategy for Abatement) monitoring point for Winston Lake is at the outflow of the polishing pond.

Ultimately the mining company plans to walk away from the mine site and allow it to revert to the Crown. The timeline is approximately 10 years.

In May of 2000, flooding of the underground workings was commenced by drawing down the water cover from the tailings and sending it underground. Subsequently, the tailings were leveled, and closure of the tailings

will involve a 1 to 2 m water cover (the spillway is constructed in bedrock and the "beaver issue" will be addressed in the future). A total of 2 million tonnes of tailings are located in the TMF. Seepage through the tailings dam is approximately 250-300 m^3 per day. No discharge of water from the tailings to the underground workings has been done in 2001, because Inmet is waiting for the tailings to flood.

At this point, the underground workings are probably about half flooded. Groundwater flow from the workings will report to the Whitesand River watershed, but where exactly is uncertain. No sampling of groundwater has been carried out and none is planned. No sampling of water in the underground workings has been carried out and none is planned. The volume of workings underground is approximately 1 million cubic meters. Inflow to the workings is described as "very dry". It would take about 13 years for the workings to flood naturally and it will probably take about 5 years using force flooding. The bottom part of the mine would naturally fill more quickly with water. The time to flood gives an indication of fracturing.

Zinc concentrations are between 0.2 and 1 mg/L in water sent underground and usually below 0.5 mg/L. A baseline survey of water quality, benthos, fish and physical characteristics of waterbodies in the Whitesand River system was carried out prior to flooding of the underground workings so that impact from groundwater might be detected.

Mine waste on site is potentially acid generating. Waste rock on surface was removed to the tailings impoundment and is being flooded with the tailings. Acid generating materials in the underground workings include surfaces, waste rock and development muck.

The Zenmac mine site reports to Kenabic Lake and Creek and joins the Whitesand River upstream of discharge from Winston Lake mine.

Cleaver Lake is stratified because it is deep and the mine effluent is dense and sinks, causing layering. The Cleaver Lake Working Group is still meeting to determine the proper course for the lake. Options are: 1) do nothing; 2) aerate; 3) pull out the bottom layer of the lake by flooding the Pick Lake workings; and 4) add chemicals to treat lake water. Cleaver Lake may be cleaned up and is contingent on a determination that the effluent treatment plant for the Winston Lake mine is no longer required. The objective for concentrations of zinc at the inflow to Cleaver Lake is 0.5 mg/L. Cleaver Lake is a flowthrough system - concentrations of metals in the upper layer of the lake are the same as at the inflow and the bottom layer of the lake is anoxic and tends to precipitate metals.

The patent claims for Winston Lake and Zenmac are held by Inmet. Sheridan is the part owner of the Zenmac site. Inmet accepts responsibility for stability and public safety hazards associated with the Zenmac site. Inmet's reclamation work at Zenmac includes the excavation of waste and its removal to the Winston Lake TMF and ensuring that openings to surface are properly capped. The mine workings at Zenmac are flooded and only bedrock and natural soils remain - all pockets of waste have been removed. There is possibility of crown pillar failure over the Zenmac workings. In 1989, water from the Zenmac mine at the confluence of Kenabic Creek with the Whitesand River contained concentrations of zinc at approximately 5 mg/L. In 1999, concentrations were down at between 1-2 mg/L (outflow over time did not vary greatly).

MOE Non-Compliance:

1997 The four month rolling average limit of 15 mg/L for BOD5 was exceeded on January 13 at 18.78 mg/L. The monthly limit of 1.0 mg/L for phosphorus was exceeded on March 8 at 8.08 mg/L.

1996 Exceedance of 4 month consecutive average for BOD once - installation of hydrogen peroxide system has resolved the problem.

Correspondence Northwatch - MNDM:

Brennain Lloyd, Northwatch, wrote to Leslie Cooper, Mine Rehabilitation Inspector, MNDM on July 16, 1999 and received a written reply of July 21, 1999. Correspondence regarded a Closure Plan Amendment about which Northwatch had many concerns. Brennain Lloyd, Northwatch, wrote to Leslie Cooper, Mine Rehabilitation Inspector, MNDM on March 19, 2000 and received a written reply of March 23, 2000. Northwatch recommended that the proposal to amend the closure plan by using effluent to flood the mine workings be rejected. MNDM responded that the proposal was "designed to meet both the surface water standards and groundwater standards that are applicable to the site."

Research Notes:

The Winston Lake Mine is owned by Inmet Mining Corp. It is located approximately 20 km north of Schreiber

(48°58.5'N; 87°22'W). It started production in 1988 and shutdown in 1998. The abandoned underground Zenmac or Zenith Mine is located 1 km southeast of the Winston Lake Mine and supplied zinc ore to an off-site concentrator plant from 1966-1970 and operated as a surface mine from 1898-1902. The Zenmac site is located within the security area for Winston Lake Mine and is partly used for storage. It is also the responsibility of Inmet Mining Corp.

Inspection Report, November 2, 2000

An assessment was completed and it was determined that two of the crown pillars at the Zenmac mine may fail in the long term. A risk assessment determined low risk due to lack of human access to the area and this is currently under interministerial review.

Inmet conducted soil cleanup to try to reduce zinc levels coming from the property. The top layer of soil was removed and placed on the tailings area. Once it has been shown that the area is no longer a major zinc contributor, placement of overburden and seeding will be done.

Surface runoff is being collected in a lined catchment basin and pumped to the tailings area until this is shown to be no longer necessary. A sump has been excavated near the catchment pond on the edge of the Whitesand River where drainage was bypassing the catchment pond. The site is an old river bed where soil was recently removed and seepage is now being pumped to the tailings. The laydown area used for the storage of oversize rejects from milling has been excavated to create a sump (near the polishing pond) that intercepts seepage from this area and sends it to the tailings area for treatment. Material from the area is to be removed.

Winston Lake continues to monitor and treat the water from the tailings area even though there is currently no discharge.

The freshwater reservoir has not yet been rehabilitated since re-routing it to its original course through the Zenmac site may not be favourable.

Winston Mine Flood Project, Closure Plan Amendment Proposal, February 9, 2000, Letter from Matt Bliss, Site Manager, Inmet Mining Corporation, to Dick Cowan, MNDM

The company is planning to flood the workings beginning in April 2000. The lime treated water offers benefits of controlling potential acid generation in the mine workings and reducing dissolved solids release to the watershed and Cleaver Lake. The outflow from the mine workings is expected to be very low, diffuse flow through bedrock fractures. The pH of flood water is to be 9.5-11.0. The workings are to act as a sedimentation pond with the optimum pH range for zinc precipitates being 9-10. The pH of flood water is expected to decline in the workings over time due to the neutralization of acidity in the workings and the dissolution of carbon dioxide from the air. The groundwater table is well below any surface openings and therefore no surface discharge is expected.

Currently, the company is not required to report water quality data at the inflow to the sedimentation pond. Therefore, the treated flood water directed to the mine workings is not subject to effluent criteria under the current Certificate of Approval.

A bulkhead has been designed and successfully constructed to give the company time to further investigate flooding options for the Pick Lake mine workings. Pick Lake mine flooding involves the withdrawal of the lower layer of Cleaver Lake in an effort to promote accelerated restoration of the lake. The company, Senes Consultants and Lakehead University are currently assessing the impacts of Cleaver Lake destratification as recommended by the Cleaver Lake Workgroup. The revised Cleaver Lake Restoration Plan will be submitted under separate cover in the Notice of Alteration for Pick flooding.

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Inmet Mining Corp., Winston Lake Division, Underground Hydrostatic Bulkhead, October 20, 1999

The intent of the bulkhead is to prevent highly contaminated Winston Lake mine water from mixing with the relatively clean Pick mine water as the mine workings are flooded.

1999 Reporting

The mine failed *Daphnia* and trout toxicity testing on January 14, 1999 due to the malfunction of the acidification system. Average annual zinc concentrations in discharge in 1999 were 0.205 mg/L ranging between 0.081 and 0.359 mg/L. Average annual copper concentrations were 0.010 mg/L. Inmet Mining Corp. discharged approximately 120 kg of zinc and 4.2 kg of copper in 1999.

1993 Closure Plan, Inmet Mining Coporation

The Winston Lake Mine is located 800 m southeast of Winston Lake, approximately 20 km upstream of Lake Superior. The abandoned underground Zenmac or Zenith Mine is located 1 km southeast of the Winston Lake Mine and supplied zinc ore to an off-site concentrator plant from 1966-1970 and operated as a surface mine from 1898-1902.

The Whitesand River begins about 4 km upstream of the mine and then flows about 20 km to Lake Superior. The river is poorly buffered and has relatively low pH between 5.5 and 7.5 with naturally elevated levels of cadmium, copper, lead and zinc.

Elevated zinc concentrations from the Zenmac Mine (via Kenabic Lake) have had a detrimental impact on the Whitesand River as far downstream as Gumboot [about 5 km from mine], Horneblende [about 8 km from mine] and Lyne [about 13 km from mine] Lakes. Self-sustaining populations of brook trout and lake trout exist in the Whitesand River system as far upstream as Cleaver Lake and then these are blocked by a series of waterfalls. Good to excellent brook trout spawning grounds occur along the Whitesand River below Cleaver Lake. Smallmouth bass, lake whitefish, burbot and white suckers are also found in Whitesand Lake.

Groundwater flow in the region of the mine occurs mainly in fractures within the rock mass and the water storage capacity of soils is low. Local groundwater is controlled by a mound in the bedrock ridge downstream and directly northeast of the main tailings dam, indicating a relatively low en-masse hydraulic conductivity of bedrock forming this ridge.

Water Quality Results:

1983: Concentrations of Zn in Kenabic Lake (5.36 mg/L) and Kenabic Creek (7.77 mg/L) create acutely toxic conditions for fish. Concentrations of copper are acutely toxic in Kenabic Creek and chronically toxic in Kenabic Lake. Toxic concentrations of zinc persist to the inflow to Cleaver Lake (2.43mg/L) and into Cleaver Lake (1.07mg/L).

1987: The LC50 concentration for rainbow trout in Cleaver Lake water is 22%. Zinc concentrations in Gumboot Lake are 0.28 mg/L at the inflow and 0.18 mg/L at the outflow.

NORANDA MINERALS INC. - GECO and WILLROY MINES

Issues:

As of 1993, loadings of zinc from the mines in Fox Creek were an estimated 30 kg/day. Reductions in zinc loadings in Fox Creek over the long term from rehabilitation measures in Fox Creek are estimated at 60-90% from Geco Mine and 60-80% from Willroy Mine. Even if the closure plan is successful in reducing loadings by 90%, there will still be an annual rate of loading from the mines of approximately 1095 kg/year in Fox Creek.

- The biological effects of the mines are described as "only very local". These effects are seen in Mose Lake (267 acres in size), and over 4.5 km of creekbed in Harry Creek and Fox Creek.
- Sediments downstream of the mines are highly contaminated with zinc, iron and copper. Zinc concentrations in sediments exceed the PWQO Severe Effect Level as far away as Agonzon Lake, over 15 km downstream of the mines. Sediment-associated metals are present in forms known to be of limited mobility.
- Over the long term, the treatment rate of effluent discharged from the Geco Mine into Mose Lake will be an estimated 90 cubic feet per minute.

Research Notes:

The Geco and Willroy mines produced copper and zinc among other commodities from open cut and underground workings. They are located close to one another a few kilometers north of the town of Manitouwage, and both are now owned by Noranda Minerals Inc. The primary closure concern for the mines is acid rock drainage and metal leaching and its related impact on water quality in the Black River system. Zinc is the most significant indicator with regard to water quality in downstream receivers.

Geco Mine (49.156N, 85.790W) operated from 1957-1995 and is the larger mine with 50 million tonnes of tailings. The Willroy mine (49.157N, 85.825W) operated from 1955-1977 and also processed ore from nearby Nama and Willecho mines and has 8 million tonnes of tailings.

GECO

The mine is accessed via a black top road that runs from the east end of town and follows the Fox Creek watershed. The site is gated. Tailings, waste rock and the workings are all acid generating. The criteria in development of the closure plan were 1) that water quality in downstream receivers would not further deteriorate; and 2) that practical, cost-effective means would be employed to improve water quality in the long term.

Presently, drainage from the tailings, the plant site and the workings is collected via gravity or pumping, and treated with lime before discharging to Mose Lake. Sludge precipitated from treatment is to be densified to 20-25% solids and disposed at the mine in the backfill quarry or the flooded workings. Over the long term, the treatment rate of drainage will be an estimated 90 cubic feet per minute.

Closure of the mine has also included regrading the tailings dam (upstream construction) and providing a rip rap toe berm along the lower portion of the slope in order to increase stability. The runoff management system (including a holding pond and water diversion dam for uncontaminated runoff) has been designed to prevent the discharge of collected runoff under a hydrologic event with a return period of at least 100 years. All major water retention structures have been designed to pass the peak flows resulting from a 24 hour probable maximum precipitation.

An open house was held in 1994 at Manitouwage to discuss closure of the mines with 45 people attending and rating the session as good to very good. A meeting with the band council of the Pic River First Nation was also held in 1994 with concerns being voiced regarding a major spill and regarding elevated aluminum levels in drinking water (for which the mines are not a source).

WILLROY

The mine is accessed via a paved road north of the town of Manitouwage. The site is gated. The mine was purchased by Noranda in 1985 and in 1998, the company acknowledged its ownership and responsibility for closure of the mine. The main component of rehabilitation, including reclamation of safety hazards, is being carried out between 1999 and 2005.

Acid mine drainage occurs both from the tailings and the waste rock. Proposed measures for dealing with acid mine drainage include: moving waste rock into open pits and/or adding lime and then covering with clean fill; improving drainage collection and ponds on site and batch liming acid mine drainage, as well as adding an automated liming plant at one pond; constructing a seepage collection facility within Harry's Creek valley in order to pump acid mine drainage to the effluent treatment plant at Geco Mine. Accumulated sludges are to be removed underground.

There is a main tailings basin on site with 8 million tons of tailings as well as an adjacent small mill site tailings deposit. Between 1977 and 1985, the tailings were graded and revegetated and covered with coarse fill. Measures to improve tailings dam stability include butressing at some locations. Other closure concerns include safety and rehabilitation of landfills.

AQUATIC EFFECTS FROM GECO AND WILLROY

Elevated zinc, iron, copper and sulfate result downstream of mine effluent and seepage sources.

Harry Creek conveys effluent from Willroy Mine a distance of approximately 2.5 km to its confluence with Fox Creek. From this point, Fox Creek flows another 2 km and conveys combined metal loadings from Geco and Willroy mines to the inlet of Manitouwage Lake. Benthos are adversely affected over this distance. Fox Creek provides the major inflow to Manitouwage Lake and a chain of lakes located immediately downstream. Water at the Manitouwage Lake inlet contains elevated zinc, iron and copper and generally meets MISA effluent requirements (1999). Zinc concentrations are expected to gradually stabilize at 0.1 mg/L in Fox Creek.

The effluent from the Geco effluent treatment plant is discharged further downstream in Mose Lake. The effluent has a pH of 9.2, zinc 0.04 mg/L, iron 0.26 mg/L and copper 0.12 mg/L. Mose Lake (267 acres in size) is meromictic - a condition induced by effluent discharge from the mine that prevents vertical circulation of the lake and reoxygenation at depth. This has led to adverse effects on benthos and fish in the lake. The impact of the mine on Mose Lake is expected to remain unchanged over the long term, with the exception of declining concentrations of ammonia. Concentrations of iron and copper approach background at Kaginu bridge on the Kaginu River, approximately 2 km downstream of Mose Lake, although zinc remains elevated. Zinc concentrations are expected to gradually stabilize at the PWQO of 0.3 mg/L at Kaginu Bridge.

