Imperial Metals

THE SCENE OF THE CRIME

A Preliminary Analysis and History of the Mount Polley Mine Tailings Storage Facility

Image Source: Risk & Liability in Geotechnical Engineering Symposium Poster, May 30, 2008, Vancouver.

By Will Koop
December 1, 2014
BC Tap Water Alliance
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Preface

British Columbia's Mount Polley copper/gold/silver mine waste tailings disaster of August 4, 2014, located near the western-most reach of Quesnel Lake, is among the largest recorded disasters, by volume, in world history, with updated estimates of about 25 million cubic meters of toxic waters and heavy metal mine waste contaminants having escaped into the nearby environments of Hazeltine Creek and Quesnel Lake, destroying and inundating everything in its path, a most terrible and preventable tragedy.

Though others are examining and lab sampling the repercussions and tragic aftermath of the disaster to the receiving environments - its various impacts on living organisms and fresh waters - and though others may be tracing the evolving narratives of how the mining company and the provincial government - set within a devolving political context of environmental deregulation - downplayed the disaster and are keeping a relatively tight lid on it, the focus of this report examines the history of the mine's waste tailings impoundment, which the mining industry and professional engineers more often refer to as a Tailings Storage Facility, or sometimes as a Tailings Management Facility.

This is the first investigative report on Mount Polley since the date of the disaster, 17 weeks previous, and provides an assessment and introductory history behind the inner workings of a terrible tragedy, of what appears to be an environmental crime. And, it is published during a time of interim darkness, as the BC government is temporarily withholding report and related information not already released concerning the planning and operations of the Mount Polley mine, perhaps until the early months of 2015 or later. That is when the reporting of one of a few separate investigations is scheduled for public release: a government-appointed three-panel member review committee (under narrow Terms of Reference) with a deadline to release a final report by January 31, 2015. Amongst the remainder, an internal, technical investigation launched by BC's Chief Inspector of Mines, Al Hoffman (see Appendix G).

In anticipation of those investigative findings, this report presents preliminary accounting and discoveries. It finds very disturbing and disconcerting matters: a mine waste tailings impoundment that was, according to professional engineers the world over, designed inappropriately; accounts from the mine's professional engineers (called the Engineer of Record) that for many years the mining company irresponsibly maintained and monitored its mine waste tailings impoundment. The Tailings Storage Facility is where 60 million or more cubic meters of mined toxic tailing wastes, mine effluent and tailings tainted waters were supposed to be safely stored forever, "in perpetuity."

A large collection of government and mining company information reports was retrieved from various sources, gathered for the most part by the author during his 'holidays' in mid September 2014 (for instance, at the Williams Lake public library), from other parties, and the internet. Thank you to those unnamed sources who freely provided the reports. The author also participated in a private tour of the mine's tailings impoundment on September 16th.

As stated in the title, this is a preliminary report, because only a limited number of annual and special reports submitted to the government by the Mount Polley Mining Corporation were previously made public. As such, the author's report may be updated and revised as more information comes to light, and may therefore be considered a living document. The intense, 'on the side' research analysis and writing of this report, conducted over a nine-week period, was self-financed and self-edited.

Will Koop, December 1, 2014

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EXECUTIVE SUMMARY

To minimize the risk to which a company is exposed during the lifetime of development of a waste storage site, proper operational control is vitally necessary. ... It is now recognized that a mine waste storage facility is not a temporary asset, that can be disposed of at the end of its useful life. If not decommissioned and closed in an environmentally and socially acceptable manner, including a viable after use, it will constitute an ongoing liability not only to the operating company and its successors, but also to the local community, the country in which it is situated and the rest of the world. (Geoffrey Blight, *Geotechnical Engineering for Mine Waste Storage Facilities*, 2010, page 1)

This preliminary report, with eleven chapters and 16 appendixes, examines the evolutionary history of the Mount Polley copper/gold/silver mine's Tailing Storage Facility (TSF), a 235-hectare, sequentially-raised, multi-component dam that was designed and licensed to safely contain and forever store extraordinarily large volumes of mined waste heavy metals, effluents and contaminated site water.

The Mount Polley Breach

In the early hours of Monday morning August 4, 2014, a statutory, provincial holiday in British Columbia, Canada, the Mount Polley tailings dam broke open, releasing a massive volume of the dam's contents over a period of many hours, causing a violent, destructive and contaminating environmental catastrophe to the Hazeltine Creek watershed and to the western extremity of Quesnel Lake.

According to an updated internet inventory by WISE (World Information Service on Energy Uranium Project, 2014, Chronology of Major Tailings Dam Failures, November 16, 2014) of the numerous mine tailings impoundment failure disasters that have occurred throughout the world since 1961, the Mount Polley catastrophe is among the world's largest, by total volume. The largest, in a "major tailings dam failures" category of 97, appears to have occurred in January 1992, where 80 million tonnes of copper mine tailings (equivalent to about 55 to 60 million cubic meters) were released from Hong-Kong based Philex Mining Corporation's Number 2 tailings pond, into the receiving environment of Padcal, Luzon, in the Philippines. No release volume statistics are yet available for 19 (20 percent) of the world's 97 major tailings failures. In total, there are over 3,500 tailings impoundments the world over, with a failure rate in the range of two to five per year, with 83 percent failures attributable to 'active' dams.

Based on monthly tailings data collected from the Mount Polley Mining Company (see Appendixes K and I), at the time of the disaster the dam held over 10 million cubic meters of supernatant water, and about 87 million tonnes of tailings, the equivalent of about 62 million cubic meters of saturated tailings (a combination of about 35.5 million cubic meters of tailings, and about 26.5 million cubic meters of pore / interstitial water).

In a September 1, 2014 internet website update, Imperial Metals Corporation re-estimated its initial estimated escaped volumes upward by 10 million, to about a combined total of 25 million cubic meters of mixed mined heavy metals waste tailings and effluents, interstitial (tailings mass pore water) and supernatant waters. After examining Mount Polley's TSF water balance table data for 2013, the author of this report believes Imperial Metals Corp.'s estimated interstitial component volume was too low, and could be about 10 million cubic meters greater, bringing the final total figure of escapement to be somewhere in the neighbourhood of 35 million cubic meters.

By comparison to other similar disasters, the Mount Polley liquefaction failure event of about 25 million cubic meters (as re-estimated by Imperial Metals) was eight times larger, and many hours longer in duration, for instance, than the notorious 1997 tailings failure event in Los Frailes, Spain, a mine which was owned by Boliden Apirsa, a Canadian company that subsequently went bankrupt.

The "In Perpetuity" Mandate

Chapters One (*Big Questions*), Four (*Centreline Tailings Dam*), and Five (*The "In Perpetuity" Mandate and Mount Polley's Upstream Tailings Dam*) of this report describe how professionally designed and engineered mine waste tailings dams / impoundments, in which milled toxic heavy metal wastes and mill processing effluents are stored, are required to be constructed so as to last "in perpetuity," forever. In fact, Imperial Metals Corporation clearly stated this objective in Volume One of its *Stage 1 Environmental and Socioeconomic Impact Assessment* report of 1990: "the tailings pond ... will be designed to operate in perpetuity." The perpetual, physical security of mine waste contaminated tailings within any impoundment structure is a central inherent or foundational

purpose apparently agreed to by all professional geotechnical engineers, as stated repeatedly in numerous professional papers, reports and books.

If the purpose, then, of its tailings impoundment was to last an eternity, as a perpetual monument for keeping its contents securely and safely stored, why did the Mount Polley Mining Corporation (MPMC), wholly-owned by Imperial Metals Corporation, fail so miserably in its promise to British Columbians to do so?

The findings of this preliminary / interim report provide important clues and disturbing insights for this crucial question, and for other related questions, findings that reveal a long-held trail of company carelessness, stupidity and incompetence, as randomly catalogued from 2008 to 2010 by its former Engineer of Record in only three among many annual TSF inspection reports that have been published for public review from 1998 to 2013. In association are implications that the provincial mining regulator may have failed to properly implement its "duty of care" to British Columbians in preventing this tragedy, those public lands and waters which have been entrusted through legislation to the regulator's legal service and administrative jurisdiction.

The findings in this preliminary report help stimulate an inevitable and sobering conclusion - that the Mount Polley mine tailings storage catastrophe could have been, and should have been, preventable. And, therefore the big questions: was this an environmental crime scene, and was there a previous and subsequent cover-up?

Limited Source Findings and Governmental Restrictions

The findings in this preliminary report are based on limited documents published by MPMC, on professional mining books, reviews and reports, and on a few statements made by knowledgeable individuals and insiders for investigative media interviews in August 2014.

Conditions in two government permits originally issued to MPMC in 1995 and 1997, with amendments made to the permits over the mine's life, state that MPMC had to file annual *Environmental and Reclamation* reports to two ministries, Mines and Environment, with the Ministry of Environment permit stating that the reports were intended for public release and review. As stated in the Ministry of Environment effluent permit PE-11678 in 1997:

> *The Permittee shall submit a comprehensive annual report, in a format suitable for public release, by April 30th of each year. The annual report shall include:*
>
> - ***3.8.1*** *an annual report on the construction and performance of the tailings impoundment and dam, including a review of the results and analysis of hydrogeological data;*
> - ***3.8.2*** *progress on reclamation and any updating of the reclamation plan; and,*
> - ***3.8.3*** *an evaluation of the impacts of the mining and milling operation on the receiving environment from the previous year, including results of any biological monitoring that may have been done.*

The reporting requirements were later updated and more elaborately described, as cited in a May 2005 amendment to the Ministry of Environment permit, "The Permittee shall submit a comprehensive annual report, in a form suitable for public release...."

The Annual Environmental & Reclamation reports, along with Dam Safety Review (DSR) reports are legal, conditional requirements shared, mostly, under both ministerial permits for Mount Polley. Annual inspection reports are required under Section 10.5.3 of *Health, Safety and Reclamation Code for Mines in British Columbia*. (See Appendix H) They are intended to provide transparency and accountability, whereby the public, to whom the government is beholden, may freely review and scrutinize their contents. And so it should be.

However, many of the required annual reports for Mount Polley are either missing or were never filed with public or university libraries. Following the tailings disaster, the BC Ministry of Energy and Mines (the Chief Inspector of Mines) has refused to release these public documents related to the operational history of this mine site not already found or filed in the public domain, provoking the logical question of "why not?"

As discovered by the author and a few investigators in early October 2014, three successive annual TSF inspection reports spanning the years 2011 - 2013, attached as separate appendixes within the permit-mandatory Annual Environmental and Reclamation reports, were mysteriously withheld by MPMC when they were released for public review and forwarded to public libraries. They have yet to be released to the public by the provincial government despite ongoing public requests. The withholding of these three recent inspection documents by the government strongly suggests some sort of cover-up, despite spoken and written remarks by top bureaucrats that to do so would somehow interfere with government investigations of the Mount Polley tailings disaster. The bureaucrats' orders originate from their bosses - the members of the provincial Cabinet, some key members of which have made misleading public comments, i.e., 'we don't know why this happened,' 'it was just another avalanche,' 'the water is safe to drink,' 'he was just a disgruntled employee,' etcetera.

The Mining Company and its Professional Association

The Mount Polley copper/gold mine facilities and operations - a few open mine pits and an underground ore body, with Potentially Acid Generating (PAG) and Non-Acid Generating (NAG) mine waste piles, and with its current destabilized and dysfunctional TSF - is located on Crown (Public) lands, situated about 55 kilometres northeast of Williams Lake and about 10 kilometres southwest of the town of Likely. These mineral claimed lands are leased to Imperial Metals Corporation (Mining Lease Tenure Numbers 345731, 410495, 524068, 566385, 573346, and Mining Claim 514039) through its division, the Mount Polley Mining Corporation (MPMC, Incorporation No. BC0778466). [1] MPMC is headquartered in Vancouver, British Columbia, a joint venture formed in April 1996 and later wholly owned by Imperial Metals by late 2000.

Imperial Metals Corporation owns and operates other mine sites, such as the copper/gold mine south of Smithers, BC, the Huckleberry mine site, which has acid generating tailings and waste rock under permanent water cover. Other than the perpetual presence and problematic containment of ARD (Acid Rock Drainage, a central problem also identified at Imperial Metal's future Red Chris

[1] In total, the Mount Polley property has 43 mineral claims over 16,478 hectares.

mine site near Iskut, BC), according to Imperial Metals Corp.'s 1997 report both mine sites have a number of commonalities: i.e., milling output, open pits, and metal concentrates shipped to Japan. Another commonality is that the feasibility reports for each claimed promises that the mine site would almost be mine-waste-effluent-discharge-free.

From August 31, 1994 to 2001, Alberta billionaire N. Murray Edwards was former chairman and CEO of Imperial Metals. As stated in successive Imperial Metals annual reports from 2002 onward, Edwards remains a "significant" shareholder. Edwards also controls Edco Capital Corporation (formerly, Edco Financial Holdings Ltd.) a private investment company which has financed loans, "lines of credit," to the Mount Polley mine and to the operations of Imperial Metals over time. Recently, in a September 3, 2014 press release (see Appendix I), Imperial Metals announced that Edco Capital offered Imperial a "non-brokered private placement of $115 million" payment, allowing Edwards to obtain an option for "an additional 3,333,333 common shares of Imperial," making Edwards an increasingly "significant" shareholder.

Imperial Metals Corporation is a recent member of the Mining Association of Canada (MAC). The Association's subcommittee, the MAC Tailings Working Group, which issued a three page Backgrounder on August 8, 2014, *The Mount Polley Incident and Tailings Management*. The MAC published a series of three lengthy guides since 1998 for its mine operator company members "to improve tailings management" and to set "global standards" in tandem with "the Towards Sustainable Mining Initiative." [2]

> *Mount Polley is in its second year of implementation of Toward Sustainable Mining (TSM); a program administered by the Mining Association of Canada (MAC) that provides a public and transparent commitment to responsible mining. The principles of TSM demonstrate leadership in the areas of community engagement and globally recognized environmental practices, and a commitment to the safety and health of employees and surrounding communities. TSM's tools and indicators drive performance and ensure key mining risks are managed responsibly.* [3]

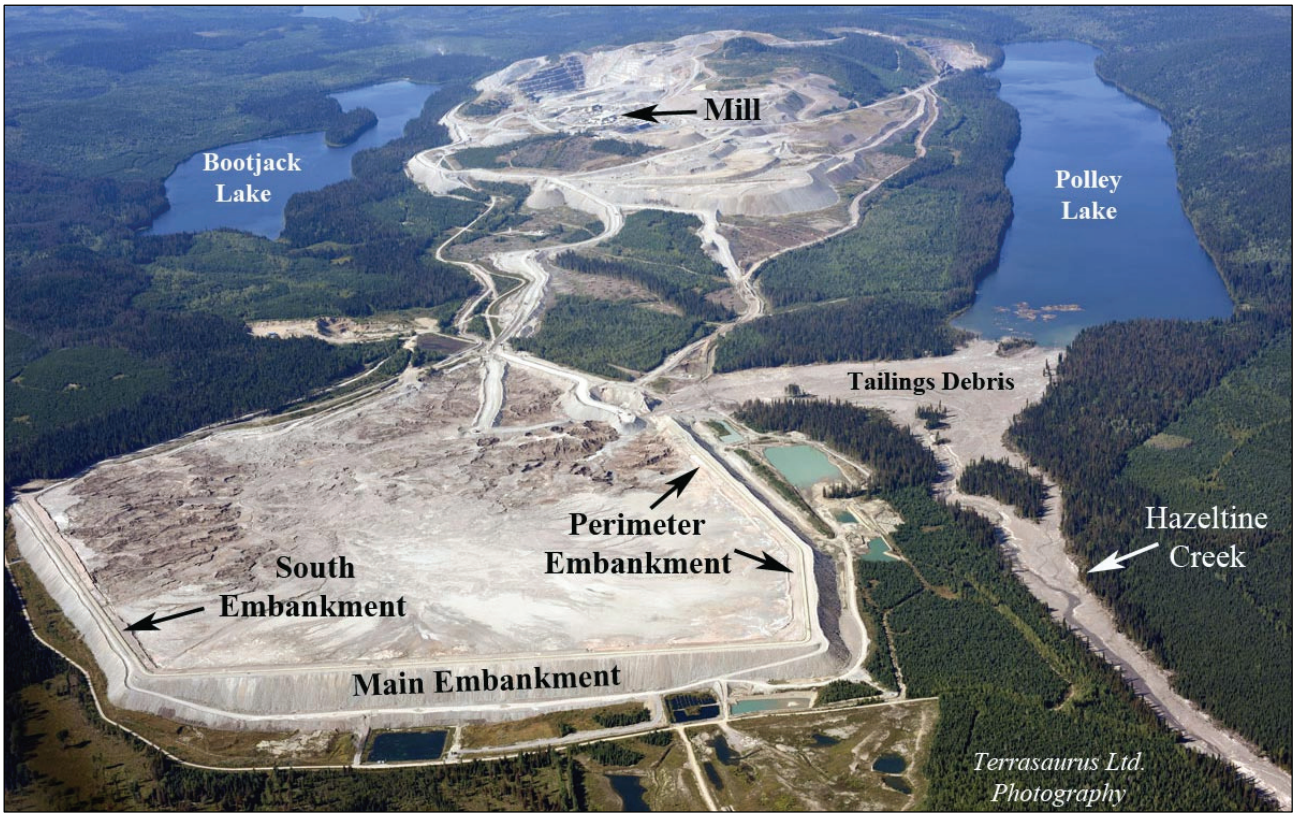
Though members of the Association have "been required to measure their performance" from tailings management guides and initiatives, one of its new members has evidently and severely tarnished the Association's reputation.

Conditional Permitting

MPMC operates under an initiating October 6, 1992 Mine Development Certificate (Mine No. 1101163), and two subsequent and primary operating permits: an August 3, 1995 BC Ministry of Mines Permit (M-200, *Approving Work System and Reclamation Program*), and a May 30, 1997 Ministry of Environment effluent discharge permit (PE-11678). Both of these permits have experienced numerous amendments and updating since their originating issuances to MPMC, during which time MPMC has sought to increase the projected operational life of its mine site from 14 to 25 years due to newly discovered ore bodies. The significant increase in mine life eventually

[2] The 2010 paper, *Hydromechanical Analysis of Upstream Tailings Disposal Facilities*, states that the Mining Association of Canada's guidelines and standards "present management guidelines only, without offering any technical frameworks or even general guidelines concerning the stability of Upstream Tailings Disposal Facilities."
[3] Page 80, Imperial Metals Corporation, *2013 Annual Report*.

challenged the 2005 amended design and mine waste disposal features for its TSF by its Engineer of Record, eventually forcing the Ministry of Environment to significantly amend its permit in June 2013 to allow the final crest height of the TSF to be built to 1,000 meters in elevation, 30 meters higher than the present crest height of the TSF. With the exception of M-200, about half of the basic amendment history of PE-11678 has yet to be released to the public.



The Tailings Storage Facility (TSF)

Professional geotechnical engineers design tailings dams under three different construction criteria methods: Upstream, Centreline, and Downstream. Some of the more recent tailings dams have been designed to incorporate an intricate blending of two or more of these methods. Downstream type dams are the strongest and most expensive, typically used to contain large bodies of water, i.e., for hydro electric dams, the life spans of which pale in comparison to the eternal life expectancy of tailings dams to contain geologic waste and chemical contaminants.

Mount Polley's 235-hectare TSF is primarily an Upstream method designed dam, the cheapest, weakest and most inappropriate sort of dam design for a TSF in a wet climate. For more than three decades, professional engineers have condemned the use of this method due the sorry history of tailings breach failures the world over resulting from this inherently weak design, a fact which was well known by government and consulting engineers when this dam was approved in October 1992, and when it subsequently went under construction in 1996 to 1997.

The Mount Polley TSF is a three-sided artificial impoundment, with the fourth and northern side positioned against up-sloping contours of a natural hill slope. Described in Chapter 4, *Mount Polley's 'Modified Centreline' Tailings Dam*, MPMC developed a mythology about its TSF, calling

it a 'Modified Centreline' impoundment, undoubtedly to avoid unwanted attention to its true design method, an Upstream dam.

Under resulting provincial concession for the application of Imperial Metals Corporation's Upstream method, strict provisions were therefore incorporated in both government permits on the staged construction and maintenance of Mount Polley's TSF. The permits stipulated that the mining operator correctly and meticulously observe all of the stated rules, which were further outlined and included in Mount Polley's annually updated *Operation, Maintenance and Surveillance Manual* (*OMS*). Without adhering to the strict wording and conditions in the maintenance of its Upstream type dam, and without proper concurrent and regular oversight by the Engineer or Record and the provincial regulator, Mount Polley's Upstream dam could be in risk of failing.

The Mount Polley TSF was sequentially raised in numerous Upstream method construction stages or phases from 1997 to 2014, through eleven amendments under Mines permit M-200, rising from its lowest or deepest contour point at about 915 meters in elevation (in the middle of the Main Embankment, with the other embankments starting at about contour level 930 meters) to almost 970 meters during final crest construction elevation when the impoundment eventually failed at a susceptible, weak corner located at the northern extremity of the Perimeter Embankment.

The Engineer of Record

Knight Piésold, an international (engineering) consulting group, which has designed and shepherded many other tailings impoundments and mine sites, was Imperial Metals' Engineer of Record for a lengthy term, a contractual relationship lasting almost 22 years from 1989 to February 2011. Knight Piésold's duties for the TSF were in "providing design, technical specifications, contract documents, construction supervision and quality assurance/control, reviews of instrumentation and monitoring records and annual inspections." [4] Following Knight Piésold's mysterious parting-of-the-way in February 2011 (partial information about which was issued in a August 8, 2014 Knight Piésold media release), AMEC, an international engineering company, became the subsequent Engineer of Record on March 8, 2011, under whose professional and transitional watch the disaster occurred some three and half years later.

Findings

This report makes the following implicit and explicit findings:

1. After Imperial Metals Corporation filed its feasibility reports and mine site designs in 1990 following, in October 1992 the BC regulator approved an Upstream phased engineering structural design of the Mount Polley TSF, the weakest and most susceptible method design for storing hazardous mine wastes forever. Some have described these types of tailings dams as "unforgiving structures." As was stated by United States-based geotechnical engineers at the time, wet climates, in which the Mount Polley TSF was built, are not suitable for such a design method. Structural amendments to this Upstream dam design were presented in two reports to the Ministry of Mines in 1995 by Mount Polley's Engineer of Record, which were then formally approved by the Ministry's

[4] Page 69, *Technical Report. Feasibility Study: Springer and Bell Pits Mount Polley Mine*, August 30, 2002.

expert staff. Further amendments of the TSF design by the mining company's Engineer of Record were submitted as reports to the Ministry in 2005, and subsequently approved by the Ministry.

2. It appears that the probable risks and associated liabilities posed to the public and its lands from such a TSF design, or any other proposed design, were not properly or sincerely communicated to the public by either the mining development proponent or by government. Had those risks been properly identified, clearly communicated and fully understood, an informed public may have either condemned the proposed Upstream structure design outright, or would have conditionally forced the government to create a special legislated monitoring program and committee to annually evaluate the performance of both the mining company and the regulator on the regular maintenance and integrity of the highly susceptible TSF.

3. In the absence of such public awareness and a conditional monitoring program, as the years progressed, both into preliminary construction phase of the mine site and after mine start-up in 1997, the mining company, the provincial regulator and the professional engineering community in British Columbia failed to heed the dire and growing warnings from professional geotechnical engineers the world over on the condemnation and susceptibility of the Mount Polley TSF Upstream method design, and therefore failed to implement amendments to the Mines M-200 permit to structurally remedy the said TSF to make its performance stronger and to enhance its integrity and longevity. Professional-code-of-ethics speaking, failure to act responsibly over critical designed structures means complicity in future outcomes.

4. Despite specific TSF maintenance performance tasks elaborated in both the Mines and Environment permits, and despite performance instructions in its Operation, Maintenance and Surveillance Manual (OMS), the mining company's Engineer of Record stated that the company failed to comply with some of its duties / responsibilities over the TSF during the "Care and Maintenance" years, the three and half year period when the Mount Polley mine was temporarily shut down from October 2001 to March 2005. The 2008 annual TSF inspection report stated that during this period the company failed to record data from piezometers that had been installed to measure foundation flow drains and upstream toe drain flows.

5. During the Care and Maintenance period, in which time "a substantial accumulation of water" had collected in the TSF, Google Earth imagery shows that the Mount Polley Mining Corporation failed to keep the supernatant water or pond line well away from the embankment crests of the TSF during its adolescent years, a serious taboo, or no-no for Upstream method built dams.

According to a series of subsequent aerial photographs taken by the mining company itself, and other photos collected from satellite imagery, the mining company appears to have acted similarly, and repeatedly so, over the following ten years, up until the moment of the dam's failure in August 2014. In fact, in about May 2014 following, there had been so much supernatant water present that it spilled over the embankment crests, which resulted in strong (yet unpublished) warnings from the Ministries of Environment and Mines.

Geotechnical engineers have provided many stern warnings against such practices in text books, reports and presentations. Whenever the supernatant "pond" comes in close proximity to or is even,

heaven forbid, positioned directly against the crests of the embankments in Upstream type dams, the water table (phreatic line) rises and creates excess vertical water presence, saturation pressure and flows within the prism of the embankments, thereby making the outer or downstream embankment walls, which are composed of mixed earthen materials, susceptible to liquefaction failure.

Added to this susceptibility, as documented by the Engineer of Record in a 2010 inspection report, the angle of the TSF's outer or downstream walls were, for many years, still too steep, and had not been properly flattened by the Mount Polley Mining Corporation to help further strengthen the already vulnerable tailings dam.

The various photos taken over a ten year period, which are shown in this report, demonstrate that the mining company had been regularly gambling with its TSF and the public's trust, breaking the most sacred of geotechnical principles and rules, pushing its luck for many years, and playing, figuratively, with fire.

6. As an example of ongoing maintenance transgressions outlined in point number 5 above, the mining company's Engineer of Record summarily stated in its 2010 inspection report that the regulator, the Ministry of Mines, conducted a geotechnical inspection of the Mount Polley TSF sometime in 2008. The resulting inspection report, which has not been made public, documented a critical "deficiency." That deficiency concerned a "lack of tailings beach development" in the TSF, whereby increasing and concentrated volumes of tailings slurry that were being deposited from large pipes in the northeast corner of the TSF, nearest to the mill, had become so large they forced or pushed the supernatant waters away in the opposite direction to the southwest corner, directly "in contact with" two embankments, the South and Main embankments. The very same "deficiency" found by the regulator in 2008 had also been documented two years earlier in a report filed by AMEC for the mining company's first formal Dam Inspection Report (DSR) - "prolonged discharge of tailings from the Perimeter Embankment has resulted in the tailings pond migrating over to the Main Embankment" - the findings of which no doubt prompted the regulator to launch its own inspection in 2008, with the alarming discovery that the former transgression was yet carelessly unresolved.

7. From the mining certificate approval stage to the early years after mine start-up (1990-2001), both the mining company and the regulator failed to properly investigate, enunciate and communicate the long term problems of cumulative mine site water balance issues and effluent discharge scenarios into the receiving environments near and into Quesnel Lake.

The mining company proponent originally sold the public a false bill of goods, making a promise in 1990 that its copper/gold mine operational life would not create a mine effluent discharge problem over time. However, as time marched onward, the water balance scenario quickly changed from "recycle" containment to "net precipitation," meaning that rain and snow melt waters were creating a steady problematic overload inside the expanding operational permit footprint of the mine site, the collective waters of which, according to the Ministry of Environment's effluent permit, were all to be contained, unless amended otherwise. The matter was left to nightmarishly fester for so long, that even after a special public review of mine effluent proposals from 2007 to 2011, and even after an amendment was granted by 2012 in effluent permit PE-11678, the mining company was unable to properly discharge enough diluted toxic mine effluent into Hazeltine Creek because of its low flows according to the *2013 Environmental and Reclamation Report*.

Because of the mining company's blinding bottom-line focus on production and profits, it was unable to halt production earlier on in the game to stand back, carefully contemplate and tackle a critical problem that ultimately led to an unspeakably horrible catastrophe - the overcapacity of the TSF with supernatant waters and the liquefaction event of August 4, 2014, after many years of TSF mismanagement and transgressions.

8. In May 2014, during the onset of the Spring freshet (snow melt, thaw), the supernatant pond waters rose passed freeboard and spilled overtop of the crest of the TSF's embankments. This was apparently the first time this had occurred at Mount Polley since operations began in 1997, an extremely serious event and crisis. Ministry of Mines and Environment staff were immediately notified and then came to assess and document the condition of the dam (this assessment and documentation has not yet been revealed to the public). Both the mining corporation and the regulator subsequently failed to notify the public of the real possibility of dam failure and the consequences of such to local residents and the environment - no condition or status of high alert was communicated. Instead, both parties allowed the matter to fester for the remaining months of June and July, until the unfortunate and catastrophic incident of August 4, 2014.

1. The Big Questions

> *The design criteria for the tailings storage facility (including the embankments, surface water diversion system and tailings and reclaim pipework systems) have been developed from appropriate and conservative design parameters for hazard classification, seismic data, hydrological studies and geotechnical site investigations. The Ministry of Energy, Mines and Petroleum Resources (M EMPR) have provided additional review comments on the design.... A LOW hazard classification or consequence category has been assessed for the tailings impoundment.* ***This implies that a failure of the impoundment would cause a low economic loss and low environmental impact.*** [Bold emphasis] [1]
>
> *Unlike a dam built for impounding water, which can ultimately be drained if the structural integrity becomes questionable,* ***a tailings dam must be built to stand in perpetuity****.* [Bold emphasis] [2]

There is a looming, pressing question concerning Imperial Metals Corporation's / Mount Polley Mining Corporation's (MPMC's) mine permit application report processes from 1989 to 1990:

- was the public specifically warned and duly informed from 1989 onward about the inherent nature of Mount Polley's tailings impoundment as a 'perpetual' risk and toxic waste liability (as clearly stated in many academic studies at the time), that the risks to the famous fresh waters of Quesnel Lake would reside as a threatening shadow, in perpetuity, forever?

The answer is - yes. However, the critical information about the tailings waste impoundment as a perpetual liability to the Quesnel Lake receiving environment was more or less hidden. It was stated only once, buried within a small paragraph on page 125 of Volume One in MPMC's July 1990, three-volume *Environmental & Socioeconomic Assessment* report:

> *5.4.3 Tailings and waste Rock*
> *At completion the tailings pond will be equipped with a permanent spillway and drainage channel to allow excess precipitation to drain away.* ***It will be designed to operate in perpetuity.***

By 1996, as stated in MPMC's *Reclamation Plan* report, the words "in perpetuity" were no longer found nor repeated. Instead, the words chosen were "long term:" ie., "long term site hydrology after closure." And, the term "long term," used within the text of the 1996 document to describe the tainted water discharge functions of the TSF over time, appeared only five times. By 2006, the International Committee on Large Dams defined "long term" as being "1,000 years, or more." [3]

Given the grave forecast for an "in perpetuity" design of the Mount Polley Tailings Storage Facility, did MPMC, through its geotechnical engineers, design such a daunting structure accordingly for an environmentally critical and water fresh rich area of British Columbia? The central finding from this preliminary report provides the following answer: **NO!**

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[1] *The Mount Polley Mine Project Reclamation Plan*, April 1996, page 3-18.
[2] *Long Term Risks of Tailings Dam Failure*, October 2011, page 2.
[3] ICOLD, Improving Tailings Dam Safety, Bulletin 139, page 39.

2. The 1989 Prospectus Document

> *The area proposed for tailings disposal was selected based on proximity to the mill for maintenance and monitoring and to minimize many of the potential concerns commonly associated with mine tailings. These include the use of excessive land area; the washout of dams, resulting in accidental discharge of tailings; and contamination of surface or ground water. The stage I Report will contain detailed information on these matters.* (Mount Polley Copper/Gold Prospectus 1989, Imperial Metals Corporation and Corona Corporation, June 1989)

According to Imperial Metals Corporation's [4] June 1989 *Prospectus* document, the initial report for the proposed Mount Polley mine Tailings Storage Facility (TSF) was to be completed by October, 1989. Though the document failed to reference the geotechnical consultant overseeing the engineering prospectus and scoping for the TSF, Volume One (page 25) of the three volume July 1990 *Stage One Environmental and Socioeconomic Impact Assessment* identified the planning consultant as Vancouver City-based Knight & Piesold Limited.

According to the document's preliminary Development Schedule, the proposed mine production was to commence by October 1991. That schedule was revised to August 1992 in the 1990 Stage I Assessment document. Following the Mine Development Certificate granted to Imperial Metals in October 1992, and the August 1995 Ministry of Mines Permit M-200, preliminary groundwork was conducted on the mine site area in 1995-1996, [5] and mill start-up didn't officially commence until late June 1997. [6]

The *Prospectus* document also stated that "environmental studies related to surface and ground water quality and quantity, acid generation potential, tailings disposal and assessments of the environmental and socio-economic impacts of the project began in April 1989."

The *Prospectus* document identified and stated the following:

> *Potential environmental and land use concerns have been identified in discussions with various groups and organizations.*
>
> *A potential concern exists with respect to water supply, pit water utilization and recycling of tailings water by the mill.*

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[4] The BC Ministry of Energy's Minfile No. 093A 008 for Mount Polley (see Appendix C) states that *"in 1987, Imperial Metals merged with Geomex Partnerships and purchased the remaining interest in the* [Mount Polley] *property from Homestake Canada and others.... Following a merger with Bethlehem Resources Corporation in 1995, Imperial completed an in-house feasibility study. Financing was arranged with Sumitomo Corporation through a joint venture with SC Minerals Canada that culminated in the formation of the Mount Polley Mining Corporation (MPMC) in April 1996.... Imperial Metals Corporation (February 1998 merger of Imperial Metals and Princeton Mining) operates the Mount Polley mine. The mine is owned 52.5 per cent by Imperial and 47.5 per cent by SC Minerals Canada Limited, a wholly owned subsidiary of Sumitomo Corporation of Japan.... At year end in 2000, Imperial Metals Corporation completed an agreement with Sumitomo Corporation of Japan that resulted in the restructuring of the mine's long term debt and Imperial acquiring 100 per cent ownership of Mount Polley mine."*

[5] For a summary description, see Appendix A, *Record of Mine Development, 1995-1997*, in the July 23, 2007, *Mount Polley Mining Corporation PE 11678 - Modified Draft Application*, BC Ministry of Environment submission.

[6] Page 5, *Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent*, July 2009.

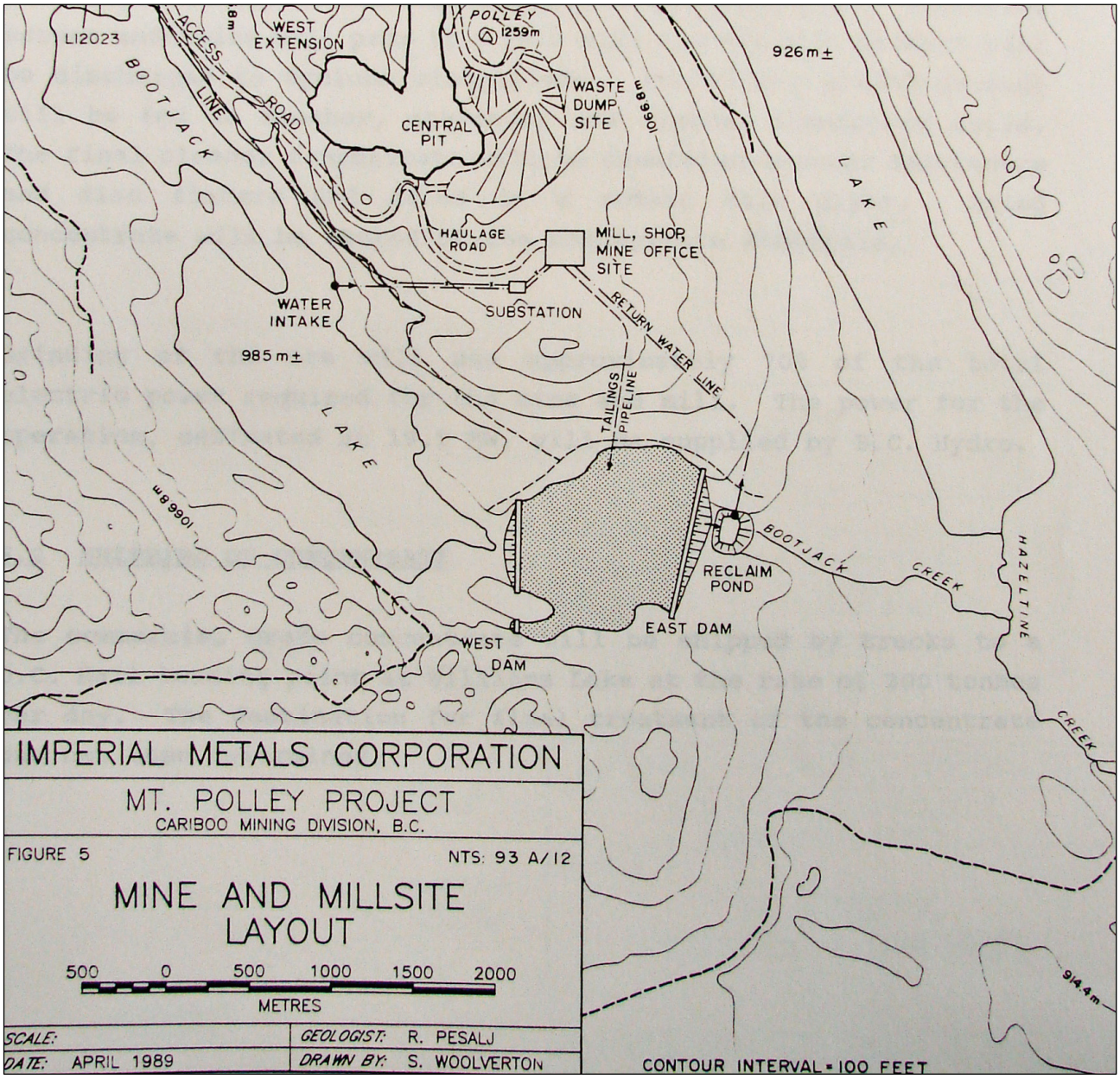


Figure 5 of the Prospectus document shows a proposed location for the TSF. In 1990 the final location was moved to the far right bottom corner of this image, a little over one kilometre distant.

Protection of existing water quality in the surface lakes, streams and the ground water is a key issue. The kinds of potential contaminants include: concentrations of various metals, industrial chemicals, oils and grease, acidic leachate, domestic wastes and enriching nutrients.

In the stage I Report, a water management plan will be presented. The plan will demonstrate the high degree of water reutilization in the mill using water recycled from the tailings pond and pits. In addition, the means for collection and diversion of run off and seepage waters will be detailed. Treatment of wastewater to meet existing water quality standards will be included, although little, if any, direct effluent discharge is expected. Measures will also be

identified to reduce the risks of accidental contamination of surface or ground water resources.

The question of acid formation is a concern for all potential mine developments. The nature of the mineralization and the rock chemistry in the Mount Polley orebody indicates that acid generation should not occur and this is supported by preliminary tests. However, during the stage I investigations, comprehensive testing will be done to accurately establish the potential for acid generation or acid consumption.

The area proposed for tailings disposal was selected based on proximity to the mill for maintenance and monitoring and to minimize many of the potential concerns commonly associated with mine tailings. These include the use of excessive land area; the washout of dams, resulting in accidental discharge of tailings; and contamination of surface or ground water. The stage I Report will contain detailed information on these matters.

The Prospectus document stated the following about the proposed Tailing Storage Facility:

The proposed layout of the tailings storage facility and reclaim pond is shown on Figure 5 (page 29). The facilities will be located 1.8 kilometres from the mill in the valley at the upper part of Bootjack Creek. This site will accommodate the tailings for the life of the mine. The tailings from the mill, in the form of a silt slurry, will be transported by a pipeline to the tailings pond. Preliminary tests indicate that the tailings are acid consuming. Additional appraisal of the potential for acid generation will be included in the stage I report. The dams containing the tailings pond will be constructed from waste rock, overburden and fill from the site. The tailings impoundment will be designed, constructed, operated and abandoned according to government guidelines.

Water recovered from the tailings pond will flow to a decantation structure, from where decanted liquids will be conveyed by gravity to the reclaim pond. The reclaim pond will be constructed similarly to the tailings pond, but water loss. Reclaim water will be maximum extent possible. it will be lined to prevent recycled to the mill to the maximum extent possible.

The mill will require approximately 5,400 Imperial gallons of water per minute for its designed capacity. Approximately 3,750 gallons per minute will be recycled from the tailings pond and the remaining 1,650 gallons per minute will be drawn from Bootjack Lake.

One of the three principal contacts for the proposed mine in the 1989 Prospectus document (other than the two mining company representatives) was environmental consultant Tom Griffing, who cited Griffing Consultants Inc. as his consulting company name, headquartered in the B.C. municipality of Delta. Griffing was the mine project's environmental coordinator, and helped coordinate and "prepare" the production of the three volume *Stage One Environmental and Socioeconomic Impact Assessment* for the *Mount Polley Project* report.

Griffing also headed International Environmental Consultants Inc. In his curriculum vitae of 1995, [7] Griffing conducted numerous environmental reviews and reports for numerous corporate and a few governmental clients.

In the 1980s, Griffing was hired as a consultant for the development proponent in one of the longest running public hearings in Canadian history [8] concerning the housing development of the Spetifore farm lands area in Delta. Griffing authored two bird and animal habitat reports in 1982 and 1989 for the developer. Griffing's two reports were met with harsh criticism by Dr. Mary Tait and Dr. John P. Kelsall, the latter of which wrote to Delta Mayor and Council on May 10, 1989:

> *Neither of the reports are scientific in nature. They are subjective and unbalanced. They contain little or no documentation. They are expressions of opinion, not the results of investigation and deliberation. They are not what one expects in professionally prepared documents for public scrutiny.*

The complaints by professional academics about Griffing's report presentations for the Spetifore farm lands may possibly suggest that a careful review of the Mount Polley data and report presentations in the 1990 three volume assessment reports is warranted.

[7] See Appendix A.
[8] See pages 20-21 of Will Koop's November 1, 1999 report, *Silty Sources: A Critique of the GVRD's (Greater Vancouver Regional District's) Ecological Inventory Project Annex and Annual Reports*.

3. Location, Location, Location: The 1990 and 1996 Reports

In July 1990, Imperial Metals Corporation filed a lengthy three volume report to the BC Mine Development Steering Committee, *Mount Polley Project: Stage I Environmental and Socioeconomic Impact Assessment*, for its proposed copper/gold/silver mine. It included studies and maps on the geology, on baseline data for fish and animals in nearby watersheds, on soils, on water balance and scenarios for the mill's life cycle operations, on mill site infrastructure including the Tailings Storage Facility, etc.