Major impacts have also occurred in the Stag/Rabbitskin/Nama Creek system. Elevated iron and zinc persist in Small Stag Creek to the confluence of Rabbitskin Creek, approximately 5 km from the Willroy tailings area. It is expected that planned rehabilitation will restore water quality in this watershed.

Sediments are highly contaminated with zinc, iron and copper. Zinc concentrations in sediments exceed the PWQO Severe Effect Level as far away as Agonzon Lake, over 15 km downstream of the mines. Sediment-associated metals are present in forms known to be of limited mobility.

The biological effects of the mines are described as "only very local".

According to the Geco Mine Closure Plan (1995), a reduction in zinc loading over the long term is estimated at 60-90% in the Fox Creek system and 25-50% in the Mose Lake system. According to the Willroy Mine Rehabilitation Project (1999), is estimated that proposed measures will reduce heavy metal loadings downstream by 60-80%.

In 1993, estimated average rates of contaminant loadings in kg/day in Fox Creek were as follows:

	copper	iron	zinc

background	0.47	28.3	0.8	
above Harry Creek	0.64	263.4	2.9	contribution from Geco tailings
below Harry Creek	1.06	737.9	13.7	contribution from Harry Creek (Willroy)
at Glory Hole	1.85	709.3	30.8	contribution from Geco plant

[In water quality monitoring programs for Willroy mine, cyanide is not being measured based on the rationale that it is easily degradable and has not been used since 1977.]

Sources: 1) Geco Mine Closure Plan Document, March 1995
2) Willroy Mine Rehabilitation Project, August 1999, prepared by AGRA Earth and Environmental Ltd.

SHEBANDOWAN

Issues:

A comprehensive groundwater characterization program is to be implemented within the next two years. Estimated groundwater seepage rates from tailings are 30,000 m3/yr and from waste rock 12,000 m3/yr. It has been inferred that impacted groundwater seepage will discharge to surface within the mine closure boundary and will be manifested in surface water monitoring.

- In future, the company is expecting that seepage, surface and groundwater can be released directly to the environment without continuing lime or other treatment and without impacting aquatic life.

As of 1995, it was estimated that nickel loadings from the minesite were 419 kg/yr over a background input of 41 kg/yr.

Abandoned Mines Inventory System (AMIS), MNDM:

Site ID: 08497; Lat: 48.597; Long: 90,248; Twp: Hagey; Operated 1971-1992; Site is owned by INCO Ltd. Now on care and maintenance and dewatered; Commodity: mainly Ni and Cu

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:

Company owned site with 15 million tonnes of tailings over 120 ha with a water cover; Acid generation is negative

2000 Site Assessment Report, MNDM:

The mine is at the west end of Upper Shebandowan Lake. Access is via an all-weather paved road from HWY 11, just east of the village of Shebandowan. MR and SR = private. Rehabilitation of site including mitigation of AMD estimated at $1,645,000.

MOE Non-Compliance:

1997 The daily limit of 30 mg/L for total suspended solids was exceeded on June 24 at 89 mg/L. The monthly limit of 15 mg/L for total suspended solids was exceeded in June at 17.6 mg/L, October at 17.61 mg/L and November at 19.33 mg/L. The BOD limit of 15 mg/L was exceeded on April 23 at 16 mg/L.
1996 Exceeded the monthly limit for total suspended solids once. Exceedance was due to construction activities and weather conditions.

Shebandowan Mine, Closure Plan, Inco Ltd. April 2001:

The mine produced nickel-copper concentrate from a sulphide ore body and the concentrate was trucked to Copper Cliff, Ontario for processing. The site is located 100 km west of Thunder Bay on the south shore of Lower Shebandowan Lake. Lake Shebandowan has important cottage and sports fishing value and the company has tried to protect these values in planning for closure of the mine. Major features on site include a paved mine road, underground mine workings, milling and concentrating facilities, waste rock piles, tailings and three landfills.

Progressive rehabilitation of the mine has been ongoing. Waste rock that was visually impacting the lake users has been excavated and relocated to the tailings impoundment. Tailings dams have been raised to accommodate higher pond water and a spillway has been constructed for closure. The water level in the tailings has been allowed to rise to completely submerge the tailings (and relocated waste rock). Water from Lake Shebandowan has been pumped to the mill and treated with lime before been directed to the tailings impoundment. Monitoring immediately downstream of the tailings impoundment is ongoing.

Rehabilitation that is still required on site includes: capping of openings to surface; revegetation; demolition of infrastructure; a comprehensive groundwater characterization program to be implemented within the next two years; the possible relocation of additional reactive waste rock to the tailings impoundment; the possible addition of a diffusion barrier on top of the submerged tailings pond; and final determination of use/reclamation for the paved

road. Perpetual monitoring of the stability of structures on site will be required, especially monitoring of the tailings dams.

In future, the company is expecting that seepage, surface and groundwater can be released directly to the environment without continuing lime or other treatment and without impacting aquatic life. Discharges from the tailings impoundment have not yet resumed. Since 1990, effluent from the tailings has consistently yielded 0% mortality in quarterly MISA toxicity tests. Studies to date indicate that environmental impacts during years of active mining operations have been minimal.

Summary of loading inputs and outputs from Shebandowan mine site in kg/yr (1995):

	INPUTS	OUTPUTS
Copper	35	52
Iron	7100	5970
Nickel	**41**	**460**
Lead	77	130
Zinc	73	140

This also includes several creeks flowing through the property from south to north that discharge to Lower Shebandowan Lake.

In general, shallow groundwater is controlled by bedrock topography and the presence or absence of overburden materials. Seepage from the tailings impoundment occurs radially outwards, primarily through dam materials and underlying glacial tills. Estimated groundwater seepage rates from tailings are 30,000 m3/yr and from waste rock 12,000 m3/yr. It has been inferred that impacted groundwater seepage will discharge to surface within the mine closure boundary and will be manifested in surface water monitoring.

Factors of safety for tailings dams and engineering design for the water cover (including weather) is listed in other related documents.

According to the company, there are no aboriginal issues associated with the Shebandowan Mine closure area.

NORTH COLDSTREAM / TIP TOP / SHIELD

Issues:
The site is owned by A.C.West Ltd.
- Water quality monitoring results of the flooded tailings impoundment should be examined.

Abandoned Mines Inventory System (AMIS), MNDM:
Site ID: 08489; Lat: 48.602; Long: 90.584; Twp: Burchell Lk; Operated 1902-1961; Over 3.3 million tons of ore were milled.

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:
Priority Ranking = 5; Metals mined: Cu, Au, Ag; Twp: Burchell Lk.; Operated 19571967; 2.7 million tons of tailings deposited in two areas including gentle cross valley and beach into lake; Contamination to Burchell Lake is buffered by a series of small ponds; Acid generation potential is high; Cyanidation involved in processing; Cottages are located around Burchell Lake; Medium to high environmental sensitivity; Tree kill around tailings; Stability is not of concern

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:
Tailings located over 15 ha; Acid generation is positive

2000 Site Assessment Report, MNDM:
MR and SR are private. The site is now under closure plan. 3 shafts need to be capped at an estimated cost of $60,000. The site is accessed via HWY 17 west of the turnoff for HWY 802 south. Follow the road to a fork and continue right to the mine site gate.

Discussion with John Robertson, Mine Rehabilitation, MNDM:
The surface rights are crown owned and the mineral rights are company owned. The Ministry reclaimed surface structures e.g. demolished and recontoured. The company reclaimed tailings areas. There are two tailings areas: 1) The tailings impoundment is “high and dry” and is covered with gravel; 2) the tailings impoundment was flooded by the company three years ago and at this time copper was elevated in drainage from the impoundment and lime was added. The company continues to monitor discharge from the tailings impoundments.

CITADEL

Issues:

The process of closure planning for the mine determined a number of additional sampling requirements at site. An update on closure planning at the mine is required.

- The Grace-Darwin Mine used the process of mercury amalgamation, and sampling of tailings and the downstream receiver (Trout Creek) is required.
- Characterization of acid generation/metal leaching potential of tailings and waste rock is required.

Field Notes:

Site visit on June 24th, 2001

At the time of the visit, Northwatch was looking for the Minto tailings impoundment, not sure of its location and not realizing that all the mines on Surluga Road belong to Citadel Gold Mines Inc. and are listed in a single closure plan. There was limited time for the visit. A single water sample was taken at the Parkhill Mine (also Citadel). The sample was taken from below the waste rock pile (15 m height x 15 m width x 40 m length).
Sample F1: from pond below waste rock pile, pH 7, conductivity 320 us/cm; sample showed iron (1.29 mg/L) elevated above PWQO

Abandoned Mines Inventory System (AMIS), MNDM:

Listed as Minto Mine; Site ID: 04132; Lat: 47.975; Long: 84.751; Twp: McMurray

Closure Plan, Citadel Gold Mines Inc., February, 1995, Trow Consulting Engineers Ltd. (including Addendum 1, February, 1996; Addendum 2, August, 1997; and Addendum 3, February 1998)

The Citadel Mine is located on Surluga Road off Highway 101, 2 km east of Wawa. The total area to which Citadel Gold Mines Inc. has control is 2,972 ha, and this includes a number of gold properties that were intermittently explored and developed from 1899-1990 under numerous company ownerships. A total of 118,000 ounces of gold were produced from the properties. The Citadel mine and mill was put on standby in November 1989.

Gold properties in the Wawa Goldfields owned by Citadel are listed here: Surluga Mine (1968-91); Jubilee (1929-39, 42 and 44); Minto (1930-34); Mariposa Shaft (1904); Parkhill (1929-38, 1940-44); Grace-Darwin (1902-37, 1940-44); Cooper Ganly (1938); Powderhouse Shaft; Cora Shaft; Horneblende Shaft; Mackey Point; and Wawa Goldfields.

During closure planning it was determined that additional terrestrial and aquatic monitoring is required. In Trout Creek, water quality sampling at 4 stations upstream and downstream of both the Darwin and Parkhill mining and tailings areas is required. Sampling of sediments and aquatic invertebrates in the mine area and sampling bodies of water in the vicinity of historical sites is required. And in addition, sampling of soil and vegetation in the vicinity of the mill is required. The work was to be completed in 1996. Citadel agreed, in principle, to the Citadel Fisheries Trust document prepared by the MNR.

Tailings from the most recent Surluga mine were disposed in Minto Lake. Water sampling was undertaken in 1995 for compliance monitoring at the Minto tailings area and a report was produced by Trow Consulting Engineers Ltd. The report stated that copper concentrations in surface area water bodies are naturally elevated. Other metals such as lead, iron and zinc occasionally appear elevated. Elevated levels do not appear to be related to discharges from the Minto tailings area. The area is not impacting receptor surface water bodies beyond a negligible level, as non-impacted waters show similar levels of apparently elevated parameters and/or PWQO exceedances.

Sampling of tailings in Minto Lake and waste rock stockpiled outside the mill for acid generation potential is required. The work was scheduled for 1998. Some tailings at Minto Lake were dredged out and remain on shore and these must be pushed back into the lake for closure or revegetated. A permanent spillway is required for Minto Lake.

The Grace-Darwin Mine employed the process of mercury amalgamation during some time in its operation. As a result, beached tailings are to be sampled at various depths and sediments in surrounding waters (Trout Creek) are to be sampled for mercury. Samples will then be compared with natural background levels of mercury in the area.

Other closure work involves extensive removal and disposal of buildings and equipment on site, contouring and revegetation. The revised total cost for closure, as of 1997, is $817,500.

RENABIE

Issues:

For more information refer to correspondence of July 28, 2001 from Northwatch to MNDM regarding the Renabie Mine "exit ticket" and a paper entitled "Renabie Gold Mines Ltd. Mine Closure and Perpetual Care" prepared by Northwatch.

- The mine is astride the divide between the Superior watershed and the Arctic watershed. Generally, the west area of the site drains to Stover Creek and to Stover Lake towards Lake Superior. The east area of the minesite which contains the tailings disposal system, drains into Renabie Lake and to Missanabie Lake via Renabie Creek and into the Arctic watershed.
- This mine is the first mine to negotiate an "exit ticket" with the provincial government. As of June 28th, 2001, the fee for the "exit ticket" had been set at $102,290 and notice was posted on the Environmental Bill of Rights Registry.
- The fee for the "exit ticket" is nominal considering liabilities on site: a collapsed crown pillar which must be perpetually fenced; lack of comprehensive ARD/ML assessment; contaminated settling ponds below the tailings; land which is located in the middle of the land claim being negotiated between the Missanabie Cree First Nation and the federal government (the First Nation does not want an "exit ticket" granted for the site, with subsequent mineral development, before they have settled their claim).
- Site visit June 18th, 2001 with Rick Nolan and John Nolan, Councillors for Natural Resources with the Missanabie Cree First Nation. B1: seep at road side, north of the main area leading to the tailings, pH=6, conductivity 366 - 413 us/cm (on the other side of the road, a small pond had low conductivity 105 us/cm); B2: at Dam 6, pH=6, conductivity 310 us/cm, sample had elevated cobalt (0.0008 mg/L), copper (0.0052 mg/L), and zinc (0.032 mg/L) at or above PWQO; B3: at Dam 4, pH=6, conductivity 310 us/cm; B4: at tailings field on pond 4, moose tracks were seen right beside where sample was taken, pH=6, conductivity 577 us/cm, sample had elevated aluminum (0.183 mg/L), cobalt (0.0023 mg/L), iron (1.08 mg/L), and molybdenum (0.012 mg/L) above PWQO.

LEITCH

Issues:

The 1995 Reclamation Report completed by Teck Corp. states that revegetation on site is happening naturally. There was virtually no revegetation of any of the waste rock piles at the time of Northwatch's site visit on June 23, 2001.

- The 1995 Reclamation Report recommends that future monitoring be conducted due to concerns regarding elevated arsenic in surface water. No additional monitoring results could be found on file. A water sample taken by Northwatch at the tailings outflow at Highway 580 on June 23, 2001 had elevated arsenic (0.280 mg/L) above PWQO.

Field Notes:

Site visit June 23rd, 2001. There is virtually no revegetation on the piles of waste rock at site. The flat pad above the tailings field is presumably the site of the old mill. Puddles on the flat pad had rust staining perhaps due to weathering of the rock. A small channel of runoff was flowing over the pad. The tailings field appears completely revegetated.

Sampling: E1: runoff channel on flat pad, pH 7, conductivity 348 us/cm, sample had elevated arsenic (0.161 mg/L) above PWQO; E2: taken at tailings field outflow at HWY 580, pH6, conductivity 385 us/cm, sample had elevated arsenic (0.280 mg/L), cobalt (0.0013 mg/L), and iron (0.76 mg/L) above PWQO.

Abandoned Mines Inventory System (AMIS), MNDM:

Site ID: 02961; Lat: 49.625; Long: 88.035; Twp: Eva; Operated 1935-1965; Commodity: gold and silver

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:

Priority Ranking: 7; 157,000 tons of tailings in uncontained beach into natural depression covering surface area of 100 ha; Creek flows through area and drains to Lake Nipigon 5 to 6 kms away; Ore is probably high in arsenic with significant contaminant potential; Cyanide was used in processing; Tailings basin is shared in common with the Sand River Mine / Undersill Mine

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:

920,000 tonnes of tailings covering 100 ha; Acid generation is negative

1994 Site Assessment Report, MNDM:

The mine is located 6 km northwest of Beardmore (turn west on HWY 580 and travel for 7.5 km). Tailings samples have been taken but results of analysis not found - pH of tailings is around 8.2 and conductivity 330 us/cm.

1995 Reclamation Report, Teck Corp.:

Demolition, removal, capping of openings to surface and contouring/resloping carried out. Revegetation happening naturally. The tailings flowed into a large swamp west of the mine. From the swamp, a creek drains into the Standingstone River and on to Lake Nipigon. The reclamation report recommends that future monitoring be conducted. "There are indications that other mines in the area used the same tailings pond." Arsenic levels were somewhat elevated in the Standingstone river sample taken upstream of the tailings at HWY 580 (0.066mg/L). Analysis of arsenic in surface waters: "small pool beside culvert" [at HWY 580?] 0.20mg/L; and at "swamp, north side flow" 0.067 mg/L.

Abandoned Mines File, MNDM:

Teck Corp. acquired the property in 1971 and some dump material was recovered and processed offsite. Slurry that remained on-site as of 1994 was sent to Williams mine to be refined.

DORION

Abandoned Mines Inventory System (AMIS), MNDM:
Site ID: 08456; Lat: 48.834; Long: 88.671; Twp: Dorion; Past producer: (350 tons of lead and zinc); Circa 1900; Tailings area reportedy 2 m deep x 25 m wide x 30 m long

2000 Site Assessment Report, MNDM:
MR and SR = private. No mention of tailings. Reclamation costs estimated at $6,000 including backfilling of a 3m deep pit and a shaft. The site is accessed east of Thunder Bay. At Dorion, turn left on Fish Hatchery Road and then right on Wolf Lake Drive and then via bush roads.

TASHOTA-NIPIGON

Issues:
The mine is located upstream of Onaman Lake, which is a very productive fishing lake with winter commercial fishing. Acid generation potential of the tailings has been listed as high and there is no growth of vegetation on the tailings, however, a water sample taken downstream of the tailings in 1994 showed neutral pH and low conductivity. Assessment is required.

Abandoned Mines Inventory System (AMIS), MNDM:
Site ID: 02973; Lat: 50.046; Long: 87.587; Twp: Coughlan Lake; Operated 19281937; Commodity: gold, silver, copper

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:
Priority Ranking: 5; 6 to 8 km west of Onaman Lake; Operated 1935-1938; 51,000 tons of tailings in an uncontained beach into a natural depression; Drains to swamp; Onaman Lake is a very productive fishing lake with winter commercial fishing; Acid generation potential is high

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:
Site is owned by the crown; Includes 51,000 tons of tailings over 2 ha in an uncontained beach; Acid generation is positive

1994 Site Assessment Report, MNDM:
SR=crown; MR=Tashota-Nipigon Mines Ltd. The site is northwest of Onaman Lake, and is accessed via Kinghorn Road, north to the Con Lake Road and then northeast on the mine road about 12 km (weak timber bridge within 1 km of minesite). The mill, waste rock pile, and an old collapsed building surround the main shaft. There is recent stripping and trenching around the historical workings. Tailings are to the north of the main shaft and some erosion of the tailings from runoff is evident. There is no growth of vegetation on the tailings. Tailings samples were taken but no analysis is provided. Water sampled downstream of the tailings had a pH of 7.4 and conductivity 190 us/cm; north of the mill pH 7.4, conductivity 420 us/cm; south of the mill pH 7.4, conductivity 200 us/cm. The estimated costs for capping openings to surface total $11,000; backfilling the pit $1500; using waste rock to mitigate erosion on tailings at $1000; and removal of non-burnable materials including barrels of lime (located south of main mill) $500.

QUEBEC-STURGEON RIVER / STURGEON RIVER

Issues:
Acid generation potential of the tailings has been listed as high and there is very little growth of vegetation on the tailings, however, a water sample taken in the tailings field in 1994 showed neutral pH and low conductivity. Assessment is required.

Abandoned Mines Inventory System (AMIS), MNDM:
Site ID: 02978; Lat: 49.750; Long: 87.774; Twp: Irwin; Operated 1935-1942; Commodity: gold.

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:
Priority Ranking: 7; Operated 1937-1942; 145,000 tons of tailings in uncontained beach into natural depression covering 6 ha; No pond on tailings; Drains to swamp; Cyanide involved in processing; Acid generation potential is listed as high (may be depleted).

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:
Company owned site with 145,000 tons of tailings over 6 ha in an uncontained beach; Acid generation is positive with no treatment present

1994 Site Assessment Report, MNDM:
SR=crown; MR=St.Andrews Goldfields Ltd. The mine is located on the south side of the Sturgeon River, about 20 km northeast of Beardmore. Access is 13.6 km northwest on HWY 801 to the south side of the Namewaminikan (Sturgeon) River, then 2 km southwest on a secondary road and then the east fork to the mine another 400 m. A cleared area located east of the shaft and access road is the location of the old townsite. Stope failure is occurring and fencing is required at a cost of $22,000. The waste rock pile northwest of the shaft has a maximum height of 18 m. Tailings are located north/northeast of the mill foundations, with very little vegetation present on them. Tailings samples were taken but no record of analyses was found. The water on the tailings field had a pH of 8.2 and a conductivity of 130us/cm; in the pond south of the shaft pH 8.5 and conductivity 200 us/cm.

PAN EMPIRE / NORTHERN EMPIRE / BEARDMORE

Issues:

Roxmark Inc. has 100% interest in the mine and there is exploration activity on site.

- The mine is near the Blackwater River and Beardmore water supply. A pump house and pipeline are located on site and tailings pond water was previously pumped to a location downstream of the Beardmore water supply. Currently, tailings pond water is spilling over an excavated breach in the lowest dam. Discharge is permitted under a Certificate of Approval by the MOE.
- Stability of tailings was a concern in an April 1991 site visit made by Golder Associates Ltd., when the lower 2 tailings ponds were near capacity and it was determined that flooding parts of the Town of Beardmore could occur if control measures were not implemented. Water was pumped out of the ponds and MOE monitored water quality downstream of the tailings ponds.
- Cyanidation was used in processing. No records of subsequent water sampling for cyanide have been located.
- Tailings continue to weather. Water sampling by Northwatch on June 23, 2001, showed that conductivity was higher in upper reaches of tailings ponds and decreased lower down. Arsenic at the outflow of the lowest pond was elevated above PWQO at 0.375 mg/L.
- Eight stope breakthroughs were recorded during a 1994 Site Assessment and, as of 1994, a geophysical study is required at an estimated cost of $45,000.

Field Notes:

A site visit was conducted on June 23rd, 2001. Sign at entrance to mine property indicates that it belongs to Roxmark Inc. Above the four tailings ponds were the mine buildings. Two parked cars were beside the mill and the doors to the mill building was open but no one could be found. There was a "working shop" past the mill building, a shed with sacks of material, and mounds of material outside that were covered in plastic, as well as remnants of a hoist from a shaft.

The four tailings ponds were examined. The top pond was dry and cracked. A culvert that was cut in half was placed over the dam, presumably to function as a decant structure. The second pond had very small puddles. The lower dam on the second pond appeared to consist of a pile of crushed rock placed on top of the tailings surface. The third pond was half covered in water and also had beached tailings < 1m above the water level with the upper 20-40 cm of these beached tailings appearing weathered. The tailings were being colonized by vegetation (e.g. horsetails, birch seedlings). The lower dam on the third pond had culverts in place for decanting through the dam. The fourth pond was entirely filled with water, ranging over 2 m in depth, that was seeping out of a small breach that had been excavated in the lowest dam. There was some colonization by cattails in the fourth pond near this outflow. The pump house located on the fourth pond was not operating. Small fish were observed in the fourth pond.

Sampling: upper end of second pond in puddles pH 7, conductivity 569 us/cm; upper end of third pond pH7, conductivity 440 us/cm; lower end of third pond pH7, conductivity 425 us/cm; D1: at outflow over lowest dam (pond 4), pH 6, conductivity 352 us/cm, sample had elevated arsenic (0.375 mg/L) above PWQO, however this discharge is permitted under a Certificate of Approval from the MOE and the MISA limit for arsenic is 0.5 mg/L.

Abandoned Mines Inventory System (AMIS), MNDM:

Site ID: 02980; Lat: 49.613; Long: 87.938; Twp: Summers; Operated 19271941; Commodity: gold and silver

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:

Priority Ranking = 2; 425,000 tons of tailings; Natural drainage to Blackwater River; East side of town of Beardmore; Cyanidation was used in processing; Near Blackwater River and Beardmore water supply with medium to high environmental sensitivity; Some facilities on site are on care and maintenance program, details unknown; pipeline in place to pump water in pond to discharge location downstream of Beardmore water supply; Stability of tailings is a concern; Lower 2 tailings ponds near capacity at time of April 1991 visit, MNDM informed of situation Consultant's Inspection:

The tailings were deposited in a steep sided valley east of the Town of Beardmore. The tailings basin

consists of a series of four dams of between 2 and 5 m height across the valley. Ponds were retained by the lower two dams. Drainage through the tailings basin is facilitated by tower decants through the dams and via an open culvert which drains to Blackwater River. A pump house is also located at the lowest dam but was not operating at the time of the visit. Both ponds were filled to capacity at the time of the visit.

The observations made during the site visit indicated that the ponds were filled to capacity, and suggested that flooding parts of the Town of Beardmore could occur if control measures were not implemented. The resident geologist and MNR (Thunder Bay) was notified of this situation on April 22, 1991. It is understood that, at the time of the preparation of this letter, MOE is monitoring water quality downstream of the basin. Pumping of the ponded water to a point downstream of the Beardmore water intake is being carried out.

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:

425,000 tonnes of tailings; Acid generation is negative

1994 Site Assessment Report, MNDM:

SR=crown; MR= Ateba Mines, Toronto 45% and Pancontinental Mining (Canada) Ltd. (55%, based in Sydney, Australia). The mine is located 1 km east-northeast of Beardmore. Access is via HWY 11 north for 200 m, then east on a gravel road and across the CN line to the mine (a distance of 1.7 km). The mill facility is in good condition and well secured. An electrical transformer should be checked for PCB's at an estimated cost of $1,000. Eight stope breakthroughs were recorded and a geophysical study is required at an estimated cost of $45,000. Fencing of the area around the hazards is required at an estimated cost of $45,000. The tailings dams appear intact and ponds remain water covered. Tailings samples were taken but no analyses were recorded. The upper tailings pond had a pH of 7.0 and a conductivity of 680 us/cm; the lower tailings pond: pH 8.6 and 550 us/cm; and the polishing pond: pH 8.2 and 380 us/cm.

Mine Scan:

From information on mine scan, Roxmark Inc. has 100% interest in both Empire and Little Longlac sites. Lac properties holds some royalties for Little Longlac. A March 1999 pre-feasibility study done for development of the rehabilitated Empire shaft - drilling indicates inferred reserves of 85,723 tonnes averaging 0.51 ounces of gold per tonne.

ZENMAC TAILINGS

Issues:

Reclamation of the Zenmac tailings site that has been completed is largely thanks to the persistence of the nearby homeowner, Mr. Reeves.

- The site was owned by Mr. J. Patrick Sheridan, who is well-known in mining in Ontario. Mr. Sheridan was receiving royalties from the operation of Winston Lake/Zenmac property from 1988-1998 located 30 km to the northeast of this site. Mr. Reeves suggested that the government do the reclamation work required at the Zenmac tailings site and then put a lean on these royalties. In fact, the government allowed the site to be returned to the Crown in the late 1990's and reclamation work on site was funded by taxpayers.
- The tailings are now stabilized and revegetation has been initiated. Although the tailings are acid generating/metal leaching and contaminated discharge directly into Lake Superior contains elevated aluminum, cadmium, cobalt, copper, nickel and zinc, this component of reclamation has not been addressed. Ideally reclamation of the Zenmac tailings would have involved their removal to the Winston Lake tailings impoundment.
- On two occasions, blowing dust (contaminated orange tailings) from the tailings impoundment was reported as a forest fire.
- The tailings spilled into Lake Superior in the 1980's and the pathway of the spill is still visible.

A waste rock dump and mill pad is located above the tailings on CPR property and CPR is responsible for its reclamation, with no clean up scheduled to date.

Field Notes:

Met with Peter Reeves, homeowner beside the Zenmac Tailings, and conducted site visit, June 21st, 2001
Coordinates: 48°50'N; 87°23"W
The tailings were an eyesore from Lake Superior. The tailings spilled into Lake Superior in the 1980's and the pathway of the spill is still visible. On two occasions, blowing dust (orange tailings) from the tailings impoundment was reported as a forest fire. Mr. Reeves has been pushing for reclamation work for approximately 10 years. In 1993, with some insistence from Mr. Reeves, a report on reclamation for the Zenmac tailings site was completed by Golder and was paid for by MNDM. Mr. Sheridan owned the Zenmac sites and was receiving royalties from the Winston Lake mine. Mr. Reeves suggested that the government do the reclamation work required at the Zenmac site and then put a lean on these royalties. In the late 1990's the government allowed the site to be returned to the crown. Ideally reclamation of the Zenmac tailings would have involved their removal to the Winston Lake tailings impoundment. The mill site located above the tailings is on CPR property and CPR is responsible for its reclamation, with no clean up scheduled to date.
Sampling: Upstream of spillway pH 6, conductivity 270 us/cm; C1: At spillway pH 6, conductivity 535 us/cm; C3: 50 m downstream of spillway in creek (beside TMF) pH 6, conductivity 417 us/cm, sample had elevated aluminum (0.358 mg/L), copper (0.111 mg/L), and iron (0.58 mg/L) above PWQO; C2: 300 m downstream of spillway in creek pH 6, conductivity 190 us/cm; C4: 100 m downslope of tailings on beach/shore of Lake Superior, rust staining noted on rocks, pH 5, conductivity 423 us/cm, sample had elevated aluminum (2.33 mg/L), cadmium (0.0153 mg/L), cobalt (0.0297 mg/L), copper (0.0663 mg/L), nickel (0.111 mg/L), and zinc (9.01 mg/L) above PWQO; Lake Superior, 5 m away from shore, pH 6, conductivity 122 us/cm

Abandoned Mines Inventory System (AMIS), MNDM:

Site ID: 03286; Lat: 49.488; Long: 86.023; Twp: Killraine; Tailings operation from Zenith Mine, pyrite, pyrrhotite, waste rock; Reference to MOE Inspection Filles

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:

Priority Ranking = 1; 12 km west of Schreiber; Zinc and copper; 165,000 tons of tailings in raised stack covering 20 ha less than 150 m from Lake Superior; Steep tailings slope; Cottages along shore of Lake Superior (0.5 km); Potential fisheries effect; High acid generation potential; Medium to high environmental sensitivity; May be proximal to Rossport and Whitesand water supply
Consultant's Inspection:

The tailings area consists of a stack on a sidehill setting adjacent to Lake Superior. The northern limits of the stacked area is bounded by a railway siding which runs along a steep sided valley with rock outcrops throughout. The stack is about 10 to 12 m high and occupies an area of about 2 ha. It retains a pond on the east side of the stack, of about 0.2 ha in area and a freeboard of about 2 m at the time of the visit. A central decant structure, in severe state of deterioration, is located at the southeastern section of the basin. A thin fan of tailings was located downstream of the decant pipe. Points of seepage were noted at several locations along the toe of the stack, particularly along the southeast boundary. Minor longitudinal cracking, probably associated with minor sloughing of the tailings slopes was noted along the crest of the stack.
Maintain pond at present level or to no higher than 1.5 m below the crest, pending review of stack stability and drainage requirements.