> *The project concept is a fully mitigated design with careful consideration for efficiency and environmental acceptability. Potential impacts will be minor and of short duration. The protection of the environment will be ensured by implementation of strategies described in the report, including, for example, sedimentation ponds, water monitoring and testing to meet both provincial and federal criteria, and maximizing recycling of process water in the mill.* [9]

Based on initial phased drilling data assessments from the targeted mineralization zones, the document formulated that the:

- "lifespan of the mine is expected to be fourteen years;"
- "mining method is open pit mining, ultimately involving three adjoining pits" (over a combined footprint area of about 60 hectares);
- "production rate during the first five years will average approximately 22,000 tonnes per day. This rate will increase in year 6, as West Pit commences, and peak in year 10 at 50,000 tonnes per day."
- "scheduled mining rate is 13,700 tonnes of ore per day (5 million tonnes of ore/year);"
- "processing of ore will consist of crushing, grinding and froth flotation producing a copper-gold concentrate at the rate 164 tonnes per day."

The two most critical engineering components of the mine planning were on:

- designing a water management plan and a water balance regime for the Tailings Storage Facility and environs of the mill site;
- designing the most appropriate area for, composition of, and ultimate height of the Tailings Storage Facility.

Once the ranges of total tonnage data for the extraction of the ore bodies from the three proposed open mine pits was well-estimated, once the daily/monthly milling rates were calculated, once the rate of water supply needed for the slurry was known, and once the daily dumping rate of the tailings slurry was known, Knight Piésold was able to determine the total area for and ultimate height of the multi-staging plan for the TSF over time. It was simple math. I.e.:

> *Process water requirements for slurrying tailings to the disposal area are 758,400 cubic meters / month or 1,039 cubic meters / hr. This is the average rate, based on 5,000,000 tons of ore throughput per year at a steady rate over 365 days per year, with the slurry being 35*

[9] Volume One, page vi.

percent solids by weight. An average of 81 percent of the water used in the mill will be recycled.

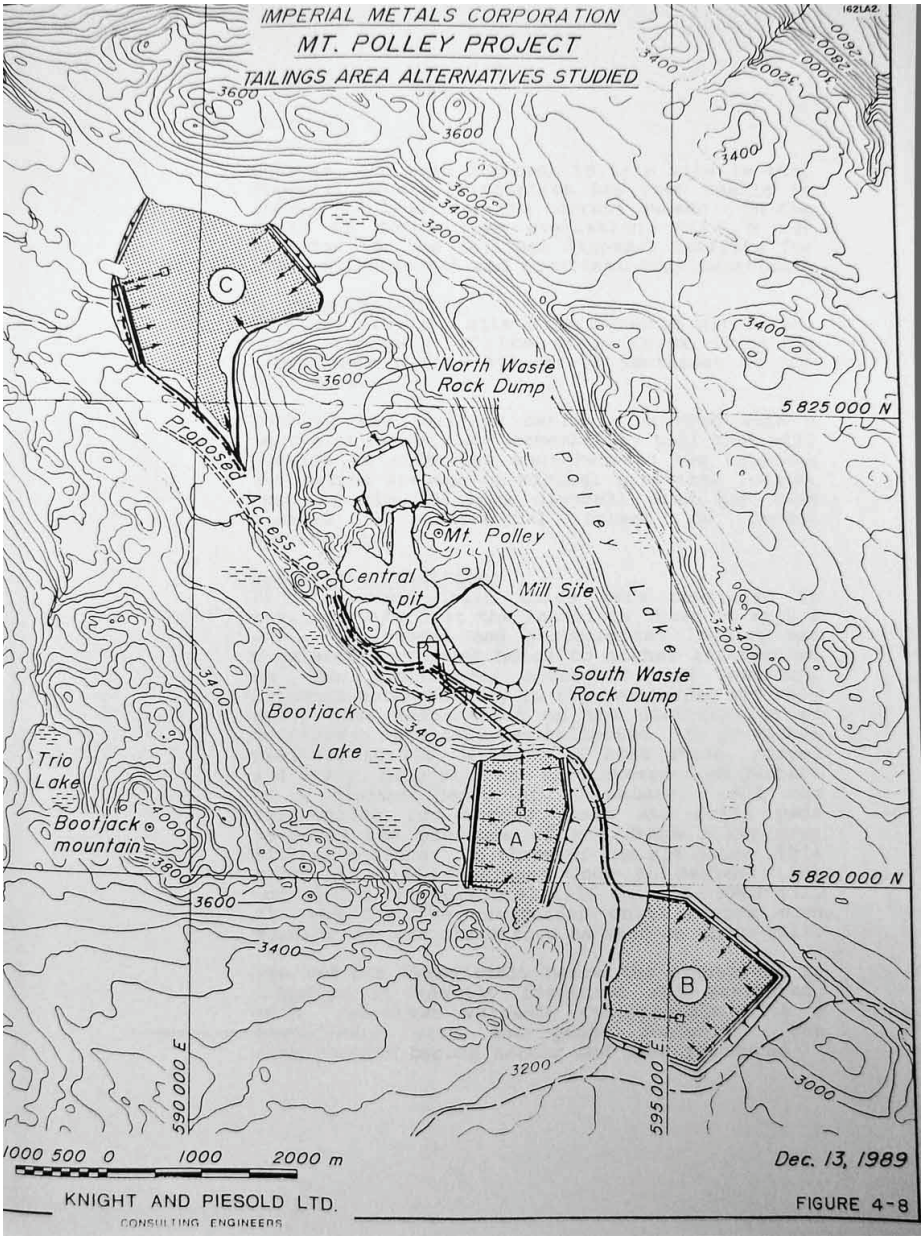
Accounting for the water retained in the tailings, the reclaim process water, precipitation, evaporation and seepage, the net demand ("make-up") for process water averages 193 cubic meters / hr as shown on the water balance flowsheet.

This net requirement includes approximately 90 cubic meters / hr of pump gland water, reagent mixing water and flotation column water.

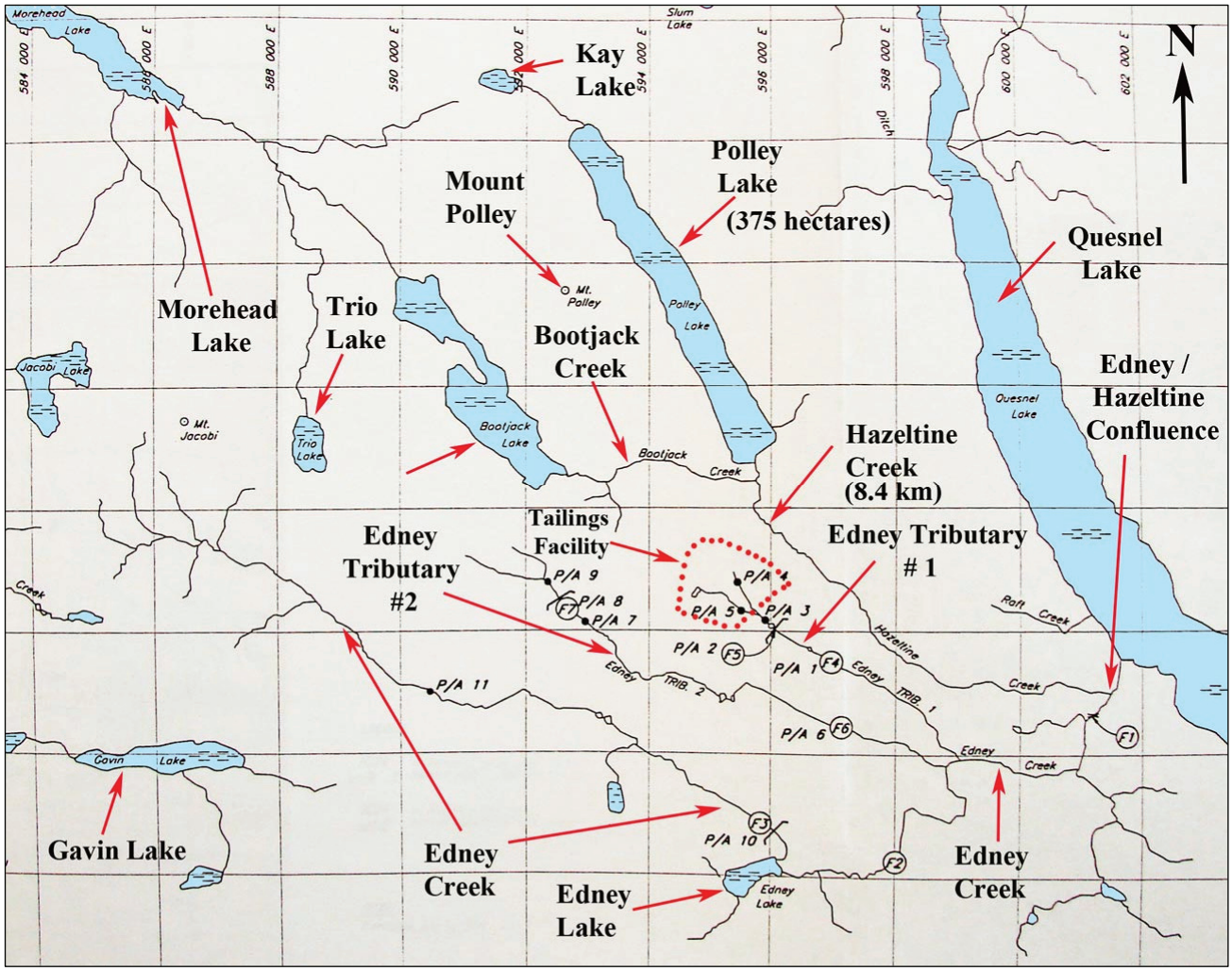
Crushing and grinding in the process plant will liberate the valuable minerals from the gangue material in the ore. This will be followed by flotation of the valuable minerals into a concentrate, which will be subsequently thickened and dewatered for load-out and transport. The process tailings will be impounded in a contained area.

Both environmental and economic considerations require that water usage be minimized, thus to the greatest extent possible the tailings slurry water will be reclaimed and reused. ***There will be no excess tailings water to be disposed of.***

Tailings will be deposited conventionally by gravity in a tailings disposal area behind an impervious till dam ***constructed initially by a centerline and later by an upstream configuration.***



There were three candidate locations chosen for the TSF, areas A, B, and C, as shown in Figure 4-8 of Volume One.



Above: Modifications made to the January 5, 1996 black and white Map Figure 2-16, *Creeks of the Mt. Polley Area and Fisheries Study Sites*, in the 1996 report, *The Mount Polley Mine Project Reclamation Plan*. The map shows the locations of lakes and streams around the Mount Polley mine site, and the location of the Tailings Storage Facility at the headwaters of Edney Tributary #1.

Area B was ultimately chosen, located at the bottom southern flank or lower contours of Mount Polley, an area situated in the headwaters of two tributary branches of the Edney Creek watershed. The waters of the Edney Creek system enter and join Hazeltine Creek as a tributary about 500 meters distant from Quesnel Lake.

> *Tailings disposal site B is situated within the upper catchment of the Edney Creek tributary approximately five kilometres southeast of the mill site.*
>
> *The Edney Creek tributary drains the small bog that is encompassed in the proposed tailings storage site. This very small stream exhibited wide seasonal fluctuations in conductivity, turbidity, dissolved solids, alkalinity, total and dissolved aluminium, arsenic, copper and iron. Total and dissolved mercury and total zinc also showed some variability above their detection limits during the fall-winter low flow periods.*
>
> *A total of 2.3 sq km will be removed from the 5.28 sq km Edney Creek tributary catchment basin for the duration of the mining operation since precipitation falling inside the tailings pond dykes will be used as process water. This will reduce the already small flows (mean*

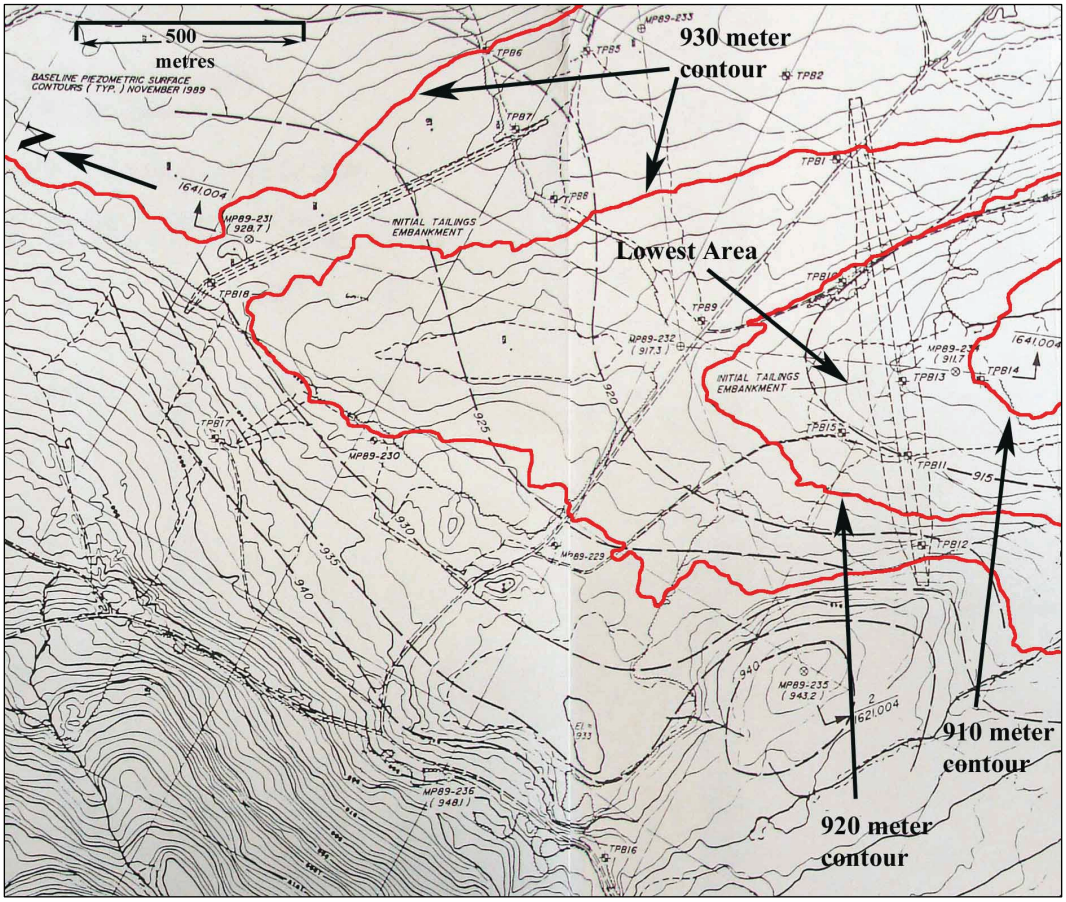
annual runoff 0.032 cubic meters/s) by approximately 44%. Once reclamation of the pond commences this area will be restored to the catchment basin.

Reduced flows in these streams during dry seasons and in mid winter significantly restricts the usable stream environment for small fish as well as their ability to escape from unfavourable conditions. Such reduced flows will be experienced in Edney Creek tributary when the tailings pond is constructed which will remove 2.30 sq km of the catchment area for this tributary and reduce stream flow for the duration of mill operations.

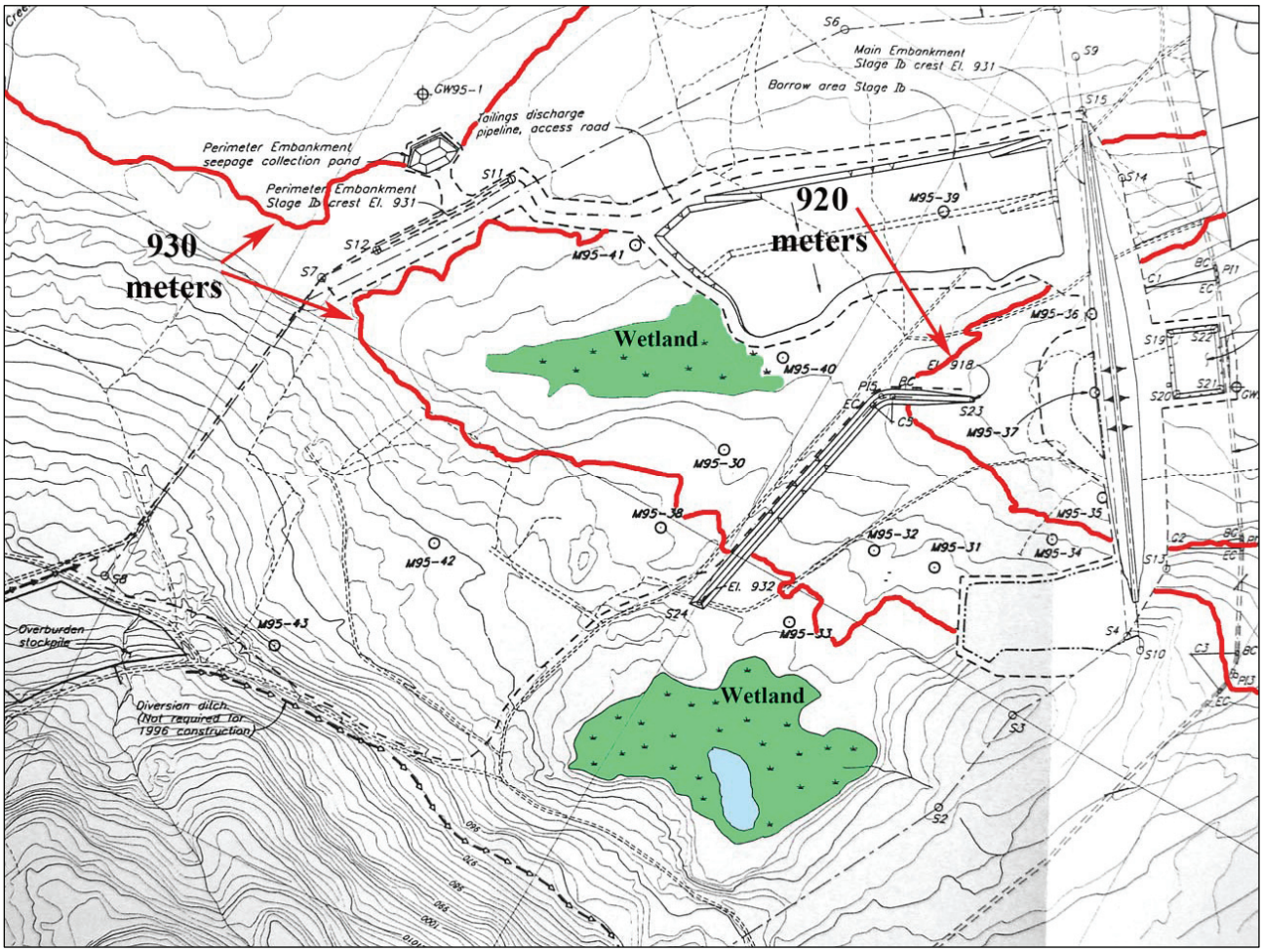
The Edney/Hazeltine Creek system is physically divided by topography which creates water velocity barriers in a steep gradient canyon located 1,650 metres upstream of the Edney Creek confluence. This canyon barrier isolates the rainbow trout populations in the headwater lakes and streams and prevents encroachment by the mixed resident and anadromous salmonoid and forage fish populations found in the lower reaches.

In lower Hazeltine and Edney Creeks mixed populations of rainbow trout, mountain whitefish, burbot, suckers, rearing juvenile chinooks, and adult sockeye salmon were documented in 1989. The lower reaches of Hazeltine and Edney Creeks are low gradient streams consisting of deep pools and riffles, large log jams and areas with excellent spawning gravels for salmon.

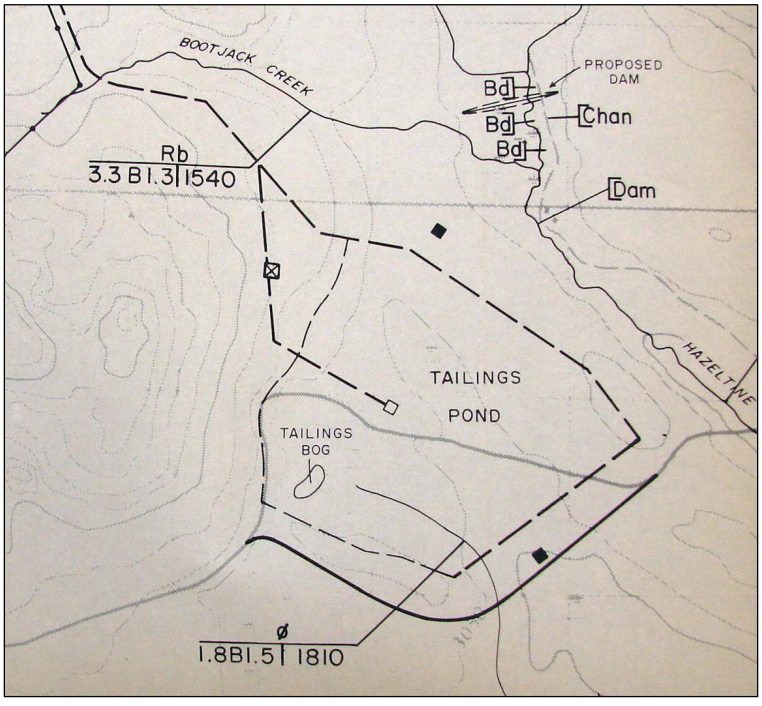
The relocation of Gavin Lake Road around the tailings pond will require a new stream crossing at Edney Creek tributary. The existing crossing by a minor forest service road is a wooden culvert. A metal culvert of suitable dimensions to meet appropriate standards will be installed at the new crossing.



Left: Figure 4-9, Area B *Test Pit and Borehole Plan*, from Volume One of the 1990 Assessment report. The highlighted red lines show the original contour elevation locations of the Tailings Storage Facility. They show the flow regime of the Edney Tributary #1 watershed. The top left area between the "930 meter contour" areas is the divide for the location of the Perimeter Embankment, where the August 4, 2014 dam failure occurred.

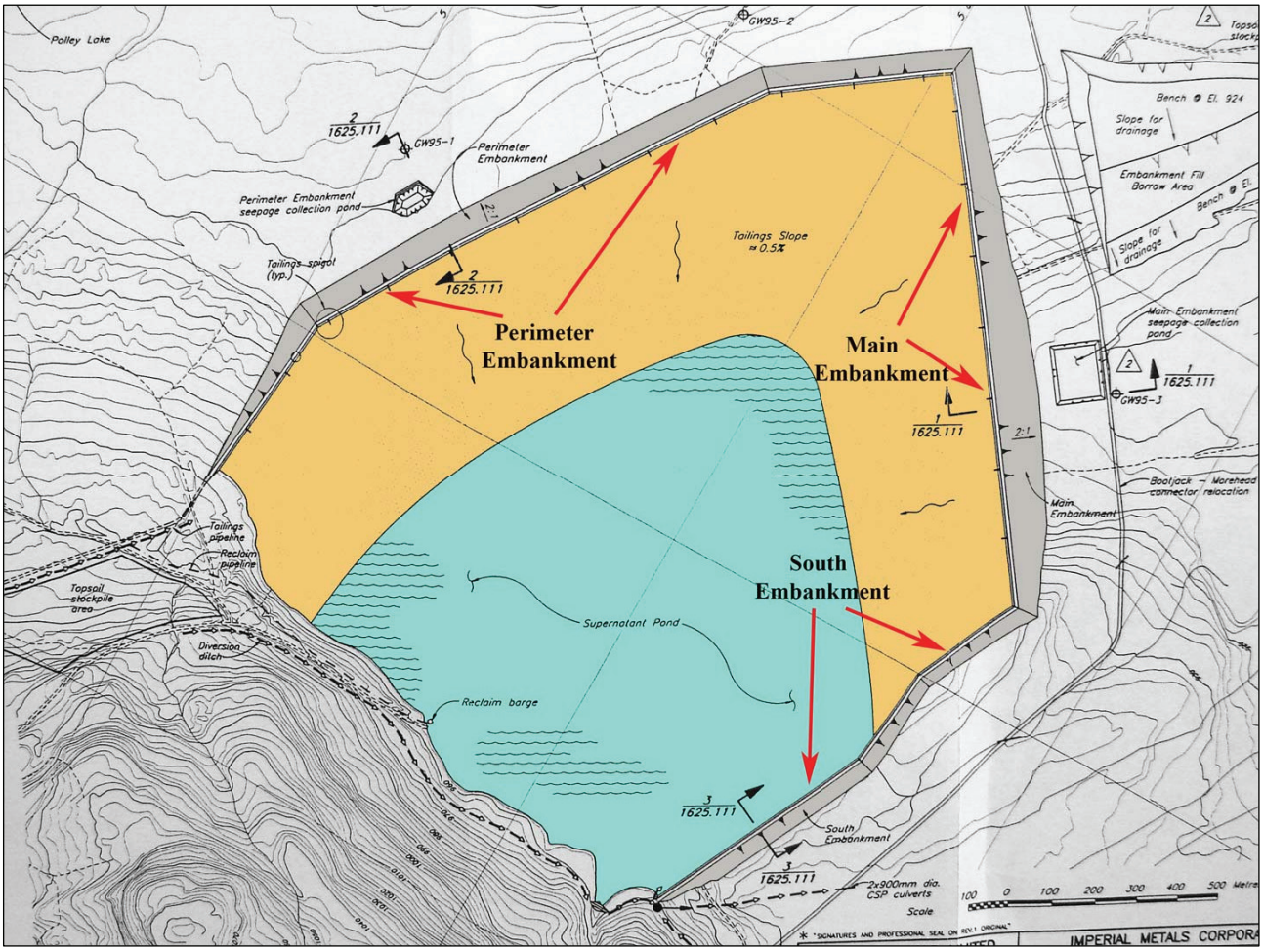


Above: Adaptation from Figure 2.2, *Soil Test Pit Locations* of the Tailings Storage Facility, in the 1996 *Mount Polley Mine Project Reclamation Plan*. The drawing shows the locations of two former wetland areas, a former pond within one of those wetlands (referred to as the "Tailings Bog"), and the original contours of the present Tailings Storage Facility (TSF) area. The lowest elevation point in the TSF is at 914 meters, about the middle of the proposed Main Embankment location.



Left: cut-out from map Figure 1, *Fish Habitat Evaluations - Hazeltine & Edney Creek System*, in Volume 3 of the 1990 Assessment report. Indicated is an area referred to as the "Tailings Bog," the pond identified in the wetland area above. The 1996 *Reclamation Plan* report states that it was "a small 3 hectare bog pond" with surrounding "2 hectare wetlands" (page 2-50).

Almost all of the area within and just outside of the TSF had been previously clear-cut logged. Four cutblocks were logged in 1970, 1978, 1979, and 1983, as described in Figure 2.19, *Tailings Pond Forest Cover*, in the 1996 *Mount Polley Mine Project Reclamation Plan*.



Above: The April 6, 1995 drawing, Figure 3.16, *Tailings Storage Facility Final Arrangement*, in the 1996 *Mount Polley Mine Reclamation Plan*, showing the final transition and supernatant locations concept of the TSF within the former natural contours of the headwaters of Edney Creek Tributary #1. The dark-gray shaded area denotes the outer downslope areas of the three embankments, the light-brown/tan shaded area is the sloped tailings slurry, and the greenish-blue area is the supernatant "pond," situated directly on top of meters-deep saturated tailings mass.

4. Mount Polley's 'Modified Centreline' Tailings Dam: Not

According to the 2007 document, *Reported Tailings Dam Failures: A Review of the European Incidents in the Worldwide Context*, Mount Polley Mine Corporation's (MPMC's) Tailings Storage Facility (TSF) at Mount Polley is classified as a "Sequentially Raised Tailings Dam." Of the four dam types the document identified under this classification,

- Upstream
- Downstream
- Centerline/centreline
- and "Unknown,"

Mount Polley's TSF is a combination of Centreline and Upstream types, termed by MPMC's former Engineer of Record since 1996 as a "modified centreline" dam. Knight Piésold classified the "modified centreline construction method" [10] as the staged structural design development for MPMC's TSF, interacting the twin method structure with a "side-hill" impoundment - the term for a natural uphill slope used as one of the four embankments for MPMC's tailings impoundment structure. Though classified by Knight Piésold as a Modified Centreline, MPMC's TSF is, in essence, a glorified Upstream type, and therefore ought to be referred to as such.

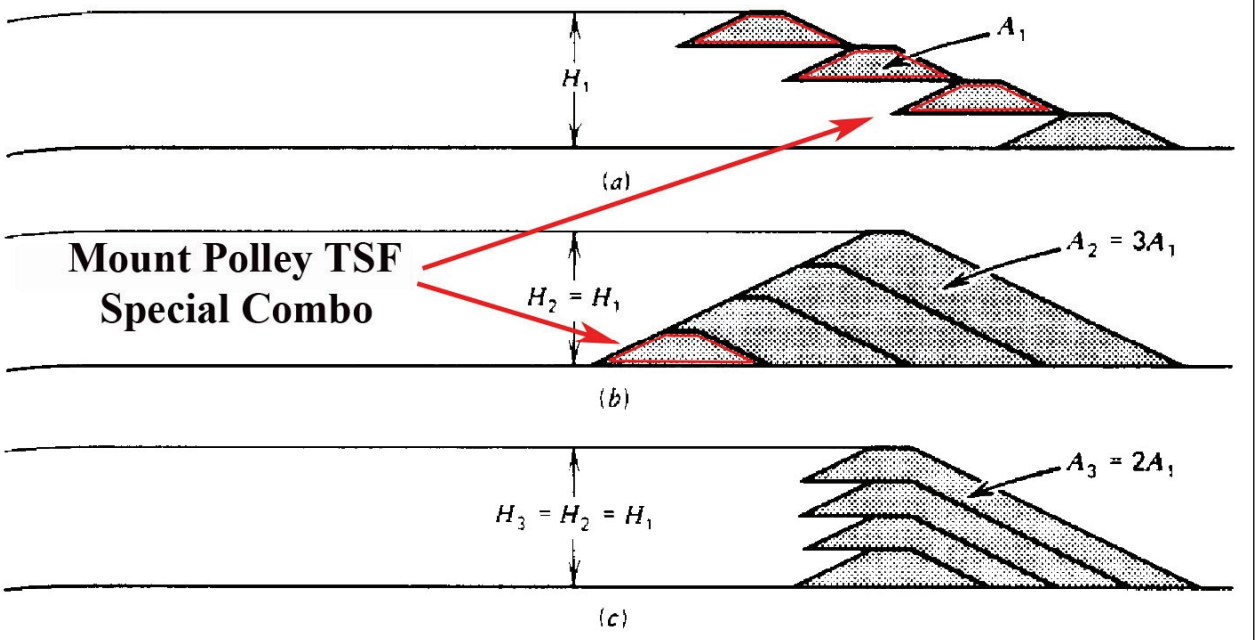


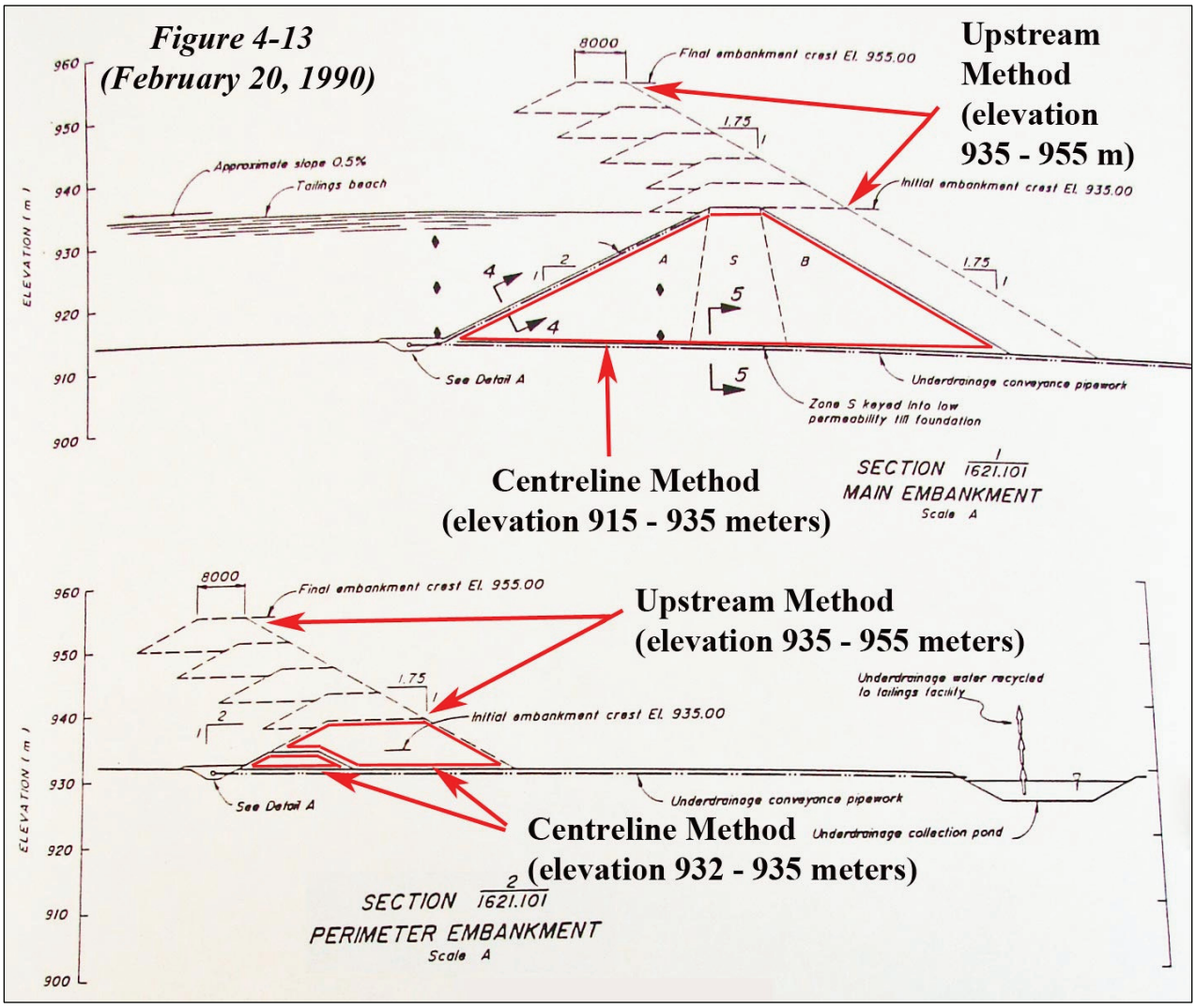
Figure 2. Embankment Types: (a) Upstream, (b) Centerline, (c) Downstream or Water Retention Type

Above: Illustration from the 1994 EPA report, *Design and Evaluation of Tailings Dams*.

The first reference by Knight Piésold of its engineering method was cited in the July 1990 *Stage One Environmental and Socioeconomic Impact Assessment* report for the Mount Polley mine. However, it was **not** specifically referred to at that time as a "modified" Centreline method:

[10] The term stated in Knight Piesold's numerous Annual Inspection reports on Mount Polley's Tailings Storage Facility.

Tailings will be deposited conventionally by gravity in a tailings disposal area behind an impervious till dam constructed initially by a centerline and later by an upstream configuration. Surface runoff from waste dumps, mill site as well as pit water will be collected in sediment ponds, tested and if environmentally acceptable released to the environment. Water not meeting water quality guidelines will be sent to the tailings pond or treated before release to the environment. [11]



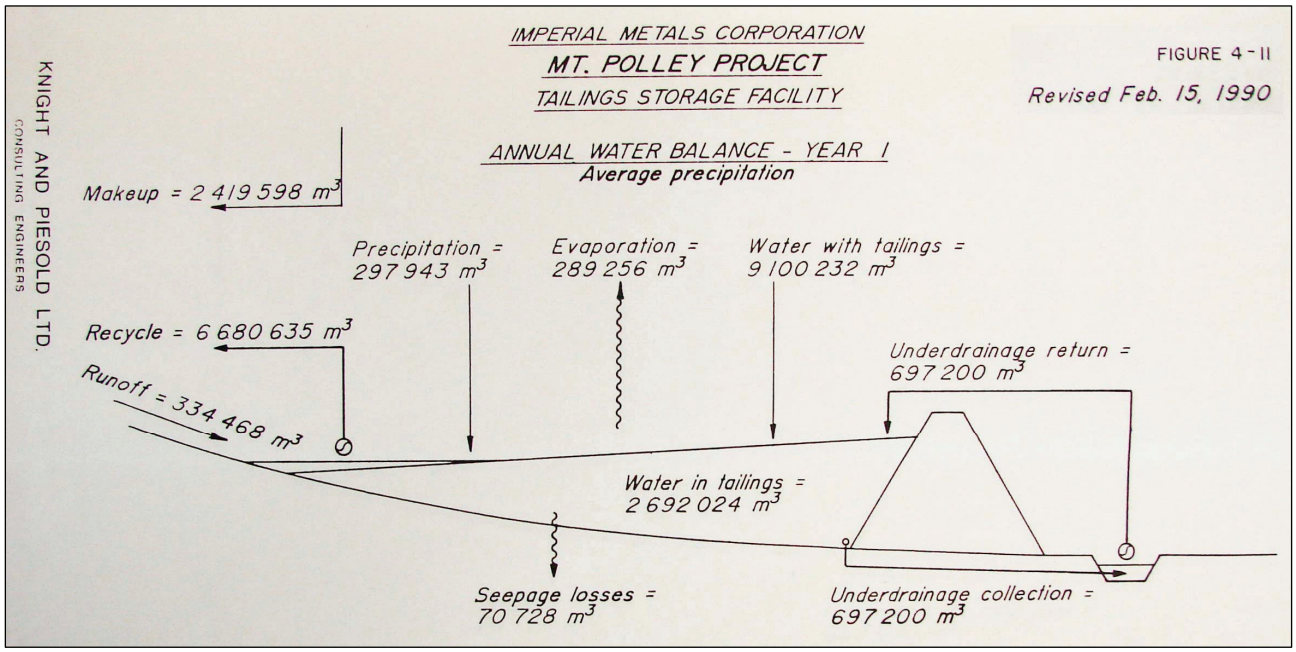
Above: Figure 4-13 from the 1990 report, *Tailings Storage Facility Embankment Sections and Details*, showing the Centreline and Upstream methods for the 'Main' and 'Perimeter' Embankments of the proposed Mount Polley TSF.

Conventional tailings disposal, by spigotting tailings behind the dam constructed of centerline configuration, was selected for the Mount Polley project. [12]

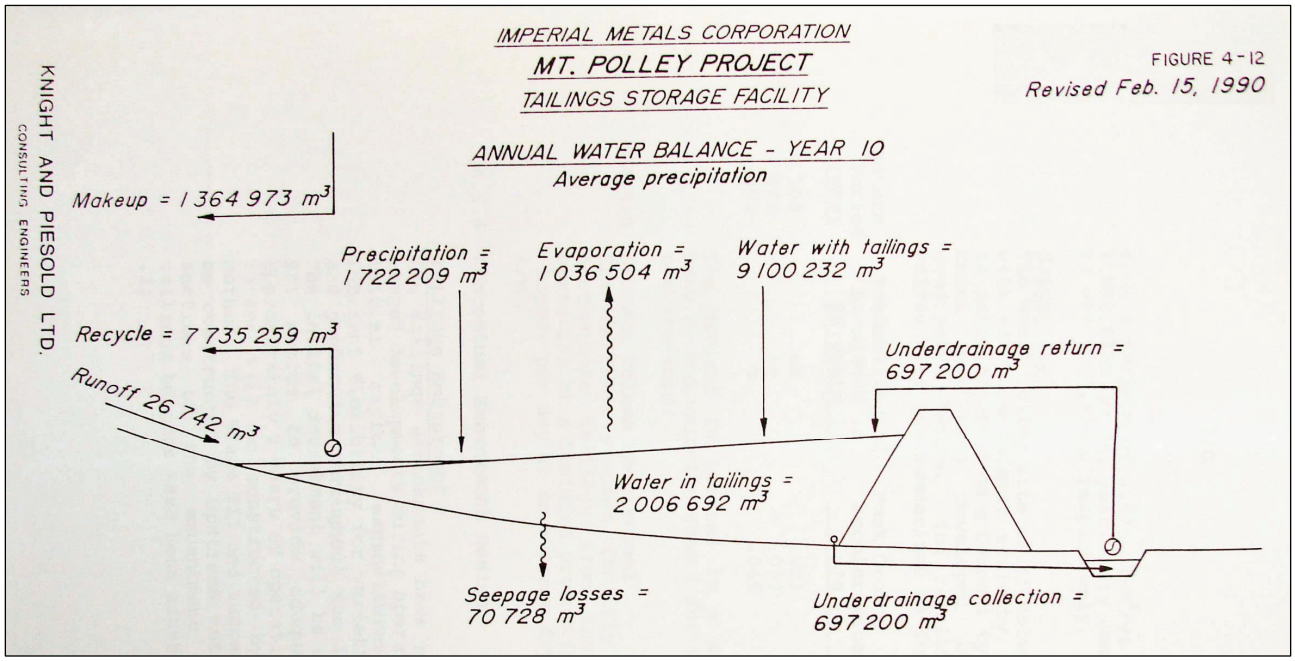
The tailings embankments have been designed for staged developments during operations to ***minimize initial capital expenditures*** [bold emphasis] *and maintain inherent flexibility for variations in operation and production throughout the life of the mine. The initial*

[11] Executive Summary, page v.
[12] Ibid., page 88.