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:
165,000 tonnes of tailings over 20 ha in raised stack; Acid generation is positive

1994 Site Assessment Report, MNDM:
(Willroy Mines, Noranda Minerals Inc.) The mine is accessed 10 km west of the turnoff for Winston Lake Mine from HWY 17, and west of Schreiber on a gravel topped road. It can also be accessed at the shoreline via Lakeshore Road 4 km to the west. A provincial park is located 2 km northwest of the minesite. Ore from the Zenith Mine, 30 km to the northeast, was shipped here for milling and concentrating. A waste rock dump is located on the north side of the CPR tracks. The tailings are massive pyrite and pyrrhotite waste from zinc and copper mining. The above ground tailings area covers 30,000 m2 and contains oxidized iron sulfides with minor amounts of copper, zinc, lead and silver. The pond runoff drains southwest to Lake Superior, 125 m away. Seepage was minimal at the time of the site visit and discharge from the tailings had a pH of 4.8 (with a pH of 7.0 measured in the creek 50 m south). The steep southern berm of the tailings is not fenced and on wet days, the lower southeast end would be water saturated and unstable so that any vehicles would be bogged down. A study is required to determine the strength of the tailings berm and issues of ARD at an estimated cost of $15,000. The decant tower should be refenced and raised by 2 m for a total estimated cost of $6,500.

Abandoned Mines File, MNDM:
A concerned citizen wrote to government regarding problems with instability, leaching and wind erosion from Zenmac Tailings - Peter Reeves, Box 732, Terrace Bay, ON, P0T 2W0. MNDM completed rehabilitation work on site that included regrading/resloping, removing tailings that were deposited on the dyke into the impoundment, improving drainage and construction of a spillway, removal of the decant tower and plugging of decant, covering with overburden and revegetating. The decant tower was removed and replaced with a spillway. [How much was spent in public funds?]

THERESA

Issues:
Demolition and cleanup of garbage is required.
- The tailings are rusty and there are some traces of sulphide minerals in the waste rock, suggesting weathering of this material. Water sampling in the tailings field in 1994 during a Site Assessment determined high conductivity. The volume of waste is relatively small, e.g. 26,000 tons of tailings. Assessment is required.

Abandoned Mines Inventory System (AMIS), MNDM:
Site ID: 02989; Lat: 49°697; Long: 86°524; Twp: McBean Lake; Operated 1936-1954; Commodity: gold

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:
Priority Ranking: 8; South of Town of Longlac, east of Long Lake; 26,000 tons of tailings covering 2 ha in uncontained beach into Making Ground River; 23 km from Long Lake Indian Reserve; Processing involved free milling gold; Acid generation potential is low; Contaminant potential is low

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:
26,000 tonnes of tailings over 2 ha in an uncontained beach; Acid generation is negative

1994 Site Assessment Report, MNDM:
SR=crown; MR=Private Duration Mines Ltd., Toronto. The mine is located in the McBean Lake area on the east side of the Making Ground River, 9.6 km south of Longlac. Access is via the Catlonite all weather gravel road with the mine located on the west side of the road. Buildings are still present including the mill, warehouse, office, generator pad, assay building and shaft house. A garbage pile has about 50 tons of scrap metal and several diesel and oil drums, with a clean up cost estimate of $4000. Concrete septic tanks 2x4m are full, possibly of sewage sludge. A precariously balanced filter drum on the mill foundation should be knocked down and landfilled at a cost of $1000. Shaft collar subsidence has an estimated reclamation cost of $5000. Warning signs should be installed $1000. Trench should be backfilled $1000. Hazardous house foundation walls should be demolished and backfilled $2000. Samples of concentrate from the old assay lab and samples of tailings were taken but no report of analyses was found. The pH of water measured in the tailings field south of the #3 shaft was 8.8 with conductivity 510 us/cm.

Abandoned Mines File, MNDM:
The mine was operated by a religious colony led from Quebec that founded the nearby village around their patron saint Ste. Therese. The mine closed in 1954 and their was some exploration conducted in the late 1980's. A site inspection was conducted by Mike Grant (of MNDM?) in September of 1998. He accessed the site via the Kimberly-Clark Forest Access road south of Longlac. He reports that the 3 shafts on site are all capped; demolition and cleanup of garbage is required; and that the tailings are rusty and there are some traces of sulphide minerals in the waste rock.

CLINE

Issues:

This site does not have an Abandoned Mines Inventory number and so it is difficult to track. Only a bit of sampling information was found.

- The site appears substantial e.g. 300,000 tonnes of tailings.

Abandoned Mines Inventory System (AMIS), MNDM:

N/A [MDI No. A0079 #94]

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:

District of Wawa; West of Dog Lake in Jacobson Twp.; Operated 1938-1948; 5 km from Tehoama River; 300,000 tonnes of tailings over 2 ha in uncontained beach into swamp; Cyanidation was used in processing; Acid generation potential is low

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:

Commodities: gold and silver; 300,000 tonnes of tailings over 2 ha in an uncontained beach; Acid generation is negative

1994 Site Assessment Report, MNDM:

The pH of sites around the mine ranged from 6.0 on the west side of the access road; 6.1 at the west end of Cline Lake on the east side of the access road; 6.6 in the exploration pit; and 7.2 and 7.3 in artesian drill holes.

COPPERCORP

Issues:

Beavers, beavers, beavers… In June 2001, MOE discovered a beaver dam constructed over a lower tailings dam that was retaining a 10 ha area of water and threatened to spill. Previously, in the mid-1970's a similar beaver dam caused a tailings spill which washed out Highway 17, a major safety hazard, and flowed into Lake Superior. And again, when Golder Associates Ltd. visited the site in 1991 a 3.5 m high beaver dam was impounding a large volume of water. Both the MOE and Golder Associates Ltd. discovered these beaver dams by chance, not because there was a monitoring program in place.

- Perpetual monitoring of the tailings dams, especially for beaver activity, is required.
- Coppercorp reverted to the Crown by forfeiture in recent years. The parcel of land that included the mine was very large. According to Mr. Dick Cowan, MNDM, under the old Mining Act, the province was obligated to accept the forfeiture. Mr. Alexander Carpenter of Maybrun Mines Ltd. states that MNDM never gave the company any orders regarding the Coppercorp Mine.
- The mine was a property of Mr. J. Patrick Sheridan, listed as Maybrun Mines Ltd., and the company still has a presence on site. As of June 2001, the water behind the beaver dam was being drawn down by siphoning, and dam reclamation will probably total about $23,000. Previously, the MOE spent approximately $250,000 on reclamation work at the mine, and following a court settlement, only approximately $50,000 was recovered from Mr. Sheridan. Reclamation of the site including demolition, contouring and capping openings to surface was to be completed this summer, however, no work had been completed as of the site visit on June 18, 2001. Mr. Alexander Carpenter of Maybrun Mines Ltd. states that reclamation of the site by the company is still planned.
- As of an Environmental Appeal Board decision of 11/02/2000, an appeal by J. Patrick Sheridan and Maybrun Mines Ltd. was dismissed. Orders required the applicants to pay $131,862.61 for costs incurred for failing to prevent the spread of PCBs at the Coppercorp Mine.

Field Notes:

Site visit on June 18th, 2001

Spoke briefly with Bob Archibald, Site Manager for the Coppercorp Mine, who indicated that the mine is a Sheridan property and that some reclamation will be carried out on site this summer. An open shaft and other openings to surface are scattered on the property. Many structures are still standing on site including the mill building with assay lab materials scattered about. A solid waste dump on the west side of the mine road contained both industrial and residential waste including automobiles and household goods (e.g. white goods - 2 stoves, washer and sink). The tailings field (reddish in color) was under colonization by vegetation. The pH of ponded water on the tailings both at the north and south ends was approximately 6-7. The spillway at the southern end of the tailings field was draining a very small amount of runoff through cattails that were colonized on the tailings (runoff had pH 6-7 and conductivity 153 us/cm). No suitable site was found to sample seepage from the tailings. A pit/trench located south of the mine was also noted.

Met with Ron Dorscht and Rod Stewart, MOE, Sault Ste. Marie, June 25th, 2001

Coppercorp is owned by Maybrum Inc. The site may revert to the crown in the near future. At the time of the meeting, dam 3 had a major beaver dam approximately 3 m in height constructed on top of it, which was retaining about 10 ha of water. A similar beaver dam at the mine previously caused a tailings spill which washed out HWY 17 and spilled into Lake Superior. The beaver dam was discovered on June 7th by two MOE environmental officers that were completing the site visit since one officer was handing over responsibility for the property to the other. In other words, it was discovered by chance and not because of a monitoring program. At the time of the meeting, the water behind the beaver dam was being drawn down by siphoning, and reclamation will probably total about $23,000. MNDM is responsible for reclamation work related to the beaver dam. The MOE spent approximately $250,000 on reclamation work at the mine, the major component of which was construction of the tailings dam. Following a court settlement, only $50,000 was recovered from Sheridan. destruction of the beaver dam.

Abandoned Mines Inventory System (AMIS), MNDM:
Site ID: 07937; Lat: 47°022; Long: 84°747; Twp: Sand Bay; Operated 1965-1969; Commodity: silver, gold, copper

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:
Priority Ranking=2; Operated 1964-1972; 1 million tailings over 20 ha
Consultant's Inspection:

The Coppercorp tailings area is a cross valley deposit with an area of approximately 20 ha, located 1.5 km from Lake Superior. There have been failures of two lower dams at some time in the past which washed out Highway 17 and resulted in tailings entering Lake Superior. The main tailings dam is constructed of pit run sand and gravel, and the impounded pond is about 1 ha in area. The outlet structure is a side decant, and at the time of our visit, there was a flow of about 200 to 300 IGPM exiting through the outlet.

The main tailings dam structure has been studied by Netherton Engineering Ltd. of North Bay, and they have proposed a remedial action plan consisting of an emergency spillway.

A 3.5 m high beaver dam was observed downstream of the previously failed Dam No. 2, and a large volume of impounded water was present behind the beaver dam.

The original assessment of the contaminant potential of the Coppercorp tailings was based on the presence of copper, and the potential presence of pyrite in the tailings. Gerry Bennett (MNDM) has indicated that the host rock contained carbonate which provides a buffering capacity for the tailings, thus reducing their contaminant potential. MNR should inspect the beaver dam, and decide whether it is practical to drain the pond and remove the dam. They can contact Frank Tesolin (MOE) to obtain the exact location of the beaver dam.

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:
Company owned inactive mine; 1 million tonnes of tailings over 20 ha cross valley; Acid generation is positive

1998 Site Assessment Report by Chris Hamblin, Mine Rehabilitation, MNDM:

The tailings dam at the south end was reconstructed by the Ministry of the Environment. There are no visible signs of ARD. Mr. Hamblin is following up on the report, and the company plans to complete the required rehabilitation work e.g. demolition, recontouring and reclamation of safety hazards. [Contaminant potential has not been identified as a concern.]

In a conversation on **June 23, 2001**, Mr. Hamblin acknowledged that perpetual care of the site is required, especially in terms of monitoring for beaver activity. When Denison Environmental Services recently siphoned water impounded behind the beaver dam, water quality was good for the most part, although there was a spike in copper and zinc concentrations when sediments were stirred up. Coppercorp reverted to the Crown by forfeiture in recent years. The parcel of land that included the mine was very large. It is Mr. Hamblin's impression that the Crown knowingly accepted the forfeiture.

TRIBAG

Issues:

A letter was written by MNDM to Sunburst Resources (1991) Inc. in 1993 reminding the company of their ownership and clean up requirements. No response was received and no follow-up has been conducted by the Ministry.

- The tailings area drains into the Batachewana River which is a prime fishing area. The main tailings dam failed approximately 15 years ago, releasing tailings into the Batachewana River and Lake Superior. There is potential for beaver activity upstream of the breach in the main tailings dam and a potential for instability of the polishing pond dam. Golder Associates Ltd. recommended assessment of the stability of the polishing pond dam and determination of the most effective method of controlling runoff from the tailings. There is no record of follow-up on this. A breach in the secondary clearwater pond dam was noted by MNDM staff in 1995.
- The 2000 Site Assessment Report contracted by MNDM does not even make mention of tailings as a site feature.
- An assessment of acid mine drainage/metal leaching of the mine waste is required.
- No one from the MOE has been into the Tribag site recently (probably in the last 10 years) to inspect the site.
- The site is a mess. Buildings burned down prior to 1995. PCB's are stored at the mine and the MOE says it is difficult to order their removal because they are allowed to be on the property as long as they are properly stored. There are openings to surface. A pile of white powder 5 m x 4 m x 4 m of unknown composition is being eroded and washed downhill by rain. A gas pump needs to be reclaimed and likely has underground fuel storage.

Field Notes:

Attempted site visit June 18th, 2001
Rough road. Unable to access mine.

Meeting with Ron Dorscht and Rod Stewart, MOE, Sault Ste. Marie, June 25th, 2001
No one from the MOE has been into the Tribag site recently (probably in the last 10 years) to inspect the site. There was a partial breach of a dam on the property about 15 years ago. MOE is responsible for the PCBs at the mine site and it is difficult to order the removal of these since they are allowed to be on the property as long as they are properly stored. MNDM would be responsible for underground fuel storage.

Abandoned Mines Inventory System (AMIS), MNDM:
Site ID 8073 - tribag, east breccia; 8068 - tribag; 8070 - tribag, breton b; 8071 - tribag, south breccia.

Golder Associates Ltd. 1991. Final Report to the Ministry of Northern Development and Mines on Preliminary Evaluation of Unattended tailings Sites, Ontario, Vol I and II.:
Priority Ranking = 2; 5 km west of Batachewana River; Nicolet Twp.; Operated 1967-1975; 1.2 million tons of tailings over 14 ha; Creek traverses tailings area; Potential for beaver activity; Tailings dam failure in 1985
Consultant's Inspection:

The Tribag tailings were originally ranked as Priority 3 due to the perceived absence of significant downstream hazards. During the site visit to the Sault Ste. Marie District, Frank Tesolin (MOE) indicated that the Tribag tailings area drains into the Batachewana River which is a prime fishing area. The main tailings dam had failed sometime in the past, releasing tailings into the Batachewana River, and into Lake Superior. However, the polishing pond dam is still intact, and the polishing pond reportedly contains a significant amount of tailings from the previous spill. An attempt was made to visit the area on April 25, 1991, but the site was inacessible due to the presence of snow on the mine entrance road.

Examination of recent (1988) airphotographs of the site indicate that there may be some potential for beaver activity upstream of the breach in the main tailings dam, and a potential for instability of the polishing pond dam.

The original assessment of contaminant potential of the Tribag tailings was based on the presence of copper, and the

potential presence of pyrite in the tailings. Gerry Bennett (MNDM) has indicated that the host rock contained carbonate which provides a buffering capacity for the tailings thus reducing their contaminant potential.
Site should be inspected and the stability of the polishing pond dam should be assessed once the mine road is accessible. Conduct a study to determine the most effective method of controlling runoff from the tailings area.

G. Feasby, CANMET and R.K. Jones, Natural Resources Canada, Report of Results of a Workshop on Mine Reclamation, Toronto, ON, March 10,11, Hosted by IGWG Industry Task Force on Mine Reclamation, 1994.:
Commodities: copper, silver, gold; Company owned inactive mine; 1.2 million tonnes of tailings over 14 ha across a valley; Acid generation is positive

2000 Site Assessment Report, MNDM:
8068 - Two large steel tanks that appear empty need to be reclaimed and soil contamination checked for ($5,000). Shaft needs to be capped ($28,000). A transformer on site may contain PCBs ($8000). A pile of white powder 5x4x4 m of unknown composition is being eroded and washed downhill by rain and is recommended for removal and disposal ($8,000). Empty barrels that probably contained processing chemicals need to be removed and disposed ($8,000). A gas pump needs to be reclaimed and likely has underground fuel storage ($5,000 + underground fuel storage costs). There is a partly collapsed loader structure on site ($2,000).
8070 - An open pit is located on site 61x9x9 m but is reportedly not a hazard.
8071 - Empty fuel tanks must be removed ($5,000).
8073 - An adit should be closed ($13,000). A waste rock pile 30x25x6 m is located on site but is reportedly not a hazard.

Abandoned Mines File:
A letter was written by MNDM to Sunburst Resources (1991) Inc. in 1993 reminding the company of their ownership and their clean up requirements. A photocopy from the Golder Report was also enclosed. Photos from 1995 show 1) a large amount of debris including that from buildings that burned down and 2) a breach in the secondary clearwater pond dam resulting exposed tailings.

LUCINDA

Field Notes:

Site visit on June 17th, 2001

The mine appeared old and small. The remaining foundations on site were built with stone. A shaft located above the foundations was filled with water . There was a pile of waste rock beside the shaft as noted in the Site Assessment Report. Two trenches 2 x 3 m were located on the other side of the access trail. No tailings were visible.

Abandoned Mines Inventory System (AMIS), MNDM:

Site ID: 07843; Lat: 46°772; Long: 84°709; Twp: Fenwick; Commodity: lead, zinc and copper

2000 Site Assessment Report, MNDM:

The site is located north of Sault Ste. Marie, west of HWY 17. Take Anderson Road west for 1.45 km and then proceed north on an ATV trail for 1.7 km to the mine. There is no mention of the tailings or of any equipment that are listed as site features in AMIS. The report notes a shaft, trenches, the foundation for the mill, and a waste rock pile 6 m x 8 m x 7 m.

PRACE / SILL LAKE

Issues:

Closure work totaling $83,450 was completed in 1993-94, however much remains to be done. Soils are contaminated with lead and oil. Tailings containment structures need to be stabilized and tailings composition should be assessed. Openings to surface present a safety hazard.

- The public has previously complained about safety issues at this site.

Abandoned Mines Inventory System (AMIS), MNDM:

Site ID: 07976; Lat: 46°770; Long: 84°264; Twp: Vankoughnet; 1975-1985

2000 Site Assessment Report, MNDM:

The site is located northeast of Jones Landing, south of Sill Lake. To access the site, proceed east on Robertson Lake Road, take a right hand turn (southeast) at approximately 8.5 km west of Buttermilk Hill and pass by the west side of Sill Lake. Four hazards are reported: 1) A stope should be backfilled ($3,000). 2) A chain link fence over a portal has been cut open and pulled away and the decline is open, water filled, and surrounded by a wood structure. The approximate cost to secure the hazard is $10,000. 3) An open cut on site appears to have a shaft at its bottom and remediation of this hazard will cost between $7,000 and $31,000. 4) A pile of rock blocks the tailings pond from going into the lake and is made of two water levels. An initial assessment of tailings composition and stability of containment structures is required at a cost of $25,000.

Abandoned Mines File, MNDM:

The site is crown land. The public has previously brought this site to the attention of government because it is a safety hazard.

Closure work totaling $83,450 was completed at the mine in 1993-94. This is detailed in the Sill Lake Mine Closure Report, which is summarized here. Work performed on site included removal and disposal of many site structures including buildings, debris, a loading dock and waste oil. An outflow weir was constructed at the road crossing to the outlet of Sill Lake. Openings were capped. Soils contaminated with oil were placed in the tailings area. Lead levels in soils that were sampled were in excess of both CCME and MOEE decommissioning requirements. Samples of water from the portal and leaving the tailings area were below both the MOEE surface water guidelines and mine effluent guidelines. Recommendations from the report are to complete required backfilling and capping; to stabilize the tailings area, main dam and spill channel; to dispose of oil contaminated soil that is in the tailings area; and to monitor possible failures of two vertical shafts.

The Hard Way: A Report on Mining in the Lake Superior Basin

By Conor Mihell for Northwatch and Great Lakes United

May 2011

Introduction

Lake Superior rests in the 1.1-billion-year-old depression left behind when plate tectonics pulled the North American continent apart.[1] Known as the Midcontinent Rift System, this geologically diverse area holds some of the world's greatest mineral deposits.[2] Unlike the lower Great Lakes, whose underlying bedrock has largely been buried beneath the sediments of saltwater seas, magma-borne granites and gabbro intersect with volcanic basalts in the Lake Superior basin, creating lodes of copper, veins of gold, silver and platinum, pockets of uranium and copious quantities of iron ore.[3] Beginning 4,000 years ago[4], aboriginal people chipped off pieces of exposed copper to fashion tools; this type of benign, "subsistence" mining is nothing compared to the multi-billion-dollar industry that it's evolved to today.

The onslaught of mining claim stakes, razed topsoil, drilled shafts and adits, and crater-like open pits that began in the 1840s Michigan's Keweenaw Peninsula continues, leaving a legacy of contaminated mounds of waste rock, toxin-laced lakes, acid-killed rivers and forests, poisoned groundwater and soil, and once-booming towns, now abandoned. The early Copper Country prospectors must have known that they were onto something good—boulders of pure copper could be collected by hand, ready for refining. Between 1855 and 1968 more than 140 mines and 40 processing mills dotted the 240-kilometre-long Keweenaw, which juts into the heart of Lake Superior. Production peaked in the early 1900s, with miners removed upwards of 120,000 metric tonnes of copper per year.[5]

Since copper production in the Keweenaw area slowed in the 1960s, humans have taken stock of the environmental impacts of a century of mining: 360 million tonnes of copper "tailings" sluiced into area waterways; and 64 million tonnes dumped directly in Lake

Superior.[6] W. Charles Kerfoot, a researcher at Michigan Tech University in Houghton, Mich., revealed in a 2007 paper that as a result of mining, "a major copper 'halo' exists around the peninsula."[7] What's more, since copper deposits often occur in conjunction with mercury, untold amounts of this neurotoxin also leached into the environment.[8]

The impacts hit home in 1987 when the Keweenaw's Torch Lake was declared an Area of Concern under the Great Lakes Water Quality Agreement and a U.S. Environmental Protection Agency Superfund site.[9] With about 20 percent of its capacity filled with mine tailings, the lake was a wasteland: Grotesque tumours "of unknown origin" showed up on fish, vegetation was poisoned by excess dissolved copper concentrations and benthos populations crashed.[10] Ironically, there's not one mining company amongst the 26 Torch Lake stakeholders listed on the EPA Website. While over $15 million in reclamation funds have regreened the shoreline, biologists estimate that it will be another 800-plus years before benthic species recover from the high concentrations of metals.[11] In his paper, Kerfoot called the case of the Keweenaw "an excellent example of the long-term consequences of mining releases."[12] The same legacy of environmental destruction, social upheaval and economic boom and bust has played out throughout the Lake Superior basin.

It's been a decade since Northwatch published the findings of a comprehensive investigation of mining activity and its associated environmental and social impacts in the Lake Superior basin. Entitled "UnderMining Superior", this 2001 report highlighted Northwatch's work in developing an inventory of past and present mining activities. In exploring countless examples of government subsidy and oversight and legacies of contaminated air, water and soil and fractured communities, the document delivered the hard-hitting message that all that glitters isn't gold.

But in 10 years, what's changed? All of the mining areas explored in "UnderMining Superior" remain active today, with new deposits ready to exploit and prospectors at work across the region in search of more.[13] Perhaps the greatest influence on mining in the past decade has been skyrocking prices for commodities, fuelled by a combination of

high demand and increasing scarcity of supply.[14] Gold is a prime example: Its price on the London Stock Exchange has increased five-fold since 2000. Meanwhile, an insatiable global demand for metals like nickel and copper has made mining in North America a high profit industry, despite an otherwise shaky economy.

On a broad scale, it could be argued that Northwatch's 2001 objective of increasing public understanding of mining issues would "lead to increased public oversight…" has been achieved.[15] In Ontario, strong public pressure to overhaul the century-old provincial *Mining Act* resulted in amendments in 2009. In the same year, a landmark court decision forced mining companies to make public the amount of toxins disposed of in waste materials and atmospheric emissions to Environment Canada's National Pollutant Release Inventory.[16] Most importantly, it is apparent that communities across the Lake Superior basin are standing up for their rights to a healthy environment and long-term social and economic stability in challenging proposed mining developments.[17]

However, largely due to governments' cursory scheme of regulations and open-door attitude towards junior exploration companies and mining giants alike, the second half of Northwatch's "UnderMining Superior" goal—to move "in the direction of maximizing benefits and minimizing costs, particularly environmental and social"[18]—has yet to be achieved. Now, amidst growing public opposition towards unbridled mineral exploration and development, it seems like a good time to review the impacts of mining on the Lake Superior watershed. Besides rampant exploration throughout the basin, new mines are looming in Marathon, Marquette, the North Shore region of Minnesota and Atikokan. It's our hope that this document will lend case study-rich support the precautionary, well-planned approach to mining that the public seems to be adopting.

An Overview of Mining in the Lake Superior Basin

Rudimentary indigenous copper mines dating back at least 4,000 years have been discovered on Michigan's Isle Royale, but the real mining rush that continues today in the Lake Superior basin began on the Keweenaw Peninsula in the 1840s. The region was

the world's second-largest producer of copper, producing 4.8 million tonnes between 1850 and 1929. [19] In 1845 the first iron mines were developed near Marquette, Mich. On the Canadian side of Lake Superior, standoffs between copper miners and local First Nations north of Sault Ste. Marie led to the signing of the Robinson-Superior Treaty in 1855, essentially availing much of the rugged north shore to future prospecting. About the same time, four decades of silver mining began at an underground deposit beneath tiny Silver Islet, in the offshore waters of Lake Superior, east of Thunder Bay. Iron mines in Minnesota's Mesabi Range opened in 1882, and the region still accounts for 75 percent of the U.S. production of iron ore. [20]

After several false starts and modest successes in the Marquette area and in Northern Ontario's Nipigon and Wawa regions, the significant gold deposits were found and exploited in the Hemlo area, south of Marathon, Ont., in the early 1980s.[21] At their peak, three Hemlo mines produced the lion's share of gold in Canada; only the multinational Barrick Gold Corporation-operated Williams Mine remains in production today, however it still employs nearly 500 workers and moves a whopping 1,500 tonnes of rock per day.[22] Wesdome's Eagle River Mine and Richmont's Island Gold both operate significant mines just north of Wawa. And closer to Thunder Bay, North American Palladium's Lac Des Iles open pit mine has produced platinum group metals since 1993.

Now, there are five mines on the horizon:

- British mining giant Rio Tinto's controversial Kennecott Eagle mine on the Yellow Dog Plains near Big Bay, Mich., west of Marquette could begin production as early as 2013 on a deposit that's projected to yield 30,000 tonnes of copper and nickel annually over six years.[23]
- A proposed platinum group mine near Marathon was delayed after a concerned local citizens committee convinced the mine's proponent, Marathon PGM (now Stillwater Canada) to shelve plans to dump tailings in a healthy cold-water lake.[24,25]
- PolyMet is currently engaged in an environmental review for a proposed copper, nickel, cobalt, platinum, palladium and gold open pit mine in Hoyt Lakes, Minn.[26]

- Orvana Minerals Corporation has staked 712 hectares of copper and silver prospects in Ontanogan County, Mich. for its proposed Copperwood Mine.[27]
- One hundred and seventy kilometres west of Lake Superior, near Atikokan, Ont., the Osisko Hammond Reef Gold Mine has proposed a twin open pit gold mine that would draw freshwater from a nearby lake for processing and drain another on the mine site.[28]

These recent developments have made the entire perimeter of the watershed remains a hotspot for mineral exploration, including ongoing uranium prospecting west of Marquette by Bitterroot Resources[29] and diamond exploration by several junior mining companies in the Wawa area of Northern Ontario.[30]

The long tradition of mining in the Lake Superior basin shapes the region socially, economically and politically. There's no doubt that mining brings employment to otherwise economically depressed regions, including high-paying blue-collar and professional jobs. For instance, Ontario's Ministry of Northern Development, Mines and Forests reports that in 2009 mineral activity in the province is worth $6.3 billion and provided 23,000 direct jobs.[31] As a result, the MNDMF mandate is clear in its priority to put mining activity ahead of environmental and social responsibilities to maintain Ontario's record as a "global mining force."[32]

Despite efforts to modernize mining legislature to encourage public consultation and accommodate the rights of First Nations, the policy and industry lags in this regard. In 2001, Northwatch noted that few if any benefits were accrued to local aboriginal groups from the Hemlo and Eagle River mines.[33] Both encompass traditional Ojibwa territory yet proponents did not produce impact-benefit agreements for local First Nations. This colonial mindset continues today, particularly in the case of Marquette's pending Kennecott mine, where Rio Tinto has not addressed local concerns that mining will desecrate Eagle Rock, an aboriginal spiritual site.[34]

Most of mining's environmental legacy and social impacts come as a result of the archaic, streamlined and non-existent policies that govern its operations. As a rule,

mining policy is pro-development, shaped by powerful industry lobbies that are well represented in government agencies like Ontario's MNDMF. Although policies have seen small improvements, a thorough assessment of environmental and social impacts is barely necessary for early exploration work—let alone the final approval of a massive-scale mine.

Policies on Development—Mining and Government Regulations

A review of various mining-related policies in jurisdictions around Lake Superior reveals a simple fact: Government agencies assume mining is the best use of land. It's this Wild West mindset that still affords prospectors "free entry" to probe (and bulldoze) privately owned land in much of Northern Ontario for minerals and freed up 120 acres of public land in Michigan's Upper Peninsula for the proposed Kennecott Eagle mine.[35] In the 110-year-old Ontario *Mining Act*, for example, the role of the lead government mining regulatory agency is to issue land tenure, not to control mining activity.[36] Once land is claimed, the prospector has the exclusive right to explore it for minerals and, in the case of public (Crown) land, the MNDMF has no right to refuse leasing the surface rights should the prospector decide to further explore the mineral potential of a claim.[37] The U.S. *General Mining Act* (1872) upholds similar archaic rights for miners.[38]

Continuing with the Ontario example, mineral exploration is subject to only minimal environmental regulations. Once land is under lease, companies are not required to submit an exploration plan and are not subject to government inspection. In fact, the rehabilitation of an exploration site isn't mandatory until more than 1,000 tonnes of subsurface rock is excavated or 10,000 square metres of vegetation and topsoil is removed from a 16-hectare claim unit.[39] And even then, the standards are flexible. Since companies aren't required to report exploration work, Ontario is littered with an untold number of abandoned exploration sites. New regulations are currently under development, but whether even the "modernized" regime will require rehabilitation of exploration sites is uncertain.