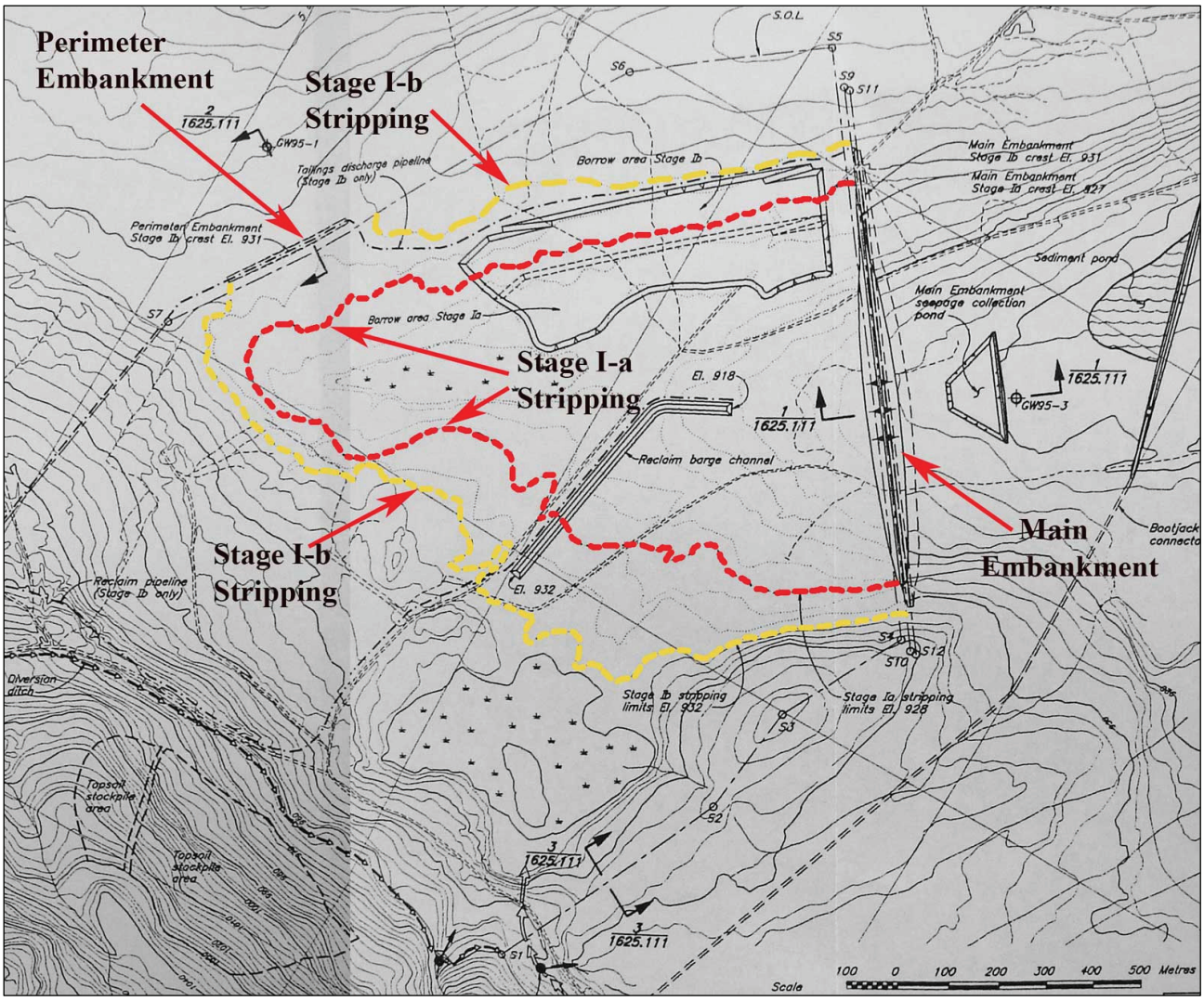
embankment will be constructed to Elevation 935 metres to provide adequate storage for approximately 2 years of operation. The stage II raises will be constructed by the centerline method. The stage III and successive raises will be constructed by upstream methods along those sections of the embankment where competent tailings beaches have been established (Figure 4-13). [13]



Above: Knight Piésold's annual TSF water balance prediction for 'year one' of mine operations. *Below:* annual TSF water balance prediction for 'year ten' of mine operations. Note differences in some of the long-term prediction data. Source: 1990 Impact Assessment Report, Volume One.



[13] Ibid., page 110.



Above: Figure 3.15, *Stage Ia / Ib Tailings Impoundment General Arrangement*, in the 1996 Mount Polley Reclamation report. The red dotted line indicates elevation 928 meters, and the yellow dotted line indicates elevation 932 meters. Stage Ia embankment crest was set at 927 meters for the Main Embankment, and Stage Ib crest was set at 931 meters for the Main and Perimeter Embankments. The height of the Perimeter Embankment for Stage Ib was about one meter, and about 16 meters in height for the Main Embankment for Stage Ib, a difference of about 15 meters in elevation between the two embankments.

As the European document, *Reported Tailings Dam Failures: A Review of the European Incidents in the Worldwide Context,* explicitly forewarns, as similarly described in many academic publication sources, the nature of and multiple activities from fresh water runoff sources or hydrology (groundwater, rain, snow, intense weather storms) make up the top key concerns about impoundment construction methodology for the containment of mine waste tailings. I.e.,

> *A water-related factor that also must be considered, particularly in valley impoundments, is the presence of shallow alluvial ground water. Ground water can infiltrate the tailings, thus raising the level of saturation within the tailings; this can be seasonal, in response to seasonal high surface water flows that interconnect with the alluvium upgradient of the impoundment (or under the impoundment itself).... The water balance may be more*

favorable after tailings slurry water is no longer being added to the impoundment/and the dam stability may be less of a concern. [14]

Because water is a major component in any tailings impoundment system, principles of hydrology (applied to flow of water through and around the tailings embankment) dictate many of the rules of tailings impoundment design. Indeed, because impoundment and dam stability are in large part a function of the water level, these principles are of fundamental concern in the design of any tailings impoundment.

One of the basic principles used in the design of impoundments and their embankments is the maintenance of the phreatic surface within the embankment. The phreatic surface is the level of saturation in the impoundment and embankment (the surface along which pressure in the fluid equals atmospheric pressure (CANMET 1977)); in natural systems it is often called the water table. The phreatic surface exerts a large degree of control over the stability of the embankment, under both static and seismic loading conditions (Vick 1990). The major design precept is that the phreatic surface should not emerge from the embankment and should be as low as possible near the embankment face (Vick 1990).

Factors that affect the phreatic surface in the embankment affect its stability. These factors include the depositional characteristics of the tailings (permeability, compressibility, grading, pulp density, etc.) and site-specific features such as foundation characteristics and the hydrology and hydrogeology of the impoundment area and its upstream catchment area. Changes in the phreatic surface in a waste embankment will change the pore water pressures and consequently the resistance of the dam materials to sliding. Changes to the phreatic surface can be caused by: malfunction of drainage systems, freezing of surface layers on the downstream slope of the dam, changes in construction method (including the characteristics of the placed material), and changes in the elevation of the pond. The level of the water table also may be altered by changes in the permeability of the underlying foundation material; sometimes these are caused by strains induced by mining subsidence (Vick 1990). [15]

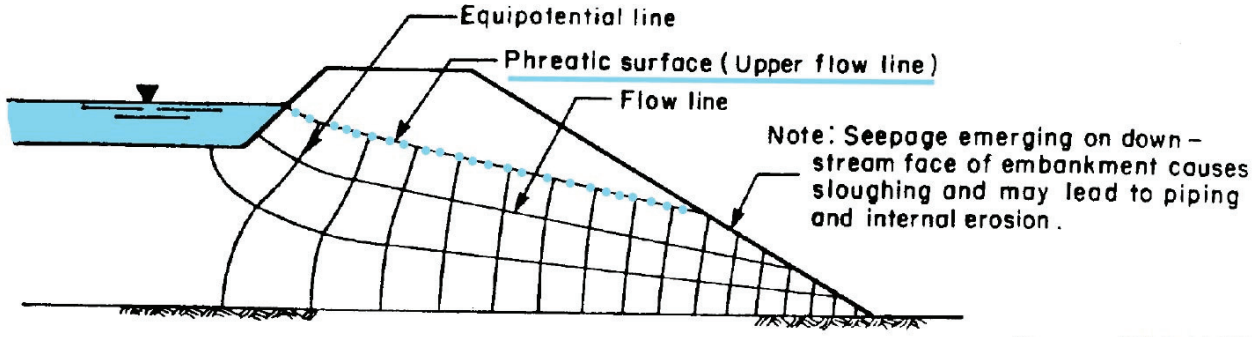


Figure 8. Upstream Tailings Embankment Construction (Source: Vick 1990)

Above: Diagram from EPA's 1994 report, *Design and Evaluation of Tailings Dams*. The blue zone is the location of water (supernatant, accumulating) in a tailings facility, and the dotted blue line is the Phreatic (water table) upper surface zone emanating through gravity from the supernatant (decant) water held in the facility.

[14] *Design and Evaluation of Tailings Dams*, EPA, August 1994, page 11.
[15] Ibid., pages 15-16.

In Table 1, *Comparison of Embankment Types*, of the U.S. Environmental Protection Agency's (EPA's) 1994 document, *Design and Evaluation of Tailings Dams*, it states that "water storage suitability" for Upstream Embankment types for tailings impoundments are "**not suitable for significant water storage**," are "**poor in high seismic areas**," and that a "**well-controlled beach is necessary**" for discharge requirements. This document was published two years prior to Mount Polley's preliminary clearing and initial construction phases Ia and Ib of the TSF, where the Centreline method was used as a platform or foundational base for the Upstream step-phased construction procedures.

The EPA document notes that Upstream construction is "the oldest and most economical method." However, such a method has significant problems ("limitations") related to hydrology:

> *In addition to tailings gradation, several other factors can limit the applicability of this method. These factors include phreatic surface control, water storage capacity, seismic liquefaction susceptibility and the rate of dam raising. Upstream embankment construction offers few structural measures for control of the phreatic surface within the embankment. Vick (1990) identified four important factors influencing the phreatic surface location: permeability of the foundation relative to the tailings, the degree of grain-size segregation and lateral permeability variation within the deposit, and the location of ponded water relative to the embankment crest. Only the pond location can be controlled through operational practices. The other factors must be planned for in the construction design phase. Both proper decanting and spigotting procedures can be used to control the distance between the pond's edge and the embankment crest. Although the pond's location can be controlled to some extent during operation,* ***a tailings pond that is expected to receive high rates of water accumulation (due to climatic and topographic conditions) should be constructed using a method other than upstream construction***. [Bold emphasis] *Any change in environmental or operating conditions (heavy rainfall, blockage of seepage outlets, rise in water levels of the pond, etc.) resulting in a rise of the phreatic line and complete saturation of the outer sand shell could quickly lead to failure by piping or sliding. An outer rockfill shell may mitigate failure potential from piping or sliding.*
>
> *Tailings embankments constructed using the upstream method generally have a low relative density with a high water saturation. This combination can result in liquefaction of the tailings embankment in the event of seismic activity. In addition, vibration of sufficient intensity and magnitude caused by blasting, trains, heavy trucks, etc., may cause liquefaction. The shear strength can be reduced to near zero such that the fluidized slimes easily burst through the remaining thin, unsaturated sand-dike shell and the dam collapses and flows. This can occur at very low heights and slope angles. Therefore, upstream construction is not appropriate in areas with a potential for high seismic activity.*
>
> *The rate of embankment raises is limited by the build-up of excess pore pressures within the deposit. This build-up of pore pressures can lead to a shear failure, which may result in breaching of the dam and the release of contained tailings (Brawner 1973). The height at which potential failures are triggered depends on the strength of the tailings within the zone of shearing, the downstream slope of the dam, and the location of the phreatic line.* [16]

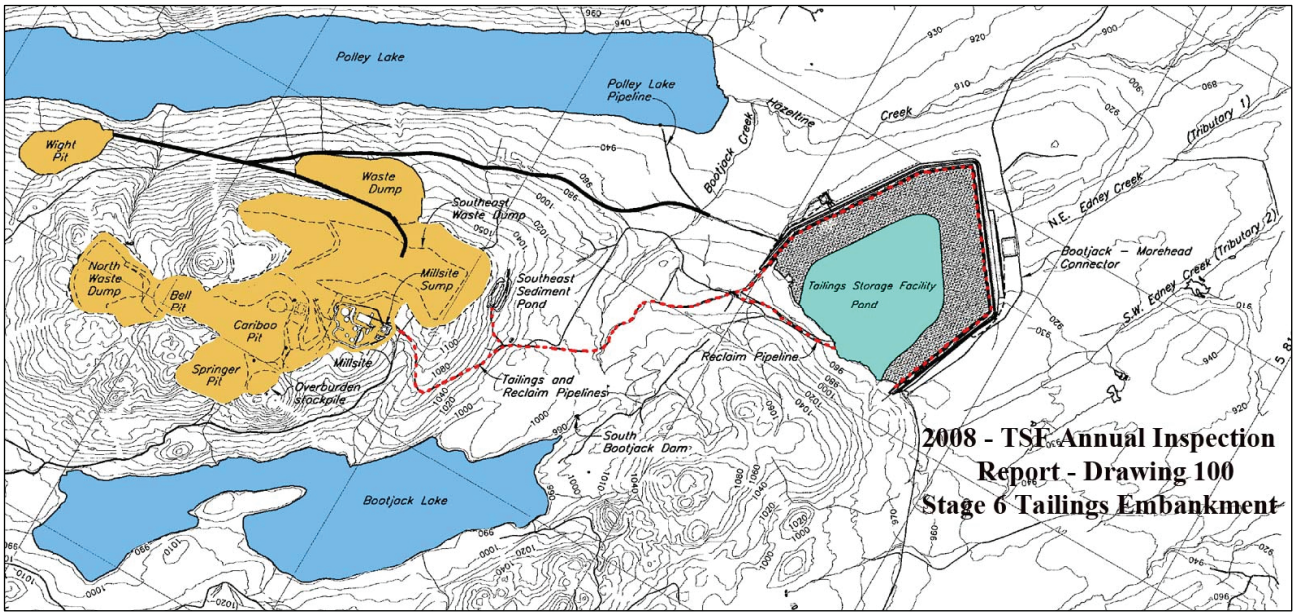
[16] Pages 25-26.

Shortly after the TSF failure of August 4, 2014, media interviews with Gerald MacBurney, a former TSF foreman at Mount Polley, stated that the TSF's water holding capacity was five times greater than the original designed capacity, and that Imperial Metals Corporation had failed to strengthen the outside sloping walls of the TSF's embankments (which had a 1.4 to 1.0 slope in sections) with 5 million tonnes of rock.

When the final TSF basin area was evaluated and assessed from 1989 to 1990 for existing surface water and groundwater regimes by professional engineers, it was stated that "*small artesian groundwater pressures were encountered in sandy materials underlying the surficial glacial till. This implies horizontal or slightly upward flow of groundwater in this area, which is confined by the overlying less pervious till."* [17] Nothing more was subsequently stated in Mount Polley reports reviewed for the present report about this natural occurrence, as these artesian groundwater sources may have been a source for additional and quantifiably unknown annual water infiltration volumes within the TFS over time.

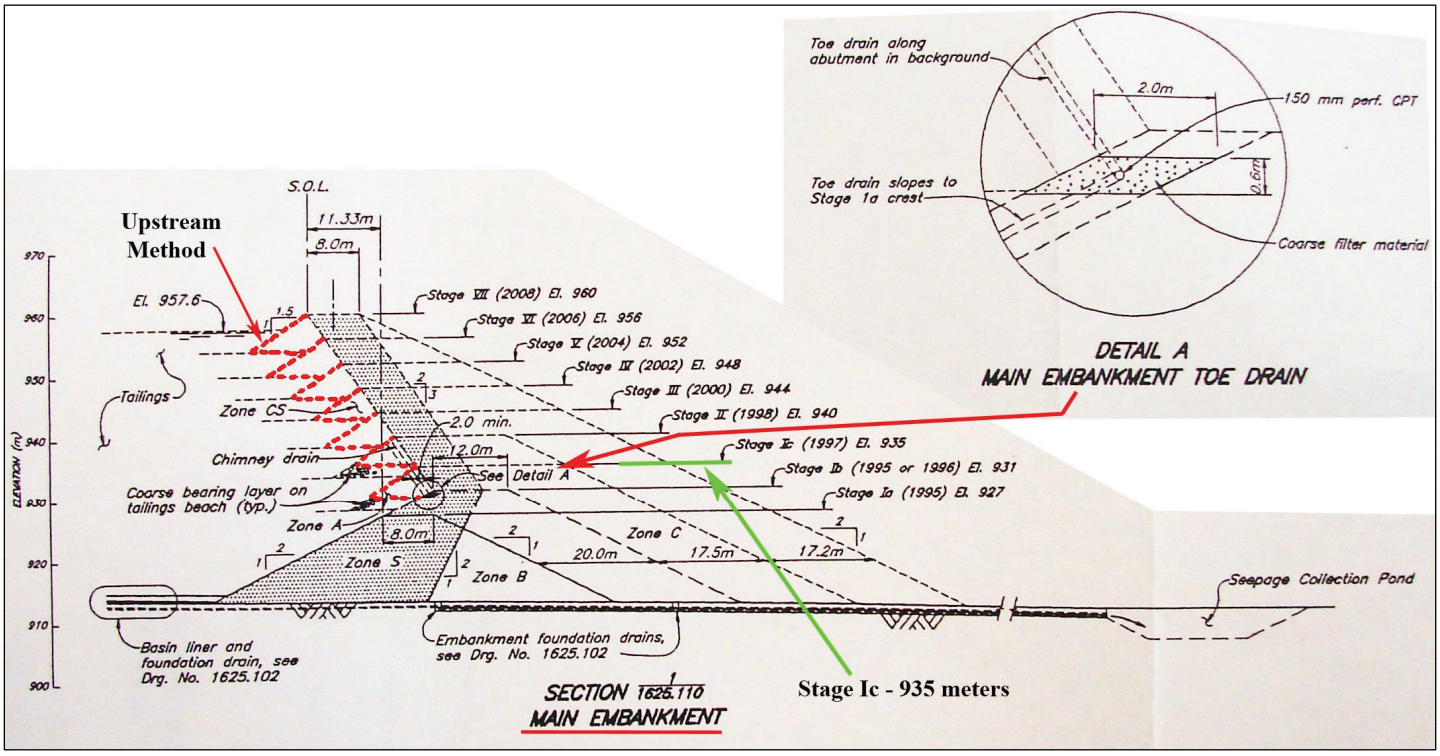
Three years after Imperial Metals obtained a mine development certificate in October 1992 from the BC Ministry of Energy, Mines and Petroleum Resources for a 13,700 ton/day open pit mining operation, Knight Piésold submitted two May 26, 1995 reports to BC's Mines Inspector as catalogued in Mines Permit M-200, *Approving Work System and Reclamation Program*: *Tailings Storage Facility Design Report* (2 volumes); and *Tailings Storage Facility Site Inspection Manual* (neither of which was available for review for this present report). [18] It was in these reports that Knight Piesold classified the combination Centreline/Upstream methods, defining both as a "Modified Centreline Method" in the April 1996 *Mount Polley Mine Project Reclamation Plan*:

> *The tailings embankment will be constructed from glacial till, most of which will be obtained from borrow sources within the tailings impoundment. The tailings embankment will be constructed in a series of raises, by means of the modified centreline method of construction.* [19]



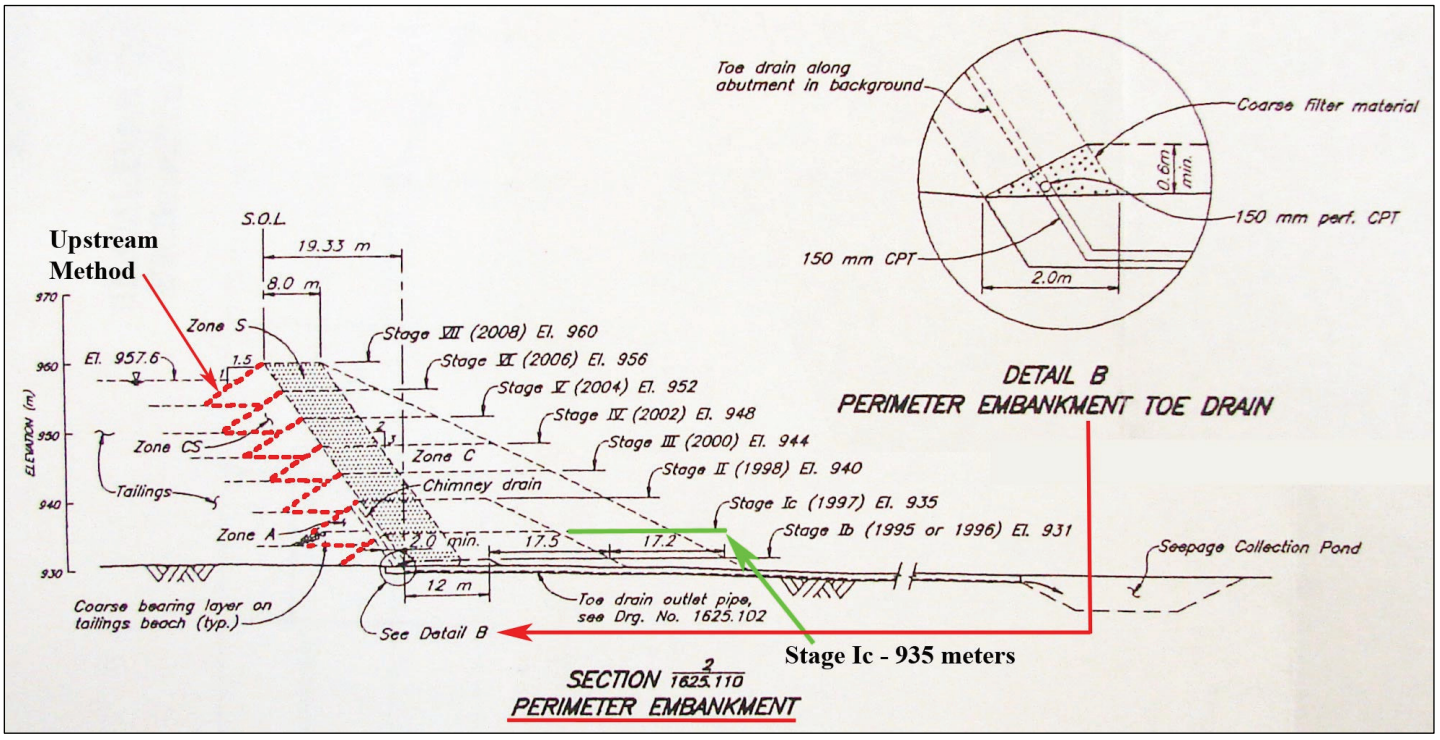
Above: Red dotted line shows location of the Tailings and Reclaim Pipelines from and back to the millsite.

[17] *Stage One Environmental and Socioeconomic Impact Assessment*, Volume One, page 105.
[18] See Appendix B.
[19] Page 5-17.

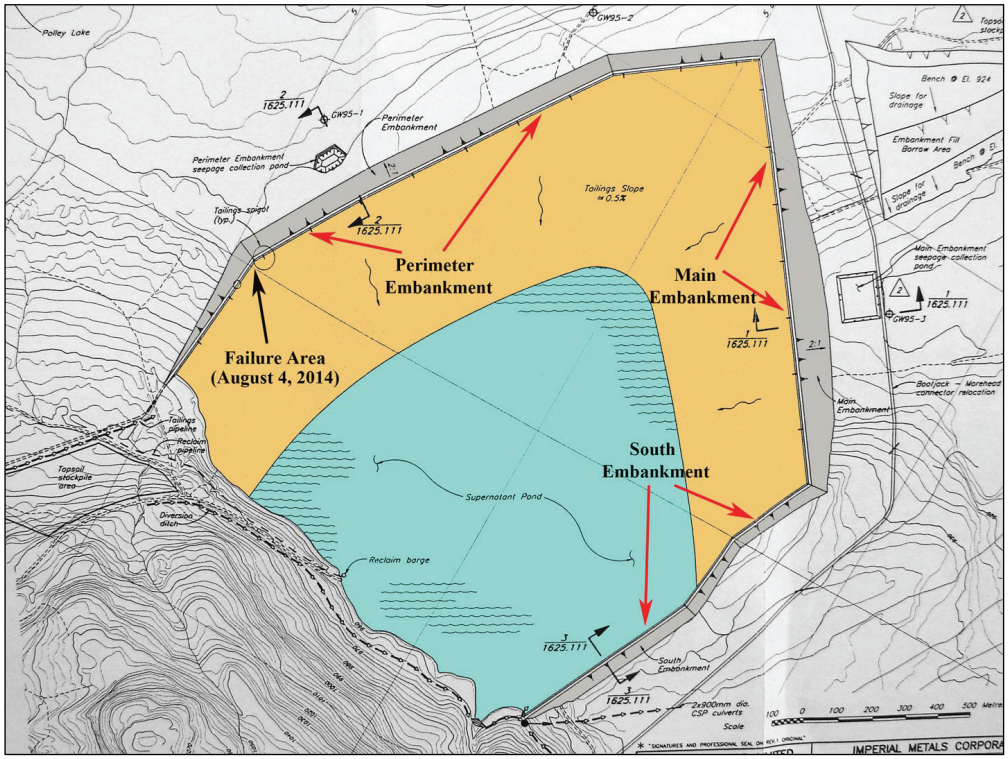


Above: Figure 3.18 from 1996 *Reclamation Plan* report. The red dotted lines show the Upstream Type method stages for the Main Embankment. Note the height in meters of Stage Ic elevation, and the large area below built up primarily of Centreline Type method, a much stronger foundation area than provided for the Perimeter Embankment foundation.

Below: Figure 3.18 from 1996 *Reclamation Plan* report. The red dotted lines show the Upstream Type method stages for the Perimeter Embankment, a section of which failed on August 4, 2014. Note the shallow base constructed for the Centreline Type method, compared to the higher and wider zone provided for the Main Embankment above.



Right: Figure 3.16, *Tailings Storage Facility Final Arrangement*, from the 1996 *Final Reclamation* report. The locations of the three embankments are named, showing the 'conceptual' location of the supernatant waters (in blue-green) well away from the higher Perimeter and Main Embankments (plenty of "freeboard"). In the area of exposed tailings are small indicators showing the integrated locations of tailings spigots (along the outer perimeter of the tan color area).



Below: Figure 3.17, *Tailings Area Filling Schedule and Staged Construction*, in the 1996 *Reclamation Plan* report. This was Knight Piesold's long-term staged elevation construction concept for the TSF, based on a 14-year-long mine life. The TSF became 'dormant,' so to speak, from October 2001 to March 2005 (referred to by Mount Polley Mines Corp. as the "care and maintenance period," when the TSF collected large volumes of groundwater, rain & snow. Note: the 2009 *Technical Assessment Report* states that it was "a substantial accumulation of water". From 2005 to 2014, the embankments were raised almost 22 meters in total crest height, a period when the mine plan was revised to accommodate newly discovered ore bodies with a projected new mine life expected to last to about the year 2025.

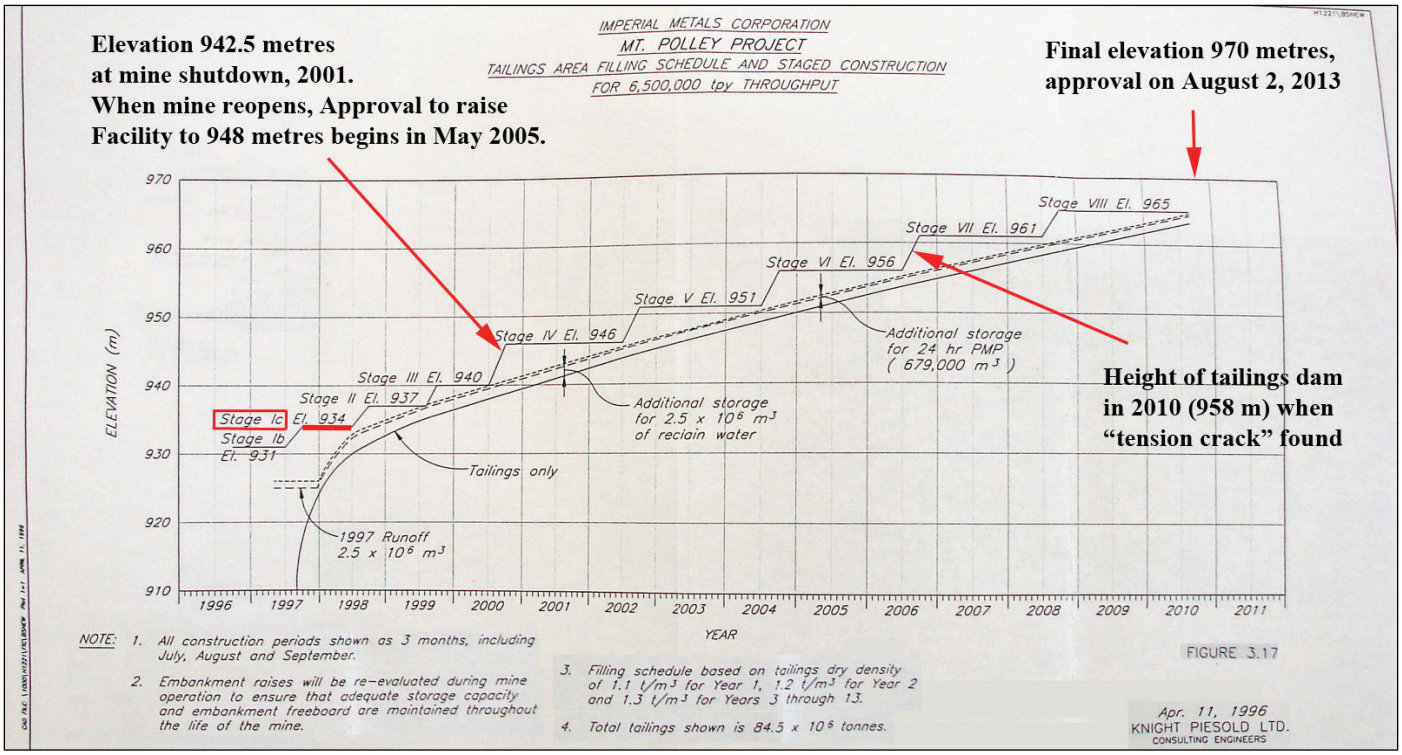
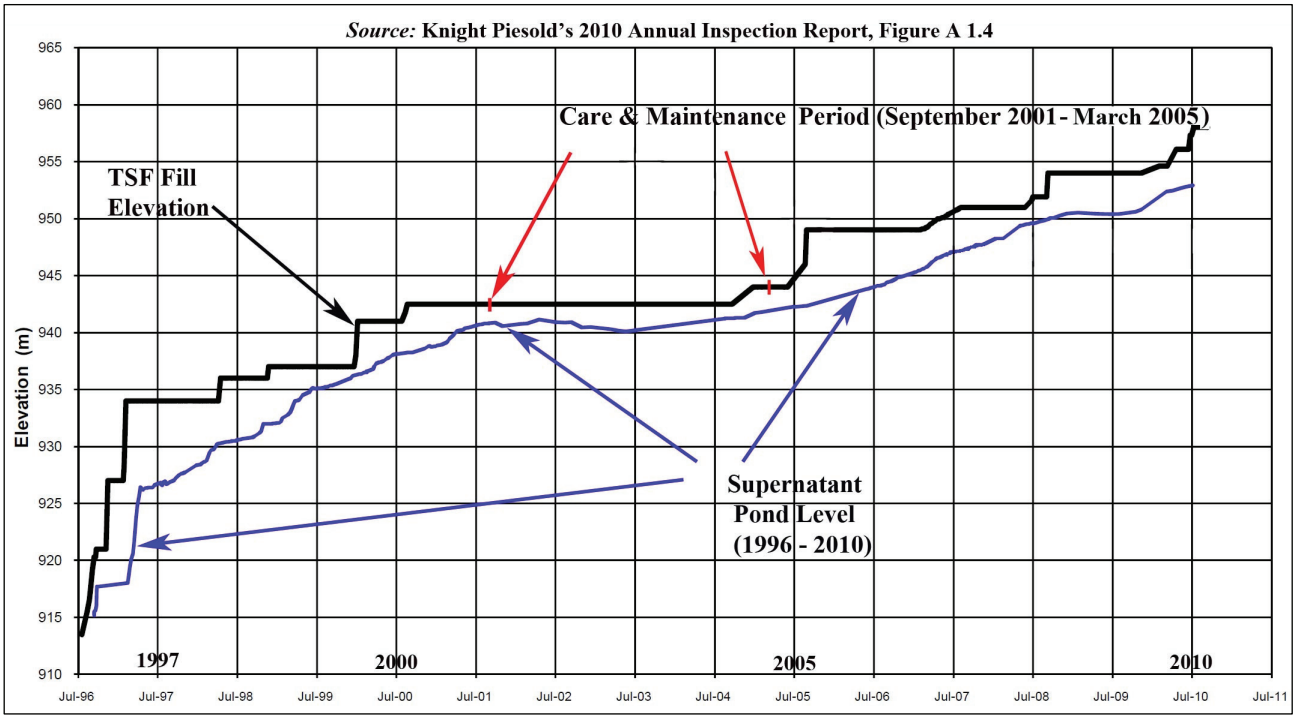
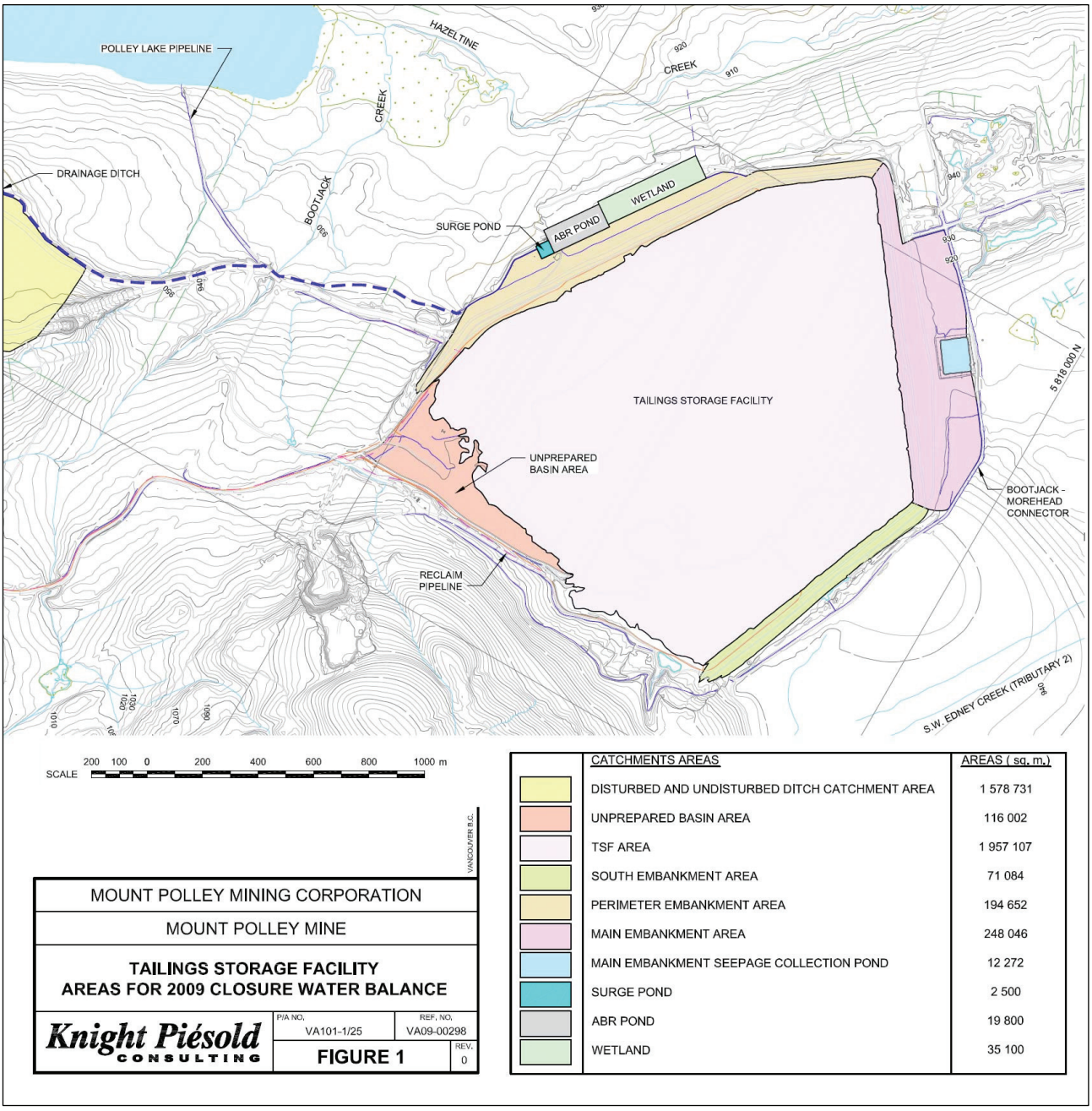


Table 4.1: B.C. Mine Permit M-200 - TSF Construction Approvals Showing Approval Date, Construction Elevation, and Construction Phase Name

PERMIT APPROVAL DATE	ELEVATION LIMIT (Meters)	CONSTRUCTION PHASE
1996 - 09 - 23	934	Stage 1-b
1997 - 04 - 07	940	Stage 2
2000 - 06 - 13	944	Stage 3
2001 - 05 - 30	945	Stage 3
	Care and Maintenance Period (September 2001 to March 2005)	
2005 - 05 - 25	948	Stage 4
2006 - 08 - 02	951	Stage 5
2008 - 02 - 19	958	Stage 6
2011 - 08 - 15	960.5	Stage 7
2012 - 06 - 29	963.5	Stage 8
2012 - 10 - 15	965	Stage 8-a
2013 - 08 - 09	970	Stage 9

Below: Graph from Knight Piesold's 2010 Annual TSF inspection report showing the evolution of the crest height of the Mount Polley TS from July 1996 to July 2010.





Above: Cut-out from Figure 1 of Knight Piésold's map in Appendix G, *Details of Proposed Discharge*, from the July 2009 *Technical Assessment* report. The map and legend provide areas in square meters of the Tailings Storage Facility and its components: i.e., by conversion, the TSF Area is 195.7 hectares in area, the Perimeter Embankment area is 19.5 hectares, etc.

The causes of failure in active dams are more diverse than those for inactive impoundments, but some general conclusions may be drawn. Rico et al. (2008b) categorized failures into eleven broad groups: foundation, slope instability, overtopping, mine subsidence, unusual rain, snow melt, piping or seepage, seismic liquefaction, structural, maintenance and unknown causes. There is some obvious overlap between several of these categories (e.g., snow melt and overtopping) and nearly all occurrences may have multiple causes (e.g., poor maintenance and structural failure). However, Rico et al. (2008b) report that 25% of worldwide and 35% of European failures are accounted for by extreme meteorological events, a failure rate which may well increase with anthropogenically-related climate change.

The integrity of tailings dams is dependent on both good design and maintenance. Most failures are preceded by warning signs, except for those triggered by earthquake or major storm events (Martin and Davies, 2000). Good maintenance programmes are, therefore, an essential requirement of effective tailings impoundment management, a vital component of which is a comprehensive surveillance programme (Martin and Davies, 2000). Structure settlement cracking and wet spots on the dam face are all good qualitative visual indications of potential problems. Piezometers, clinometers and pressure gauges may all be employed to good effect in a sensibly designed monitoring protocol (Vick, 1983; Vandeberg et al., 2011). The combination of these data with properly maintained operational logs (e.g., recording dates, locations and meteorological conditions at the time of disposal) allows for a reliable quantification of risk, thereby enabling effective proactive preventive responses.

(*Mine Tailings Dams: Characteristics, Failure, Environmental Impacts, and Remediation*. D. Kossoff, et. al., in Applied Geochemistry 51 (2014). pages 229-245)

5. The "In Perpetuity" Mandate And Mount Polley's Upstream Tailings Dam

> *A well intentioned corporation employing apparently well-qualified consultants is not adequate insurance against serious incidents.* [20]

> *The factors listed above, taken together with the difficulty in characterization of shear strength for conventional upstream tailings dams, and the many publicized failures of conventional upstream dams, make the author an ardent believer in Rule 1 as stated by Carrier (1991), who recommends* ***"geotechnical engineers should avoid designing upstream tailings dams"****.* [21] [Bold emphasis]

> *Both tailings dams were nearly 25 m high with one constructed directly upstream of the other. ... The dams were upstream constructed with outer slopes ranging between 1.2 to 1.5 horizontal and 1 vertical. Based upon the likely state of the in-situ tailings, the soil mechanics curiosity with this failure is that the dams could attain such a height prior to failure. There is no question that the design of these dams was not consistent with even the most elementary engineering principals available at the time. There are a number of "rules" for upstream tailings dam engineering (summarized recently by Davies and Martin, 2000) that were understood for many years prior to the Stava failure. The Stava dams both broke far more of these rules than they followed.* [22]

In the early 1980s, an acute interest by professional engineers in the proper (wise?) construction and stewardship of mine waste tailings dams led to the publication of key documents by U.S. Federal and State agencies in the early 1990s. According to a 2001 publication by the International Committee on Large Dams (ICOLD), United States professional engineer researchers and academics were attempting a fill a big knowledge gap in the reporting and accounting history of tailings dams following the initiation of an ICOLD technical committee on tailings dams in 1977.

For example, comprehensive publications, such as Stephen Vick's classic and forerunner 1983 book, *Planning, Design, and Analysis of Tailings Dams*, which was revised in 1990, became integral foundation material and fodder for future technical reports in North America.

> *Use of the upstream raising method, however, is limited to very specific conditions and incorporates a number of inherent disadvantages.*
>
> *Upstream embankments, while providing the simplest and least costly raising method, are subject to a number of very critical constraints. Proper use of the method can be justified only when those constraints are thoroughly investigated and satisfied.* [23]

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[20] N.R. Morgenstern. *Geotechnics and Mine Waste Management - An Update*. Proceedings of ICME/UNEP Workshop on Risk Assessment and Contingency Planning in the Management of Fine Tailings, Buenos Aires, November 1998, pages 172-175. The quote was in reference to the Sullivan Mine tailings disaster that occurred in August, 1991 in British Columbia.

[21] Page 2, *Characterization of pore pressure conditions in upstream tailings dams*, by T.E. Martin, February 2002.

[22] Michael P. Davies, *Tailings Impoundment Failures: Are Geotechnical Engineers Listening?*, in Geotechnical News, September 2002, page 34.

[23] Vick, 1983, pages 70-74, 158.

Technical report OFR 94092, filed in 1992 by the US Bureau of Mines, *RCRA Regulation Impact on Alaska Mineral Development - Tailings Management*, was prepared for the Alaska U.S. Bureau of Mines. The report was highly critical of the Upstream-Type construction, the same method chosen by Imperial Metals Corporation as its design for Mount Polley, the design approved in October 1992 and monitored by the BC Ministry of Mines from October 1997 onward. Another technical report was published by the Environmental Protection Agency in August 1994, *Design and Evaluation of Tailings Dams*.

During this period of reformation interest by geotechnical engineers, in 1994 the United States Committee on Large Dams published Bulletin 97, *Tailings Dam Incidents*, which described the highly vulnerable nature of Upstream Type or Method tailings dams as a major commonality in 185 mine waste tailings disaster incidents.