Meanwhile, Canadian statistics demonstrate that about one in every 10 mining claims will advance to the exploration stage, but only about one in 1,000 exploration projects will develop into an operating mine (and the claim to mine ratio continues to shrink as exploration increases).[40] This is in large part because of the huge federal and provincial tax incentives for junior mining companies. Effectively, these companies are mining the stock market, often at the expense of environmental quality. Investing in these upstart miners is encouraged by a series of "flow-through" tax breaks including 15 percent federal and 5 percent provincial credits. All told, this makes it far more lucrative to explore for new sources of raw materials rather than conserving or recycling existing supplies.[41]

In the odd instance where a prospect evolves into a full-fledged mine, environmental regulations for development are similar regardless of jurisdiction, with few (if any) opportunities for an independent, cumulative and long-term review of impacts.[42] In Ontario, a loophole has exempts proposed mines from provincial environmental assessment since 1981. (Now into its fourth extension, the MNDMF insists it is developing a streamlined "Class" EA for mining projects in Ontario).[43] In Michigan, the proposed Kennecott Eagle mine was the first to be subject to the state's Department of Natural Resources and Environment (MDNRE) so-called Part 632 regulations of the *Natural Resources and Environmental Protection Act* for non-ferrous metallic mineral mining, which were established in 2004.

On paper, the Part 632 requirements are leaps and bounds ahead of previous legislation. The process involves a proponent-led environmental impact assessment, environmental protection and contingency plans, and upfront financial assurances for closure. Besides describing proposed mining operations in detail, the proponent must embark on two years of site-specific flora, fauna and water resources surveys; they must identify potential "cumulative impacts and additive effects"; mitigation options must be discussed; and the proponent must describe a reclamation plan to "achieve a self-sustaining ecosystem with no perpetual care." Once submitted, the proposal is reviewed by an MDNRE "mining

team" of experts. The public is offered to opportunities to comment throughout the process.[44]

However, it must be noted that Part 632 is entirely proponent-driven. There are no independent decision points—no opportunities to step back, take it all in and ask, Is this the best use of this land? What's more, who knows if a proponent's "performance bond" or the like will be sufficient for reclamation? Opponents of the Kennecott (which, incidentally, is a wholly owned subsidiary of Rio Tinto) proposal have complained that the process has been muddled, that the developer's consultants did not deliver the full requirements of the law and that Part 632 does not consider the bigger picture of "mining, transport, and milling of ore, as well as other potential mining projects in the vicinity of the Yellow Dog Plains."[45] Regardless of the concerns, MDNRE senior policy director Frank Rusnick approved the Kennecott Eagle mine on behalf of the state in January 2010.

Divisions of power between federal and provincial/state jurisdiction further complicates the regulatory process, but also lend important additional scrutiny. In Canada, "triggers" such as the potential to disturb fish habitat invokes the federal *Canada Environmental Assessment Act*. Depending on the scope of the project, this could entail a small-scale "screening review", a comprehensive EA or, rarely, a panel review process where independent experts assess more complex or controversial projects.[46] It is important to note that in Canada to date, only panel review EA has had the clout and discretion to dismiss mining projects altogether, in the case of two proposed gold and copper mines in northern British Columbia.[47]

The root of mining's legacy of environmental and social impacts is a lack of critical oversight on the part of decision makers. A 2007 report by West Coast Environmental Law cuts to the core of the problem: "Once mining exploration has occurred and there is a desire to build a mine, industry pressure is such that it is virtually impossible to prohibit this development in order to respect other land uses and objectives."[48]

The Environmental Legacy

Mining has the capacity to alter the natural environment like no other form of development. First off, there's the footprint of the mine itself—the open pits, underground shafts, mounds of waste rock and sprawling tailing ponds that obliterate habitat, not to mention the roads and hydro transmission corridors necessary to service the site. In the case of Stillwater Canada's proposed platinum-group mine in Marathon, operations would include an open pit larger that the town site itself;[49] a waste rock pile 27 stories tall;[50] and the rerouting of 13 watercourses with a series of dams to contain discarded tailings[51]—all in what was once a relatively pristine tract of boreal forest. Similarly the footprint alone of the Kennecott Eagle mine will impose significant impacts on one of the largest remaining tracts of roadless land in Michigan's Upper Peninsula, bringing with it habitat fragmentation and a new vector for the introduction of exotic species.[52]

Next are the impacts of exposing millions of tonnes of once-buried rock to air and water. According to MiningWatch Canada, mining is essentially a "waste management industry," with Canadian mines producing an estimated 650 million tonnes in byproducts per year containing over 500,000 tonnes of toxic materials—more than any other industry in Canada.[53] MiningWatch indicates that for any given ore body, 95 to 99.9995 percent of the raw material mined is discarded.[54] Besides mountains of overburden, sludge ponds of fine-grained mine waste known as "tailings" comprise about 25 percent of mineral extraction byproducts.[55] Tailings are often laced with toxic metals like mercury, lead, cadmium and arsenic. In the Lake Superior basin, for example, Hemlo's Williams Mine in 2009 disposed of 346,119 kilograms of arsenic, 581,137 kilograms of lead and 2,157 kilograms of mercury, among other heavy and base metals, in its waste rock piles and tailings ponds.[56] All this material threatens ground and surface water and food webs and requires advanced engineering to contain. Yet impoundment facilities occasionally fail, with two being breached in Canada in 2008.[57]

Tailings storage areas have huge ecological footprints. When it closed in 1996, the White Pine Mine in Michigan's Ontanogan County, east of the Keweenaw Peninsula, 70 years of mining had produced a 2,630-hectare field of dry tailings from copper mining operations.[58] Wind erosion caused regular "dust storms" of tailings[59] that impacted nearby communities, and the estimated cost of "capping" the impoundment area with a layer of clay was pegged at $72,000,000.[60] Today, the site is revegetated with hardy plant species after two years of research and reclamation work by the University of Montana and ongoing maintenance.[61] Yet questions remain at any reclamation site about the subsequent uptake of metals by plants that could flow upwards into the food chain.[62]

Among the most concerning trends in mining today is industry's desire to use natural lakes and waterways for storing tailings. This practice is by no means new—it was the approach favoured by old-time miners like those in the Keweenaw who dumped the wastes of copper mining into the waters of Torch Lake and Lake Superior. What's worrisome is a 2002 addition to Canada's *Fisheries Act* has made it possible to reclassify lakes, wetlands and waterways to be designated as "tailings impoundment areas."[63] Ontario got dangerously close to having its first "Schedule 2" exemption in 2010 when the proponent of Marathon PGM listed Bamoos Lake, a cold, deep-water lake in the Lake Superior watershed with a native lake trout population, amongst potential storage areas for the 68,000 tonnes of rock and tailings it will produce daily for 11 years.[64] In a press release, Marathon PGM vice-president of operations Raymond Mason said, "After consultation with First Nations, government agencies and residents of Marathon and surrounding communities, it became clear that the loss of the fishery in Bamoos Lake was undesirable."[65]

Furthermore, since most contemporary mining in the Lake Superior basin occurs in sulphur-bearing rock, so-called "sulphide mining" carries an elevated risk of waste rock and tailings developing acid mine drainage and metal leaching. These interconnected chemical processes occur when subsurface, sulphur-bearing materials are exposed to and react with water and air, creating sulphuric acid.[66] Because dangerous metals like lead, zinc, copper and mercury become more soluble in acidic conditions, a positive feedback

loop develops where increasingly acidic mine runoff becomes laced with higher and higher concentrations of toxins.[67] Paradoxically, acid mine drainage does not necessarily occur immediately and may take years, decades or even centuries to develop.[68] Abandoned mine sites like Wawa's MacLeod mine are ticking time bombs: Once water levels in open pits and craters hit a certain point the production of sulphuric acid and the leaching of dangerous metals can occur.[69] Two abandoned Noranda Minerals Inc.-owned mines near Manitouwadge, Ont. will generate acidic, heavy metal-contaminated runoff in perpetuity.[70]

Leaching of arsenic, selenium and molybdenum can also occur in neutral and alkaline conditions.[71] Needless to say, the costs of dealing with such challenges are steep, and the need for monitoring is perpetual. At the closed White Pine Mine in Ontanogan, underground mining released mineral-laced groundwater into surface water, with Mineral River, a Lake Superior tributary, containing 10 times the concentration of dissolved solids in seawater.[72] A 2009 Lake Superior Binational Program report indicated that in 50 years, the Mineral River would not be able to support life and a four-hectare area at its mouth on Lake Superior would reach "chronic toxicity."[73]

Dangerous chemicals like ammonia, cyanide and grease are used in everything from explosives to access ore bodies, processing to separate the small percentage of valuable minerals from tailings and lubricating mine equipment, and all have been known to enter the environment and exceed government regulations.[74] Most processing techniques employ vast quantities of freshwater. At the Hemlo gold mines east of Marathon, water is used to separate the gold from the tailings. In the case of the now-closed Golden Giant and David Bell mines, metal-laced effluent is then flushed into nearby Lim Lake. According to Newmont Mining's original predictions Golden Giant, dissolved metals would be contained in Lim Lake and not detectable downstream in the White River watershed, which flows into Lake Superior. However, it was shown that effluent not only contaminated Lim Lake, but also impacted water quality and effected aquatic biota far downstream: Provincial Water Quality Objectives were not met for more than 20 kilometres from the point of discharge.[75]

Finally, there are the impacts of using heat to refine and process raw materials into desirable commodities. Known as smelting, sintering or roasting, these "pyrometallurgical" processes can release sulphur and toxic metal particles into the atmosphere. Over time, massive swaths of "dead zones" occur when it drops as acid rain on the earth, and soil resources become laced with elevated metal concentrations. Algoma Ore Division's now-defunct sintering operations in Wawa are a prime example, which resulted in a 100,000-hectare, 40-kilometre-long "fume kill" area of barren rock and acidic soil.[76] A Ministry of the Environment (MOE) study showed that soil levels of arsenic were up to 50 times the MOE guidelines in the area; and the study estimated the risk of cancer to Wawa residents as a result of exposure to arsenic was 100 times the level used to set provincial standards.[77]

A less documented, longer-term impact of mining in the Lake Superior basin is the unknown number of abandoned exploration projects and mine sites in the region. The Ontario MNDMF estimates that the province has over 5,700 abandoned mines, with about 4,000 listed as being hazardous to public safety and/or the environment.[78] The Ontario government committed over $100 million of public funds to reclamation work.[79] There's no doubt that across the Lake Superior watershed there are dozens of these sites that have slipped beneath the radar and gone unchecked, and could be polluting water sources with deadly sulphuric acid and toxic metals. Northwatch's research in 2001 revealed a number of examples of contemporary mines with significant red flags: At the recently played out David Bell mine in Hemlo, Northwatch noted that groundwater contaminated with copper, zinc and molybdenum seeped outwards from the tailings area, likely leading to long-term effects on aquatic ecosystems.[80] Tailings pond effluent at the decommissioned Winston Lake Mine near Schreiber, Ont. was sluiced into the mine's underground workings where it was likely to be contaminated by sulphuric acid and metals and could eventually penetrate bedrock fractures and enter the Whitesand River, which flows into Lake Superior.[81]

Critical in the Lake Superior basin is considering the impacts of mining in light of the environmental objectives established by the Great Lakes Water Quality Agreement. Signed between the United States and Canada in 1978 "to restore and enhance water quality in the Great Lakes System," the GLWQA formed Lakewide Management Plans (LaMPs) for each Great Lake.[82] Unique to the Lake Superior LaMP was the concept of a Zero Discharge Demonstration Program, which was launched in 1991. Using 1990 basin-wide emissions of mercury and other toxins as a baseline, this program endeavours to reduce toxins entering Lake Superior to zero discharges and emissions in a stepwise manner by 2020. By 2005, emissions were reduced by 71 percent of 1990 levels.[83] However, organizations like the Sault Ste. Marie, Mich.-based Chippewa Ottawa Resource Authority (CORA) have noted that this binational toxic strategy could be sacrificed due to a "rapid and unprecedented proliferation of mining."[84]

Michigan Tech University researcher W. Charles Kerfoot indicates that mining has released the bulk of toxins into the atmosphere and watershed over the past century. For example, Reserve Mining Company's taconite (an iron ore and clay product that's used to fuel blast furnaces) mine in Silver Bay, Minnesota, dumped 500 million tonnes of asbestos-laced materials directly into Lake Superior between 1955 and 1980.[85] Until recently, there was no mandatory reporting of mercury emissions, with companies maintaining a "don't look, don't tell" approach. However, Kerfoot's research suggests that mines in the Nipigon region on Lake Superior's Canadian shore released 115 tonnes of mercury a century ago;[86] he estimated that today's Hemlo operations could release at least 55 tonnes of atmospheric mercury over their lifecycle[87]; and Minnesota's iron mines are the currently leading the region's mercury outputs at approximately 300 kilograms per year.[88]

It follows that Kerfoot estimates suggest that Lake Superior has accumulated trace metals at rates five to eight times what would be expected from "normal atmospheric deposition."[89] Indeed, as long as the current practices of mining operations continue in the basin, Lake Superior Zero Discharge Demonstration Program will never succeed. Additionally, CORA indicates that with Ontario government pushing to develop chromite

mines in the so-called "Ring of Fire" region north of Thunder Bay, there is the potential that new smelters in the region could further inhibit plans to eliminate the release of toxins into Lake Superior.[90]

This environmental legacy makes it clear that mining is not a temporary use of land. The impacts are long-standing, and time will tell if today's legislation will have any effect on environmental quality when boom turns to bust. What's more, the public holds significant liability for the closure and long-term maintenance of mines because the financial securities posted by the mining companies are inevitably much lower than actual costs, which may transcend generations due to acid mine drainage, metal leaching and groundwater contamination. CORA has gone so far as to call for prohibiting open pit mines (such as the proposed Marathon PGM and PolyMet mines) altogether, arguing "the threat posed by open pit sulfide mining is unprecedented and will necessarily impinge on the GLWQA and many other initiatives," such as toxics reductions, air quality, wetlands protection and habitat conservation.[91]

However, the recent spree of new discoveries has revealed the same old mentalities. The Kennecott Eagle mine was approved despite a number of red flags: A landscape-altering footprint that will destroy a productive terrestrial environment that's home to rare species of plants; mining operations and tailings storage in close proximity to the Salmon Trout River, the only river remaining on Lake Superior's American shore that provides habitat for endangered coaster brook trout; and a sulphur-based geology that has good odds of producing perpetual acid mine drainage.[92]

Whether it's the destruction of productive fisheries, contaminated soil and water resources, impacts to tourism, the loss of spiritual or aesthetically pleasing sites, or the direct health impacts to miners themselves, mineral development has a way of reminding us that human lives are inextricably connected to the environment. Too often, it seems, the short-term economic benefits of mining win out over the longer-term environmental and social impacts.

Social Impacts: The Other Side of the Mine

The economic benefits of mining—in the short term, at least—are clear. With so much money to be made investors and government agencies have been quick to support the industry. But while stock market figures steadily rise, the tide is slowly changing in the communities that host mining developments. In 2001, Northwatch reported on the incidence of silicosis in Hemlo miners, the lack of impact-benefit agreements between First Nations and mining companies, and the threat of arsenic-poisoned soil in the vicinity of Algoma Ore Division's abandoned Wawa sinter operations. These concerns remain strong today in mining communities, along with new revelations of the dangers of sinking all hope in what is essentially a temporary industry, and a growing resentment towards the adverse effects resource extraction has on sustainable industries like tourism. In spite of governments' inability to fully grasp the perpetual impacts of mining on the environment, communities have become more wary of promises of short-term jobs and prosperity.

The ongoing situation on the Yellow Dog Plains near Marquette offers a prime example. Over time, the region's historic iron mining-based economy has morphed into one dependent on tourism. A Michigan State University study revealed that tourism was worth $85 million in Marquette County in 2000, with 1,761 direct jobs supported by the industry.[93] There's little to suggest that this value cannot be sustained or even increased in the long-term, with tourism revenue and jobs increasing by 19 and 14 over 1998 values, repectively.[94] The Kennecott Eagle mine, on the other hand, is projecting 500 construction jobs and 200 permanent jobs over its six-year life cycle.[95] Over 15,000 Michigan residents have called on governor Rick Snyder to dismiss the project, arguing that its pending environmental impacts and threats to the tourism industry aren't worth its short term benefits.[96] For local residents, the nearby Deer Lake Area of Concern speaks to the costly impacts of mining: Historic gold operations contaminated Deer Lake and Carp River with mercury, rendering fish unsafe to eat and curbing the reproductive capacities of birds and animals.[97] With Kennecott located in relatively wild, headwaters region that feeds the last remaining coaster brook trout rivers on Lake Superior's south

shore and hosts endangered plant communities, the potential consequences of development outweigh any promised benefits.

More ignorant and insulting is Kennecott Eagle's outright dismissal of local First Nations concern over the plan to drill a mine portal into Eagle Rock, a significant spiritual site. Indigenous groups across the Lake Superior watershed are standing up for their treaty rights to negotiation with regards to mining exploration and development on traditional land. In a 2011 letter to the U.S. Environmental Protection Agency, the Chippewa Ottawa Resource Authority insists that tribal and First Nation involvement in evaluating future mining proposals is imperative on a "government to government basis" to reflect treaty and traditional land use rights.[98]

Other communities have taken different approaches when mining prospects loom in their region. Members of the community watchdog group Citizens for a Responsible Mine in Marathon resigned that it would be "political suicide" to oppose the proposed Marathon PGM mine altogether given the region's depressed economy.[99] Instead, they took a more constructive approach, actively agreeing to welcome the development so long as it met all environmental regulations. Their first objective was to eliminate Marathon PGM's proposal to dump its waste rock and tailings into Bamoos Lake. When the company relented to this request in the summer of 2010, community members lobbied for a panel review environmental assessment under the Canada Environmental Assessment Act.[100] This case highlights a growing public awareness of the impacts of mining and overall skepticism of government regulations and corporate promises.

The future of mining promises fewer and fewer jobs, as large-scale multinationals seek to minimize costs through automation and new technology. These trends are already well underway: According to the Lake Superior Binational Program the workforce in Minnesota iron mines has decreased by 83 percent since 1979.[101] This fact of improved technology has done little to settle the volatile, boom-bust economy of mining communities. Rio Tinto, the same company promising plenty of nickel mining jobs at its Kennecott Eagle mine in northern Michigan, touts robotic mining as the industry's future.

According to its website, mines will be managed and operated from remote office complexes, rendering the traditional blue-collar role of miners obsolete. Rio Tinto's trademarked "Mine of the Future" is already being piloted in Australia.[102] According to the company, the future of mining includes "unprecedented levels in automation," with "some of the roles currently based at the mine site…based in a city thousands of kilometres away."[103] Ironically, it's foreseeable that local ore bodies will be fully exploited and the tourism industry long since vanished due to environmental degradation by the time residents of northern Michigan get to experience the "Mine of the Future."

On the Horizon

Of the many insights revealed by 150 years of mining in the Lake Superior basin, three general trends stand out: The oft-touted economic benefits rarely match environmental and social impacts; government policy and decision-making protocols highly favour development; and, ultimately, if the objectives of international accords like the Great Lakes Water Quality Agreement are to be met, the premise and practices of mining require critical updates. With the next wave of mining poised to begin operations on all sides of Lake Superior's perimeter and intense exploration suggesting more developments to come, it is imperative to address these issues immediately.

Pressure is mounting on governments to rethink their attitudes towards mines. In Michigan, the Chippewa Ojibwa Resource Authority has offered compelling arguments to make minimizing mining-related threats a key component to the Lake Superior Lakewide Management Process. Indeed, it is critical to assess the impacts and benefits of mining in the Lake Superior basin from a variety of angles—including achieving the objectives of the Great Lakes Water Quality Agreement and upholding Lake Superior Zero Discharge Demonstration Program. To this end, CORA suggests the concept smaller-scale, "micro-mining" projects that yield fewer environmental impacts and "longer and more sustained benefits"[104] to communities. Since all of today's generation of mine proposals involve potentially acid-generating sulphide rock, small, underground mines could be the best way to contain overall impacts.

In Ontario, provincial Environmental Commissioner Gord Miller has highlighted the need for mining legislation reform in his annual "watchdog" report of environmental policies and practice. For too long, mining exploration and development have only been subject to a piecemeal, uncoordinated review by various government agencies and exempt from comprehensive provincial environmental assessments altogether. "Once mine exploration has occurred, and there is a desire to build a mine, industry pressure is such that it is virtually impossible to prohibit this development in order to respect other land uses and objectives," notes Miller[105]—a trend that's pervasive on either side of the Canada-U.S. border.

A key to more responsible decision making that's been highlighted by Miller, MiningWatch Canada and many other environmental organization is the need for comprehensive assessments that take all impacts and benefits—present and future—into account. Alarming elements are common in all of the current generation of mining proposals. In the case of Kennecott Eagle's proposed Marquette mine, these include habitat impacts to endangered species of flora and fauna, the potential for long-term acid mine drainage, impacts to the local tourism industry and the destruction of a sacred site to local First Nations. While each of these negative impacts can be mitigated individually with various degrees of certainty, taken as a whole the project is clearly a juggling act.

The power of coordinated, all-encompassing, independent review is clear in the case of the *Canadian Environmental Assessment Act*'s panel review approach to EA. Last November, a panel of independent experts rejected Taseko Mines' Prosperity project in Williams Lake, B.C., arguing that its "significant environmental effects"[106] could not be justified. It is this kind of unbiased assessment that yields appropriate decisions.

Meanwhile, mining activities continue and the environmental legacy of today's mines will likely befall future generations until developers own up to the full, decades-long costs of mining. The current trend of mining giants creating sacrificial subsidiaries and "mining the market" for banks, brokers, fund managers, and individual investors means

that even large companies do not use their own money to finance a project. This could lead to trouble in the future, like when the Eagle deposit at Marquette dries up, Kennecott disappears into oblivion and Rio Tinto claims ignorance from its London, U.K. head offices.

It is concerning that the concluding remarks from a decade ago in Northwatch's UnderMining Superior report remain valid today:

> But what will we learn from the hard lessons taught by more than a century of mining on Lake Superior? We face a new century with the still un-met challenge to make Lake Superior a demonstration zone for zero discharge of persistent toxic pollution and ecosystem stewardship. And as fervently as we can envision healthy, diverse economies, clean water, clean air and renewed landscapes, the shifting shape of mining's global footprint poses serious challenges for Lake Superior's future.[107]

At least we can consider ourselves forewarned.

End Notes

[1] See: http://www.geo.mtu.edu/great_lakes/MCRS/

[2] Ibid.

[3] Lake Superior Binational Program: Mining in the Lake Superior Basin Webinar Series. "Overview of Mining in the Lake Superior Basin—Background Information". 13 January 2009.

[4] Ibid.

[5] W. Charles Kerfoot, Jaebong Jeong, John A. Robbins: "Lake Superior Mining and The Proposed Mercury Zero-discharge Region" (Draft version). In "State of Lake Superior" (2007). M. Munawar (ed.).

[6] Ibid.

[7] Ibid.

[8] Ibid. Kerfoot et al. indicate that there is a "high correlation" between copper and mercury in parent ore bodies. Historically, the authors note, there was "no surveillance" of mining operations. "How many tailings dams have failed and how many closed mines have leaked heavy metals and acid mine drainage into streams and rivers?"

[9] See: http://www.epa.gov/glnpo/aoc/trchlke.html

[10] Ibid.

[11] W. Charles Kerfoot, Jaebong Jeong, John A. Robbins: "Lake Superior Mining and The Proposed Mercury Zero-discharge Region" (Draft version). In "State of Lake Superior" (2007). M. Munawar (ed.). See pp. 44

[12] W. Charles Kerfoot, Jaebong Jeong, John A. Robbins (2007). "Lake Superior Mining and The Proposed Mercury Zero-discharge Region" (Draft version). In "State of Lake Superior", M. Munawar (ed.).

[13] Ontario Prospectors Association (2011). "Ontario Mining and Exploration Directory 2011". Available online at:

[14] Mark Severson (2006). "Trends in Mining". A presentation to the Lake Superior Binational Forum Public Information Session, Hibbing, Minn.

[15] Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[16] See: http://www.miningwatch.ca/en/incomplete-reporting-still-reveals-mining-companies-toxic-threat-environmental-groups-worry-some-can

[17] For example: http://citizensforaresponsiblemineinmarathon.blogspot.com/; http://www.savethewildup.org

[18] Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[19] W. Charles Kerfoot, Jaebong Jeong, John A. Robbins (2007). "Lake Superior Mining and The Proposed Mercury Zero-discharge Region" (Draft version). In "State of Lake Superior", M. Munawar (ed.).

[20] Iron Range Resources and Rehabilitation Board (2008). Explore Minnesota: Iron Ore. Available online at: http://www.ironrangeresources.org/mining-timber/minerals

[21] Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[22] Ontario Prospectors Association (2011). "Ontario Mining and Exploration Directory 2011". Available online at:

[23] See: http://www.riotinto.com/media/18435_media_releases_19294.asp

[24] See: http://citizensforaresponsiblemineinmarathon.blogspot.com/

[25] See: http://www.marathonpgmproject.com/

[26] See: http://www.polymetmining.com/business.php

[27] See: http://www.orvana.com/projects/copperwood/index.html

[28] See: http://www.osisko.com/pdfs/HammondReef_FactSheet.pdf, http://www2.mpmo-bggp.gc.ca/MPTracker/Project-Projet-01.aspx?PID=147, http://www.atikokanprogress.ca/2011/04/21/osisko-hammond-reef-gold-wont-be-involved-in-old-steep-rock-site/. According to Annette Tobin of the Government of Canada's Major Projects Management Office in an email dated 29 April 2011, in late April 2011 the CEAA began its "90-day pre-environmental assessment planning period to determine if a comprehensive study should be commenced. The CEA Agency will be distributing the project description to federal authorities to determine their interest in the project."

[29] See: http://www.bitterrootresources.com/s/Upper-Peninsula.asp

[30] For example: http://www.chalicediamond.com/s/NewsReleases.asp?ReportID=420435

[31] Ontario Prospectors Association (2011). "Ontario Mining and Exploration Directory 2011". Available online at:

[32] Ibid.

[33] Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[34] For example: http://www.savethewildup.org/sulfide_101/, http://wn.com/1_Kennecott_Eagle_Mine_Stomping_on_Native_American_Rights

[35] See: ttp://www.yellowdogwatershed.org/blog/sulfide-mining-campaign/ "Kennecott applied for a permit to fence of 120 acres of public land to build their crushing facility, rock storage facility, and waste water building. The State recently granted them this permit even though this much land has never been removed from public access for this long in the state's history, 120 acres for 40 years."

[36] See: http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90m14_e.htm

[37] See: http://www.miningwatch.ca/en/environmental-commissioner-ontario-calls-major-overhaul-mining-act. For more information, see Gord Miller (2007) "Reconciling our Priorities: Environmental Commissioner of Ontario Annual Report 2006-2007" pp. 64-69. Available online at: http://www.eco.on.ca/eng/index.php/pubs/eco-publications/2006-07-annual-report.php

[38] See: http://www.blm.gov/wo/st/en/info/regulations/mining_claims.html

[39] Marilyn Crawford (2007) "Facts about the Ontario Mining Act: The System of Free Entry" Available online at: www.uraniumcitizensinquiry.com/submissions/submission188.doc

[40] See: MiningWatch Canada (2007) "Mining Investors and the Tax System" Available online at: http://www.miningwatch.ca/en/mining-investors-and-tax-system

[41] Ibid. See also: Joan Kuyek (2007) "Mining Investors: Understanding the legal structure of a mining company and identifying its management, shareholders and relationship with the financial markets" MiningWatch Canada. Available online at: http://www.miningwatch.ca/en/mining-investors-resource-available

[42] Gord Miller (2007) "Reconciling our Priorities: Environmental Commissioner of Ontario Annual Report 2006-2007" pp. 64-69. Available online at: http://www.eco.on.ca/eng/index.php/pubs/ecopublications/2006-07-annual-report.php

[43] http://www.miningwatch.ca/en/another-three-year-delay-environmental-assessment-mining-ontario

[44] Michigan Department of Natural Resources and Environment—Office of Geological Survey (Year unknown) "Regulatory Requirements for Metallic Mining in Michigan". Available online at: http://www.lic.wisc.edu/glifwc/binational/ (See: W5_P1_MI Regs_Maki1.pdf)

[45] See: http://www.savethewildup.org/blog/wave-group-petitions-governor-snyder/

[46] For more information see: http://www.ceaa.gc.ca/010/basics_e.htm

[47] For Kemess North project see: http://www.ceaa.gc.ca/052/details-eng.cfm?pid=3394. For Taseko (Prosperity Mine) project see: http://www.ec.gc.ca/default.asp?lang=En&n= 714D9AAE-1&news=59F03FA9-63AD-4EED-A14F-04BBF32906CF and www.ceaa.gc.ca/050/documents/41844/41844E.pdf

[48] Quoted by Gord Miller, Environmental Commissioner of Ontario. See: http://www.ecoissues.ca/index.php/Reforming_Mining_Law

[49] See: http://citizensforaresponsiblemineinmarathon.blogspot.com/

[50] Jane A. TenEyck, executive director of the Chippewa Ottawa Resource Authority, described the Marathon PGM project in a letter to the U.S. Environmental Protection Agency's Great Lakes National Program office dated 3 March 2011.

[51] Ibid.

[52] See: http://www.savethewildup.org/sulfide_101/

[53] See: http://www.miningwatch.ca/en/incomplete-reporting-still-reveals-mining-companies-toxic-threat-environmental-groups-worry-some-can. "Data released late last week through Canada's National Pollutant Release Inventory (NPRI) reveals for the first time some of the pollutants released by mines to their tailings and waste rock dumps between 2006 and 2009. It showed approximately two million tonnes of pollutants placed in tailing and waste rock piles between 2006 and 2009."

[54] See: http://www.miningwatch.ca/en/two-million-tonnes-day-mine-waste-primer

[55] Ibid.

[56] See: http://www.ec.gc.ca/pdb/websol/querysite/facility_substance_summary_e.cfm?opt_npri_id=0000003197&opt_report_year=2009

[57] See: http://www.miningwatch.ca/en/two-million-tonnes-day-mine-waste-primer

[58] See: http://ecorestoration.montana.edu/mineland/histories/metal/white_pine/default.htm

[59] Lake Superior Binational Program—Mining in the Lake Superior Basin Online Workshop Series. Part II: Environmental Impacts of Mining in the Lake Superior Basin—Background Information. 25 March 2009. "The tailings are powder sized and caused dust storms that reached the nearby town of White Pine…"

[60] See: http://ecorestoration.montana.edu/mineland/histories/metal/white_pine/default.htm

[61] Ibid.

[62] Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[63] See: http://www.miningwatch.ca/en/schedule-2-getting-around-protection-lakes-and-rivers; and *Fisheries Act* Metal Mining Effluent Regulations: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/FullText.html and http://www.ceaa-acee.gc.ca/050/documents/42822/42822E.pdf (slides 4 to 8)

[64] See: http://citizensforaresponsiblemineinmarathon.blogspot.com/p/bamoos-lake.html

[65] See: http://citizensforaresponsiblemineinmarathon.blogspot.com/2010/07/ marathonpgm-withdraws-bamoos-option.html

[66] See, for example: http://www.miningwatch.ca/en/emcbc-mining-and-environment-primer-acid-mine-drainage and Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[67] Ibid.