These and other reports were communicated and read by the engineering community throughout North America's geotechnical engineering companies, firms and groups, and those within governmental agencies and structures, the make-up of the mining triangle of academia, government and private industry, which the author has heretofore nicknamed ***the Tailings Triangle***. Moreover, engineers the world over were actively engaged in this resurgent interest, particularly in Europe, Australia and South Africa.

For instance, in 1994 came the establishment of the annual meetings of the International Conference on Tailings and Mine Waste, [24] the most recent of which was held on October 5-8, 2014 at the Keystone Resort in Colorado where many attendees were no doubt whispering about the Mount Polley tailings disaster, one of the world's largest, by volume, registered disasters. One of the organizing committee members of the 2014 conference is professor Dirk Van Zyl from the University of British Columbia, who is also one of the three panel members appointed by the BC government to review the Mount Polley mining disaster.

In 1995, the International Committee on Large Dams (ICOLD) established the Committee on Tailings Dams and Waste Lagoons, which included a British Sub-Committee on Tailings Dams. The Tailings Dams Committee had representatives from 17 nation states: Australia, Brazil, Bulgaria, Canada, Chile, China, France, Germany, Italy, Iran, Poland, Romania, Russia, South Africa, Sweden, the United Kingdom, and the United States. Colorado-USA author Stephen Vick was on the ICOLD Committee since 1996.

By 2001, the Tailings Dams Committee, through preparations by its British Sub-Committee, published *Tailings Dams Risk or Dangerous Occurrence: Lessons Learnt from Practical Experiences*, a document that produced incontrovertible evidence of increasing tailings dams failures the world over, most of the 221 incident failures of which were caused from Upstream-Type designed dams. [25] All of the incident case records were presented in a lengthy appendix which included a table with 9 categories and a summary description of each incident.

---

[24] According to the Tailings and Minewaste website (www.tailingsandminewaste.org), the conferences were an outcome of "a series of symposia on mill tailings management that originally started at Colorado State University in 1978." The conferences continued annually until 2004, and then resumed in 2008 following.

[25] The document states that ICOLD published 9 bulletins on "guidelines for the design, construction and closure of safe tailings dams," Numbers: 45, *Manual of Tailings Dams and Dumps* (1982); 44a, *Bibliography* (1989); 74, *Tailings Dam Safety* (1989); 97, *Tailings Dams - Design of Drainage* (1994); 98, *Tailings Dams and Seismicity* (1995); 101, *Tailings Dams. Transport, Placement and Decantation* (1995); 103, *Tailings Dams and the Environment* (1996); 104, *Monitoring of Tailings Dams* (1996); 106, *A Guide to Tailings Dams and Impoundments* (1996); and another bulletin by

With the intention of trying to determine the causes of these incidents, 221 case records have been collected. They are given both in brief detail and discussed in general terms. The main causes of these reported cases of failure and incidents were found to be ***lack of control of the water balance, lack of control of construction and a general lack of understanding of the features that control safe operations****.* [Bold emphasis] *There were one or two cases of unpredictable events and other cases caused by unexpected climatic conditions, including earthquakes, although it can be argued that with today's knowledge, allowance should have been made for these events.*

Water retaining dams in most countries are controlled by legislation, and in some countries the legislation applying to embankment dams retaining water are equally applied to tailings dams. There appears to be a requirement for a more extensive application of legislation to the non-revenue raising activity of storing waste tailings, in order to reduce the occurrences of tailings dam failures and unsatisfactory behaviour.

In gathering incident case data for ICOLD's Committee report of 2001, it stated that the Committee "encountered a reluctance amongst the owners of tailings dams to expose incidents or failures unless they came into the public domain through the media or published papers."

Satellite imagery has led us to the realisation that tailings impoundments are probably the largest man-made structures on earth. Their safety, for the protection of life, the environment and property, is an essential need in today's mining operations. These factors, and the relatively poor safety record revealed by the numbers of failures in tailings dams, have led to an increasing awareness of the need for enhanced safety provisions in the design and operation of tailings dams. The mining industry has a less than perfect record when tailings dam failures are reviewed. Examples of notable failures that have been costly to life, the environment and to asset value, are given by Table 1.

Table 1. Examples of tailings dam failures

- ***October 2000.*** *Martin Country Coal Corporation, Kentucky, USA. 0.95 million m3 coal waste slurry released into local streams. Fish kill in River Tug and drinking water intakes had to be closed.*
- ***Sept 2000****. Aitik mine: Sweden: 1.8 million* m^3 *water released.*
- ***March 2000****. Borsa: Romania: 22,000 t tailings contaminated by heavy metals released.*
- ***Jan 2000****. Baia Mare: Romania: 100,000* m^3 *cyanide contaminated water with some tailings released.*
- ***April 1999****. Placer, Surigao del Norte: Philippines: 700,000 t cyanide contaminated tailings released; 17 homes buried.*
- ***Dec 1998****. Haelva: Spain: 50,000* m^3 *acidic and toxic water released.*
- ***April 1998****. Aznalcóllar: Spain: 4-5 million* m^3 *toxic water and slurry released.*
- ***Oct 1997****. Pinto Valley: USA: 230,000* m^3 *tailings and mine rock.*
- ***Aug 1996****. El Porco: Bolivia: 400,000 t involved.*
- ***March 1996****. Marcopper: Philippines: 1.5 million tonnes tailings released.*
- ***Sept 1995****. Placer: Philippines: 50,000* m^3 *released, 12 killed.*

ANCOLD (Australian National Committee), *Guidelines on Tailings Dam Design, Construction and Operation* (1999). It states: "If the recommendations given in these guidelines were to be closely followed, the risk of a failure or dangerous occurrence with a tailings dam and impoundment would be greatly reduced. Unfortunately the number of major incidents continues at an average of more than one a year. During the last 6 years the rate has been two per year."

- ***Aug 1995***. *Omai: Guyana: 4.2 million m^3 cyanide slurry released.*
- ***Feb 1994***. *Merriespruit: South Africa: 17 lives lost, 500,000 m^3 slurry flowed 2 km.*
- ***July 1985***. *Stava: Italy: 269 lives lost, tailings flowed up to 8 km.*
- ***Jan 1978***. *Arcturus: Zimbabwe: 1978: 1 life lost, 20,000 m^3 flowed 300 m.*
- ***Nov 1974***. *Bafokeng: South Africa: 12 deaths, 3 million m^3 slurry flowed 45km.*
- ***Feb 1972***. *Buffalo Creek: USA: 125 lives lost, 500 homes destroyed.*
- ***Sept 1970***. *Mufilira: Zambia: 89 deaths, 68,000 m^3 into mine workings.*

According to an international conference presentation report, by the year 2000 there were a total of "130 STDFs [Surface Tailings Disposal Facilities] in British Columbia (Canada) alone." [26]

The "In Perpetuity" Mandate

Summarized in a 2002 report, *Stewardship of Tailings Facilities*, by the International Institute for Environment and Development (IIED), under its Mining, Minerals and Sustainable Development (MMSD) initiative, "Tailings storage facilities typically represent the most significant environmental liability associated with mining operations:"

> *Stewardship is defined for the purposes of this paper as "taking care of". A tailings facility must be appropriately "taken care of" in all aspects of design (conceptual through detailed), construction, operations, inspection, surveillance, review, and management (corporate policies, training, roles and responsibilities, documentation and reporting, etc.) in seeing a tailings facility through from conceptual design to closure. ... All tailings facilities must be completed, and maintained, in a manner that assures their safety and integrity (physical and environmental) for the closure period, which is perpetuity. Perpetuity is a long time.*
>
> *Given that tailings dams must last in perpetuity, the tailings dam designer must recognize that they are designing for a period for which there is no design precedent.*
>
> *Conventional dams generally do not need to be designed to last forever, as they have a finite life. Tailings dams have a closure phase as well as an operational phase. The have to be designed and constructed to last "forever", and require some degree of surveillance and maintenance long after the mining operation has shut down, and generation of cash flow and profit has ceased.*

Due to the nature of toxic and heavy metals properties and mine effluents stored within mine waste tailings masses, sometime in the 1980s conscientious design engineers began stating that all tailings dams should be built to last "in perpetuity," a logical and practical maxim.

The "in perpetuity" mandate is therefore reiterated in ICOLD's Tailings Committee report of 2001:

> *Some governments already have a role in approving all phases – design, construction, certification, surveillance, closure, emergency planning. The post – closure phase is of*

[26] *Upstream Constructed Tailings Dams - A Review of the Basics*, by M.P. Davies and T.E. Martin, Proceedings of the 7th International Conference on Tailings and Mine Waste, 2000, held in the Netherlands.

particular importance to governments because the stability of closed tailings facilities must be maintained in perpetuity.

Imperial Metals Corporation also recognized this mandate, incorporated in its July 1990 *Stage I Environmental & Socioeconomic Assessment* report to the BC government for the Mount Polley open pit copper/gold mine proposal:

> *At completion the tailings pond will be equipped with a permanent spillway and drainage channel to allow excess precipitation to drain away. It will be designed to operate in perpetuity.* [27]

Imperial Metals Corporation Red Chris open pit copper/gold mine feasibility application reports filed with the BC Environmental Assessment Office from 2003 to 2004 also cite the words "in perpetuity" to describe the ultimate intended function of its gigantic tailings dam. [28]

The May 1999 Australia report, *Safe Design and Operating Standards for Tailings Storage*, states the following:

> *In an above ground facility tailings are generally stored behind a purpose built embankment. The embankment may be constructed in several stages or in one pass to its designed maximum height. The purpose built tailings storage embankments differ significantly from conventional water storage dams in a number of important aspects, including:*
>
> - *The design life of a TSF* [Tailings Storage Facility] *is, effectively, perpetuity. A TSF could be considered to have two phases in its life – a depositional phase with active human involvement followed by an erosion free, environmentally benign, stage with no further human intervention, forever.*

Synthesized from many reports and documents, the authors of the October 2011 report, *Long Term Risks of Tailings Dam Failure*, summarized the following:

> *Tailings dams, however, require a very conservative choice of design event. Once these structures are built, it is not economically or environmentally viable to move the waste that is impounded behind the dam. The dam must hold this waste safely in perpetuity. We don't know how long 'perpetuity' means, but 10,000 years (e.g. the approximate time since the last ice age) is a minimum approximation.*
>
> > *"According to the current ICOLD guidelines, large dams have to be able to withstand the effects of the so-called maximum credible earthquake (MCE). This is the strongest ground motion that could occur at a dam site. In practice, the MCE is considered to have a return period of several thousand years (typically 10'000 years in countries of moderate to low seismicity)." (Wieland, ICOLD, 2001)*

[27] Page 125, Volume 1.

[28] Stated in Imperial Metals 2007 Annual Information Form, on March 15, 1997 it acquired 97.8 % of bcMetals assets in a takeover bid, with bcMetals having received an environmental certificate from the BC Environmental Assessment Office in 2005 for the Red Chris feasibility project.

As a society we still don't fully understand the long term implications of storing billions of tons of potentially harmful waste in large impoundments. We have been building large tailings dams for about a century, but these structures must maintain their integrity in perpetuity, so we have only a relatively short history of their performance.

> *"Conventional dams generally do not need to be designed to last forever, as they have a finite life. Tailings dams have a closure phase as well as an operational phase. They have to be designed and constructed to last "forever", and require some degree of surveillance and maintenance long after the mining operation has shut down, and generation of cash flow and profit has ceased." (MMSD, 2002, p. 8)*

> *"Conventional dams are viewed as an asset. As a result, their construction, operation, and maintenance receives a high standard of care and attention from owners, who often retain in-house dam engineering expertise. Contrast this to tailings dams, which have until recently been viewed by their owners as an unprofitable, money-draining part of the mining operation. The significance of this aspect is that with such attitudes a mining operation would be naturally less inclined to expend effort in the management of its tailings facility than the owner of a conventional dam." (MMSD, 2002, p. 8)*

Upstream Dam Types: Unforgiving Structures

T.E. Martin, with AGRA Earth & Environmental Limited, who co-authored the 2002 MMSD report, *Stewardship of Tailings Facilities*, also co-authored another report with E.C. McRoberts in 2002, *Some Considerations in the Stability Analysis of Upstream Tailings Dams*. In that report, the authors laid out "eight fundamental rules" on the stewardship and maintenance for Upstream-Type or Method tailings dams, which they classified as "unforgiving structures."

> *Upstream tailings dams are unforgiving structures, and any one or combinations of improper design, construction and operation have resulted in a number of well-known, catastrophic failures, that have in some instances caused loss of life, such as the Stava failure in Italy (Berti et al., 1988, Chandler and Tosatti, 1995). The United States Committee on Large Dams (USCOLD, 1994) published a review of tailings dam failure records available to them in 1994. This review found that upstream-constructed tailings dams have recorded the largest share of documented failures.*
>
> *The authors therefore expanded the checklist above to the following eight fundamental rules for design, construction and operation of upstream tailings dams:*
>
> *1. A sufficiently wide beach, relative to the ultimate height of the dam, must be maintained at all times, to achieve segregation of the coarser tailings sizes and to form a relatively strong, wide, drained (unsaturated), and/or dilatant (non-contractant during shear) outer shell. The dam slope must not be underlain by tailings slimes, unless the designer has satisfied Rule 4 below. The shell must be of sufficient width to retain the "bursting pressures" [see Casagrande and MacIvor] of the upstream contractant beach sands or slimes if they liquefy.*
>
> *2. The rate of raising of the dam must be sufficiently slow such that there is a sufficient degree of dissipation of excess pore pressures in the outer shell and in the slimes, and such that excess*

pore pressure buildup does not occur in foundation materials.

3. There must be sufficient underdrainage (drainage blanket, finger drains) and/or a pervious foundation to maintain the sand shell in a relatively drained condition, and to prevent seepage from issuing from the face of the tailings dam.

4. Design analyses must include both undrained strength analysis (USA) and effective stress analysis (ESA), with design controlled by the analysis type giving the lowest factor of safety. A wide range of factors including material type, degree of consolidation and stress path must be assessed in assigning the appropriate USA.

5. A high degree of regular performance monitoring, reviews, and ongoing involvement by the designer is essential to check that design intent is being satisfied, to confirm design assumptions, and to identify any design changes that may be required.

6. Conventional upstream dams cannot be considered for areas of moderate to high seismicity. Improved upstream construction, involving a combination of compaction of the outer shell and good internal drainage, can be used in such areas.

7. The design must be consistent in terms of design requirements (e.g. minimum beach width) versus operational requirements (e.g. pond size required for clarification, storm storage and freeboard). The geotechnical design of upstream tailings dams cannot be carried out in ignorance of operating constraints.

8. Seepage conditions within the dam must be well-defined, requiring a good understanding of pore pressure profiles and hydraulic gradients. The distinction between pore pressure measured at a given point, and saturation level, must be well understood and correctly applied in stability analyses, especially in instances where there is strong downward drainage.

Only where Rule No. 1 is satisfied, and the dam configuration is as shown on Figure 1a, can reliance solely on ESA be justified. Continued reliance on such an approach for upstream dams that violate Rule No. 1 ignores the fundamentals underlying triggering and pore pressure response during undrained shear in contractant materials, and is likely to lead to future failures of upstream tailings dams.

Concerns about proper construction, maintenance and limitations of Upstream Type tailings dams are stated widely and prevalently in professional engineering literature. Here is another, more recent example in Allan J. Breitenbach's 2009 paper, *Improvement in the Stability of Upstream Method Phosphate Tailings Dams with Rock Fill Shells*, presented at a phosphate conference held in Marrakech, Morocco.

The upstream method dam construction was common into the 1980's and 1990's, however studies of world wide dam failures indicate hydraulic fills are more susceptible to instability from seismic (earthquake) liquefaction, overtopping, and tailings delivery or water return decant pipe breaks compared to downstream method compacted earth and rock fill tailings dams [5]. A fast rate of rise in hydraulic fill tailings disposal operations can also increase the potential risk of static liquefaction [4]. Therefore upstream method tailings dams have seen less frequent use in recent times in high seismicity zones of the world, as well as any areas where the tailings dam can be classified as a high hazard structure.

The single most important factor in upstream method dam stability is adequate tailings beach drainage, which requires the ability to deposit settled tailings above the impoundment water pool level (prevent submerged tailings disposal with related low density, strength, and poor drainage issues). Therefore the lowest risk upstream method dams have the water pool located away from the dam as much as practical after startup operations. In addition, the perimeter tailings paddock cells and beach surface should be allowed to dry by rotation of active disposal areas for densification and reduction of pore pressures in controlled and relatively thin hydraulic fill layers.

The water pool location, operational storage volume, and return water system are important aspects in the stability of the upstream method tailings dams. Most of the upstream method tailings dam failures to present day are related to excess water balance conditions (overtopping of the dam), location of the water pool at the perimeter dam limits (failure in weak slimes material or high phreatic surface seepage conditions), and gravity water return pipeline breaks or plugged and inaccessible impoundment decant towers (gravity decant towers with pipelines extending beneath the impoundment and dam limits).

The impoundment water pool is generally located in the main valley drainage or in a side valley drainage area closest to the plant site for return water flows. The impoundment water pool limits are located as far as practical away from the upstream method tailings dam to achieve the following goals: 1) minimize any direct hydraulic drainage from the water pool into the tailings beach materials, 2) deposit the low strength finer tailings slimes material away from the dam and settled tailings beach section, 3) allow drying and densification of the perimeter settled beach materials, and 4) increase the freeboard elevation from the dam crest to the operating water pool level to contain operational upsets and design storm events.

As narrated in the following chapters of this report, Imperial Metals Corporation / Mount Polley Mining Corporation failed to abide by critical principles enunciated by professional engineers the world over on the stewardship and maintenance of its Tailings Storage Facility. And, as stated by its former Engineer of Record, Mount Polley was not in compliance with its Operation, Maintenance and Surveillance Manual, which, as a condition of its mining operating permit, was updated and regularly submitted to BC's Chief Inspector of Mines, i.e,: "The tailings facility and embankment dam shall be monitored in accordance with the updated OMS manual." [29] And, British Columbia's mining regulator is also on the hook for having neglected its public fiduciary duties, its "duty of care," in the ultimate oversight of the Mount Polley mine's inappropriate design and appalling lack of mine operator stewardship.

[29] Permit No. M-200, August 15, 2011, Amendment to Permit, Approving Mining of the C2 and Boundary Zone Pits.

6. A TSF *Never* Hibernates: The Water Accumulation Dilemma During the "Care and Maintenance" Years

> *While operating, Mount Polley mill tailings and site water have been discharged into* ***the environmentally-secure TSF****, with supernatant from the TSF recycled for re-use in the milling process. In addition, site water was allowed to accumulate in the TSF during mine closure from 2001 to 2005.* ***In accordance with the updated mine plan and water balance*** [30]*, mine water stored in the TSF will be treated and discharged to an appropriate receiving watercourse.* [Bold emphases]
>
> *The SSWQO (Site-Specific Water Quality Objectives) development process is critical to understanding the potential for adverse water quality effects to aquatic organisms that may result with discharge of Mount Polley Mine effluent into Hazeltine Creek. To further understand the biological implications associated with discharging treated effluent into Hazeltine Creek, the Mount Polley Mine also wishes to evaluate the potential for any adverse physical impacts related to increased stream flow. Increased flow can physically affect stream channel stability by causing stream bed and/or bank erosion, which in turn can severely limit aquatic life by altering available spawning and rearing habitat, in-stream cover, food chains and other structural and functional components of the system. Such influences may constitute a Harmful Alteration, Disruption or Destruction (HADD) of fish habitat as outlined under Section 35 of the Canadian Fisheries Act (DFO 1998). Any adverse effects to fish habitat is of particular concern in lower Hazeltine Creek, which is used by Quesnel Lake kokanee salmon (Oncorhynchus nerka) as spawning habitat.* [31]

A critical, problematic phase of Mount Polley Mining Corporation (MPMC) operations occurred four years after initial mine start-up in 1997. Due to a plunge in the world market price of copper, the mine was shut down for about a 42-month period, from October 2001 to March 2005. [32] MPMC refers to these limbo months as the "Care and Maintenance Period".

For about three years during this Period, the crest height of the Tailings Storage Facility (TSF) remained at construction elevation 942.5 meters (Stage 3A/B), until it was raised to elevation 945 meters (Stage 3C) in late 2004 in preparation for mill re-start. In these hibernation years, the mill no longer re-cycled or used the supernatant / decant waters, and precipitation, surface water run-off, and unknown groundwater sources freely filled the TSF, resulting in overcapacity of water within the TSF and within the footprint of the mill's water balance regime. As a result, "water balance" suddenly and somehow became a significant issue, so much so that in 2005 when MPMC restarted milling ore it officially began developing an annual "water balance spreadsheet." [33]

Presently, very little is publicly known about this critical and transitional Period. Those that did know the in-house political details were mine managers, professional consulting engineers and a few provincial staff with the Ministries of Mines and Environment. Knight Piésold, MPMC's former geotechnical engineering consultant, conducted annual inspections and published reports of

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[30] The date of the amendment is not given. Perhaps the July 20, 2004 application is cited in Mines Permit M-200?
[31] Appendix D, Project 2120, *Hazeltine Creek Habitat Characterization*, by Minnow Environmental Inc., April 2007, in MPMC's July 2007 *Modified Draft Application - Mount Polley PE 11678*.
[32] Knight Piesold's 2008 TSF Inspection Report, page 7 of 15: "mining operations started up again in December 2005."
[33] Noted in Knight Piesold's 2008 annual TSF inspection report, section 2.5.4.

the TSF in 2002, 2004 and 2005 in accordance with government permits, documents which may have described the water balance regime and summarized various engineering problems encountered concerning that regime period. However, those and other reports which, according to a condition in Environment Permit PE-11678 (see Appendix E), were to be available for public review and/or registered in public libraries, are momentarily restricted, yet to be made public.

Above: 2004 Google-Earth photo of Mount Polley's temporarily abandoned Tailings Storage Facility. The TSF was evidently left in this state for the "Care and Maintenance" period, where the mining company failed to properly and uniformly shape the tailings beaches around the TSF's crest. The top area three-angled wall or embankment in the photo is the Perimeter Embankment, the straight wall to the right is the Main Embankment, and the bottom straight wall is the South Embankment. On the left there is no artificial wall, as the TSF impoundment used the natural slope contours as a functioning wall, expanding upslope, with landscape stripping as the impoundment was raised in stages over the years.

After the BC government's three appointed panel review members are scheduled to release their assessment report (under narrow Terms of Reference) at the end of January 2015 on the TSF's physical failure, some officials with the BC government made weak promises that the public documents that may describe this period of time will be released to the public. Until those promises are fulfilled, there are a few documents obtained by the author of this report that provide some clues about what occurred during the "Care and Maintenance Years":

- *Mines Act Permit M-200 Amendment Application Northeast Zone*, July 30, 2004
- *Mount Polley Mining Corporation PE-11678: Modified Draft Application*, July 2007
- Appendix 1, *Tailings Storage Facility Report on 2008 Annual Inspection*, in Mount Polley Mine's *Annual Environmental & Reclamation Report 2008*.
- *Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent*, July 2009

- *Independent Review of the Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent (2009)*, June 2011

The most important clue about the 42-month-long Care and Maintenance Period is contained in the July 2009 *Technical Assessment Report* cited above, which summarized on page 2 (see below) that "a substantial accumulation of water" had been collected in the TSF during this period. However, there was no table data or accounting provided anywhere in the July 2009 report on what the total "accumulation of water" had been, nothing even included in the 2,256 pages of the attached appendixes. [34] The report generally stated on the same page that "excess water" conflicted with the goal of maintaining "optimal performance of the TSF."

The answer to the question as to how much volume of water had been collected within the TSF during the Care and Maintenance Period was eventually revealed in a 2013 report, *Mount Polley Water and Load Balance*, Appendix O in the 2013 *Annual Environmental and Reclamation* Report. It states that "the initial volume of water in the TMF [Tailings Management Facility] at the end of 2004 provided by MPMC **was approximately 5,000,000 Mm^3**." [Bold emphasis] No official data or table was provided in the 2013 Annual Report for MPMC's 2004 estimated figure of 5 million cubic meters of supernatant water.

In the 2008 annual TSF inspection report, Knight Piésold stated that "on December 31, 2008 the inventory of water stored in the Tailings Storage Facility [itself] was 3.11 million cubic meters." The report failed to narrate that for a two month period, from May to June 2008, the total supernatant water volume within the TSF was as high as **5.4 million** cubic meters (See Appendix I), similar to the total volume in December 2004 as reported by MPMC.

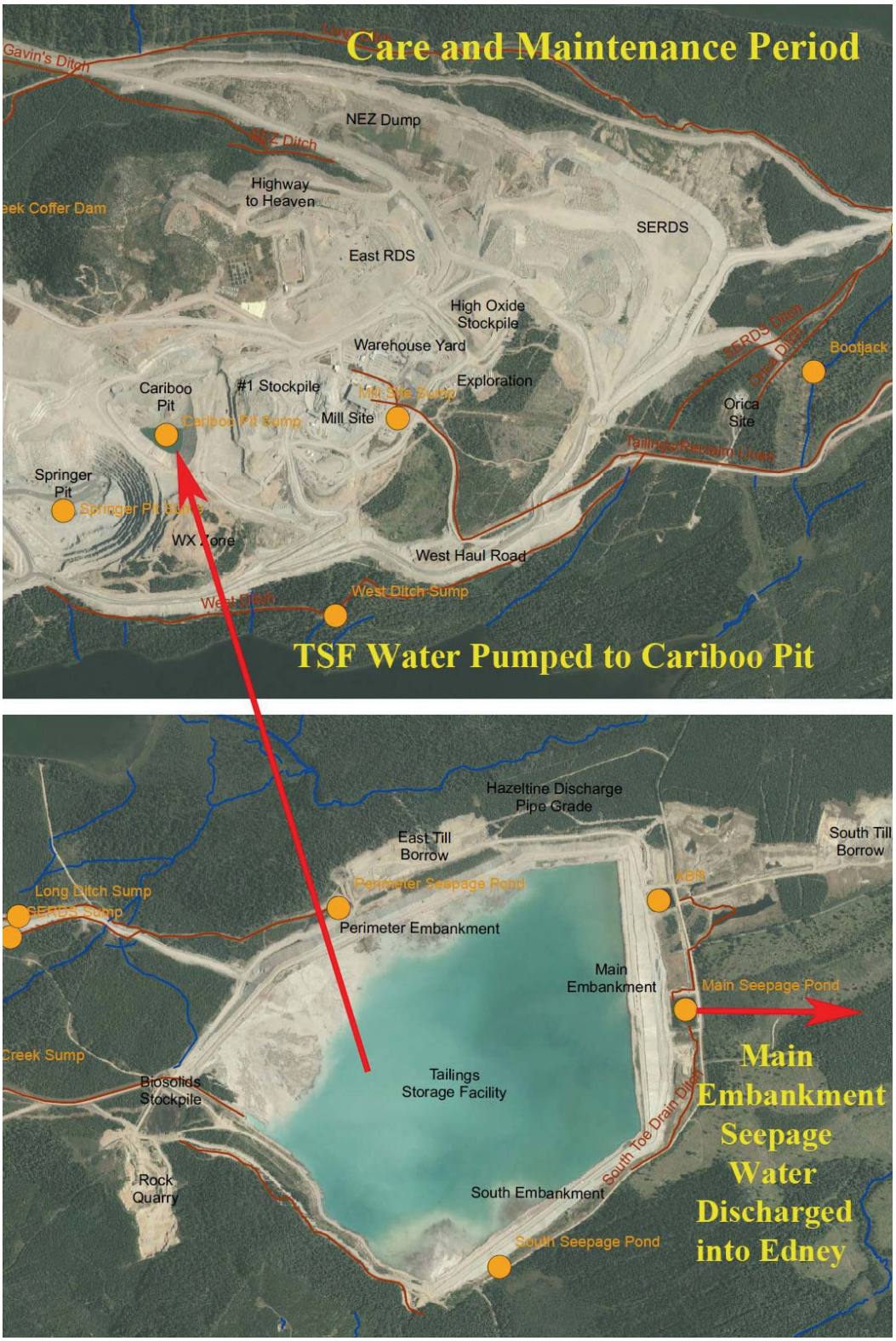
The July 2009 *Technical Assessment Report* also states that during the Care and Maintenance Period mine waste effluent water had been diverted from the seepage collection pond, located at the toe of the Main Embankment, and released/discharged into a tributary of the Edney Creek system, because MPMC could no longer properly handle or store the growing volume of contaminated waters. [35]

According to Effluent Permit PE-11678 (see Appendix E), **after** May 2005 the Ministry of Environmental allowed MPMC to continue discharging a maximum of 2,000 cubic meters of water/day into the upper Edney Creek system, and up to 100,000 cubic meters/year of "supernatant and runoff water" into the Cariboo Pit, one of the mine's three open pits.

> *During the first stage of operation (1997-2001), water (tailings supernatant) from the TSF was recycled for re-use in the milling process. Some additional water was drawn from Polley Lake to provide volume sufficient for use in milling and for optimal functioning of the TSF. Following the placement of the Mount Polley Mine on care and maintenance (September 2001), water was allowed to accumulate in the TSF, TSF water was managed by pumping it to the mined-out Cariboo Pit, and water from the Main Embankment Seepage Collection Pond (which collects seepage, limited runoff and precipitation) was permitted to*

[34] Appendix C, *Mount Polley Water Balance*, which the author retrieved, failed to provide an accounting of those figures. There is a reference made to a 2004 document, *Mount Polley Water Balance* (Cont. No. V4-0816, July 2004).
[35] The amendment documents for effluent permit PE-11678 that described the discharge conditions for the Care and Maintenance years between 2001 and May 2005 were not obtained for this report. Oddly, **these documents were excluded** from Appendix B of the July 2009 Technical Assessment report, an accounting of the effluent permit history.

discharge into the north-east tributary of Edney Creek (Permit # PE-11678 under the British Columbia Environmental Management Act; Appendix B). ***At the time of re-opening in 2005, the Mount Polley Mine had a substantial accumulation of water in the TSF***. [Bold emphasis] *Despite the careful management of water at the Mount Polley Mine through the application of best management practices (e.g ., water recycling, storage in mined-out pits, use in dust suppression), the current and future Mount Polley water balance for the mine indicates surplus water of roughly 1.4 million cubic metres per year (KPL 2009a; Appendix C). Accordingly, the Mount Polley Mine has a need to eliminate excess water to maintain optimal geotechnical performance of the TSF.*



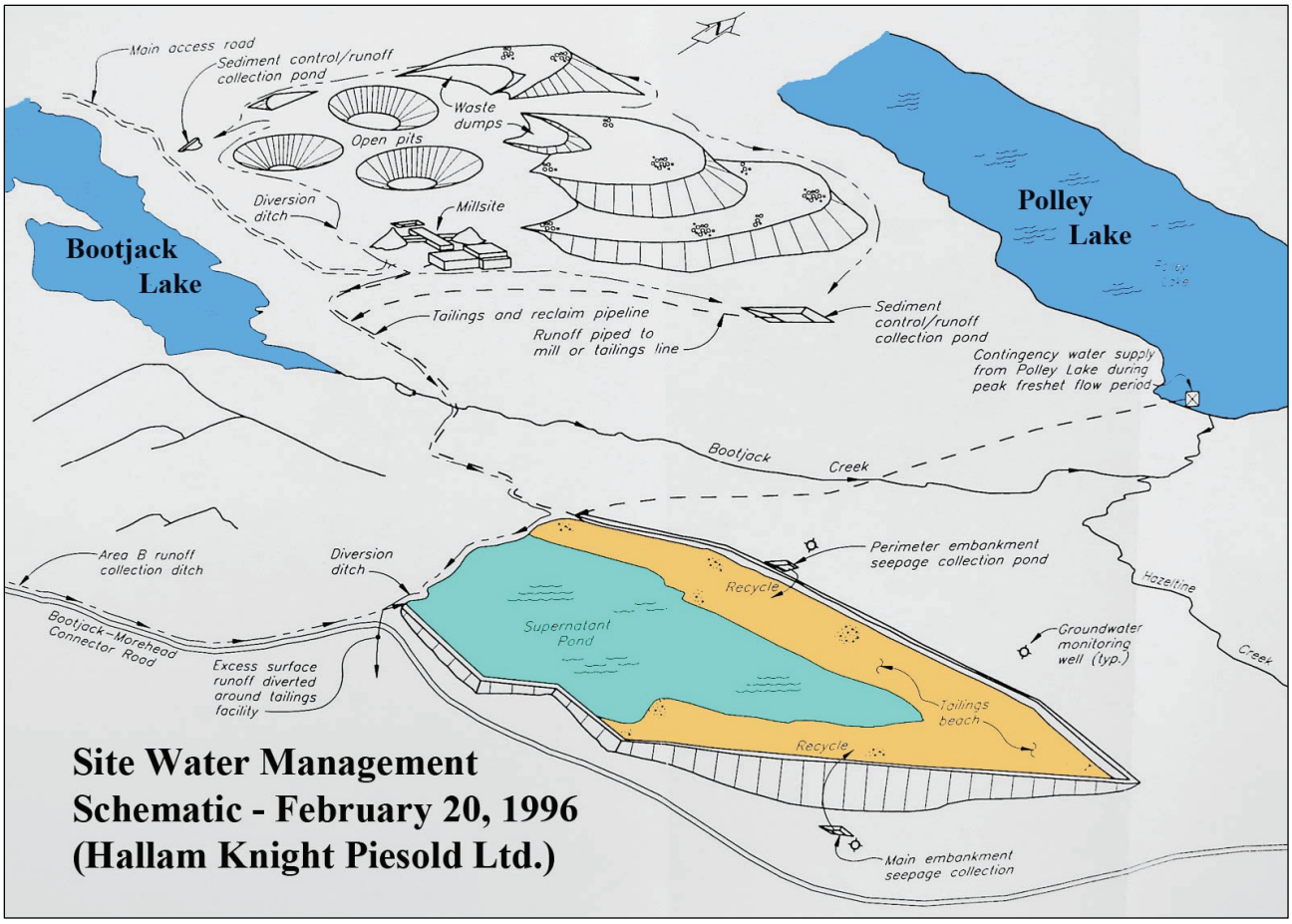
Evidently, the "substantial accumulation" of waters collected in the TSF had also created a 'substantial' environmental dilemma toward the end of the "Care and Maintenance" years. The water accumulation problem would not only create an ongoing nightmare about a proposed amendment to a Ministry of Environment effluent permit (PE 11678) for optional long-term discharge dilution of mine effluent into Quesnel Lake via Hazeltine Creek, with associated problematic public consultations over a 4 year-long period, but the increasing storage problem would eventually wreak havoc in August 2014 to an impoundment structure that was not designed to continuously contain the added "substantial" volumes of water stored within it.

According to MPMC's September 1, 2014 news update for the company's second estimate of total water volumes released from the tailings disaster of August 4, 2014, 17.1 million cubic meters of combined TSF waters - 10.6 million cubic meters of "supernatant water", and 6.5 million cubic meters of "interstitial water" or pore water - escaped from the TSF, five times the total 2 million cubic meters supernatant water volume capacity that Knight Piésold had initially and apparently designed the TSF for in 1995. And, there are good reasons to suggest that MPMC's second estimate release of 6.5 million cubic meters of interstitial waters was well off the mark, which at the time totalled over 30 million cubic meters. More likely, about 15 - 20 million cubic meters of interstitial water was most likely and eventually drained from the TSF and released into Quesnel Lake. [36]

[36] The bottom elevation area of the breach was about 930 meters in the bathymetry of the TSF. With that as the lowest point, with upwards of 40 meters of elevation storage area above it, and with a curving basin below it to about 915 meters in elevation, means that the majority of pore water contained in the TSF was able to drain outward toward the breach area.

Originally, Knight Piésold made projections about the long-term TSF-collection-centered Water Balance in the 1990 *Environmental and Socioeconomic Assessment* report and in the 1996 *Reclamation Plan* report, wherein a "net water deficit" was projected. Therein, the consultants provided a maximum storage capacity of 2 million cubic meters of process reclaim water "on top of the tailings surface" over time.

> *The water balance was designed as an iterative process considering many factors of vital importance to process design, metallurgy, water use, environment and economics. The objective was to achieve a workable balance that is technically competent, safe to the environment and economically feasible.* ***The selected water balance has a net water deficit*** [bold emphasis] *for all years, with the possible exception of part of the final 1-2 years as the final volume of the tailings pond is utilized and if those years coincide with exceptionally heavy precipitation.*



Above: Figure 2.1 from Appendix G, *Fisheries Compensation Report*, in the 1996 *Reclamation Plan* report.

> ***The selected water balance provides that no surface effluent will be discharged to the environment by the tailings pond.*** [Bold emphasis] *Examples of model simulations using varied precipitation assumptions for each month and operating year are shown in Tables 4-1 through 4-6. Table 4-5 shows that if year 10 were a wet year the water deficit would be slightly positive for the year (row 24).* ***Under such circumstances, action would be initiated to increase recycle rates or enhance evaporation to prevent an effluent discharge.*** [Bold emphasis]

Detailed water balances have also been carried out to determine if water collecting in the pits and/or runoff water from the waste rock dumps and mill area could be safely included in the tailings pond. ***It was determined that such inclusion is possible during dry years but would result in net positive water surpluses in some wet and even some average precipitation years during the life of the mine. This would substantially increase the likelihood of effluent discharges in order to rebalance the system. That risk seemed unnecessary and unwise to Imperial Metals Corporation and was not pursued further****.* [37] [Bold emphasis]

The tailings facility has been designed to contain 68.6 million t of tailings solids at an average dry density of 1.28 t/m^3 (1.1 t/m^3 for Year 1, 1.2 t/m^3 for Year 2 and 1.3 tm^3 for Years 3 through 14). ***Additional storage capacity has been incorporated into the design by including 2 million m^3 of storage for process (reclaim) water on top of the tailings surface****.* [38] [Bold emphasis]

<u>2.0 Project Water Management Strategy</u>
The water management strategy for the Mount Polley project is detailed in the "Report on Project Water Management" (Knight Piésold Ltd., February, 1995). The tailings impoundment will be utilized as a water reservoir for project water requirements both prior to start-up and during operations, thus providing a lower impact alternative to the initial design, which included a dam on Polley Lake. Probabilistic water balance analysis was conducted to describe a range of precipitation conditions during the life of the project. From these results, estimates were made of the probable requirements for tailings pond volume and make-up water. The requirements include:

- *The diversion of approximately 1.7 x 10^6 m^3 of surface runoff to the tailings storage area prior to start-up;*
- *Providing a minimum volume of 1.5 to 2.0 x 10^6 m^3 of water in storage on the tailings surface during on-going operations to provide sufficient process water during winter months; and*
- *A contingency for phased withdraw of up to 300 x 10^3 m^3 water from Polley Lake during the peak of freshet, over the first three years of operation plus during years of drought experienced during mine life (probability <5%).*

The detailed water balance is presently being refined to reflect final design features; however, the annual requirements of supplementary water over the mine life will vary little from that described above. [39]

About three years after the mine re-started, Knight Piésold reported the following in its 2008 annual TSF inspection report, whereby the TSF was experiencing "water surplus":

The principal objectives of the TSF are to provide secure containment for tailings solids and to ensure that the regional groundwater and surface water flows are not adversely affected during or after mining operations. The design and operation of the TSF is integrated with

[37] 1990 Assessment report, Section 4.1.2, *Water Balance*.
[38] *The Mount Polley Mine Project Reclamation Plan*, April 1996, page 3-19.
[39] Ibid., Appendix G, *Fisheries Compensation Report*.

the overall water management objectives for the entire mine development, in that surface runoff from disturbed catchment areas is controlled, collected and contained on site.

MPMC mine personnel complete on-going surface water monitoring and water management activities to ensure compliance with the current mine permits. The water balance for the TSF is updated regularly by MPMC with periodic reviews by Knight Piésold. ***The mine site is currently operating with a water surplus, as total inflows from precipitation and surface runoff exceed losses from evaporation, void retention in the tailings mass in the TSF, and seepage removal.*** *Site surplus water is currently being stored in the TSF and the Cariboo Pit.* ***MPMC is currently exploring ways to discharge water from the site to reduce the increasing site storage requirements in the TSF and the Cariboo Pit.*** [Bold emphases]

The Mount Polley Mine has undergone considerable development in the last couple of years. The water balance is reviewed and updated by MPMC on a monthly basis to ensure that it is current with the on-going development of the mine site.

The design basis for the TSF includes a freeboard allowance to contain the 72-hour PMP event, which corresponds to approximately 1,070,000 m^3. This would result in an increase in the TSF pond elevation of approximately 0.6 m. The freeboard requirement for wave run-up is approximately 0.8 m, for a total freeboard requirement of 1.4 m. The supernatant pond was at elevation 949.9 m at the time of Mr. Galbraith's inspection on September 25, 2008. The freeboard requirement of 1.4 m has been maintained during the previous year by MPMC.

Almost 6 years after the re-opening of the Mount Polley mine in March 2005, the June 2011 report, *Independent Review of the Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent (2009)*, had re-confirmed MPMC's looming dilemma. Contrary to the early, rosy forecasts from 1990 to 1996 to the BC government for Mount Polley's TSF by Knight Piésold and MPMC report editors about the mine's seemingly neutral and forever water balance regime, the opposite scenario was being hardened in fast-setting concrete: the Mount Polley Mine site was now officially characterized as a "net precipitation site:"

The mine site has been characterized as a ***net precipitation site*** *resulting in MPMC's stated need to release ~1.4 million cubic meters of effluent annually from the TSF. MPMC can continue to raise the banks of the TSF, however, they will soon need to discharge effluent from the TSF. MPMC's preferred option is to discharge effluent to Quesnel Lake via Hazeltine Creek. This will require a discharge permit from the Province.*

Hydrological studies funded by MPMC indicate that the MPM site is a net precipitation site. This means that the amount of water (precipitation) falling onto the site is greater than the amount that is (i) consumed by mining operations (i.e., production of mining concentrate, dust suppression), (ii) lost to groundwater seepage, (iii) retained in the voids of the tailings storage facility (TSF), and (iv) lost via evaporation and transpiration. Currently, the mine operates within a closed-loop system and does not have a discharge permit. To store excess water, the capacity of the TSF has been expanded annually. To address this water management situation in the near- , long- and post closure term, MPMC has identified the need to discharge excess water off-site.

MPMC currently holds Permit PE11678, originally issued by the BC Ministry of Environment (BCMOE) in 1997 and amended several times since. PE11678 requires that MPMC maintains at least 1 m of freeboard in the TSF at all times to avoid overflow and to report to BCMOE when the freeboard falls below 2 m, as a precautionary measure. ***Traditionally, MPMC has raised the TSF dam annually to retain all water on site****. Dam-raising activities are presently underway in anticipation of conditions in 2012 and beyond.* ***In looking ahead to a post-closure scenario, a sustainable means of discharging excess water is required because dam building cannot continue indefinitely.*** *The annual excess of water that must be discharged in order to maintain the integrity of the TSF, and to meet TSF freeboard permit conditions, is~1.4 million cubic meters (1.4 M m^3).*

During the MPM closure from 2001–2005, MPMC discharged effluent under provincial permit from the Main Embankment Seepage Collection Pond (which collects seepage from the TSF) to Edney Creek. ***Resumption of the small permitted discharge to Edney Creek was not a viable option to address the annual 1.4 M m^3 need for discharge, due to the smaller size of Edney Creek, and therefore its increased sensitivity to water quality impacts. The resulting capital costs required to treat and deliver the effluent to Edney Creek were also deemed by MPMC to be prohibitive.*** [Bold emphases]

MPMC's proposed solution is to discharge effluent to Quesnel Lake via Hazeltine Creek. The MPM effluent and run-off would originate from a variety of sources, including the TSF, the Main Embankment Seepage Collection Pond, the Perimeter Embankment Seepage Collection Pond, the Wight Pit and the Northeast Rock Disposal Site seepage via the diversion ditch. If approved, water from a combination of these sources would be conveyed to the Perimeter Embankment seepage collection pond and then to a sediment/polishing pond located downstream of the Perimeter Embankment.

In hindsight, how could the geotechnical engineering consultants and mine management have gotten the water balance prediction question so wrong in the application stage processes? Did no one double check and seriously question the water balance scenario data in those early years?

The following is what MPMC stated in its 1996 Final Reclamation report:

2.4.5.4 Long-term Discharge from Underdrains

During operations the water quality of the underdrainage flows in the tailings basin will initially be similar to the tailings supernatant, and will be collected in the collection ponds and continuously recycled to the tailings facility. As operations continue, the quantity of flow will decrease and the water quality will tend towards rainwater as the percent of precipitation infiltration in the underdrain flow increases. The quality of flow in the long term will decrease to approximately 20 m^3/hr after mine closure, based on 20% infiltration of precipitation over an area of 50 ha. The long-term water quality will tend towards pure rainfall and will potentially include the rainwater leachable metals indicated by the Carbonic Acid waste extraction test results. This shows elevated concentrations in the extract for arsenic (0.097 mg/L), copper (.006 mg/L) and zinc (0 .008 mg/L). These concentrations do not pose any hazard to livestock, and when diluted with downstream flows, will not affect downstream surface water quality significantly.

3.5 Tailings Disposal

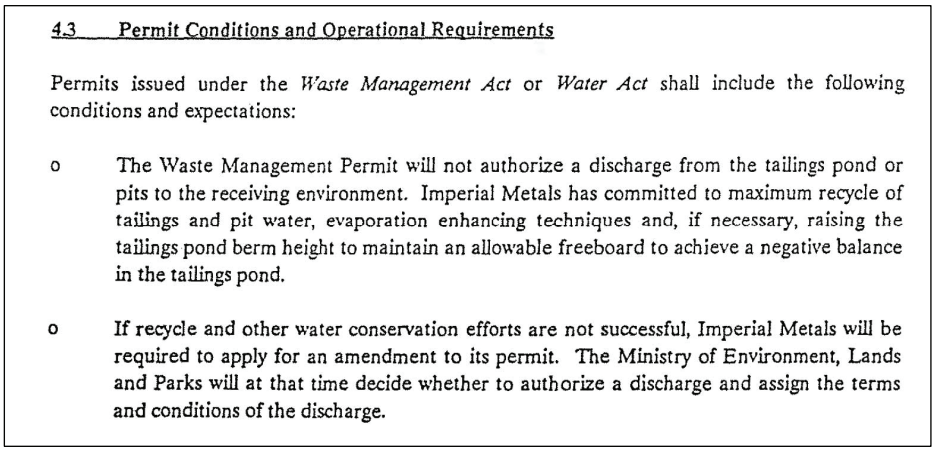
The principal objectives of the tailings impoundment will be to ensure complete protection of the regional groundwater and surface water flows, both during operations and in the long-term, and to achieve effective reclamation at mine closure. Further details may be found in "Tailings Storage Facility Design Report 1625/1" (Knight Piésold Ltd. 1995).

7. A Bizzare Promise

Despite the careful management of water at the Mount Polley Mine through the application of best management practices (e.g., water recycling, storage in mined-out pits, use in dust suppression), the current and future Mount Polley water balance for the mine indicates surplus water of roughly 1.4 million cubic metres per year. [40]

The rumor of "zero discharge" allowed from the mine is not true: Mount Polley's discharge proposal is consistent with the Mine's Development Certificate (which can be viewed on line); the certificate states that there can NOT be a direct discharge from the Tailings Storage Facility or of pit water. [41]

When was the original Effluent permit issued? I don't recall any public consultation process around that. It should be reviewed and revoked. [42]



4.3 Permit Conditions and Operational Requirements

Permits issued under the *Waste Management Act* or *Water Act* shall include the following conditions and expectations:

- The Waste Management Permit will not authorize a discharge from the tailings pond or pits to the receiving environment. Imperial Metals has committed to maximum recycle of tailings and pit water, evaporation enhancing techniques and, if necessary, raising the tailings pond berm height to maintain an allowable freeboard to achieve a negative balance in the tailings pond.
- If recycle and other water conservation efforts are not successful, Imperial Metals will be required to apply for an amendment to its permit. The Ministry of Environment, Lands and Parks will at that time decide whether to authorize a discharge and assign the terms and conditions of the discharge.

In the three years leading up to the October 1992 Mine Development Certificate granted by the provincial government to Imperial Metals Corporation for its proposed open pit mining development and operations at Mount Polley, the company promoted a peculiar pitch, a bizarre promise, to pacify and ward off prominent public concerns about the mine polluting the waters and fisheries of the Quesnel Lake system. That pitch was about containing and preventing mining "effluent discharge" - toxic heavy metals and re-agents - as identified in the June 1989 *Prospectus* document:

The water resources in the area represent a prominent and important resource.

Potential environmental and land use concerns have been identified in discussions with various groups and organizations.

A potential concern exists with respect to water supply, pit water utilization and recycling of tailings water by the mill.

Protection of existing water quality in the surface lakes, streams and the ground water is a key issue. The kinds of potential contaminants include: concentrations of various metals,

[40] Page 1, *Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent*, July 2009.
[41] Minutes from 3rd Pre Application Meeting regarding PE-11678 Amendment Application, September 13, 2007, Appendix H, *July 2009 Consultation Report, PE-11678*.
[42] Letter from Likely resident Wayne Henke to Mount Polley Mining Corporation, August 27, 2009, as cited on pdf page 72, July 2009 *Consultation Report*.

industrial chemicals, oils and grease, acidic leachate, domestic wastes and enriching nutrients.

In the stage I Report, a water management plan will be presented. The plan will demonstrate the high degree of water reutilization in the mill using water recycled from the tailings pond and pits. In addition, the means for collection and diversion of run off and seepage waters will be detailed. ***Treatment of wastewater to meet existing water quality standards will be included, although little, if any, direct effluent discharge is expected.*** [Bold emphasis] *Measures will also be identified to reduce the risks of accidental contamination of surface or ground water resources.*

The western reach of Quesnel Lake, where the mine is located, is situated within the western limits of the Quesnel Highlands physiographic region and within the transition zone of the BC Interior Wet Belt or Rainforest (Interior Cedar-Hemlock biogeoclimatic zone), which has fair amount of annual rain and snow fall, i.e., "precipitation is well distributed throughout the year ranging from 600 mm to 800 mm annually and averages 755 mm with 300 mm falling as snow." [43] There are Western Red-Cedar trees that populate the forests at the foot of Mount Polley's Tailing Storage Facility (TSF), a species that is water dependent.

The 'no-effluent-discharge' pitch was elaborated at length by Imperial Metals Corporation a year later in section 4.0, *Environmental Management*, of its *Stage One Environmental and Socioeconomic Impact Assessment* document of July 1990, which was presented to the B.C. Mine Development Steering Committee. [44]

The water management plan utilizes the maximum amount of pit and site drainage that can be handled ***without risking overflows from the tailings pond****.* [Bold emphasis] *Detailed water balances of the tailings facility including pit water, millsite and waste dump runoff have been carried out as part of the preliminary engineering, and were used to arrive at the proposed water management plan.*

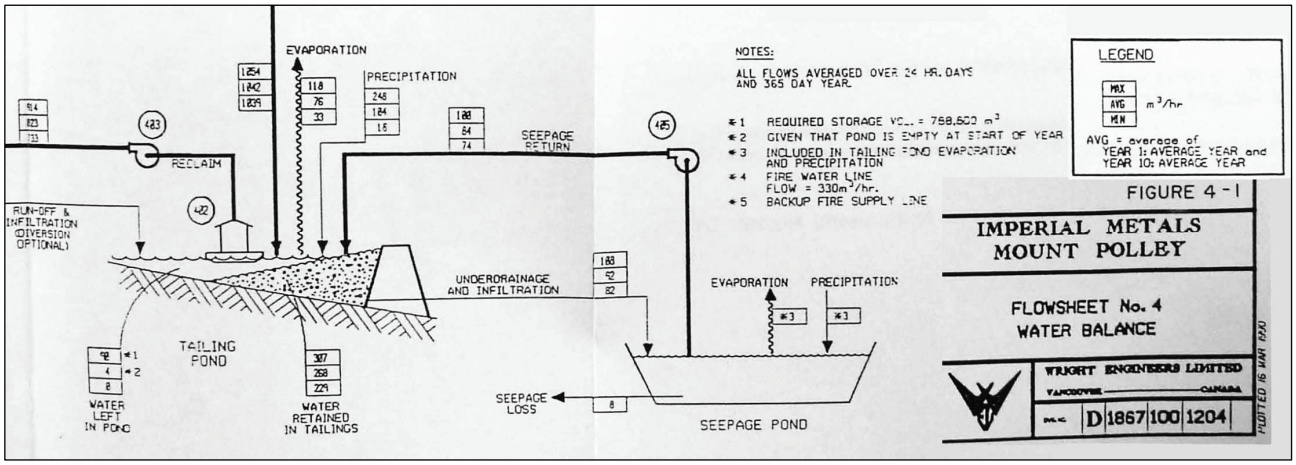
1. Natural surface flows in the project area will be protected and maintained through the installation of properly engineered dams, diversions, culverts, ditches, ponds and associated facilities.

3. The volume of water used in operations will be minimized by recycling whenever practicable. ***No effluent of process water or domestic waste water will be discharged to the environment****.* [Bold emphasis]

Both environmental and economic considerations require that water usage be minimized, thus, to the greatest extent possible, the tailings slurry water will be reclaimed and reused. Capacity of the tailings pond will be maintained at a size adequate for treatment and storage of the slurry water while it is being recycled to the mill. The quality of the reclaim water will be suitable for use in the mill and will meet government standards that qualify it for release to the environment should that become necessary.

[43] Page 13 of 112, *Mines Act Permit M-200 Amendment Application Northeast Zone*, July 2004.
[44] The Mine Development Steering Committee, along with representatives from federal and provincial environment and fisheries agencies, reviewed the draft sections of the water balance scenarios and information.

Figure 4-1 is a flowsheet which schematically demonstrates the water balance for the mine. ... No process water is discharged to the environment either before or after treatment and seepage from the tailings pond is almost completely collected and returned to the system for reuse.



The water balance was designed as an iterative process considering many factors of vital importance to process design, metallurgy, water use, environment and economics. The objective was to achieve a workable balance that is technically competent, safe to the environment and economically feasible. The selected water balance has a net water deficit for all years, with the possible exception of part of the final 1-2 years as the final volume of the tailings pond is utilized and if those years coincide with exceptionally heavy precipitation. Dry years are represented by below average total precipitation that is greater than one standard deviation (assumed to be 50%), while wet years exceed the average by the same amount.

The selected water balance provides that no surface effluent will be discharged to the environment by the tailings pond. [Bold emphasis] *Examples of model simulations using varied precipitation assumptions for each month and operating year are shown in Tables 4-1 through 4-6. Table 4-5 shows that if year 10 were a wet year the water deficit would be slightly positive for the year (row 24). Under such circumstances, action would be initiated to increase recycle rates or enhance evaporation to prevent an effluent discharge.*

In a wet climate area with so much precipitation, how was the mining company going to manage to operationally 'contain' all the mine site water over the initial projected 14 years of mine life?

Following stakeholder and public review of the July 1990 Assessment documents, meetings were also held with local First Nations. A final March 14, 1991 letter, signed by Bruce Mack from the Cariboo Tribal Council to Norm Ringstad of the Ministry of Energy, Mines and Petroleum Resources gave "general support to the project, provided environmental considerations could be met." [45]

When Mine Development Certificate No. 92-13 was issued to Imperial Metals Corporation on October 6, 1992 by both the Minister of Energy Mines and Petroleum Resources and the Minister of

[45] Mount Polley Public Liaison Committee Information Letter - December, 1996.

Environment, the Certificate included a companion document, *A Report Summarizing the Reasons for the Decision Relating to the Issuance of a Mine Development Certificate, and Outlining Commitments, and Permits, License and Approval Information Requirements*. [46] It stipulated the following under section 4.3, *Permit Conditions and Operational Requirements*:

> *Permits issued under the Waste Management Act or Water Act shall include the following conditions and expectations:*
>
> - *The Waste Management Permit will not authorize a discharge from the tailings pond or pits to the receiving environment. Imperial Metals has committed to maximum recycle of tailings and pit water, evaporation enhancing techniques and, if necessary, raising the tailings pond berm height to maintain an allowable freeboard to achieve a negative balance in the tailings pond.*
>
> - *If recycle and other water conservation efforts are not successful, Imperial Metals will be required to apply for an amendment to its permit. The Ministry of Environment, Lands and Parks will at that time decide whether to authorize a discharge and assign the terms and conditions of the discharge.*

Explained in the previous chapter, the increasing volumes of supernatant water within the Mount Polley TSF from precipitation accumulation and runoff (and unacknowledged and undocumented groundwater sources) apparently and somehow started to become noticeable and problematic for Imperial Metals Corporation / Mount Polley Mining Corporation (MPMC) shortly after 2001, four years after start-up, and more significantly so with the passing of each year.

A chronology of these concerns were recorded in the meeting Minutes of October 24, 2006, summarized by MPMC's environmental superintendent, Ron Martel, during a meeting held at the Ministry of Environment office in Williams Lake:

> ***In 2001:*** *The mine shut down and the tailings pond started collecting water.*
>
> ***In 2001, 2002 and 2004:*** *Water from the tailings pond was pumped up to the vacant Cariboo Pit.*
>
> ***In 2002 through 2004:*** *Drain water from main pond (E4) was discharged to Edney Creek tributary.*
>
> ***In 2004:*** *In anticipation of mine re-start MPMC and MOE met to evaluate the need to discharge water. Modeling suggested the large amount of effluent discharged over a short period of time resulted in exceedance of the Provincial Water Quality Objectives.*
>
> ***In 2005:*** *With the onset of the mine restart (March 2005) an updated water management plan was developed to aid in planning and to predict water surplus volumes. Hence, the water balance was updated to reflect recent mine discoveries and projected mine disturbances. The water management plan includes the following objectives:*

[46] Explained in a November 9, 2007 letter by the Williams Lake Field Naturalists to the Mount Polley Mining Corporation, cited on pdf pages 51-53 of the July 2009 *Consultation Report, PE-11678 Amendment Application*.

- *To effectively manage water to minimize the need for regulated discharges to surface water and prevent any need for water removal from Polley Lake.*
- *To capture and manage all water that has been affected by mine components.*
- *To divert runoff from undisturbed areas away from the minesite and tailings storage facility.*
- *To store some excess TSF water to be used to accelerate pit filling at closure.*
- *To drain the TSF at closure by routing the water into the open pits.*
- *Work commenced on the SSWQO and initial meetings were held. The initial round of site-specific water quality samples were taken and a review of the entire data was done.*

The meeting Minutes for October 24, 2006 also included some disturbing news, with follow-up comments about Mount Polley's "need" to "commence discharge in August of 2007":

> *Martel explains that Mount Polley maintains an accurate water balance ... current inventory is close to 3.0 M* [million] *cubic meters. Next year it will be approximately 6.0 M cubic meters, the year after close to 7.0 M.*

Even more serious and disturbing news was presented in a single sentence, a sentence missing some descriptive information about what was actually stated to the meeting audience in the Ministry of Environment office by a MPMC representative:

> ***Mount*** [Polley] ***expressed difficulty in maintaining beaches and are experiencing challenges of managing Water Dam versus a designed Tailings Dam.*** [Bold emphasis]

The critical nature of "maintaining beaches," that is for maintaining the integrity of MPMC's highly vulnerable and cheaply built TSF, is described in the *Blooper-Natant* chapter of this report.

In Ron Martel's chronology for 2002 - 2004, he states that MPMC had been discharging "drain water" from the seepage collection pond located at the downstream face of the TSF's Main Embankment into an Edney Creek tributary. This had been approved by the Ministry of Environment through an amendment made to Effluent Permit PE-11678. According to conditional information in the May 5, 2005 amendment of PE-11678 (see Appendix E) concerning flow rates and water quality characteristics, [47] up to a maximum of 2,000 cubic meters/day of mine effluent from the seepage pond was permitted to be discharged directly into the Edney tributary following mine re-start after May 5, 2005.

However, the details of the mine effluent discharge contained within earlier amendments to PE-11678 after the year 2000 have yet to rear their heads publicly. As later stated on pages 2 and 9 of the 2009 *Technical Assessment Report for a Proposed Discharge of Mine Effluent*, a grand total of about 265,000 cubic meters of mine effluent water was reportedly discharged into the Edney over a three year period, [48] and that MPMC had discontinued discharging mine effluent after restarting the mine in March 2005:

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[47] The July 12, 2007 Minutes of a Pre-Application Meeting for PE-11678 stated that the Main Embankment seepage pond waters that were discharged were "not in fact "dilution" " water, and did not meet the definition of dilution.

[48] This would convert to a combined total of 132.5 days, or an average of 44 days/year, of discharge at a maximum 2,000 cubic meters/day. Pre-application meeting Minutes of April 3, 2007 document that "water volume reporting to the Main Embankment seepage pond is approximately 350,000 cubic meters/year."

> *During care and maintenance (2001 to 2005), water from the MESCP* [Main Embankment Seepage Collection Pond] *was permitted to discharge into Edney Creek (Permit # PE-11678 under the British Columbia Environmental Management Act; Appendix B). Approximately* ***265,000 m3*** *of water from the MESCP discharged to Edney Creek from initiation in July 2002 to termination in February 2005.*
>
> *Mount Polley has elected not to discharge since the re-start of operations in 2005 in order to evaluate available options and to ensure that the most environmentally benign option is selected.*

In Ron Martel's chronology of events, cited above, he forgot to include an important event that occurred in 2005. According to Appendix F, *Evaluation of Options for Discharge*, in the July 2009 *Technical Assessment* report, it provided a brief summary of "technical group meeting" with the Ministry of Environment "in early 2005." When the mine was entering re-start production phase in March 2005, a discussion arose as to how "to deal with excess accumulation of water." The document states that Ministry of Environment staff

> *suggested that water management alternatives should be fully assessed to support a request for* ***a permit to discharge tailings supernatant*** [bold emphasis] *from the Mount Polley Mine. Consequently, a list of alternatives was initially developed in-house by Mount Polley.* [49]

And, it was in May 2005 that the Ministry of Environment amended effluent permit PE-11678.

According to the Minutes of an April 3, 2007 pre-application meeting regarding a review of an initial draft report amendment for PE-11678 held at the Ministry of Environment office in Williams Lake, MPMC initially considered discharging mine effluent directly into Polley Lake, an "option" that was subsequently dropped "in favor of a discharge into Hazeltine Creek." The Minutes also reported that "the current [supernatant water] volume in the tailings storage facility is 4 million" cubic meters, two million cubic meters more, or twice the volume, than the ultimate supernatant capacity MPMC's Engineer of Record had designed the tailings impoundment for in 1995/1996.

MPMC submitted a lengthy Modified Draft Application to the Ministry of Environment on July 23, 2007, proposing to amend Effluent Permit PE-11678. Copies of the Application were forwarded to "First Nations, Provincial government agencies, Environment Canada and Fisheries and Oceans Canada." [50] Under point number 10 of *Application for an Authorization to Discharge or Store Waste under the Environmental Management Act*, MPMC sought to discharge:

- an "average rate of waste" of **1.1 million cubic meters per year (18,000 cubic meters/day)**;
- or a maximum "rate of waste" of **1.85 million cubic meters per year (30,000 cubic meters/day)**.

These proposed annual effluent discharge rates were never enunciated in Mount Polley's original application / feasibility documents in 1990, were in fact hidden from public scrutiny. This had to do

[49] In the section, *Alternatives Assessment of Selected Options for the Release of 1,000,000 M3 / Year of Excess Mine Water*.
[50] July 2009 *Consultation Report*, page 1.

with 'selling' the mine in proximity of valuable environmental values concerning Quesnel Lake, which included its world-renowned fisheries.

In contrast, bcMetals / Red Chris Development Co. Ltd. stated in the *Tailings Impoundment Water Balance* section of their October 2004 application/feasibility report to the BC Environmental Assessment Office that the proposed and 'isolated' Red Chris mine near Iskut (now owned by Imperial Metals Corp.) was going to discharge an average 6 million cubic meters of water annually from the tailings impoundment during its projected 18 year operating mine life. [51] That would amount to about a total of 110 million cubic meters of mine waste water. The document also stated that "in the post-closure period the amount of water to be discharged to the receiving environment is estimated to be 10.0 million" cubic meters per year.

Under point number 8 of the Mount Polley 2007 Modified Draft Application, *Source of Waste*:

> *The waste will be supernatant from Mount Polley's proposed SEDIMENT / POLISHING RETENTION POND DOWNSTREAM OF THE PERIMETER EMBANKMENT. The source (influent) will originate from the TAILINGS MANAGEMENT SYSTEM supernatant either through direct transfer or through seepage collection and recycling systems; tailings impoundment foundation, toe and chimney drain system, outfall; and related appurtances.*

Under point number 11, *Operating Period*:

> *The discharge may be continuous from the date of approval until it is no longer required. The projected life of the Mount Polley Mine is until 2015; however, exploration is ongoing and this may be extended.*

Under point number 18, *Potentially affected persons*:

> *Due to the limited use of Hazeltine Creek, and the fact that the Mount Polley Mining Corporation has tenure of the land adjacent to Hazeltine Creek (mining leases), it is anticipated that there will be no persons affected by the discharge to Hazeltine Creek. However, it is recognized that Hazeltine Creek discharges into Quesnel Lake and that this lake is used by numerous persons for a variety of purposes. The influence of Mount Polley on Quesnel Lake is expected to be minor, but will be assessed through a study characterizing effluent mixing as well as chemical and biological characterization of the immediate receiving environment.*

About a year before its July 2007 Application, MPMC submitted an initial draft Application in May 2006 to the Ministry of Environment "that outlined the approach Mount Polley wanted to take in establishing protective water quality limits for discharge (Site Specific Water Quality Objectives)." [52] Three months passed before a formal meeting was held between MPMC and Ministry of Environment staff on August 9, 2006 "to discuss this approach." In October 2006, a pre-Application meeting was held with the Soda Creek and Williams Lake Indian Bands, and with Ministry of Environment and Fisheries and Oceans Canada. A second pre-Application meeting was held at the Ministry of Environment office on April 3, 2007, where participants were given copies of and reviewed the initial draft amendment Application.

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[51] Page 3-130.
[52] Ibid., pdf page 3.

The amendment Application for MPMC's Effluent Permit is regulated under the *Waste Discharge Regulation*, which falls under the *Environmental Management Act*. [53] Stipulated in the *Regulation*, the Application involves a rigorous process of completing two formal reports as separate but interconnected components of the final Application: a technical assessment report and a consultation report, both of which were submitted in July 2009, four years and four months after mine re-start, during which time MPMC processed about 27,840,000 tonnes of ore and produced about 210 million pounds of copper, about 175,000 ounces of gold, and about 1,650,000 ounces of silver (see Appendix K).

> *In association with the Draft Application, Environmental Protection Notices and public invitations to attend information sessions were published in the BC Gazette and the Williams Lake Tribune; were posted in local communities, at the mine site, and at the bridge closest to the proposed discharge site; and were mailed out to stakeholders. Two public information sessions were held at the mine site on August 13th 2007 followed by a public meeting in the community of Likely on November 26th 2007. Numerous letters were received from the public and stakeholders following the posting of the Environmental Protection Notices and the August 13th information sessions. Mount Polley mine responded to all correspondence regarding the discharge application and developed a "response document" that addressed concerns. In addition, Mount Polley's Public Liaison Committee [54] was restarted with meetings held in 2008 (August) and 2009 (May).*
>
> *Mount Polley has taken the information received from the Ministry of Environment, other regulatory agencies, the public and stakeholders into account in developing and completing the Technical Assessment that accompanies the permit amendment application. Much of 2008 and the first half of 2009 was spent completing the components of the Technical Assessment.*
>
> *Once the Ministry of Environment has made a preliminary review of the final amendment application and Technical Assessment it is Mount Polley's intentions to finalize the consultation process for this amendment application by presenting the final details to the referral group.* [55]
>
> *In accordance with the identified need to eliminate water from the mine site, the Mount Polley Mine has undertaken a Technical Assessment to support an application for an amendment of Permit PE-11678 under the Waste Discharge Regulation (WDR) of the British Columbia Environmental Management Act to allow the discharge of excess water to Hazeltine Creek. ... Application for waste discharge authorization involves a number of steps outlined in the WDR (Table 1.1; BCMOE 2007), one of which is a Technical Assessment of the potential for the discharge to cause an impact. Requirements for*

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[53] The details on the application process under the *Environmental Management Act* are provided in Appendix D, *British Columbia Waste Discharge Regulation Guidance for Technical Assessment*, in the July 2009 document, *Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent*.

[54] The Mount Polley *Public Liaison Committee*, resurrected in August 2008, was created in 1996 during the construction phase of the mine site, with the first meeting held on June 14. In the Minutes of the second October 10, 1996 meeting held at the Morehead Lake Lodge, the following was noted under section 7, *Major Permits*: *Doug Krogel stated that, as a result of failure to respond to MELP* [Ministry of Environment, Lands and Parks] *concerns regarding environmental baseline monitoring information, MELP will not process further permitting applications. The company has not submitted monthly discharge reports and as such are out of compliance with waste management permits.*

[55] July 2009 Consultation Report, page 1.

Technical Assessment are outlined in associated guidance (BCMOE 2003; Appendix D). This Technical Assessment is also intended to support, at least in part, other permitting requirements for discharge (i.e., under the federal Fisheries Act, the federal Navigable Waters Protection Act and the British Columbia Water Act).

In accordance with the WDR, this report is accompanied by a comprehensive Consultation Report (Mount Polley 2009). The Consultation Report provides a record of all consultation undertaken through the process of application for waste discharge authorization. [56]

The Perpetual Effluent Rubber Hits the Quesnel Lake Road

A public consultation meeting was held in the Town of Likely on November 26, 2007. According Imperial Metals' meeting Minutes, Jim Gibson's question - "Why wasn't the water managed during closure?" - and other questions, were answered as follows:

A: *The water was managed during closure; majority of excess water was transferred to the Caribou Pit and a small proportion was released to Edney in accordance with the permit.*

- *During the closure period Imperial Metals was in a very poor economic situation and there wasn't money available for further water management.*

Q: *How is the community of Likely supposed to trust Mount Polley mine after the mine was abandoned and neglected during the closure period? (Jim Gibson)*
A: *The mine was not "abandoned" or "neglected" during the shut down; someone (or several) people were on site during this time. Money was a factor, but the site was still being managed during that time.*

Q: *Why can't the mine build a second Tailings Storage Facility to contain the excess water? – None of these options address NOT discharging water! (Meral)*
A: *Building a second structure would double the risk, Mount Polley is trying to reduce the risk associated with the Tailings Storage Facility not increase it.*

Statements made by Corey Ducharme:

- *The Tailings Storage Facility is at risk of breaches and the spills will report to the seepage ponds which will feed into the discharge system.*
- *Knight Piésold sends Mount Polley their youngest, least experienced engineers to oversee the dam construction.*

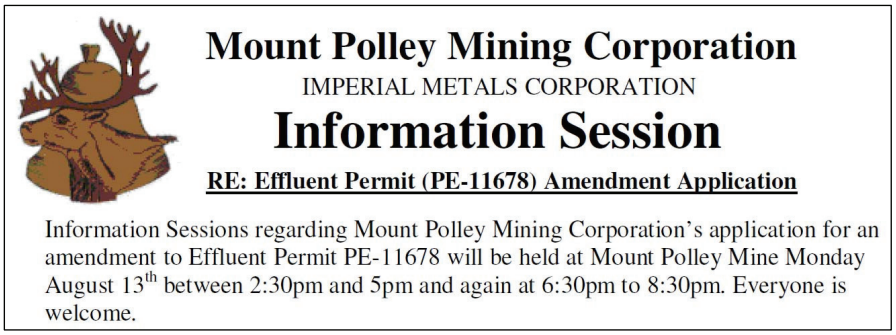
Q: *Where is Mount Polley in the Application Process?*
A: *Mt. Polley is currently in the Stage 2 (mid-way) of the Permit Amendment Application Process in which we hold additional Pre-Application meetings to get further input from agencies, First Nations and the public. Once this consultation process is complete we will begin drafting the Technical Assessment Report and application package for submission to Ministry of Environment.*

[56] July 2009 Technical Assessment Report, pages 2-3.

We are not questioning your science. We just want you to listen to what has been said here tonight - "No Discharge."

Drinking Water: if you drink it for two years. Then we will let you discharge it.

The Third or Fourth Amendment?



Mount Polley Mining Corporation

IMPERIAL METALS CORPORATION

Information Session

RE: Effluent Permit (PE-11678) Amendment Application

Information Sessions regarding Mount Polley Mining Corporation's application for an amendment to Effluent Permit PE-11678 will be held at Mount Polley Mine Monday August 13th between 2:30pm and 5pm and again at 6:30pm to 8:30pm. Everyone is welcome.

On August 13, 2007, Wayne Henke, a director of the Likely and District Chamber of Commerce, was one among a small number of local Likely and other area residents who attended MPMC's information session held at the mine site. Depending on where one lives, it still is a long drive to get there.

In Henke's August 27, 2007 response letter sent to MPMC, he wrote that he "was extremely disappointed in a number of things" about the information session:

1. The information (or Lack of it) was very poorly presented. There was no agenda or format to the presentation. As you said you did not really expect anyone to show up.

2. There was no one taking notes or recording any of the concern's presented. I believe these meetings are held to pass on to government any and all concern's brought forward by the public. Forms were passed around for people to write down their concerns but not all people are able or comfortable with this method.

3. There was no Ministry of Environment representative or other non-biased expert present to verify the few facts presented. We have a UNBC Landscape and Ecology Chair at the research facility in Likely. Were they invited?

4. There were no alternatives to the discharge of effluent into Quesnel Lake brought up for discussion. In short, the amendment was presented as a done deal. Is this the case and is this process just a formality?

5. When was the original Effluent permit issued? I don't recall any public consultation process around that. It should be reviewed and revoked.

6. It was brought up that during the original public meetings before the Mine permit was issued that there would never be any discharge of anything off of the Mine site. Are there any records of those meetings?

Point number five in Henke's list of six is somewhat intriguing, and worth investigating. However, Henke failed to comment on and ask a more important or relevant question:

- When MPMC applied for an amendment to PE-11678 for a mine effluent discharge during the beginning of the Care and Maintenance years (end of 2001 to March 2005), why wasn't there a requirement initiated by the Ministry of Environment for public consultation and technical report submission as was later required in 2007 under the *Environmental Management Act*'s *Waste Discharge Regulation*?

The clue about this intrigue in Henke's question number 5 is stated in MPMC's 'Dear Wayne Henke' response letter of October 15, 2007, as the company was obligated to respond to all public questions under the powers of the formal consultation process. The letter advised Henke to "Please refer to Section III: General Concerns and Perceptions (Part 3)" of MPMC's response document, wherein "you will find the responses" to points number 5 and 6.

The 22-page long *Response Document* (which MPMC also refers to as a "letter") was later included in Appendix F of MPMC's July 2009 main Consultation Report. Under point number 3, *The Mine Previously Stated They Would Not Discharge*, of Section III, the following clever wording was stated as a formal response to Henke's question number 5:

> *Although we were not present at meetings held before the mine began operating, the available documentation suggested that this plan was updated in 1998. It should be noted that most mines make changes to their operations over time as ore grades change or are further defined, as economic conditions change, as available technologies change, or simply as planning becomes more advanced.* ***This change to include effluent discharge was made public with the application for a permit to discharge effluent in 1997. Communication was consistent with the terms of the Environmental Management Act. However, as noted in response II-1., we feel that communication can be improved****.* [Bold emphasis]

In section II, *Transparency and Trust*, under point number 1, *Communication and Community Involvement*, of the *Response Document*, it states that:

> *Mount Polley will strive to improve upon our record of communication and community involvement. We feel that the public meeting of August 13th was an important step in opening the lines of communication between the mine and the public. We see this as a first step, not an only step.*

The clue pertaining to information about MPMC's amendment to PE-11678 during the Care and Maintenance years is found in an August 1, 2004 Technical Report, *Mount Polley Mine 2004 Feasibility Study, Likely, B.C., Canada*. Under Appendix A, *Permits, Mount Polley Mine: Government Permits, Licenses and Approvals*, the Ministry of Water, Land & Air Protection Effluent Permit PE-11678 was first issued on **May 30, 1997**.

Under the PE-11678 Effluent Permit were six topics:

- Approval of Works;
- Mill Site Runoff into Tailings Impoundment;
- North and Southeast Waste Dumps underflow into Tailings Impoundment;
- Open Pit Dewatering into Tailings Impoundment;
- Sewage Effluent into Tailings Impoundment;
- and Special Waste Consignor.

The 2004 report also states that there was an accumulation of three approved Permit amendments: one on October 20, 1997; a second in January 2000; and a third in February 2002. However, another MPMC document of July 30, 2004, *Mines Act Permit M-200 Amendment Application Northeast Zone*, states that PE-11678 "was last amended on December 21, 2001." This statement in the July 30, 2004 document brings confusion to the permit history accounting of PE-11678 in the August 1, 2004 report.

Moreover, Appendix B, *Mount Polley Effluent Discharge Permits* (one a series of 10 appendixes attached to the July 2009 *Technical Assessment* report), which catalogued five amendments made to PE-11678 from 1997 up until 2005, **failed to include the effluent permit amendments of December 21, 2001 and February 2002**. The exclusion of these two amendments, or others, is both odd and curious, because the July 2009 Technical Assessment report specifically refers to effluent discharges authorized under PE-11678 during the Care and Maintenance years and cites Appendix B, however the amendments were never included for review.

In section 20.1.3, *Permit PE 11678 - Effluent Permit*, of the 2004 *Feasibility Study*, it states:

> *The Ministry of Water, Land and Air Protection issued this permit. It was last amended on February, 2002. This permit covers all aspects of surface water, groundwater, biological and hydrological monitoring. It also includes any climatology collected onsite as well as the discharge of tailings to the TSF.*
>
> ***The latest amendment*** [the third or fourth amendment?] ***changed the operational monitoring program to a care and maintenance-monitoring program.*** *Thus, monitoring has been decreased while the mine is idle. The most significant change is the suspension of the biological monitoring program that is conducted once every three years. At present, it has only been conducted once while in operation. When Mount Polley Mine reopens, this program will be reinstated. In addition, new Federal Metal Mining Effluent Regulations (MMER, formerly MMLER) were implemented in 2002. These regulations include new Environmental Effects Monitoring (EEM), which is the Federal equivalent of the Provincial Biological Monitoring Program. The pre-existing biological monitoring program at Mount Polley will be revised to meet the new Federal EEM program once the mine reopens.*
>
> *Water discharge amendments were applied for under this permit for three specific locations:*
>
> • ***The two seepage collection ponds at the TSF***
> • *The drainage from the East RDS*
> • *The drainage from the North RDS*
>
> *A permit allowing discharge from seepage collection* ***ponds*** *was granted for the care and maintenance period.*
>
> *Mount Polley Mining Corporation is proceeding with site-specific water quality studies and future application to the Ministry of Water, Land and Air Protection to direct further surface runoff away from the Tailings Storage Facility and to discharge water from the TSF. These studies are given high priority.*
>
> *The discharge permits are not required prior to final closure operations.* [Bold emphases]

In almost all of MPMC's documents retrieved by the author from 2006 following, nothing is stated that the amendment to PE-11678 granted discharge from **two** collection ponds during the Care and Maintenance years, as there are only references to MPMC having discharged from the Main Embankment seepage pond into Edney Creek. The 2004 Feasibility Study twice states that the amendment permitted discharge from "two seepage collection ponds at the TSF." And, nothing is stated in the 2004 feasibility study about MPMC having to conduct an amendment Application for public consultation technical report process under the *Waste Discharge Regulation* for either of the two approved effluent discharge amendment of December 21, 2001 and February 2002 to PE-11678.

Appendix E of this report, a 12-page excerpt of PE-11678, states that the amendment date for that document is May 4, 2005. If MPMC's February 2002 amendment for PE-11678 included discharge approvals for two ponds, it is no longer described as such in the May 4, 2005 amendment document. Another, more careful screening was conducted of MPMC documents to double check on the matter of the two ponds. Beginning with the 2011 Annual Environmental & Reclamation main report, and the two succeeding annual reports, it notes in section 2.3.4 that Site E7, the Perimeter Embankment Seepage Collection Pond

> *was previously a permitted discharge location from the mine site. In 2006 this permit was removed and sampling was no longer a requirement of PE 11678.*

If what is said is true in the recent annual reporting that the discharge permit was removed in 2006, then why is nothing found or stated in the May 4, 2005 amendment document for PE-11678 about this early permitting for the Perimeter Embankment seepage collection pond?

Knight Piésold's 2004 Water Balance Report


J. Brian Kynoch

A 36-page document, dated July 30, 2004, and reviewed by Knight Piésold's Managing Director, Ken Brouwer, was forwarded to MPMC president Brian Kynoch at his headquarters at 580 Hornby Street in downtown Vancouver, not far from Knight Piésold's headquarters at 750 West Pender Street. It stated underneath the "Dear Brian" intro: "We have developed a water balance for the Mount Polley Mine Site as requested."

The six page narrative, with 11 tables and 9 figures, called Appendix F, *Mount Polley Water Balance, Knight Piésold Consulting*, was one of six appendixes attached to the 2004 document, *Mines Act Permit M-200 Amendment Application Northeast Zone*. It attempted to address and help resolve MPMC's water accumulation predicament, as MPMC was evidently contemplating mine re-start by the second half of 2004 and seeking government approval of a "new mine plan."

> *A water balance has been developed for the Mount Polley Mine Site to aid in water management planning and to predict water surplus or deficit volumes after the resumption of operations in 2004. This water balance updates an earlier water balance by adding new development areas (including Springer Pit, Wight Pit, and the Northeast Rock Disposal Site (RDS), updating precipitation estimates, and modifying other aspects of the balance to match the new mine plan.*

The discussion in Knight Piésold's report Appendix under section 5.0, *Water Balance Results*, signified a new shift and heralded a radical departure from the originating vision and scope of the Mount Polley mine plan. It essentially contradicted Imperial Metals Corporation's original myth promised to the public that excess mine water balance issues and effluent discharges would be minimal and/or be non-existent. Moreover, the revised vision grants credence to the inherent dangers and pitfalls of mine plans that can change overnight through an amendment whim, a simple stroke of a permit pen.

From "general assumptions used for the water balance" provided in Table 11, Knight Piésold presented MPMC with a seven year, multi-optional, water balance strategy, beginning in 2005 (Year 1) to 2012 (Year 7), after which "closure" was presumed to kick-start in 2013 (see Appendix P). In a few years following Knight Piésold's 2004 Water Balance report, the operational life of the mine would begin to be extended, eventually to the year 2025 and longer.

Peering into the new 2004 crystal ball, Knight Piésold proposed the possibility of extending the effluent discharge conditionally granted under PE-11678 during the Care and Maintenance Years into the remaining operational years of the Mount Polley mine.

> *Another iteration of the water balance was conducted assuming that the seepage, groundwater, and surface runoff that collects in the seepage pond were discharged. Approximately 400,000 m^3 of water was assumed discharged per year. A discharge of 2,000 m^3/day (or approximately 700,000 m^3) is allowed In Mount Polley's present permit for the care and maintenance period. This discharge allowance is no longer valid once operations resume but it may be beneficial to pursue the extension of the discharge permit for during operations. Water quality monitoring of the seepage pond by Mount Polley staff reports consistent water quality from during operations to the present at levels well below those in the present permit. If discharge through the seepage pond were to continue throughout operations,* ***the volume of stored water in the TSF would be reduced, increasing the tailings beach and improving the stability of the facility****. [Bold emphasis] The discharge of good quality water would also help maintain the water levels in downstream waterways.*
>
> *Discharge Option*
>
> *A separate water balance has also been conducted which assumes that the existing water discharge permit is amended to also be applicable when operations recommence. The water balance with discharge assumed from the Main Embankment seepage recycle pond indicates that, approximately 4 million m^3 of water will be stored in the TSF as shown in Figure 6, which presents a schematic of the water balance for Years 1, 3, and 7. It may be beneficial to discharge water through the seepage pond to reduce TSF water storage requirements.*

As stated in its annual *Environmental and Reclamation* reports after 2004, though the Ministry of Environment granted MPMC continuance to discharge mine effluent in May 2005, for undisclosed reasons MPMC chose not to.