[68] Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[69] Ibid.

[70] Ibid.

[71] Bill Price (Environment Group, Mining and Mineral Sciences Lab, Natural Resources Canada). "What are Metal Leaching and Acid Rock Drainage and Why are They Important to Mining?" A presentatio to the Lake Superior Working Group Workshop. 27 October 2009 Available online at: http://www.lic.wisc.edu/glifwc/binational/ (See: W4_P2_Price 2009 Introduction Lake Superior ARD Notes short.pdf)

[72] Lake Superior Binational Program—Mining in the Lake Superior Basin Online Workshop Series. Part II: Environmental Impacts of Mining in the Lake Superior Basin—Background Information. 25 March 2009.

[73] Ibid.

[74] Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[75] Ibid.

[76] Ibid. A summary and full report is available from the Ministry of the Environment: www.downloads.ene.gov.on.ca/envision/sudbury/survey_of_arsenic/01_summary.pdf

[77] Ibid.

[78] See: http://www.mndmf.gov.on.ca/mines/mg/abanmin/default_e.asp

[79] Ibid.

[80] Northwatch (2001). "UnderMining Superior: A Report on Mining Activities and Impacts in the Lake Superior Basin". Available online at: http://www.web.ca/~nwatch/

[81] Ibid.

[82] See: http://www.ijc.org/en/activities/consultations/glwqa/agreement.php

[83] See: W. Charles Kerfoot, Jaebong Jeong, John A. Robbins: "Lake Superior Mining and The Proposed Mercury Zero-discharge Region" (Draft version). In "State of Lake Superior" (2007). M. Munawar (ed.) and Lake Superior Binational Program—Mining in the Lake Superior Basin Online Workshop Series. Part II: Environmental Impacts of Mining in the Lake Superior Basin—Background Information. 25 March 2009.

[84] In a letter to the U.S. Environmental Protection Agency's Great Lakes National Program office dated 3 March 2011, Jane A. TenEyck, executive director of the Chippewa Ottawa Resource Authority, expressed concerns that mining will compromise the objectives of the Lake Superior Zero Discharge Demonstration Program and the overall goals of the Great Lakes Water Quality Agreement.

[85] See: W. Charles Kerfoot, Jaebong Jeong, John A. Robbins: "Lake Superior Mining and The Proposed Mercury Zero-discharge Region" (Draft version). In "State of Lake Superior" (2007). M. Munawar (ed.)

[86] Ibid.

[87] Ibid.

[88] See: Lake Superior Binational Program: Mining in the Lake Superior Basin Webinar Series. "Overview of Mining in the Lake Superior Basin—Background Information". 13 January 2009. Taconite (iron ore) mining in the Lake Superior basin produced 303 kilograms of atmospheric mercury emissions in 2005.

[89] See: W. Charles Kerfoot, Jaebong Jeong, John A. Robbins: "Lake Superior Mining and The Proposed Mercury Zero-discharge Region" (Draft version). In "State of Lake Superior" (2007). M. Munawar (ed.)

[90] Chippewa Ottawa Resource Authority letter to the U.S. Environmental Protection Agency's Great Lakes National Program office dated 3 March 2011.

[91] Ibid.

[92] See: http://www.savethewildup.org/sulfide_101/

[93] Daniel J. Stynes (2001) "Economic Importance of Tourism to Marquette County, Michigan" Research supported by Tourism Michigan and Michigan State University. Available online at: www.web4.canr.msu.edu/mgm2/econ/miteim/satellite/marquettesat .pdf

[94] Ibid.

[95] Bruce Edward Walter (2010) "Michigan Mine Clears Permitting Hurdles" The Heartland Institute. Available online at: www.kennecotteagleminerals.com/library/media/ Heartland_Institute.pdf

[96] See: http://www.savethewildup.org/blog/wave-group-petitions-governor-snyder/

[97] See: http://www.epa.gov/glnpo/aoc/drlake.html In 1981, mercury contamination of fish in Deer Lake exceeded the 1.5 mg/kg "ban on total consumption." The elemental mercury pollution stems from the Ropes Gold and Silver Company, which mined in the area between 1882 and 1897. According to the

USEPA, Beneficial Use Impairments include: Restrictions on fish and wildlife consumption; bird or animal deformities of reproductive problems; and eutrophication or undesirable algae.

[98] Chippewa Ottawa Resource Authority letter to the U.S. Environmental Protection Agency's Great Lakes National Program office dated 3 March 2011.

[99] See: Conor Mihell (2010) "Frontier Conservation" In *ON Nature* magazine. Available online at: http://onnaturemagazine.com/frontier-conservation.html

[100] See: http://citizensforaresponsiblemineinmarathon.blogspot.com/ for an overview of Marathon PGM developments

[101] See: Lake Superior Binational Program: Mining in the Lake Superior Basin Webinar Series. "Overview of Mining in the Lake Superior Basin—Background Information". 13 January 2009.

[102] See: http://www.riotinto.com/ourapproach/17203_mine_of_the_future.asp

[103] Ibid.

[104] Chippewa Ottawa Resource Authority letter to the U.S. Environmental Protection Agency's Great Lakes National Program office dated 3 March 2011.

[105] See: Gord Miller (2007) "Reconciling our Priorities: Environmental Commissioner of Ontario Annual Report 2006-2007" pp. 64-69. Available online at: http://www.eco.on.ca/eng/index.php/pubs/eco-publications/2006-07-annual-report.php and http://www.ecoissues.ca/index.php/Reforming_Mining_Law and

[106] See: http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=59F03FA9-63AD-4EED-A14F-04BBF32906CF On 2 November 2010 the Government of Canada rejected Taseko Mines proposed Prosperity Mine in Williams Lake, B.C. based on the findings of a review panel. "'The Government has considered both projects carefully, particularly their environmental impacts,' said Environment Minister, Jim Prentice. 'We believe in balancing resource stewardship with economic development… the significant adverse environmental effects of the Prosperity project cannot be justified as it is currently proposed.'"

Appendix 1 (a): Active Mines in the Lake Superior Basin

Name/Location	Type	Production/Reserves	Notes
Hemlo/Williams Mine (Barrick Gold Corp., Marathon, Ont.)	Gold; underground	245,000 oz (1.3 M oz remaining)	- According to the National Pollutant Release Inventory (onsite disposals in 2009): 346,000 kg arsenic, 12,983 kg cadmium, 581,137 kg lead, 2,157 kg mercury, 62 tonnes chromium, 44 tonnes copper, 38 tonnes nickel
Eagle River Mine (Wesdome Gold Mines, Wawa, Ont.)	Gold; underground	38,000 oz (400,000 oz remaining)	- Nearby "Mishi" open pit mine has been in development pipeline for more than a decade
Island Gold Mine (Richmont Mines Inc., Wawa, Ont.)	Gold; underground	45,000 oz (264,085 oz remaining)	- Intense exploration continues in this area to discover additional ore deposits - Processing releases 3.5 tonnes of ammonia, 4.9 tonnes of nitrate and 30 kilograms of cyanide into water sources (2009, according to NPRI)
Lac Des Iles Mine (North American Palladium Ltd., Thunder Bay, Ont.)	Platinum, palladium, gold, nickel, copper; open pit, underground	13,000 tonnes/day (production rate) and 11.4 M tonnes remaining (open pit); 2,000 tonnes/day (underground)	- Closed from Oct. 2008 to Apr. 2010 due to market conditions
Hibbing Taconite (Cliffs Natural Resources, Hibbing, Minn.)	Taconite (iron ore), open pit	7.3 million tons	- Minnesota's Masabi Range taconite (iron ore and clay) mines produce 75% of the U.S. supply of iron ore - In 2005, taconite mines are responsible for 91% of mining-related atmospheric mercury emissions in the Lake Superior basin (303 kg) - Tailings at Masabi Range mines typically contain 30 to 45% usable iron ore content, making reprocessing of waste a possibility
Keewatin Taconite (U.S. Steel, Keewatin, Minn.)	Taconite (iron ore), open pit	5.2 million tons	
Minntac (U.S. Steel, Mt. Iron, Minn.)	Taconite (iron ore), open pit	12.8 million tons	
Minorca Mine (ArcelorMittal, Virginia, Minn.)	Taconite (iron ore), open pit	2.5 million tons	
Northshore Mine (Cliffs Natural Resources, Silver Bay, Minn.)	Taconite (iron ore), open pit	5.0 million tons	
United Taconite (Cliffs Natural Resources, Eveleth, Minn.)	Taconite (iron ore), open pit	5.3 million tons	

Appendix 1 (b): Pending Mines in the Lake Superior Basin

Name	Location	Type	Notes
Marathon PGM	Marathon, Ont.	Palladium group; open pit	- Tailings to be contained by a series of dams that will reroute 13 watersheds; 27-storey-tall waste rock piles. - 1,000-hectare open pit in sulphide rock increases likelihood of "perpetual maintenance."
Osisko Hammond Reef Gold Mine	Atikokan, Ont.	Gold; open pit	- According to the proponent, the Hammond Reef Gold Mine would require the draining of Mitta Lake for one of its two open pits. - Proposed open pits would measure 345 and 225 metres deep. - The proponent has applied to the Major Projects Management office to determine the level of federal environmental assessment. - If assessment goes according to Osisko's plans, the mine will be operational by 2016.
Essar Steel Minnesota	Nashwauk, Minn.	Taconite (iron ore)	- A $1.65 billion project to reopen an abandoned iron ore mine and produce steel - Projected to begin mining in 2012
PolyMet	Hoyt Lakes, Minn.	Copper, nickel, palladium group; open pit	- Open pit in sulphide rock increases likelihood of "perpetual maintenance" - The U.S. EPA rated that PolyMet's 2010 environmental assessment was "Environmentally Unsatisfactory – Inadequate" due to the potential for "substantial and unacceptable adverse impacts on aquatic resources of national importance." - In 2011, PolyMet announced plans to process some materials offsite, decreasing environmental impacts but also eliminating 40 permanent jobs
Kennecott Eagle Mine	Big Bay, Mich.	Copper, nickel; underground	- 30,000 tonnes/year copper and nickel with 6 years of reserves - 120 acres of public land awarded for mining - Tailings to be stored adjacent to Salmon Trout River, the last U.S. waterway providing habitat for coaster brook trout

Appendix 1(c): Closed Mines in the Lake Superior Basin (since 1990)

Name	Location	Type	Notes
Algoma Ore Division	Wawa, Ont.	Iron ore; open pit	- Arsenic in soil near former processing (sinter) plant measures 1,000 ug/g - 100,000-hectare "Fume Kill" zone due to acid fallout - Mine sites require long-term monitoring for acid mine drainage - Fume Kill area is site of current diamond exploration
Hemlo Mines (David Bell and Golden Giant)	Marathon, Ont.	Gold; underground and open pit	- Ground water contaminated with elevated levels of copper, molybdenum and zinc - Flooded tailings and underground workings require perpetual maintenance due to acid mine drainage and metal leaching
Inmet/Winston Lake Division	Schreiber, Ont.	Gold; underground	- Tailings pond effluent flooded mine shaft and could infiltrate bedrock and contaminate Whitesands River with sulphuric acid
LTV	Hoyt Lakes, Minn.	Taconite (iron ore); open pit	- Reopening pending approval of new Mesabi Nugget mine
White Pine Mine	Ontonagan County, Mich.	Copper, silver; underground	- Was one of the largest mines in the U.S. - Reclaimed 2,630 ha tailings area requires monitoring - Mine drainage continues to contaminate Mineral River (and Lake Superior) with dissolved metals - Advanced exploration continues in the area for nickel and copper by Orvana Minerals for its proposed Copperwood Mine

Appendix 2: The Mining Process

1.) Preliminary Exploration and Staking: Prospecting to identify potential ore bodies using geochemical or geophysical techniques. Once claims are staked, a prospectr may strip overburden and drill to obtain samples.

2.) Advanced Exploration and Development: Additional exploration and feasibility studies to determine ore body concentrations and profitability; mine site is planned and construction begins (shafts, pits, roads, hydro corridors and storage facilities).

3.) Mineral Extraction: Waste rock (overburden) is removed and discarded and remaining ore is transported to a mill for processing.

4.) Concentration/Beneficiation: The ore is crushed and ground at the mill and desired metals are extracted using gravity, magnetic or floatation techniques, often in a water-based solution which may contain chemicals like cyanide or mercury. The slurry-like byproducts of this stage are known as "tailings," which must be discarded and stored in contained "impoundment areas." Waste in most mines range from 95 to 99.995 percent of material mined.

5.) Further Processing: Pyrometallurgic (heat-based) processes like smelting, sintering or roasting are most often used to further refine mined materials and may change their chemical nature.

6.) Site Closure: Involves developing strategies to deal with the long-term impacts of mines—primarily containing wastes and dealing with the significant threat of tailings impoundment failures, as well as addressing dust issues, contaminated soils, capping mine shafts and open pits and attempting to revegetate the mine site. Due to the perpetual nature of acid mine drainage, closure often transcends mine property ownership and becomes the responsibility of taxpayers.

Appendix 3: Types of Mines

- Open Pit: Relatively low grade, dispersed mineral deposits that are found close to the surface are accessed by removing massive amounts of overburden–sometimes even entire mountain tops. The process creates a crater, frequently of vast proportions. The proposed Marathon PGM open pit mine would measure 1,000 hectares. The environmental impacts of active open pit mines stem from the fact that operations usually extend below the water table and require constant draining, which alters hydrology and pollutes surrounding waterways. Furthermore, the huge amount of material removed and exposed to water and air increases the likelihood and risks of acid mine drainage and metal leaching.

- Underground: This technique is used to access concentrated reserves that are buried deep in the earth's mantle and are accessed by drilled mine shafts. North America's deepest mine is located in Timmins, Ont. where Xstrata's Kidd Mine extracts copper and zinc at depths of more than 2,600 metres. While underground operations are less destructive than open-pit mining, the process still produces toxic waste materials that must be stored in tailings ponds on the surface.

- Quarry: This type of open pit mine produces aggregates – gravel-like mixes of bedrock, such as limestone, basalt, or shale that are used in the construction of highways and buildings. Besides concerns related to ground- and surface water contamination, quarries are also a significant source of dust and noise pollution, and destroy huge swaths of habitat.

Pic Forest / Forét Pic MU966 Nawiinginokiima Forest Management Corporation 2021-2031 Forest Management Plan Plan de gestion Forêstière 2021 - 2031 Summary Map / Carte Sommaire Harvest / Coupe

- Community/Ville
- Municipal/Other Road / Route Municipale/Autre
- Primary Road / Route primaire
- Highway / Autoroute
- OBM Grid / Grille cartographique OBM
- Strategic Management Zone / Zone de gestion stratégique
- Management Unit / Unité d'amenagement
- Branch Road Corridor / Corridor de route secondaire
- Primary Road Corridor / Corridor de route primaire
- Waterbody / Lacs ou Rivières
- Park/Conservation Reserve / Parc/Réserves de Conservation
- Federal/Other Land / Terres Fédérales/Autre
- Previous Depletions / Récolte Précédente (2002 - 2019)

Harvest / Coupe

- Regular / Régulière
- Bridging / Bloques à Ramener
- Second Pass / Coupe Secondaire
- Contingency / La Contingence

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Spatial Reference: NAD83 UTM ZONE 16
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