A prediction was outlined in section 5.0 about the TSF in the year 2012 ultimately containing an average range between "an absolute minimum volume" of about 4.5 million cubic meters (under dry climatic conditions) to "an absolute maximum volume" of about 10 million cubic meters (under wet climatic conditions) of supernatant water. Deciding on a predicted assumption of 7 million cubic meters, under the assumption that "both the minimum and maximum values predicted by at risk are

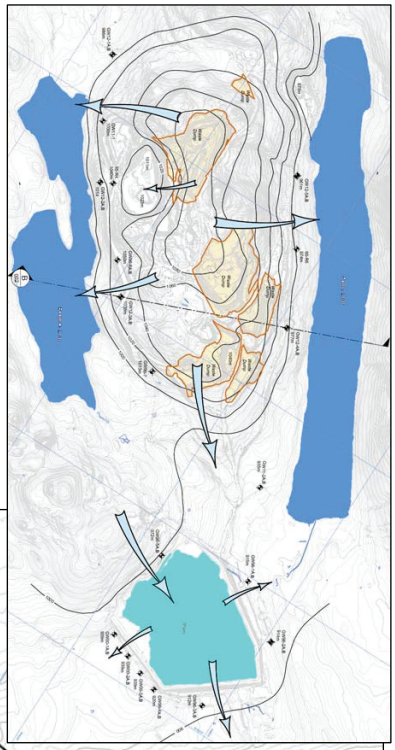
unlikely to occur," Knight Piésold's recommendation counteracts geotechnical science concerning the inappropriateness and vulnerability of Upstream method dams to impound large volumes of water, flirting with and inviting catastrophe.

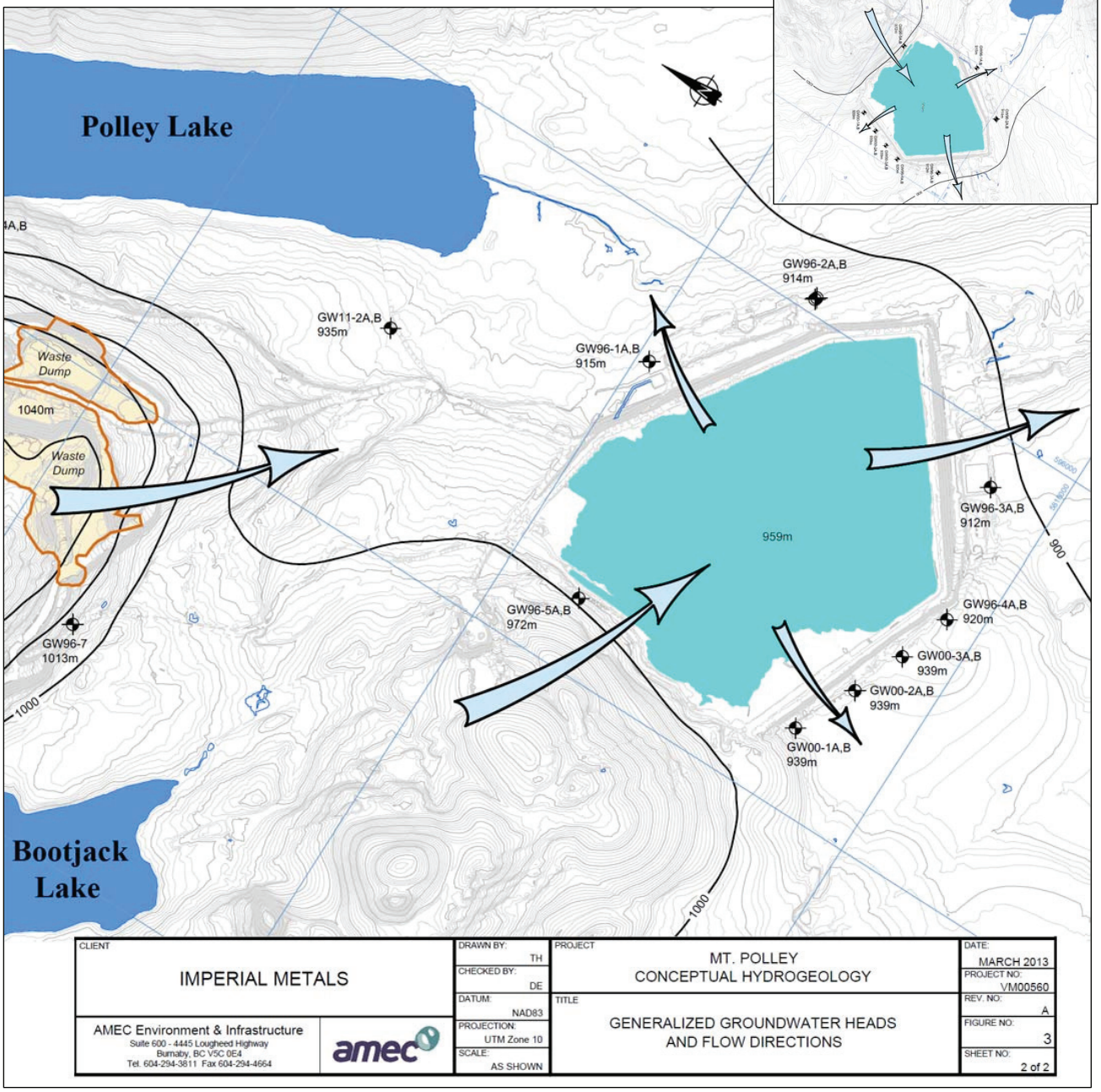
> *By the end of Year 7 approximately 7 million m^3 of water will be stored In the TSF. At closure this water will be routed to the Springer Pit, which will have a capacity to store 18 million m^3 of water, to accelerate pit filling. Runoff from disturbed areas will also be directed to the Springer Pit until the areas are reclaimed. The Springer Pit will have a large storage capacity and will benefit from water inputs to accelerate the filling of the pit. At the end of Year 7 the Cariboo and Bell Pit will be storing backfilled waste rock with approximately 3 million m^3 of water filling the voids between the rocks. Cariboo Pit has a capacity of approximately 6.2 million m^3 and the Bell Pit has a capacity of approximately 4.1 million m^3. A void ratio of about 30% is assumed. The Springer Pit will contain up to approximately 3.7 million m^3 of water. This is a conservatively high number as it assumes a constant infiltration rate as the pit fills.*
>
> ***It is estimated that approximately 2 million m^3 of storage capacity is available for each meter rise in the tailings pond level. If the TSF is storing 7 million m^3 of water as predicted by the water balance, a rise of about 3.5 m is expected.*** [Bold emphasis] *The increased pond level will result in a larger pond area with more of the beaches inundated by water. The beaches have an average slope of about 1% so water will extend across the beach approximately 350 m horizontally as the pond rises 3.5 m. Sufficient beaches will be maintained upstream of the embankments to prevent any stability concerns. The embankment crest elevation will be adjusted to maintain freeboard requirements for storage of the probable maximum precipitation (PMP) event plus 1 m for wave run-up as required by the current permit.*

The outline of the 2004 strategy was described in Table 1, *Water Management Timeline*, which identified that the predominant mining activity would stem from excavating the Springer Pit beginning in year 2 and ending in year 7, the largest-by-volume pit at Mount Polley, projected to "have a capacity to store 18 million cubic meters of water." [57] Immediately following the end of mining operations in Springer Pit, the over 7 million cubic meters predicted average of supernatant water that was to be eventually "stored" in the TSF would finally be "drained by pumping water to the Springer Pit." In other words, the Springer Pit was called upon to be the proverbial saviour of the mine site as final closure stage was to set in. In essence, that was the next most likely vision under several "iterations" of water balance schemes in the 2004 guidance strategy.

[57] A second, or "Updated Water Management Timeline" was presented as Table 2 in Appendix C, *Mount Polley Mine Water Balance*, in the July 2009 *Technical Assessment* report re PE-11678.

Mount Polley Conceptual Hydrogeology drawing from AMEC's March 26, 2013 Appendix C report, *Mount Polley Mine Hydrogeology Assessment and Data Review*, in the *2012 Environmental and Reclamation Report*. The light blue arrows generally indicate the gravitational paths of groundwater flows emanating from at the Mount Polley mine site. Note the three directional arrows leaving the TSF area, from which contaminated groundwater sources may enter streams draining into and toward Quesnel Lake. This is another effluent discharge problem issue with this, and all other mine site tailing storage facilities.





Turbo-Misters: Enhanced Evaporation or Effluent Discharge?

During a tour of the TSF on September 16, 2014, the author photographed three "Turbo-misters" actively discharging untreated mine waste finely sprayed water from the Main Embankment seepage pond into the atmosphere and over and onto the adjacent Crown-owned landscape. It was an innocent, routine documentation, which upon later reflection became significant.

The seepage pond collects and temporarily stores mine waste tailings water that has seeped or been forced through the dam's pervious embankment material under gravitational force and pressure from the TSF tailings mass, which is then recycled back into the TSF.

> **2.4** Surface Runoff and Mine Drainage Control
>
> **2.4.1** All seepage collected from down gradient of the tailings impoundment shall be returned to the tailings impoundment.

The rates of these embankment 'seepages' vary according to factors related to combined saturated tailings mass pressure and from the total volume weight of supernatant floating above the tailings mass. In other words, the artificially lined seepage ponds constructed at the base of Mount Polley's embankments contain mixed and variable concentrations of toxic heavy metals (and whatever else) that have migrated through gravity into the seepage ponds.

Although Mount Polley had a permit to continue to discharge mine waste water from the Main Embankment seepage pond into the tributary of Edney Creek in a May 2005 amendment to effluent permit PE-11678, Mount Polley Mining Corporation (MPMC) stated that it chose not to do so in numerous reports after mine re-start in March 2005. For instance, in MPMC's 2012 Environmental and Reclamation Report:

> *MOE Effluent Permit PE 11678 was amended in May 2005 to allow the discharge of effluent from the Main Embankment Seepage Collection Pond (MESCP). There have been no discharges from this location since 2005. In November 2012, the MOE approved an*

amendment of this permit to allow effluent discharge into Hazeltine Creek (projected to begin in spring 2013). Discharge from the MESCP is no longer permitted.

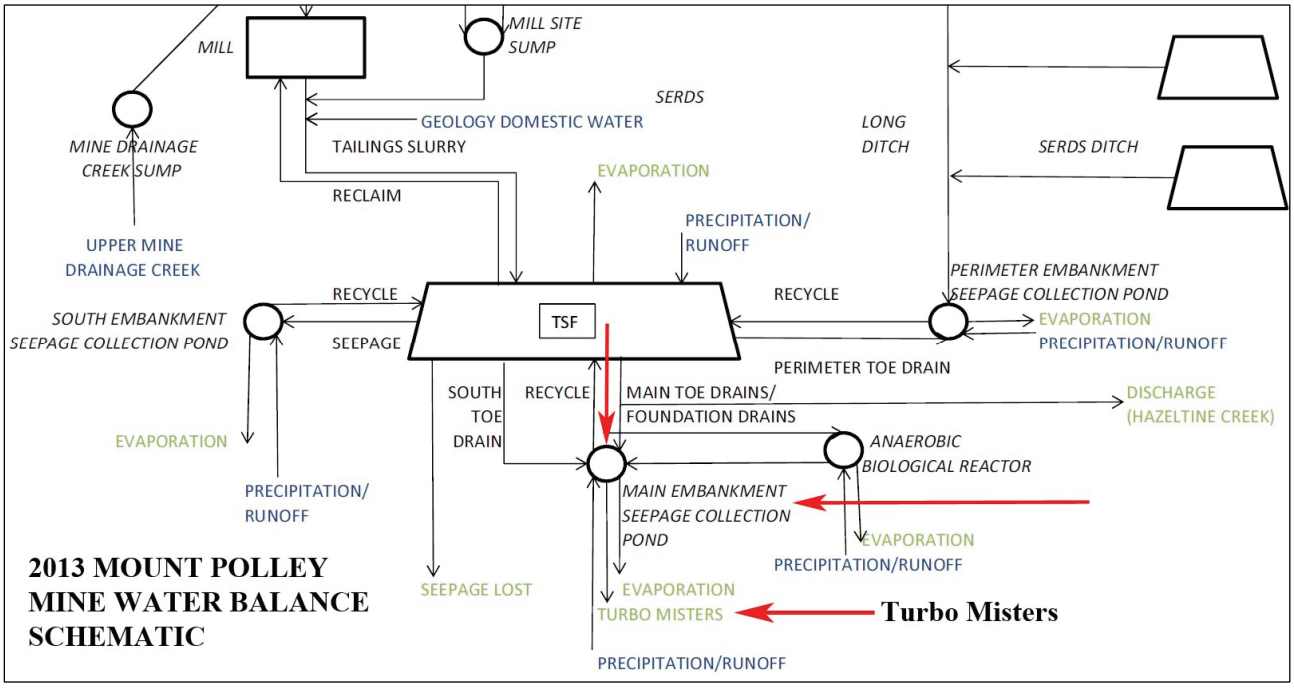
The 2012 annual report did state that it used "sprinklers" to evaporate water in the seepage ponds, but did not identify the type of sprinkler.

As Slimline Manufacturing advertises on its Turbo-Mister website, industrial evaporators, such as the three sold to Mount Polley, are being used by the mining industry to "solve the harshest nuisance water problems:"

> *The traditional way of dealing with it* [wastewater] *in the mining sector is to store it in a pond and allow it to evaporate, but ponds are expensive to construct, take a long time to evaporate and there's always a risk of the discharge of hazardous material into natural water systems.*

The resulting question is, was MPMC using the Turbo-Mister product correctly? Not according to simple principles outlined on the Turbo-Mister website. Under its "Tailings Pond" link, the Turbomist Enhanced Evaporation Systems are "superior" for "good public image," only when "using technology such as wind sensors, containment fencing and bird balls to eliminate bird kills, and contain pollution due to drift." As the website promotionally claims:

> *If you added 1,411,810 gallons per day (as many as 34 units can operate a 10 acre pond) to the pond using Turbomist evaporators, by the end of the year, this 10 acre pond would still be 10 acres in size, in fact: as long as you run our enhanced evaporation equipment, the pond will continue to be the same size until the inflow of 1,411,810 stops, then it would be empty in under 12 days. Project complete ... Liability gone.*



Due to the ongoing problem of 'net precipitation' at Mount Polley, the July 2009 Technical Assessment report identified "enhanced evaporation" as one option strategy in section 4.1,

Overview of Options. Stated in the July 2009 *Consultation Report*, on page 11 of the October 2007 report within it, are comments about "enhanced evaporation."

> *Mount Polley has tried and is still using an evaporation system on an experimental scale. We have found that it is efficient only on days in which the temperature reaches 25 degrees Celsius. Overall, optimizing evaporation will only modestly reduce our total discharge needs.*

Though "evaporating enhancing techniques" were originally included as part of the permit license in the October 1992 Mine Certificate (see above), it was no doubt understood that such an application would occur within the footprint of the mine site, and probably entirely contained through supervision of spray overtop of an effluent 'pond', and not to be physically discharged onto lands outside of the mine site containment boundaries. It is not known how long, and if Mount Polley may have been spraying directly overtop of Crown lands outside of its containment area. If they had been, as documented by the author on September 16, 2014, then that could properly be defined as an "effluent discharge" into the receiving environment, even though MPMC may claim otherwise.

Appendix N, Water Balance, of the 2013 Annual Environmental & Reclamation report registers "Turbo Misters" in a Water Balance Schematic, and states in the *MPMC Site Water Balance - Framework* table that in the *Water Out of Tailings* category a "bank of 3 Turbomisters" had evaporated waste water. Many questions need to be asked, and answers provided on this turbo-mister history.

Supernatant Math Mystery

Stated in the previous chapter, MPMC reported that as of December 2004 about 5 million cubic meters of supernatant water had accumulated in the TSF, an astounding volume. Even during the early period of the raised stage design of the TSF, that was 3 million cubic meters beyond the design capability of the TSF as developed in 1995/1996. Nothing was stated at the time if freeboard had been maintained or exceeded by 2004 or following into 2005.

If that volume of 5 million cubic meters is added to the cumulative annual predicted <u>average</u> 'net precipitation' figure of 1.4 million cubic meters from 2005 to July 2014, conservatively estimated at about 13 million cubic meters, that would mean that at least 18 million cubic meters of supernatant water was stored somewhere within the footprint of the Mount Polley mine site, as MPMC had not discharged any of this surplus supernatant, and only began discharging minor volumes of mine effluent into Hazeltine Creek by the year 2014. The figure of 18 million cubic meters (not including

total groundwater seepage sources) could in actuality be much higher, given that the figure is based on rain and snow fall averages.

If, according to Imperial Metals Corporation information update of September 1, 2014, that 10.6 million cubic meters of supernatant water escaped on August 4, 2014 during the tailings catastrophe, then where is the remaining 7.4 million or more cubic meters of supernatant water?

8. Those Piezometers: The Instrumentation Saga

One of the limitations of the present report is the restricted unavailability of published reports and relevant documents held by the provincial government. This is a main disadvantage for the topic of installed monitoring instrumentation at Mount Polley's Tailings Storage Facility (TSF). I.e.:

- the four types of piezometers used to monitor 'pore pressures' in the TSF's tailings mass, embankment fill materials and drains, and within the foundation materials;
- and inclinometers that detect physical movement or shift in the TSF's three slope structures.

As one of the physical engineered "components" of the TSF, these instruments monitor the critical internal workings of an artificial structure that professional engineers say is supposed to be designed and last for an eternity.

The documents that were retrieved only cover accounts for three annual TSF inspection reporting years, 2008, 2009 and 2010, with only summary comments found in annual reports for years 2011, 2012, and 2013. Despite the missing descriptive records before 2008 and those after 2010, the information contained in the three annual reporting years relate an ominous and disturbing tale about neglect and mismanagement.

2008 TSF Report

Knight Piésold, Mount Polley Mining Corporation's (MPMC's) former geotechnical consultants (1989 - February 2011), gave a short and a simple overview of the TSF instrumentation in the Executive Summary of its *TSF Report on 2008 Annual Inspection*.

> *The TSF instrumentation currently consists of four slope inclinometers installed at the Main Embankment and 68* [58] *operating vibrating wire piezometers installed in the Main, Perimeter and South Embankments. The piezometers monitor the pore pressures in the foundation materials, embankment fill materials, the tailings mass, and the embankment drains. There have been no significant deviations in the inclinometers and no unexpected or anomalous pore pressures reading in the vibrating wire piezometers.*

The next sentence in the same paragraph issued an "however" warning:

> *However, inclinometer SI01-02 is showing slight deviations at an approximate depth of 10 m below ground in the lacustrine silts. The short term recommended action is to increase the monitoring frequency of the instrumentation to weekly, with weekly reporting to Knight Piésold, and increasing the buttress at the Main Embankment.*

If all that a member of the public chose to read of the 97-page long, 2008 annual TSF inspection report was the *Executive Summary*, then one would walk away with an impression that all was rosy (a smiley face) on the Mount Polley TSF front. However, the Executive Summary's editor(s) wasn't forthcoming on very serious problems found in two pages of the main report.

[58] The number given, 68, for operating piezometers, seems to be at odds with the numbers given in section 4.0 of the 2008 TSF report (see below), where only 60 are reported as operating, not 68.

Section 4.0 of the report concludes that 32 of the 92 piezometers installed throughout the TSF structure, or 35 percent, were no longer functioning, with a total of **65** located in the Main Embankment, **17** in the Perimeter Embankment, and **10** in the South Embankment. (See Appendix F for the list of the piezometers) It also states one of the five inclinometers was no longer functioning:

- only 11 out of 19 Tailings Piezometers installed throughout the "tailings mass" to measure pore pressure regimes are "in operation;"
- only 12 out of 21 Embankment Foundation Piezometers installed in the three embankment foundations "remain in operation;"
- only 22 out of 32 Embankment Fill Piezometers installed in the fill materials of the three embankments "remain in operation;"
- only 15 out of 20 Drain Piezometers installed in the drains of the three embankments "remain in operation."

Of the 32 non-functioning piezometers, only seven of them were specifically identified in Table 4.1, *Maximum Artesian Head Values for Embankment Foundation Piezometers*, shown below.

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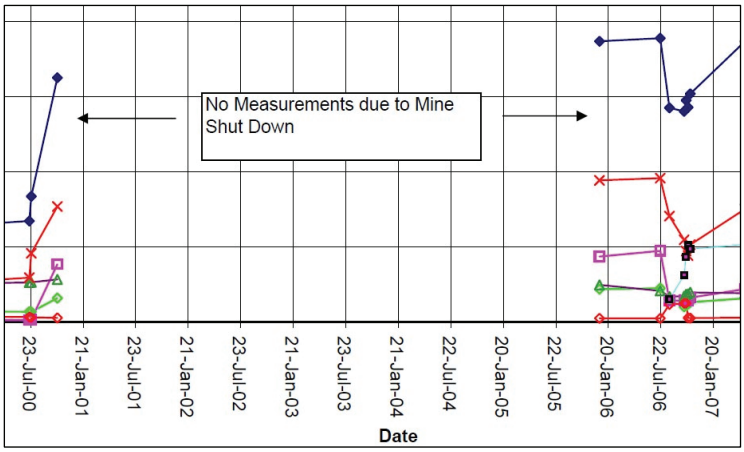
Piezometer	Piezometer Elevation (m)	Surface Elevation (m)	Sept 2008 Pressure Elevation (m)	Sept 2008 Artesian Pressure (m)
A2-PE2-01	903.68	912.67	No Longer Functioning	-
A2-PE2-02	909.77	912.67	No Longer Functioning	-
A2-PE2-06	898.01	912.91	No Longer Functioning	-
A2-PE2-07	902.81	912.91	915.91	3.00
A2-PE2-08	907.56	913.36	912.49	-0.87
B2-PE1-03	914.05	915.55	915.55	0.00
B2-PE2-01	901.98	916.98	No Longer Functioning	-
B2-PE2-02	909.51	916.98	920.35	3.37
B2-PE2-06	914.59	916.89	No Longer Functioning	-
C2-PE1-03	912.59	-	No Longer Functioning	-
C2-PE2-02	910.53	915.71	916.64	0.93
C2-PE2-06	906.84	915.99	914.82	-1.17
C2-PE2-07	912.29	915.99	No Longer Functioning	-
C2-PE2-08	914.03	915.99	914.37	-1.62
D2-PE2-02	927.32	930.92	931.15	0.23
E2-PE2-01	914.21	918.81	917.19	-1.62
E2-PE2-02	909.66	918.81	916.48	-2.33

M:\1\01\00001\24\A\Report\Tables\[Section 4 Tables1.xls]Table 4.1

The names and data for the remaining 25 non-functioning piezometers were not identified.

Another disturbing revelation contained in Figures 3.1 (*Foundation Drain Flows*) and 3.2 (*Upstream Toe Drain Flows*) was that for a period of 3 and a half years no measurements of piezometers installed to monitor the foundation drain flows and the upstream toe drain flows were taken from 2001 to 2005, "due to Mine Shut Down". The document fails to state why those measurements were not taken, or who was responsible for not doing so.

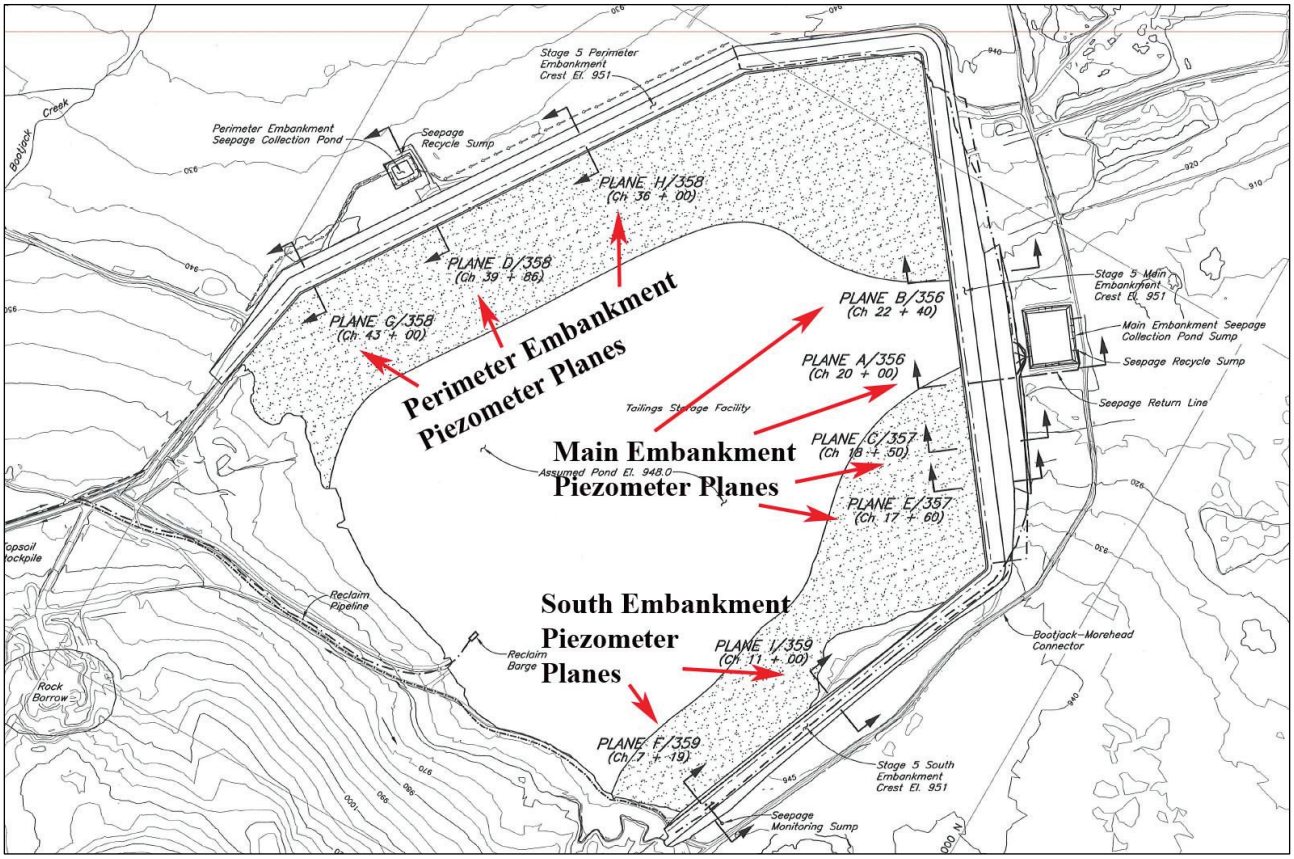


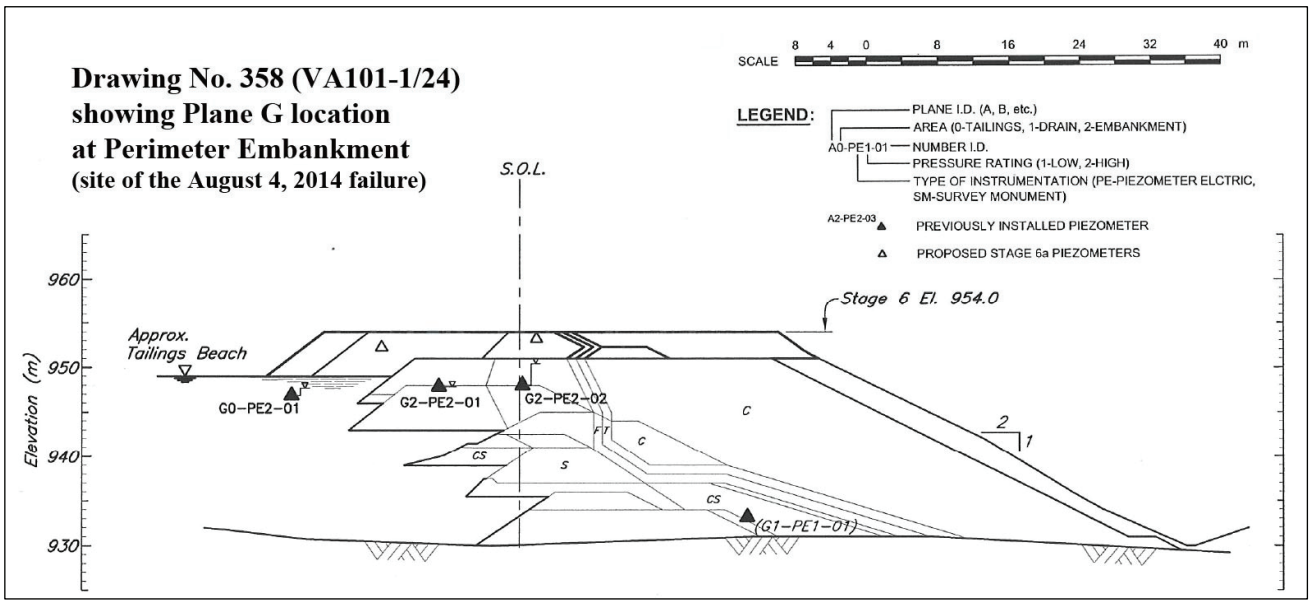
The 2008 TSF inspection report failed to properly contextualize or adequately describe in a devoted section of that report the instrumentation recording oversights and problems which had evidently been accumulating and occurring on Mount Polley's TSF from 2001 through to 2008, as they are only noted in isolated and disjointed sections of the annual report.

More of these accumulating problems were stated in Appendix C, Knight Piésold's *Overview of 2006 Dam Safety Review*, a formal dam review conducted by AMEC, the international professional engineering and design company:

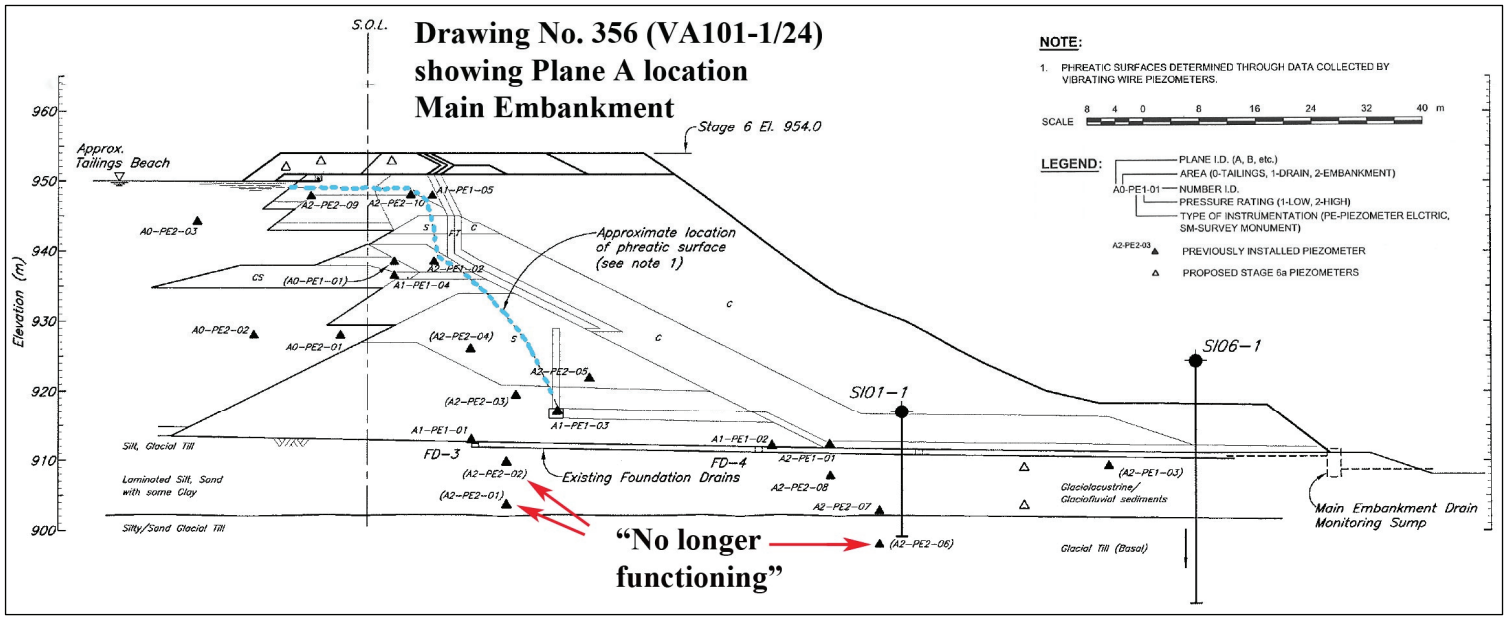
> *A Dam Safety Review (DSR) for the Tailings Storage Facility at Mount Polley Mine was completed by AMEC in October 2006. The results of the DSR were issued in a report to Imperial Metals Corporation in December 2006.*
>
> *1. Operating criteria for pond and beach management are presently at odds with the optimal dam seepage performance and stated closure objectives, with the latter issue being of greatest concern.*
> *A beach width of at least 20 m is to be maintained along the abutments of the embankments (where the embankment contacts natural ground) and at least 10 m width elsewhere to keep the pond away from the embankments. Knight Piésold has recommended that MPMC develop a plan and schedule to enable the minimum target beach widths to be re-established within a 2 week period should they be infringed upon. MPMC shall increase the frequency of measurements to at least once per week for embankment instrumentation systems (piezometers and foundation drains - flow rate and turbidity) during any periods that ponded water encroaches within the minimum target beach widths.*
>
> *5. There were "about the right" number of piezometers installed in the embankment dams, however there is nothing in the way of much redundancy and any lost instrument locations need to be re-established with a new installation.*
> *A total of 57 vibrating wire piezometers have been installed at the TSF as of the end of the Stage 4 construction program. The piezometers are grouped into tailings, foundation, embankment fill and drain piezometers.* ***A total of 22 piezometers were accidentally destroyed*** *during the Stage 4 construction program, and* ***six additional piezometers have previously stopped functioning****. MPMC and Knight Piésold attempted to locate and splice the damaged piezometers and successfully repaired five of them.* ***The number of functioning piezometers at the end of the Stage 4 construction program was 34****. Additional piezometers will be installed in the tailings and embankment fill materials and tailings during the Stage 5 construction program, which is currently in progress.*
>
> ***Although a number of piezometers are no longer functioning at the TSF, replacing all of them is not practical nor considered necessary at this time*** *as there are functioning piezometers in the vicinity of most that were damaged. However,* ***five of the damaged piezometers were foundation piezometers at the Main Embankment, where there are slight artesian conditions (less than 3.0 m).*** *Additional piezometers will be installed in the Main Embankment foundation materials during Stage 6 to offset those that are no longer functioning. The foundation piezometers at the Main Embankment will have a trigger level of 15 m above ground, which corresponds to the elevated pore pressure that reduces the factor of safety to 1.1.* [Bold emphases]

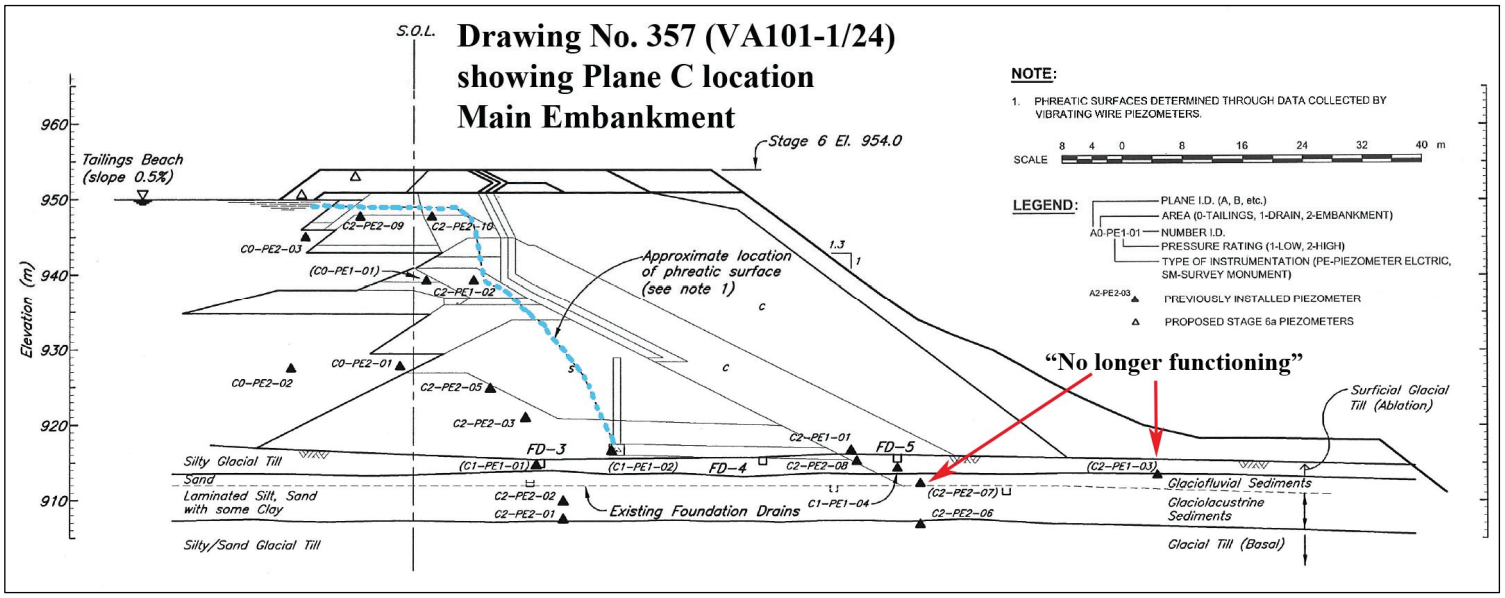
The 9 location "Planes" of the TSF's piezometers are shown in Drawing No. 345, on pdf page 39 of Knight Piésold's 2008 inspection report. The Perimeter Embankment had three Planes: D, G, and H, with 17 piezometers. The Main Embankment had four Planes: A, B, C, and E, with 65 piezometers. The South Embankment had two Planes: F and I, with 10 piezometers. Map representations from three of the nine Planes and piezometer locations, published in the 2008 report, are shown below.





Above: One of the three Planes from the Main Embankment. Unlike the following two drawings, the approximate location of the Phreatic (water table) line is not shown/presented for the Perimeter Embankment. The 2:1 slope for the above drawing appears to be less steep than the actual slope as photographed by the author on September 16, 2014.





Above and Below: Two sections from drawings in the 2008 TSF inspection report showing Planes A and B piezometer locations within the Main Embankment. Here are shown 5 of the 32 "no longer functioning" piezometers as reported for 2008 in Table 4.1. Note the "approximate location" of the Phreatic (water table) surface line shown in blue dots.

2009 TSF Report

Much of the same news presented by Knight Piésold in the 2008 annual TSF inspection report about the sorry state of piezometers was also stated or repeated in the 2009 annual TSF inspection report.

- *<u>Tailings Piezometers.</u> A total of 18 piezometers have been installed in the tailings mass of which 13 remain in operation.*
- *<u>Embankment Foundation Piezometers.</u> A total of 19 piezometers have been installed in the embankment foundations of which nine remain in operation. The piezometers installed in*

this area are used to monitor the pore pressures and to confirm that they remain below the threshold level of 6 m above ground level.

- *Embankment Fill Piezometers. A total of 35 piezometers have been installed in the embankment fill materials of which 25 remain in operation.*
- *Drain Piezometers. A total of 19 piezometers have been installed in the embankment drains, of which 15 remain in operation.*

The 2006 Dam Safety Review (DSR) stated that there were "about the right number of piezometers installed in the embankment dams". The DSR also noted that there was little redundancy with respect to the piezometers and lost instrument locations should be re-established with new installations. Mount Polley Mine is currently developing a program to re-establish/replace the damaged piezometers.

2010 TSF Report Warning Shots

Operation, Maintenance and Surveillance Manual for Stage Ib Embankment CEI. 934m) by Knight Piésold Ltd., dated November 24, 1997.

The tailings storage facility shall be operated in accordance with the Operation, Maintenance and Surveillance (OMS) manual.

The Operation, Maintenance and Surveillance manual shall be updated as necessary to include revised monitoring criteria, including piezometer and slope inclinometer thresholds. [59]

Worse news about piezometer accounting came in Knight Piésold's final TSF annual inspection report for 2010. It was painfully obvious that Mount Polley Mining Corporation (MPMC) was not heeding the ongoing recommendations from its geotechnical professional engineers to replace the faulty TSF instrumentation, as even more piezometers were "no longer operating."

This time, Knight Piésold blasted a deafening warning shot over the bow of the MPMC ship: "No additional raises of the TSF should be constructed until the lost instrumentation is replaced"!

The instrumentation at the TSF consists of vibrating wire piezometers and inclinometers. There have been no unexpected or anomalous instrumentation readings. However, approximately 40% of the vibrating wire piezometers installed at the TSF are no longer functioning. Replacing the lost instrumentation is an outstanding item from the 2006 Dam Safety Review and the program to replace the lost instrumentation has not yet been implemented. ***Replacing the lost instrumentation should be considered a high priority by MPMC. No additional raises of the TSF should be constructed until the lost instrumentation is replaced.*** [Bold emphasis]

And, as summarized in chapter 10 of this report, *Stewardship 'Tension' and the Changing of the Engineering Guard*, there was a list of other pressing, unattended issues related to MPMC's evolutionary mismanagement of the TSF that Knight Piésold also identified in the 2010 report.

[59] Mines Permit M-200, *Approving Work System and Reclamation Program*.

In section 3.2.3 *Tailings Beach*, in Knight Piésold's 2010 report, it stated the following disturbing comments, which included concerns about instrumentation monitoring:

> *MPMC is currently single point discharging tailings near the northwest corner of the TSF. Prolonged discharge from this location has resulted in the supernatant pond migrating towards the Main and South Embankments where there is a lack of beach development.* ***The beached tailings, when left to drain and consolidate, form the competent foundation required for the modified centerline construction embankment raises.*** [Bold emphasis]
>
> *Knight Piésold has previously recommended to MPMC [60] the following regarding tailings beach development in the TSF:*
>
> - *A beach width of at least 20 m is to be maintained along the abutments of the embankments (where the embankment contacts natural ground) and at least a 10 m width elsewhere to keep the pond away from the embankments.*
> - *MPMC should develop a plan and schedule to enable the minimum target beach widths to be re-established within a 2 week period should they be infringed upon.*
> - *MPMC shall increase the frequency of measurements for embankment instrumentation systems (piezometers and foundation drains - flow rate and turbidity) to at least once per week during any periods that ponded water encroaches within the minimum target beach widths.*
>
> *It is recommended that MPMC adhere to the previous recommendations and develop a tailings management strategy that results in the MEMPR requirements for beach development along all of the embankments.*

In report section 3.2.7, *Drain Flow Data*, Knight Piésold stated that MPMC had again failed to adhere to the *Operation, Maintenance and Surveillance Manual*, whereby "weekly" inspection "frequency for the upstream toe drains and the foundation drains" were "**only measured once since June 2009**." [Bold emphasis]

The geotechnical consultants again stated in section 3.2.8, *Piezometer Data*, that MPMC was not adhering to the *Operation, Maintenance and Surveillance Manual*, whereby a minimum requirement to read all of the TSF's piezometers on a monthly basis

> ***was not maintained during the last year***. [Bold emphasis] *The reading frequency tends to increase during non-construction periods.*
>
> ***The piezometric levels provide valuable input to the design and operation of the TSF*** [bold emphasis] *and it is recommended that MPMC develop an instrumentation reading plan to ensure the piezometers are read and reported to the design engineer at the required frequency.*
>
> *The TSF has been in operation since 1997 and approximately 92 vibrating wire piezometers have been installed in the TSF,* ***of which approximately 60% are still functioning.*** [Bold emphasis] *The 2006 DSR stated that there were "about the right number of piezometers*

[60] Knight Piésold Memo – Geotechnical Inspection by MEMPR – Ref. VA08-01436. August 5, 2008.

installed in the embankment dams", but also noted that there was little redundancy with respect to the piezometers and lost instrument locations should be re-established with new installations. An instrumentation installation program has been proposed to MPMC to replace the lost instrumentation. [61] *This program is expected to be carried out toward the end of 2010.*

The function and strategic placement of piezometers in a TSF play a critical role, as stated, for instance, in a 2002 paper by T.E. Martin:

Pressure piezometers, installed at various depths within the tailings deposit, are used to measure pore pressures and seepage gradients (horizontal and vertical components). These piezometers can also be used to assess the relative degrees of consolidation within the deposit profile, and to whether or not the deposit is responding in a drained or undrained manner to ongoing raising. This is a key consideration when considering ESA versus USA approaches to the stability analysis of the dam. [62]

Knight Piésold reported that "there are currently 10 functioning tailings piezometers." In its 2008 report, the consultants stated that 11 out of 19 of these piezos were in operation, now one less in 2010.

The tailings piezometers are typically installed close to the embankments and the pore pressures are sensitive to the location of the tailings pond in relation to the embankments. The pore pressures observed in the tailings piezometers at the Main Embankment have shown slight fluctuations during the Stage 6b construction program in response to the development of the tailings beach and the subsequent re-location of the tailings pond away from the embankment.

The "Stage 6b construction program," completed by August 2010, was the lifting of the TSF impoundment from elevation 954 meters to 958 meters. When the construction occurred, Knight Piésold also stated on page '8 of 16' that by June 2010, MPMC had somehow decreased the annual accumulation of supernatant water in the TSF - which had been constantly increasing by an average of 1.4 million cubic meters per year - down to a standing volume of 650,000 cubic meters.

Knight Piésold reported that there were four fewer Embankment Foundation piezometers in operation than there were in 2008. Now only 8 out of the 19 were functioning.

There are currently no functioning piezometers located in the Plane A foundation at the Main Embankment. Additional piezometers are planned for installation in this location in the upcoming piezometer installation program.

It is recommended that no additional raises be completed on the TSF until the lost instrumentation has been established.

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[61] Knight Piésold Letter – Mount Polley Tailings Storage Facility – Instrumentation Repair, Productivity Upgrade and remote Monitoring Capacity. Ref VA10-01175. July 22, 2010.

[62] Page 10, *Characterization of pore pressure conditions in upstream tailings dams*, by T.E. Martin, February 2002.

Knight Piésold reported that there were now 23 out of 32 Embankment Fill Piezometers functioning. In 2008 there were 22 that were functioning.

> *Piezometer A2-PE2-03, located at the Main Embankment, showed a slight increase in pore pressures corresponding to fill placement during the Stage 6b construction program. This trend has been observed in the past with this piezometer and it is anticipated that the slightly elevated pore pressures will dissipate following the construction programs as they have previously.*

Knight Piésold reported that there were 15 out of 20 functioning Drain Piezometers, the same amount cited in its 2008 report.

Without having access to descriptive information found in Knight Piésold's initial two-volume, 1995 *Tailings Storage Facility Design Report*, and/or its updated revisionary March 2005 *Design of the Tailings Storage Facility to Ultimate Elevation*, [63] where criteria are no doubt provided on the limited physical design integrity of Mount Polley's TSF, the placement of 65 out of 92 piezometers in the Main Embankment denotes the importance and added emphasis that Knight Piésold had made on that section of the impoundment's structure. The engineers' attentive concern to the greatest number of piezometers on the Main Embankment was due to the Embankment's total construction height and base width, with the lowest elevation point of the Embankment at 913 meters. With Knight Piésold's design for a maximum TSF height at 965 meters, a final holding wall of the Main Embankment was to be **52 meters in total height**!

For most likely the same engineering design criteria, only 17 piezometers (74 percent fewer) were placed throughout three Planes within and alongside a much longer Perimeter Embankment. It's lowest construction base, where the August 4, 2014 breach occurred, began at elevation 931 meters with full build out to elevation 965 meters, a final holding wall of **34 meters in total height**.

The geotechnical engineers placed less piezometer attention and required less physical foundational strength (through the "modified centreline construction method") on the Perimeter Embankment section of the TSF because the engineers considered the Main Embankment as the most vulnerable over time due to its overall height. However, the engineers no doubt acutely understood the structural vulnerability of the Perimeter Embankment should the dam's crest rise beyond what they referred to as "the ultimate embankment crest elevation of 965 meters."

> *A preliminary design of the TSF, completed by Knight Piésold in 2005, considered an ultimate embankment crest elevation of 965 m and provided storage for approximately 85 Mt of tailings. The MPMC mine plan is evolving as new resources are discovered and it is possible that the ultimate mineable resource will exceed the ultimate storage capacity of the TSF as defined in the 2005 study.* ***It is recommended that the tailings storage requirements be re-evaluated to assess whether modifications are required to the TSF layout.*** [Bold emphasis] *Additionally, the closure and reclamation plan for the TSF should be updated to reflect the increased resource and tailings storage requirements. The TSF should be designed for closure and defining the ultimate storage requirements along with the closure and reclamation plan for the TSF are key considerations for future design phases.*

[63] See Appendix B.

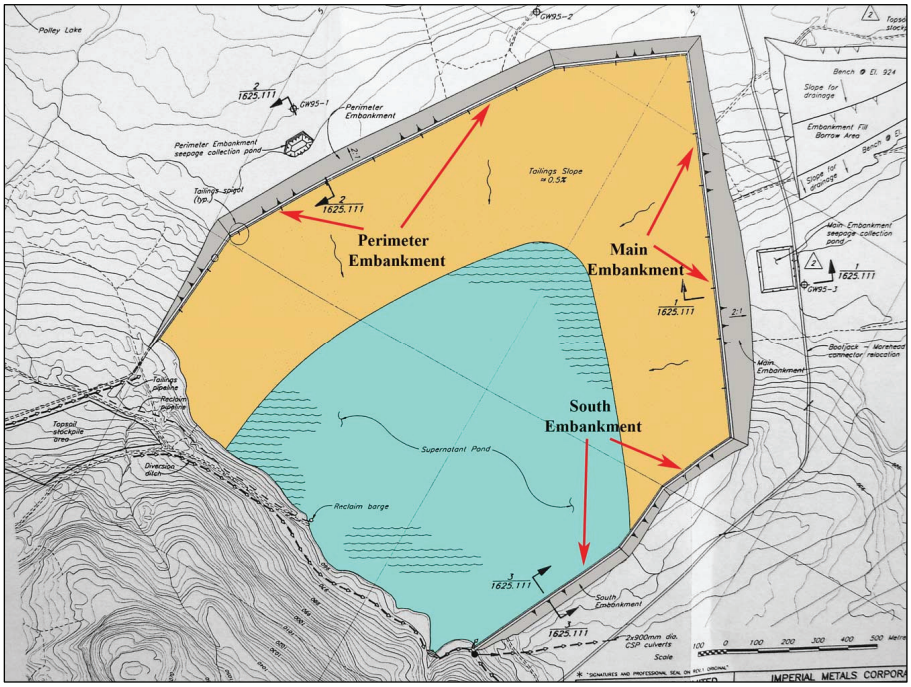
Apparently, concerns about the Perimeter Embankment's structural integrity first became evident in 2010. When engineer Les Galbraith arrived for the annual TSF inspection on October 7, 2010, MPMC informed him of a "tension crack," which had initially been discovered by a grader operator two months previous. The tension crack was located on the crest of the eastern section of the Perimeter Embankment near corner "S6." When observed and reported by the grader operator to management in August 2010, management failed to report the disconcerting finding to its geotechnical engineers, and is therefore why Knight Piésold states in its report:

> *It should also be noted that the identification of a tension crack, or any other abnormal observation at the tailings dam,* ***should be reported to the design engineer immediately and prior to any remedial action being taken****.* [Bold emphasis]

9. Blooper-Natant

> *Raising the dam is only a viable option for the short term, as the water balance is such that there will be an on-going accumulation of water in the impoundment. However, the impoundment has a finite capability to store excess water in the pond on top of the tailings solids. An increasing volume of water in the impoundment reduces the capacity for storage of tailings solids and creates additional complexities in the design and operating requirements of the tailings facility. Specifically, as water levels increase within a tailings dam, the ability to maintain tailings beaches decrease.* ***Without tailings beaches, seepage rates through the dam increase significantly. This creates two problems: 1) the substantially greater quantity of seepage water; and 2) an increased risk of dam failure. Mount Polley is dedicated to the proper management of our tailings storage facility including the maintenance of tailings beaches***. [64] [Bold emphasis]

Throughout its role as Engineer of Record, Knight Piésold's numerous drawings of Mount Polley's Tailings Storage Facility have a consistent, ideal look about them concerning the correct shape and location area of the supernatant waters or 'pond' within it. And, there are critical reasons for having that look about them, namely that the TSF is to "provide secure containment for tailings solids." [65]

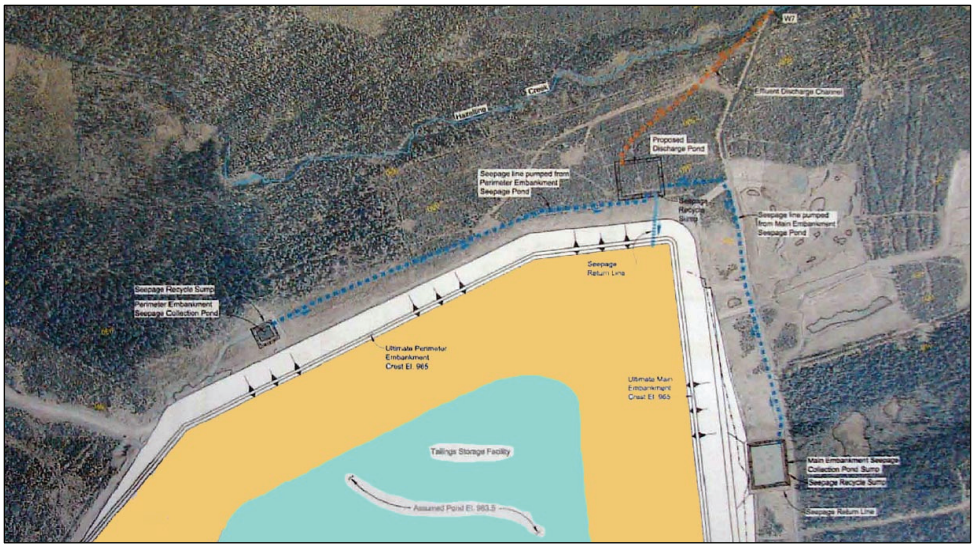


The drawing seen here, for instance, Figure 3.16, *Tailings Storage Facility Final Arrangement*, is the first such conceptual of the "supernatant pond" found in a lengthy public report, the 1996 *Reclamation Plan*. The outer perimeter of the supernatant waters (colored in greenish-blue) is well back from the crests of all three Embankments, except for just over half of the South Embankment, where its low wall is snugly nested into the contours of the existing mountain slope landscape. The tan-color areas of this image show the gently-sloped, depositional 'beach' zones of the mill's tailings slurry (sands and slimes). Though not shown in this drawing, the very bottom area of the TSF at the edge of the South Embankment is where the final spillway was designed for eternal reclamation.

---

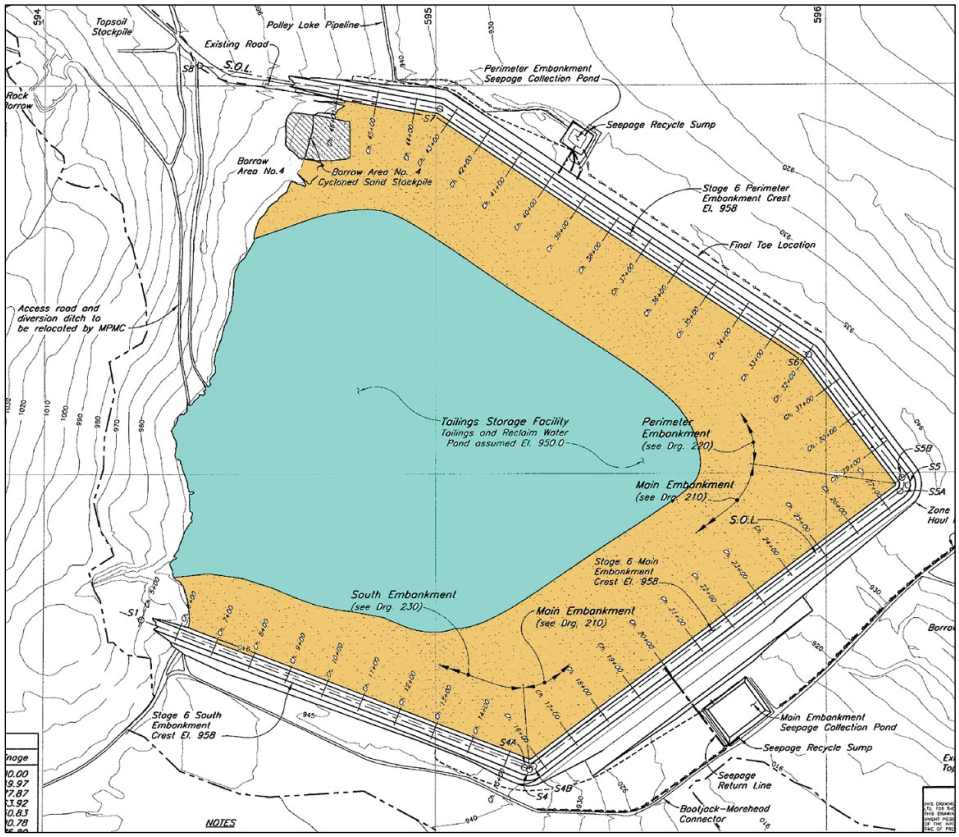
[64] Page 10, *Appendix F, Response Document, Mount Polley Mining Corporation: Response to Topics of Concern to the Community of Likely, British Columbia as Expressed During a Public Meeting of August 13th, 2007 at the Mount Polley Mine and in Subsequent Letters to the Mine*, in *Consultation report, PE-11678 Amendment Application*, July 2009.

[65] Page 3 of 15, Knight Piesold, *Tailings Storage Facility Report on 2008 Annual Inspection*.



The next image (left) is Figure 2, *Schematic of Proposed Seepage Pond and Effluent Discharge Channel*, in MPMC's July 2007 *Modified Draft Application PE-11678* report proposal. Intriguingly, though the landscape around the TSF is an actual image from an undated aerial photograph, the TSF area was cut out from the aerial photo, and then Knight Piésold's conceptual drawing of the TSF was pasted into Figure 2. This revision may have been done to obfuscate the fact that the supernatant pond and tailings beach areas may not have been where they should have been in that aerial photo, that is, according to Knight Piésold's ideal and proper configuration. (The two areas denoting the supernatant water and the tailings beach in that figure were colored by this report's author to highlight their locations.) The drawing states that the final or ultimate height of the supernatant pond waters was to be at elevation 963.5 meters, with a freeboard of 1.5 meters of the final/ultimate dam crest elevation of 965 meters.

Next is a drawing from Knight Piésold's 2008 TSF inspection report, *Stage 6 Tailings Embankment General Arrangement*. It better presents the same ideal supernatant pond and tailings beach configuration than the one drawn in 1996. It is also presented in the subsequent two annual TSF inspection reports for 2009 and 2010. The supernatant pond is well away and distant from the crests of each of the three stage-raised Embankments, and the tailings slurry/slimes beach is well-defined and evenly distanced.



Knight Piésold's engineers, who designed Mount Polley's TSF staged 'Upstream Type' structure, which they consistently define as a "Modified Centreline" Type structure, were aware of the consequential dangers of its client straying away from their supernatant location design. Those fears were realized and described in two of the three successive annual TSF inspection reports of 2008 and 2010, just before AMEC's contract as new Engineer of Record took effect in early 2011.

The year following Mount Polley mine re-start-up, those same concerns about the proper placement of supernatant waters were forcefully stated in AMEC's first formal Dam Safety Review (DSR) of October 2006 (yet to be released to the public), as summarized in Appendix C of Knight Piésold's 2008 annual TSF inspection report:

> *There were a few operational issues raised in the DSR, as discussed below:*
>
> *1. Operating criteria for pond and beach management are presently at odds with the optimal dam seepage performance and stated closure objectives, with the latter issue being of greatest concern.*
>
> *A beach width of at least 20 m is to be maintained along the abutments of the embankments (where the embankment contacts natural ground) and at least 10 m width elsewhere to keep the pond away from the embankments. Knight Piésold has recommended that MPMC develop a plan and schedule to enable the minimum target beach widths to be re-established within a 2 week period should they be infringed upon. MPMC shall increase the frequency of measurements to at least once per week for embankment instrumentation systems (piezometers and foundation drains - flow rate and turbidity) during any periods that ponded water encroaches within the minimum target beach widths.*
>
> ***Prolonged discharge of tailings from the Perimeter Embankment has resulted in the tailings pond migrating over to the Main Embankment, which has resulted in increased flows reporting to the Main Embankment upstream toe drain.*** [Bold emphasis] *MPMC has recently purchased additional HDPE pipe to facilitate the deposition of tailings from around the entire facility without having to relocate the tailings pipeline. This will allow MPMC to quickly develop tailings beaches in response to the pond encroaching on the embankments.*

Perhaps it was because of this scathing and embarrassing criticism by AMEC in October 2006 that led to the manipulation of the aerial photo portion of the TSF a year later in MPMC's 2007 *Modified Draft Application PE-11678* report, as shown and described above.

Over a period of three years, Knight Piésold noted the serious problems about MPMC's methods of discharging tailings into the TSF, and how those practices were influencing and push-migrating the supernatant pond closer to and against the crests of the TSF Embankments. These summary concerns are documented in the following quotes from the 2008 and 2010 *TSF Reports on Annual Inspection*:

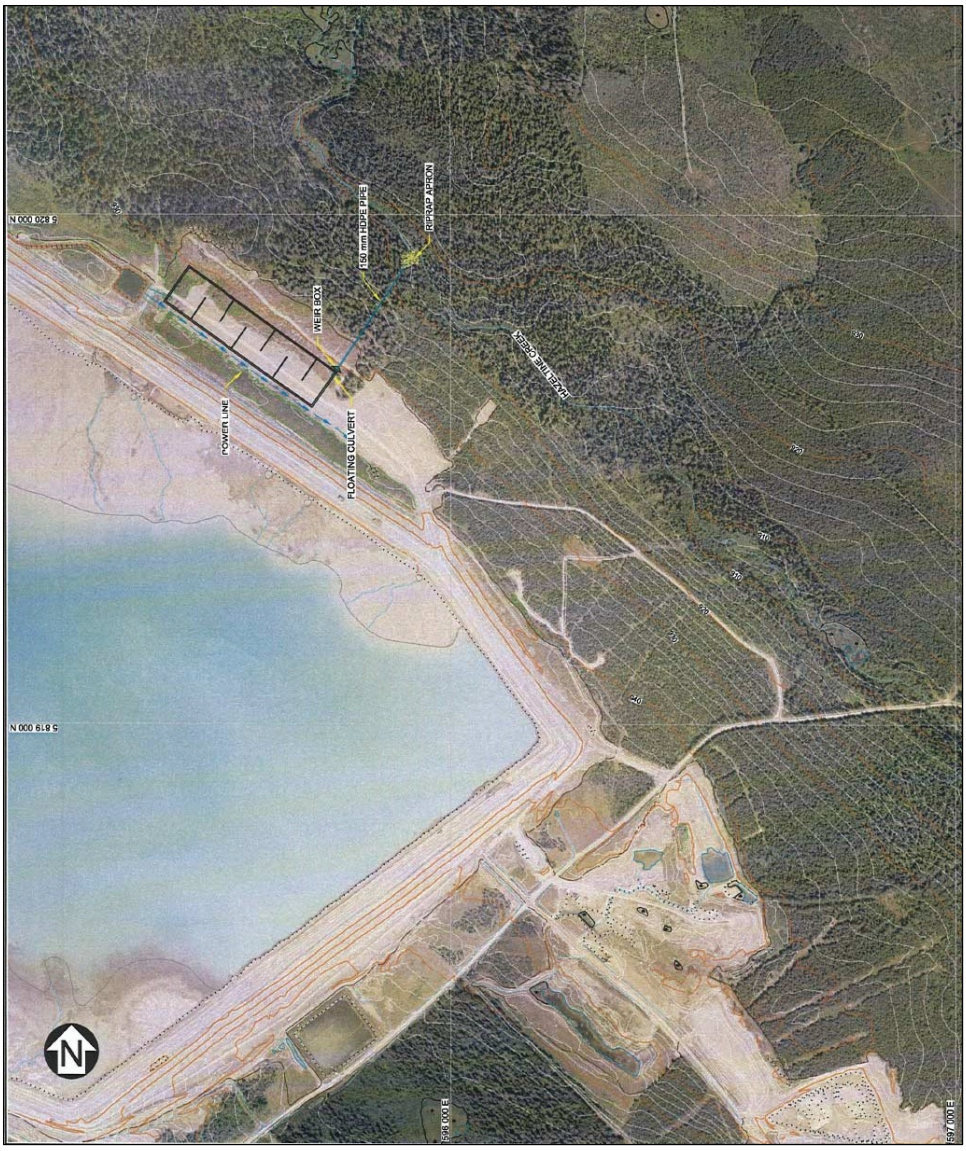
2008:

> *The flows at the ME* [Main Embankment] *Corner foundation drain have decreased in the last year due to the development of a tailings beach in this area. The flows from the upstream toe drains fluctuate throughout the year in response to the tailings deposition location and the tailings pond location.*

Prolonged discharge of tailings from the Perimeter Embankment has previously resulted in the tailings pond migrating over to the Main Embankment, which has resulted in increased flows reporting to the Main Embankment upstream toe drain. *MPMC purchased additional HDPE pipe in 2007 to facilitate the deposition of tailings around the entire facility without having to relocate the tailings pipeline and are now able to quickly develop tailings beaches in response to the pond encroaching on the embankments.* [Bold emphasis]

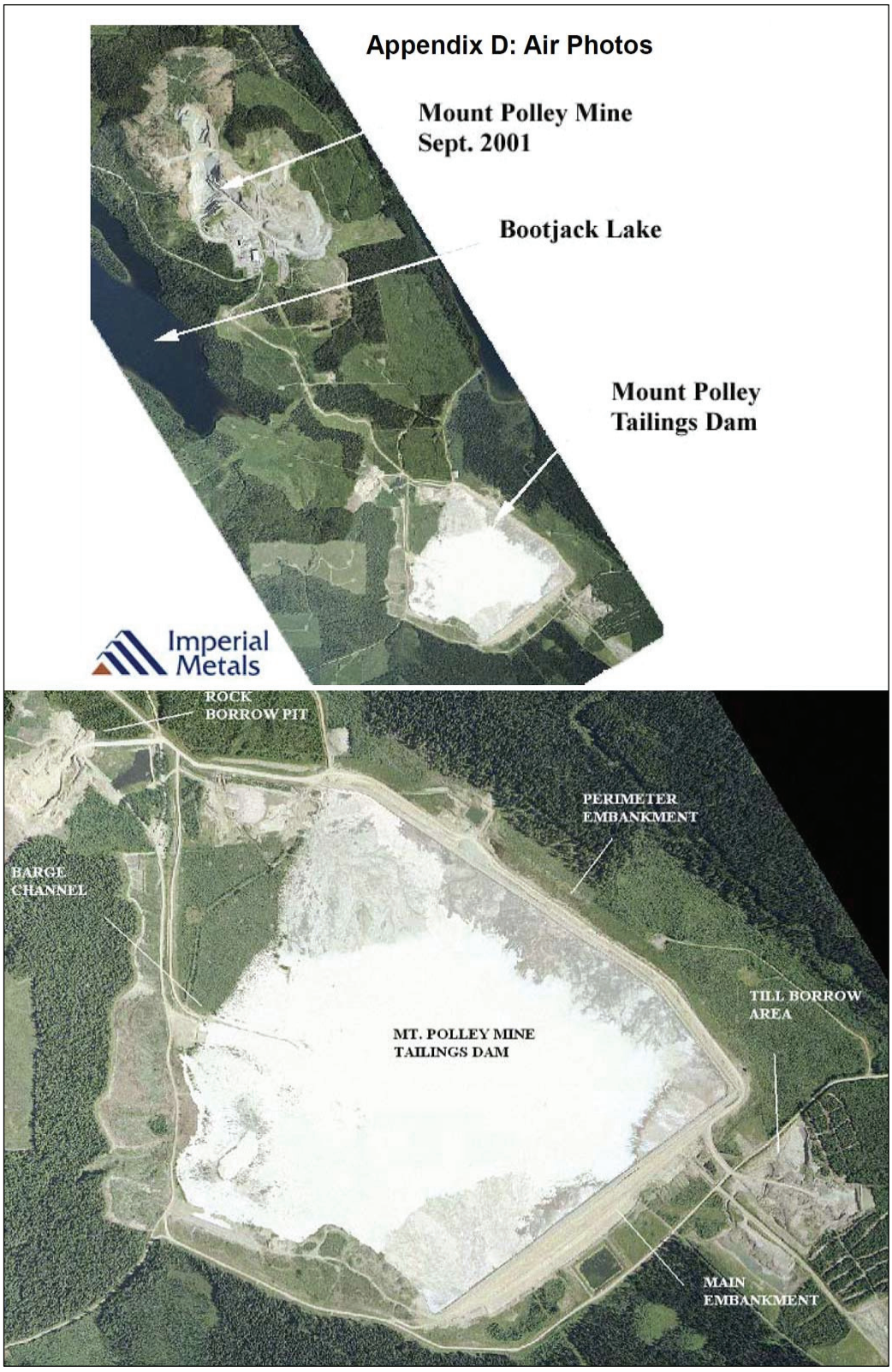
2010:

[Results and Recommendations] *Develop a tailings deposition plan to deposit tailings around the perimeter of the facility to facilitate the development of tailings beaches and manage the location of the tailings pond.* ***The lack of tailings beach development was a deficiency identified in a 2008 geotechnical inspection by the Ministry of Energy, Mines, and Petroleum Resources (MEMPR).*** *The tailings were being deposited from the west abutment of the Perimeter Embankment at the time of the inspection and the supernatant pond was in contact with the South and part of the Main Embankment.*



Left: Photo from Figure 1, *Sediment / Polishing Pond General Arrangement*, in Appendix G, *Details of the Proposed Discharge*, from the July 2009 *Technical Assessment Report* for Effluent Permit PE-11678. the image shows the eastern half of the Mount Polley TSF, where the supernatant pond has been pushed up against most of the Main Embankment and against the eastern most section of the Perimeter Embankment. In August 2010, a grader operator noticed a long, thin tension crack along the crest of the eastern extent of the Perimeter Embankment.

Above: Image of the Mount Polley TSF from Google Earth, snapped by the author on the afternoon of August 5, 2014. The date of the imagery was registered as December 31, 2004. The image was no doubt taken sometime earlier in 2004, during the middle period of the "Care and Maintenance" years. This is MPMC's abandoned design or configuration state of the supernatant pond during the "Care and Maintenance" years. Note how some of the lands within the TSF were not yet submerged (top area just south of the Perimeter Embankment, and middle left along the South Embankment), as the embankments were at stage 3 raised construction elevation, 945 meters. Note the tailings beach fan developed from the Perimeter Embankment, keeping the supernatant waters pushed diagonally across to the Main Embankment's southern corner. Note the position of the supernatant pond (for that day), against the lower end of the Main Embankment. (Note: Google Earth has since changed and updated the satellite imagery for Mount Polley area, dated August 9, 2014, for the world to see the tailings disaster imagery.)



Above: Same air photo of Mount Polley mine and TSF, used as Appendixes in two technical reports: *Feasibility Study: Springer and Bell Pits Mount Molley Mine*, August 30, 2002, Appendix A; and *Mount Polley Mine 2004*, August 1, 2004, Appendix D. Besides providing intelligence on the state of the TSF in September 2001, there is something very odd about this photo. The supernatant pond appears to be white, almost as though it is covered in ice, while Bootjack Lake is a dark blue color, without ice or snow. It leads to a logical question on whether or not the TSF portion of the air photo may have been doctored, photo-shopped, or manipulated.

3.2.3 Tailings Beach
MPMC is currently single point discharging tailings near the northwest corner of the TSF. ***Prolonged discharge from this location has resulted in the supernatant pond migrating towards the Main and South Embankments where there is a lack of beach development****. The beached tailings, when left to drain and consolidate, form the competent foundation required for the modified centerline construction embankment raises.*

Knight Piésold has previously recommended to MPMC [66] *the following regarding tailings beach development in the TSF:*

- *A beach width of at least 20 m is to be maintained along the abutments of the embankments (where the embankment contacts natural ground) and at least a 10 m width elsewhere to keep the pond away from the embankments.*
- ***MPMC should develop a plan and schedule*** *to enable the minimum target beach widths to be re-established within a 2 week period should they be infringed upon.*
- *MPMC shall increase the frequency of measurements for embankment instrumentation systems (piezometers and foundation drains - flow rate and turbidity) to at least once per week* ***during any periods that ponded water encroaches within the minimum target beach widths.***

It is recommended that MPMC adhere to the previous recommendations and develop a tailings management strategy that results in the MEMPR requirements for beach development along all of the embankments.

3.4.1 Tailings and Reclaim Pipelines
The tailings pipeline was in operation at the time of the inspection with tailings being single point discharged at the northwest corner of the embankment. There have been no reported problems with the tailings pipeline.

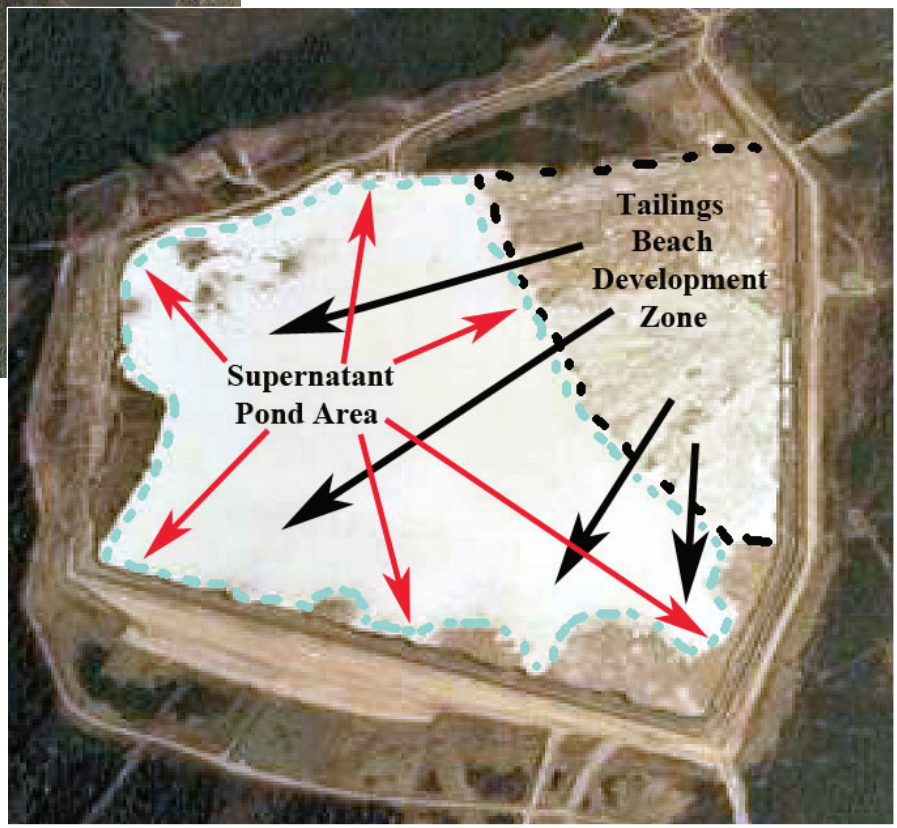
Develop a tailings deposition plan *to deposit tailings around the perimeter of the facility to facilitate the development of tailings beaches and manage the location of the tailings pond.*

Continue regular monitoring of the tailings pond elevation. [Bold emphases]

The 2010 TSF inspection report states that the Ministry of Mines had conducted a geotechnical investigation of the TSF in August of 2008, wherein the government had found a "deficiency," namely a "lack of tailings beach development." Nothing else is stated in the 2010 inspection report about the government's two-year-old investigation. Oddly, nothing was even referenced about the government's August 2008 investigation in Knight Piésold's 2008 TSF inspection report, nor stated in the bulk of the 2008 *Annual Environmental and Reclamation Report*. What is important to note is that MPMC was not being a good steward about the safety of its dam over a period of many years,

[66] Knight Piésold Memo – Geotechnical Inspection by MEMPR – Ref. VA08-01436. August 5, 2008.

Aerial Photo, October 2005, and cut-out close-up, as shown in Figure 1.1 of Knight Piésold's 2008 TSF inspection report. The concerns about supernatant pond location movement due to concentrated tailings deposition from single-point or uneven spigot discharging from the three Embankments go back to the "Care and Maintenance" years. In October 2005, the crest elevation of the dam was about 951 meters.



The cut-out (right) indicates the problems later stated by AMEC and Knight Piésold about supernatant ponding, here next to all three Embankments, with almost no beaching of tailings.

despite being told otherwise both verbally (on and off site) and in official reports by both the Ministry of Mines and by its Engineer of Record advisors.

Given the serious nature of improper supernatant pond location and shape in Mount Polley's Upstream Type TSF structure (described at length below by geotechnical engineer Steven Vick), a glaring weakness of the annual TSF inspection reports is an absence of supernatant pond location analysis over a given 12-month/annual TSF operating period. According to statements in the *Scope of Report* section of the annual TSF report, it may be that the B.C. Ministry of Mines' Guidelines for Annual Inspection Reports do not require such an analysis, but clearly ought to. Though Knight Piésold regularly presents graph data from piezometer readings recorded by MPMC staff over the regular 12-month mine operating period, it offers no similar analysis from aerial photos or client-based regular photo monitoring of the TSF's supernatant pond over the same period. Though there are randomly chosen day-of-inspection photographs included in the annual TSF report's appendixes, they are clearly insufficient.

For instance, the following satellite images, published by the BC Tap Water Alliance on September 1, 2014, *The Mount Polley "Tailings Storage Facility": Landsat 8 Satellite Imagery, 2009-2014.* They show the shifting locations of the 'pond' area over time, butting up against the Embankments.

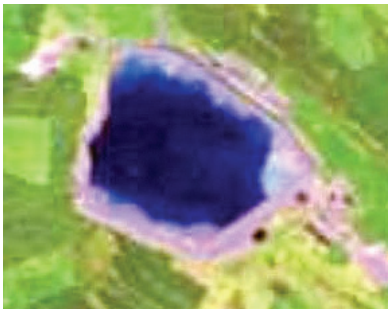
October 20, 1999

August 20, 2009

September 24, 2009

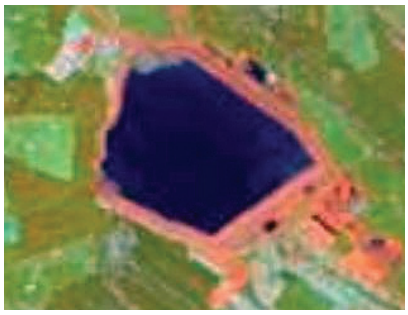
May 15, 2010

July 25, 2010



September 7, 2011

October 16, 2011

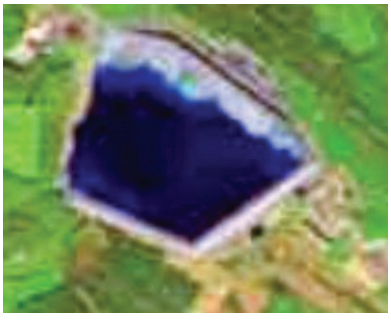


April 21, 2013

July 1, 2013

July 26, 2013

September 12, 2013



October 21, 2013

Sometimes, there may be one or two aerial photos found in the main body and appendixes of the annual *Environmental and Reclamation Reports* for Mount Polley (in which the annual TSF inspection reports appear as appendixes) that may show supernatant location. However, even when they are shown, no originating dates for the images are provided, a serious problem for researchers and investigators who require this information. Complicating this oversight, sometimes early aerial photos of the TSF are shown many years later in other company reports and presentations without similar identification.

Above: an undated aerial photo used in Figure 7.1, *Disturbed and Reclaimed Surfaces 2011*, in the 2011 *Annual Environmental and Reclamation Report*. Note the location of the supernatant pond adjoining half the mid-crest length of the Main Embankment. The configuration of the pond is roughly similar to the May 15, 2010 satellite image above.

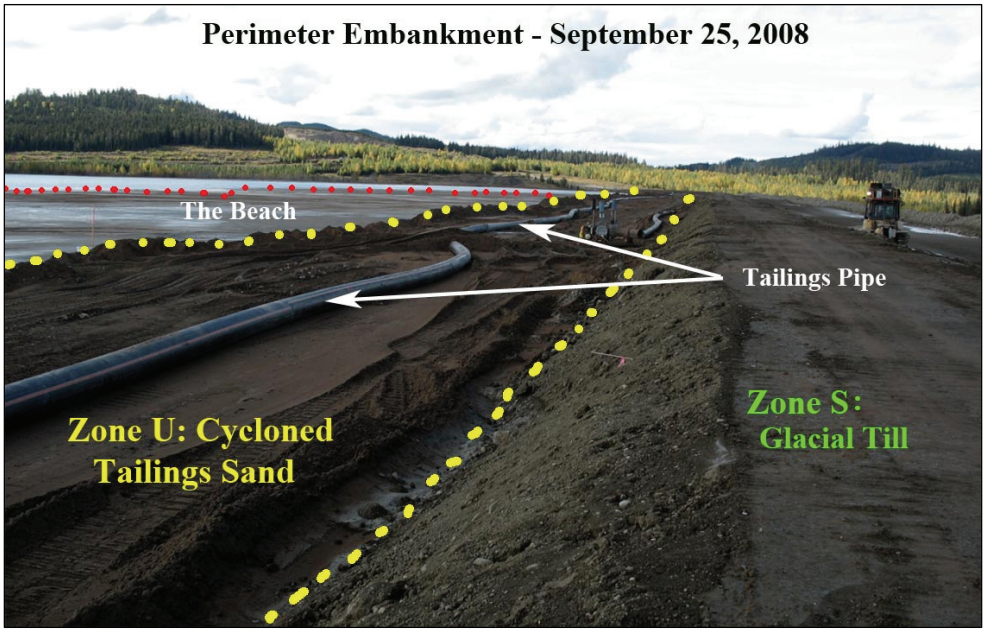
Steven G. Vick, one of the leading and celebrated authorities on mine tailing impoundments, who was recently appointed by the BC government as one of three prominent and professional panel members to assess and review Mount Polley's tailings disaster, has some dire warnings and sober thoughts when it comes to engineering a staged Upstream Type tailings impoundment and the delicate placement of tailings and mine effluent within such an impoundment by mine operators.

In his 1983 book, *Planning, Design, and Analysis of Tailings Dams* (revised in 1990), [67] Vick carefully lays out the sordid problems associated with tailings placement under various design and operating scenarios, wherein he contextually cautions against the very practices noted again and again by MPMC's geotechnical engineers regarding their Mount Polley client from 2006 onward.

[67] In 1994, when the U.S. Environmental Protection Agency published *Design and Evaluation of Tailings Dams*, the agency relied heavily on Vick's book, stating that it was "a major source" for sections of that report: "Vick (1990) may be the most recent and most comprehensive examination of topics covered by this report."

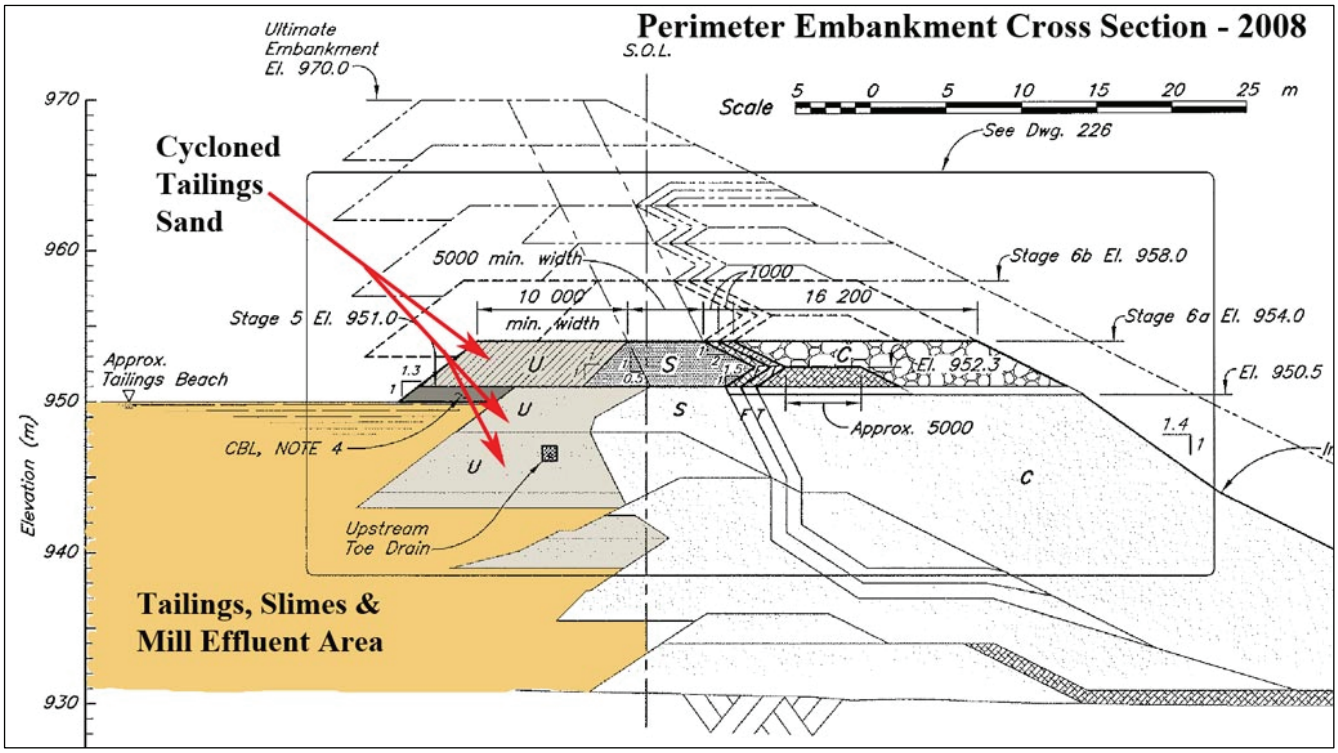
Raised embankments may assume many configurations, each with unique characteristics, requirements, ***advantages and pitfalls****.*

Central to the application of the ***upstream method*** *is that the tailings form a reasonably competent beach for support of the perimeter dikes. ...* ***The major advantages of the upstream method are cost and simplicity****. Only minimal volumes of mechanically placed fill are necessary for construction of perimeter dikes, and large embankment heights can be attained at very low cost. ... Beach sand tailings often provide a convenient source of fill for perimeter dikes, with excavation from the beach and placement by either dragline or bulldozer.*



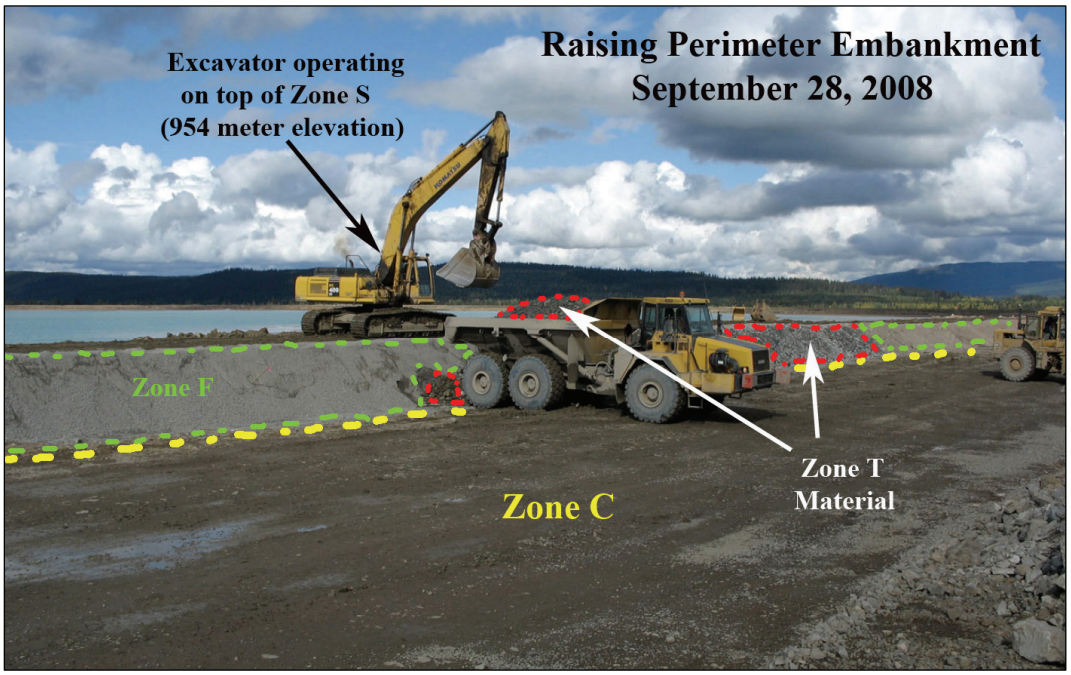
Right: Photo from 2008 TSF inspection report showing construction staging activities on the Perimeter Embankment just south of the August 4, 2014 failure site. The photo shows the Upstream Type design locations for materials, the zones "U" and "S" of which are shown in the drawing below.

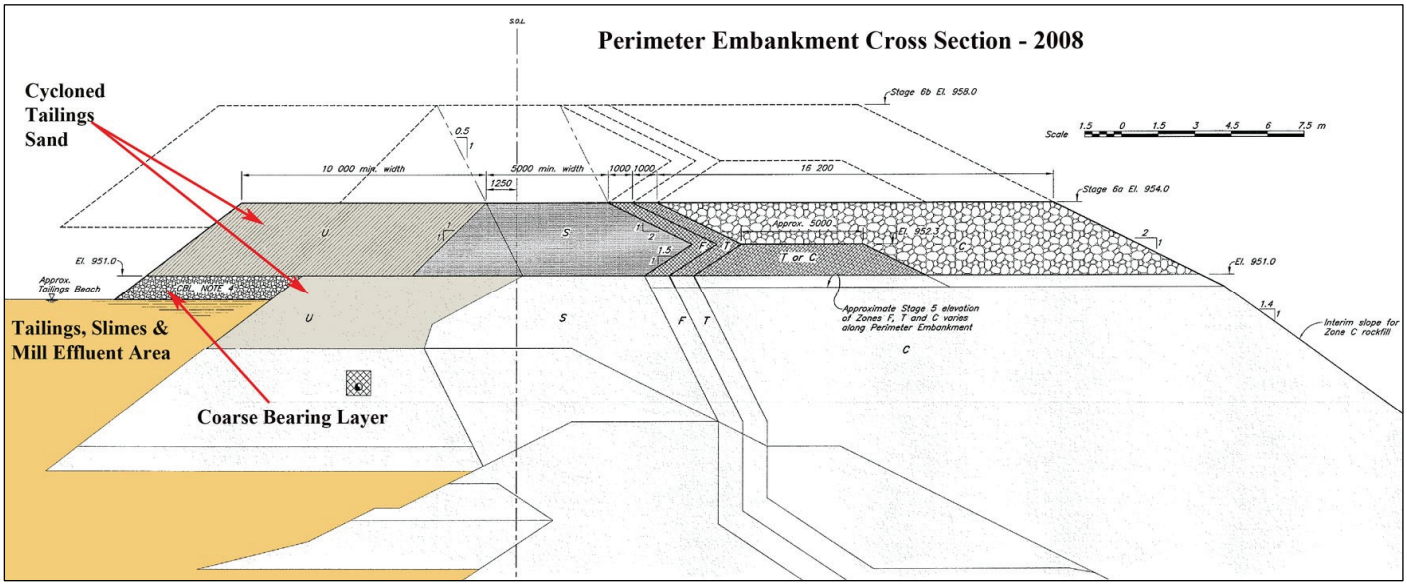
Below: drawing No. 225 from the 2008 TSF inspection report shows the Upstream Type design locations for zones "U" and "S" on the Supernatant Pond side, or upstream side, of the Perimeter Embankment.



Right: Photo from 2008 TSF inspection report showing construction staging activities on the Perimeter Embankment.

Below: drawing No. 225, Detail A/225, from the 2008 TSF inspection report shows the Upstream Type design locations for zones "U" and "S" on the Supernatant Pond side, or upstream side, of the Perimeter Embankment.





Use of the upstream raising method, however, is limited to very specific conditions and incorporates a number of inherent disadvantages. *Factors that constrain the application of the upstream method include* ***phreatic surface control***, ***water storage capacity***, *and* ***seismic liquefaction susceptibility***.

The location of the phreatic surface is a critical element in determining embankment stability. *For upstream embankments constructed by tailings spigotting, there are few structural measures for control of the phreatic surface within the embankment. ... Although cycloning can be used to promote segregation of sands and slimes within the deposit and such measures as underdrains can be used to have the effect of increasing foundation permeability,* ***pond water location is the only factor influencing the phreatic surface that can be controlled during operation***.

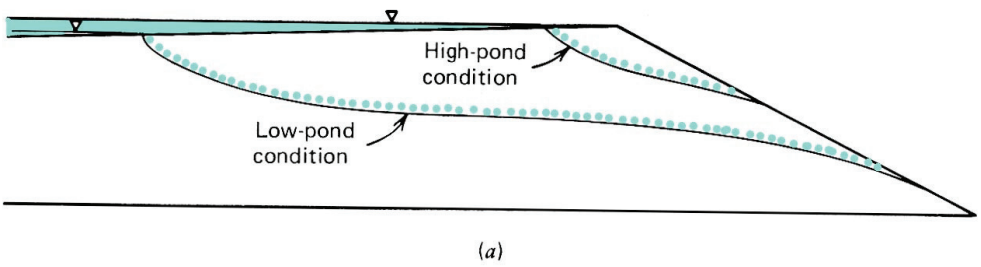


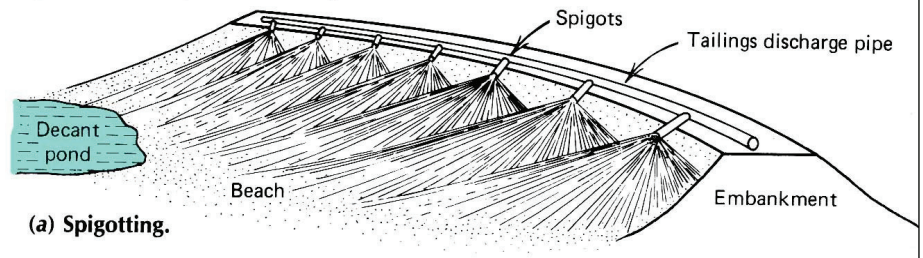
Figure 3.3 Factors influencing phreatic surface location for upstream embankments. (a) Effect of pond water location.

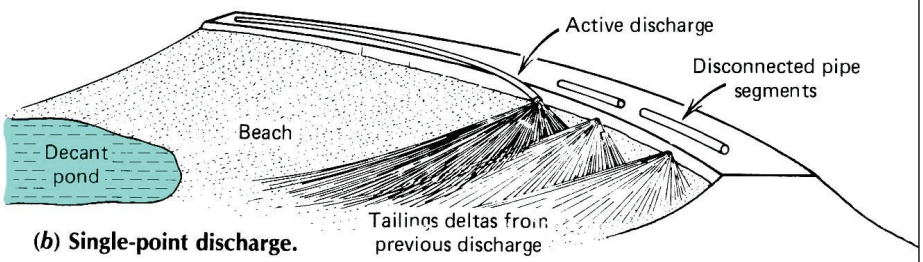
As shown in Figure 3.3a, ***pond water encroachment on the tailings beach produces very high phreatic conditions near the embankment face, which endanger stability. In extreme cases, overtopping and consequent embankment breaching result. Many if not most failures of upstream embankments can be attributed to inadequate separation distance between the decant pond and the embankment crest****. Ponded water can be pushed back from the embankment crest during operation* ***by proper tailings spigotting and decant procedures****. Increase in decanting rates lowers the pond elevation and increases pond-crest separation distance.*

"Tailings discharge procedures can have significant affect on pore pressure regime. Here the designer is completely at the mercy of the operator."

(Page 2, *Characterization of pore pressure conditions in upstream tailings dams*, by T.E. Martin)

Figure 1.6 Peripheral discharge methods.





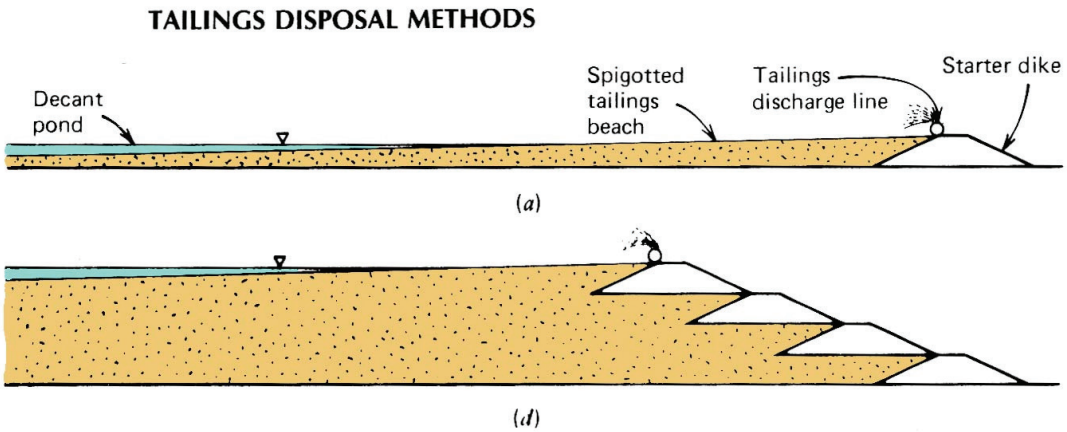


Figure 3.2 Sequential raising, upstream embankment.

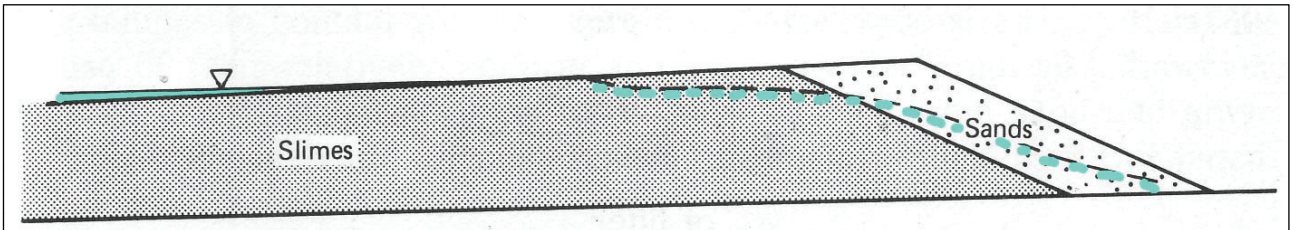
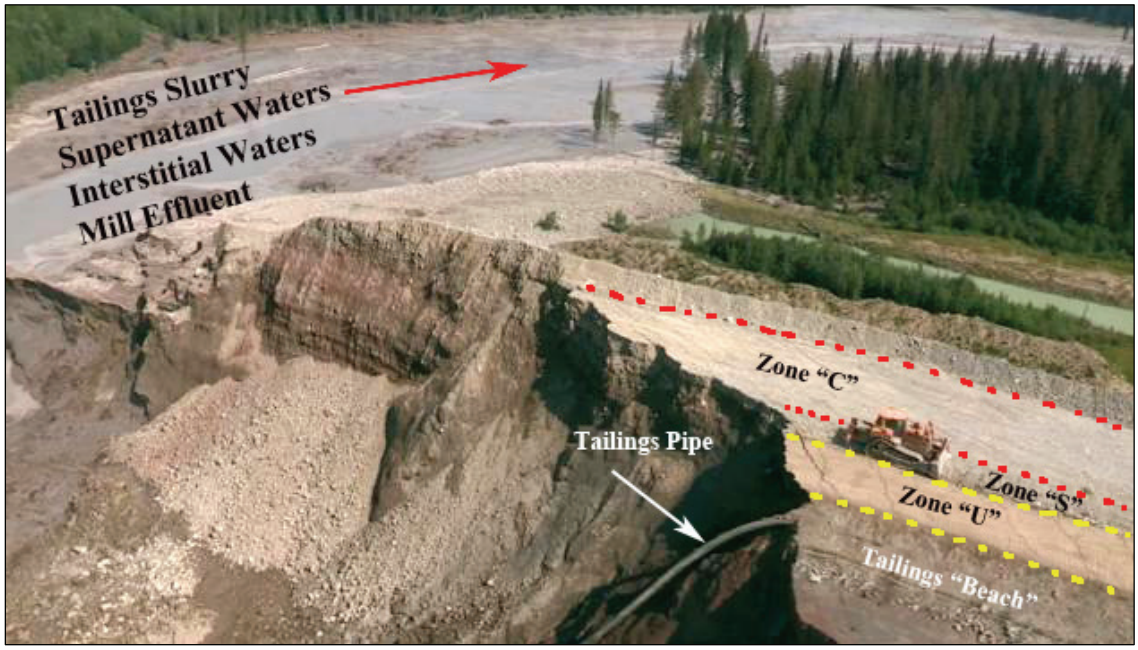


Figure 7.4 Use of tailings for internal drainage. (a) Upstream embankment.

While these water-control measures can be effective during normal operation, ***control of ponded water and its effects on the phreatic surface is difficult under the influence of appreciable flood or normal runoff inflows****. For example, assuming a typical 1% tailings beach slope, each one foot rise in the elevation of ponded water will produce 100 feet of pond water encroachment on the beach. For this reason, upstream embankments are poorly suited to conditions where water accumulation is anticipated due to flooding, long-term accumulation of seasonal runoff, or high rates of mill water accumulation.* ***In general, upstream embankments cannot be used for water retention.*** [Bold and underline emphasis] *Near-total diversion of runoff and flood inflow is essential for this raising method.*

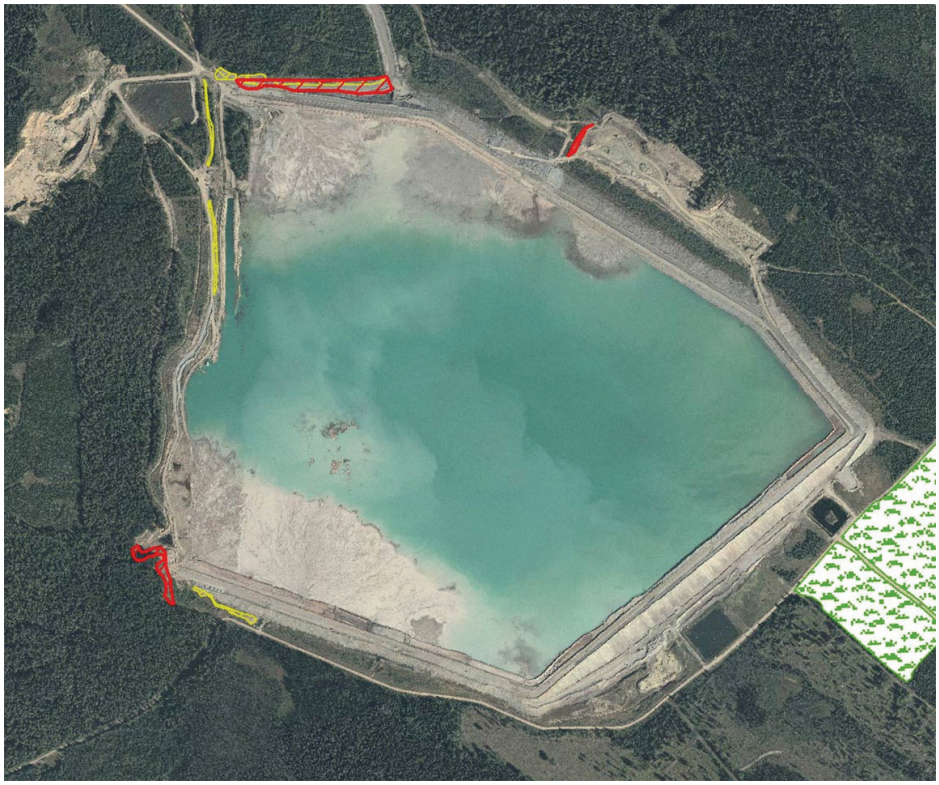


Upstream embankments, while providing the simplest and least costly raising method, are subject to a number of ***very critical constraints****. Proper use of the method can be justified only when those constraints are thoroughly investigated and satisfied.* [68] [Bold emphases throughout]

*Central to the success of using cycloned tailings zones to control the phreatic surface is that runoff under both normal and flood conditions be minimal. Storage of any significant quantity of water is precluded (****unless a core is present****), and* ***a wide beach is necessary at***

[68] Vick, 1983, pages 70-74.

***all times**. Should large water inflows cause the decant* [supernatant] *pond to come into direct contact with the pervious sand zone for any of the embankments shown in Figure 7.4, failure could quickly result.* [69]

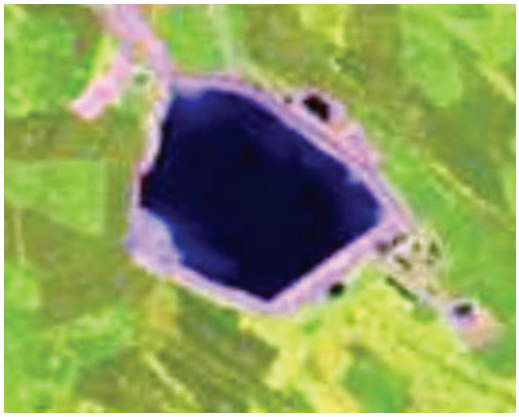


Right: Undated photo of TSF in the 2012 *Annual Environmental & Reclamation* Report.

Below: Undated photo of TSF in the 2013 *Annual Environmental & Reclamation* Report. Note how both undated photo locations of the supernatant waters are in close proximity to the three Embankments.

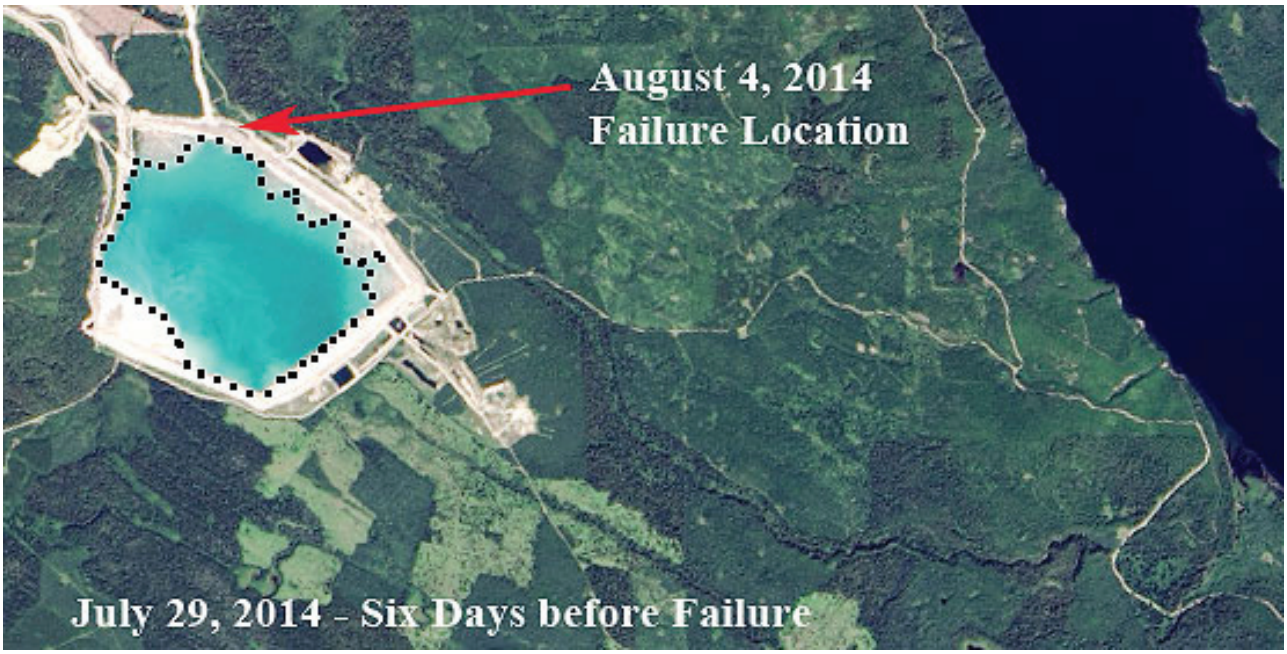
[69] Ibid., page 158.

May 10, 2014



July 13, 2014

When it came to the ongoing stewardship (Best Practices ???) of its Tailings Storage Facility, Mount Polley Mining Corporation seems to have transgressed a number of sacred engineering design laws and principles for the functional and environmental safety of its Upstream Type Embankment dam, more and more so as the years and months led up to the disastrous failure of August 4, 2014. As one of the main reasons as to why the Mount Polley raised Embankment dam failed, and the accounts by Gerald MacBurney that the supernatant waters had gone beyond freeboard and spilled over the crest of the dam's Embankments in 2014, it was only a matter of time for an impending failure, particularly on the poorly strengthened and susceptible corner of the Perimeter Embankment.



Lack of control of the hydrological regime is one of the most common causes of failure. Of the cases reported here, the majority of failures were due to overtopping, slope instability, seepage and erosion; all caused by a lack of control of the water balance within the impoundments. [70]

[70] ICOLD, 2001, quote, cited on page 31 in *Long Term Risks of Tailings Dam Failure*, 2011, by David Chambers.

A Bold-Faced Lie

From findings catalogued in Chapter 7 of this report, *A Bizarre Promise*, there were two statements made in MPMC's July 2009 Appendix F *Response Document* presented to the public that were tantamount to a bold-faced lie.

> *By the end of the mine life Mount Polley will have invested nearly $50,000,000 in dam construction* ***providing a safe secure impoundment of tailings*** *stored at the site.* (Page 7)

> *Raising the dam is only a viable option for the short term, as the water balance is such that there will be an on-going accumulation of water in the impoundment. However, the impoundment has a finite capability to store excess water in the pond on top of the tailings solids. An increasing volume of water in the impoundment reduces the capacity for storage of tailings solids and creates additional complexities in the design and operating requirements of the tailings facility. Specifically, as water levels increase within a tailings dam, the ability to maintain tailings beaches decrease. Without tailings beaches, seepage rates through the dam increase significantly. This creates two problems: 1) the substantially greater quantity of seepage water; and 2) an increased risk of dam failure.* ***Mount Polley is dedicated to the proper management of our tailings storage facility including the maintenance of tailings beaches****.* (Page 10) [Bold emphases]

From concerns and accounts documented in at least four reports for TSF operational time periods up until end 2010 - AMEC's Dam Safety Report of 2006, and three Knight Piesold annual TSF inspection reports of 2008, 2009, and 2010 - they document how MPMC's stewardship over the structural integrity and safety of its TSF was careless and un-dedicated.

As MPMC consciously admits on page one of its October 2007 *Response Document*:

> *During the care and maintenance stage, and subsequently as the mine footprint expanded, a significant quantity of surface water accumulated in the tailings storage facility. This accumulation of water is problematic for Mount Polley for two reasons: 1) the accumulation requires dam raises; and 2)* ***the accumulation prohibits the formation of proper tailings beaches thereby increasing seepage and causing conditions that are geotechnically undesirable****.* [Bold emphasis]

Photo, October 2014. The remains of the 35-40 meter high Perimeter Embankment, on the south side of the breach. Note the layers exposed, showing the Upstream Method stage-phased construction materials facing to the inside of the dysfunctional TSF.

10. Stewardship 'Tension': Changing of the Engineering Guard

> *Crews were working to raise the tailings dam at the Mount Polley mine by up to four metres before the structure failed and sent a torrent of waste and debris into surrounding waterways.... "While AMEC serves as the engineer of record on the most recent raising of the dam, implementation of the AMEC design has not been completed and some construction activity was still taking place to complete our design," she* [Lauren Gallagher] *added. In a telephone interview on Thursday, Imperial Metals vice-president Steve Robertson said the construction, begun in May, was part of an annual routine. "We usually do a three- or four-metre raise on the impoundment just to increase the capacity for tailings," Mr. Robertson said.* [71]
>
> *Tailings management often represents the most significant environmental challenge associated with mining projects. A spate of recent and well-publicized incidents involving tailings impoundments has placed the mining industry in general, and those responsible for tailings impoundment design and safety in particular, under intense scrutiny.... Significant advances have been made on many fronts to develop and implement the principles underlying effective and responsible stewardship of tailings facilities.* ***Learning the lessons readily available from the failure database has largely facilitated development and implementation of these principles.*** [Bold emphasis] *International organizations, mining industry associations, and individual mining companies themselves, have been very proactive in recent years in advancing the state of practice for stewardship of tailings facilities. In particular, the environmental, financial, and political consequences of well-publicized failures have made it clear to the mining industry that its own best interest demands safe tailings management practices....* ***given that tailings dams must last in perpetuity, the tailings dam designer must recognize that they are designing for a period for which there is no design precedent.*** [72] [bold emphasis]

Over a relatively short period of time, BC provincial and Canadian national newspaper, radio and television reporters were digging in like jackrabbits to root out the big story behind the August 4th, 3-4 a.m. failure at the Mount Polley tailings dam that deposited a toxic cocktail of heavy metals tailings slurry and mine effluents into the famed fresh waters of Quesnel Lake. What catapulted a host of investigators forward were the graphic, horrible scenes of the destructive tailings that were still, unbelievably, oozing out of the storage facility as a dense dark-grey soluble mobile-wavy muck-mass filmed by the RCMP in a helicopter some five or more hours after the initiating breach of what would become the world's largest documented (by volume) tailings disaster.

The helicopter video recording was handed over to the Cariboo Regional District, which promptly published the flight's 37 minute-long findings on YouTube. As Glenda Ferris, one of BC's top mining critics, would later comment on CFAX radio and in the Georgia Straight newspaper:

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[71] In, *Mount Polley operator was raising height of tailings dam at time of breach*, The Globe and Mail, August 15, 2014.

[72] From the Abstract and page 11 in, *Stewardship of Tailings Facilities*, by T.E. Martin, M.P Davies, S.Rice, T. Higgs and P.C. Lighthall, AMEC Earth & Environmental Limited, Burnaby, and AMEC Simons Ltd., Vancouver, April 2002.

"It was really wonderful the regional district took those pictures - those aerial photos from a helicopter - and then released them to the media," Glenda Ferris told the Straight by phone from her home in the Houston area. "If that had been a ministry person, we never would have seen those photos." [73]

August 4, 2014 image of the Mount Polley Tailings Storage Facility from the helicopter flight showing the breach at the northern end of the Perimeter embankment. The height of the embankment, at the far left of the image, from the road to dam crest, is almost 40 meters. Note the sinkhole/depression at the outer edge of the breach area and remaining slump of embankment material located just above the sinkhole area. After initial burst flows of water and tailings began to subside from the tailings mass to the far right of the image, cascading, draining flows then began to unravel from the center area of the image. According to company records, the total area of the Tailings Facility is about 235 hectares.

The first interesting news out of the gate came by way of a CBC Television interview on August 5th with Brian Olding, the consultant hired by both Williams Lake area First Nations and the Mount Polley Mining Corporation (MPMC) in 2010. Olding's task was to sort out and boil down the technical workings of a complicated and lengthy 2009 report proposal submission by MPMC [74] regarding an amendment to Ministry of Environment effluent permit PE-11678. MPMC was seeking to discharge increasingly large volumes of diluted toxic mining waste waters into Hazeltine Creek and ultimately Quesnel Lake.

"More water was coming in over the year than they could deal with," Olding said. "They just kept building the walls up higher and higher every year and got to the point where it was untenable." No analysis of the dam's structural integrity was done as part of the

[73] *Environmentalist credits regional district for filming tailings flow from Mount Polley mine*, by Charlie Smith, Georgia Straight, August 7, 2014.

[74] *Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent*, July 2009. The report was only recently published on the internet, without, however, the all-important Appendixes. Brian Olding and Associates, in association with LGL Limited, published a 43-page response report in 2011, *Independent Review of the Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent (2009)*.

review, he said. "I requested a structural engineering company be involved, and that was nixed. They did not want to deal with that problem at that time." [75]

On the heels of Olding's statement came the astounding August 6th testimony of Gerald MacBurney on CBC Television news, *"Forman warned of tailings pond disaster."* MacBurney, the former foreman of the Mount Polley Tailings Storage Facility (TSF), had continually warned the mine's management about a looming, imminent disaster for at least two years running. [76] In that first CBC interview with MacBurney, he stated that the company added five times the supernatant water volume the TSF was designed to hold without having strengthened the impoundment's three outer walls. MacBurney also stated that the BC government had issued repeated warnings to the mining company about the increased and very high water levels, and that in May 2014 the supernatant water had actually gone past "free board," spilling over top of the impoundment's crest. As explained in Chapter 9, *Blooper-Natant*, spillage overtop of the Embankment crests is a very nasty engineering no-no or taboo, especially for Mount Polley's earth-filled and primarily 'Upstream Type' impoundment structure. MacBurney also stated that MPMC/Imperial Metals Corp. ignored the advice of AMEC, its second Engineer of Record:

For two years they were told to build the dam wider. AMEC is the company that engineered the dam. They were told to build that dam wider. They just kept smoke and mirrors on AMEC and got away with not doing it, and this is the disaster that happened from it.

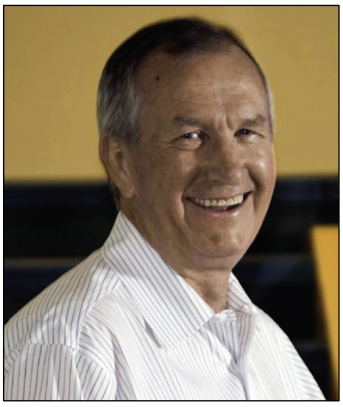
August 4, 2014 image from the helicopter flight.

[75] *Polley Mine tailings pond was growing at unsustainable rate, says environmental consultant*, The Canadian Press, August 6, 2014.

[76] The Vancouver Sun reported on August 12, 2014, *Company, province warned about size of tailings dam*, that *"Likely resident Gerald MacBurney worked at Mount Polley for seven years, the last two he says as foreman directing work on the tailings dam."*

On August 12th, the Vancouver Sun newspaper ran a follow-up story with more details, where MacBurney stated how:

> *AMEC instructed the company to bring in five million tonnes of rock to shore up the outside of the dam in order to handle the increased amount of water in the tailings pond. He said the company never carried through, perhaps only bringing in one million tonnes of rock. That's because they didn't want to take their large equipment - big haul trucks that can carry as much as 120 to 200 tonnes - away from delivering ore to the mill.* [77]



Former Knight Piésold president, Jeremy Haile. Photo source: Summer 2012 edition of CFReview.

Current Knight Piésold president, Ken Brouwer. Photo source: Knight Piésold website.

Just four days after the tragic incident that wiped out and inundated the Hazeltine Creek channel and nearby forests with thick deposits of tailings slurry, mill effluent, human waste, and other unidentified materials and chemicals, on Friday August 8th MPMC's former geotechnical consultant (1989 - February 2011) came out of the proverbial closet and made an intriguing news announcement through the CNW Group, a PR newswire company. As investigators were hunting down the real story about the failed integrity of the tailings dam, Knight Piésold, which had most likely received key advice from its legal counsel, made a bold chess move by releasing a digital pdf copy of a February 10, 2011 letter signed by Knight Piésold's Managing Director Ken Brouwer and President Jeremy Haile, addressed to MPMC boss Brian Kynoch:

> *We have completed all assignments and on January 25, 2011 issued to Mount Polley Mining Corporation (MPMC) the final versions of the 'Tailings Storage Facility - Report on the 2010 Annual Inspection and Tailings Storage Facility - Report on Stage 6B Construction'.*
>
> *We are currently assuming that MPMC will be retaining the services of a separate individual or organization to take over as the Engineer of Record for the tailings storage facility, as a result of Knight Piésold's decision to opt out of the bidding process implemented by MPMC late last year. We would like to facilitate a formal handover to the new individual/group, as it is essential that it be recognized that Knight Piésold will not have any responsibility for any aspects of the on-going operations, or of any modifications to the facilities that are undertaken from now onwards. To date, the tailings impoundment has been developed using the observational approach, wherein the design is modified as appropriate depending on actual performance and conditions. It must be understood that Knight Piésold will no longer have any responsibility for the performance of the tailings storage facility.*
>
> ***The embankments and the overall tailings impoundment are getting large and it is extremely important that they be monitored, constructed and operated properly to prevent problems in the future.*** [Bold emphasis] *Knight Piésold would be happy to assist in the formal handover to the new Engineer of Record.*

[77] Ibid.

As we have a long relationship with the Mines Branch and the Ministry of Energy, Mines and Petroleum Resources, we consider that it is prudent to notify them of the change in status. Therefore, we have copied them on this correspondence.

By week's end the testimonies of the three sources had formed linked, corroborating statements about what was beginning to smell like bona-fide corporate incompetence extraordinaire, an environmental crime, that would be identified as one of the largest documented tailings breach disaster by volume, so far, in world history. And, as the rubber was beginning to hit the road, investigators began to uncover the possibilities of linked provincial ministerial mismanagement and failed professional oversight regarding "care of duty" responsibilities.

Knight Piésold let the world know that its international reputation was not going to be tarnished by the new solemn entry brazened on its former Mount Polley 'Engineer of Record' portfolio, a portfolio which had been transferred in March 2011 into the professional stewardship hands of AMEC, a London-based multinational company, with dozens of international satellite offices. [78]

While providing evidence to the world's inquisitors that ultimate or integrated originating blame about the environmental disaster was not to be cast in its direction, Knight Piésold's correspondence is interesting in that it states that the BC's Mines Branch had been formally notified at that time about the professional consultants' concerns regarding the future state of the Mount Polley TSF.

The insider inference within Knight Piésold's tactfully polite letter of February 10, 2011 is that MPMC's TSF was entering a critical and dangerous phase. That phase was linked to management's bottom-line mindset about mining newly discovered ore bodies on the leased Mount Polley property limits, and the consequences of doing so would not only require an increased Tailings Facility lifespan and rate of tailings slurry within a structure with limited and end-of-life design features, a structure that was beginning to show signs of stress, [79] but was intertwined with looming water balance crises and thorny issues concerning a controversial mining effluent permit proposal into receiving fish-bearing fresh creek and lake waters. And, within a June 7, 2013 amendment to Ministry of Environment mine effluent permit PE-11678, it now stated that the Mount Polley Mining Corporation had the authority to build its Tailings Storage Facility to the ultimate crest height of 1,000 meters in elevation, **35 meters** above Knight Piésold's 2005 design amendment of the ultimate crest height of 965 meters, double the height of the Perimeter Embankment's as-built design in 2014.

1.1.6 The maximum elevation of the tailings impoundment supernatant is 1000 meters above sea level.

Due to the BC government's tight restrictions announced by the Chief Mines Inspector in early October 2014 on the release of published documents, reports and correspondence related to Mount Polley, very little is presently known about AMEC's three-and-a-half year Engineer of Record stewardship activities from early 2011 to August 3, 2014. In fact, AMEC's three successive annual TSF inspection reports for the Mount Polley Mining Corporation, 2011-2013, were never included in the Mount Polley Annual Environmental and Reclamation reports that were to be provided for

[78] Professionally, AMEC and Knight Piesold were twin engineering contractors with Imperial Metals Corporation report studies for its Red Chris mine in northwest BC.
[79] As found in Knight Piesold's final TSF inspection report of 2010.

public review and record, even though the inspection reports are referenced in the documents. Those peculiar omissions created an atmosphere of great intrigue and suspicion during the latter half of September 2014 following, when a few investigators were looking for better information and clues about the world's largest tailings disaster.

Appendix M: 2011 Annual Tailings Storage Facility Inspection (digital only) (*to be distributed in May 2012)*

Appendix L: Annual Tailings Storage Facility Inspection (AMEC, 2013)

10.1.2. ***Tailings Storage Facility and Associated Works***

The TSF and associated works were inspected in 2013 by AMEC. The completed "2013 As-Built and Annual Review Report" will be provided to MEM under separate cover from this report.

Above: Cut-outs from the 2011, 2012, and 2013 Annual Environmental and Reclamation reports, indicating references to the missing annual TSF inspection reports.

In addition to those strange and mysterious omissions, the BC government has also refused to release AMEC's formal *Dam Safety Review* (*DSR*) report of October 2006 for Mount Polley's TSF. And, of even greater curiosity and importance, there has been no admission or confirmation by the government about AMEC's second DSR report that had ultimately been re-scheduled for 2013 by BC's Chief Inspector of Mines in 2005.

According to Knight Piésold's 2008 annual TSF report, a second DSR was scheduled for 2011:

> *A Dam Safety Review (DSR) for the Tailings Storage Facility was completed in October 2006. The results of the DSR were issued in a report to Imperial Metals Corporation in December 2006. The DSR review concluded that the Mount Polley TSF is adhering to an excellent dam safety program and confirmed that the TSF is performing as designed and meets or exceeds the guidelines set forth by the appropriate guidelines for dam safety. The DSR also provided recommendations concerning the hazard classification, design storm, pond and beach management, instrumentation, and the foundation stability at the Main Embankment. The Dam Safety Review recommendations and the Knight Piésold comments are included in Appendix C.*
>
> *A Dam Safety Review (DSR) was performed in 2006. The next Dam Safety Review should be carried out by 2011, or during detailed closure design, whichever is earlier.*

On May 25, 2005, former Chief Inspector of Mines F.W. Hermann stated in Mount Polley Mines Permit M-200 that

> *a formal dam safety review shall be completed in 2006 and at an interval of 7 years based on the high consequence classification.*

Chief Inspector Hermann's schedule for a second DSR for 2013 was two years off the mark than Knight Piésold's recommendation for one in 2011.

In a telephone conversation on the afternoon of October 2, 2014 with the subsequent Chief Inspector of Mines, Al Hoffman, I specifically asked for official confirmation on whether / if a second DSR had been conducted for Mount Polley's TSF. Hoffman replied that he was not aware of such an audit report. In an email sent the following day to Hoffman, asking for clarification on this matter - "was there a 2011, or thereafter, DSR conducted for the Mount Polley TSF?" - the following reply was sent by email:

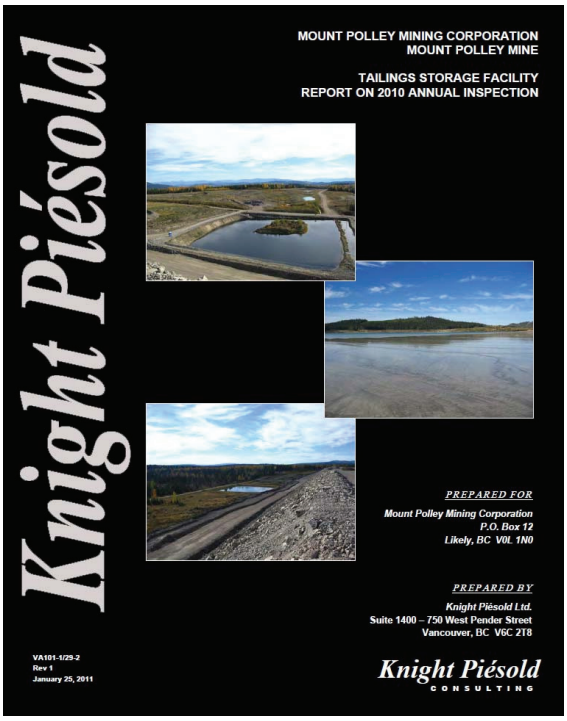
Al Hoffman

> *The determination of whether or not a DSR was conducted at Mount Polley in 2011 forms part of our investigation. I cannot release that information at the present time.*

Knight Piésold's Last Hurrah: Polley-tics and the 2010 TSF Inspection Report

In the real world, tensions may exist, develop and fester between a given engineering contractor and a mining project client/operator, particularly when an undercurrent of big money and investment capital is involved in a volatile market where metal prices can fluctuate overnight. Big problems occur when a 'bottom-line' attitude or philosophy dominates and takes precedent over and interferes with performance of engineering excellence standards. As explained in previous chapters of this report, documents tabulate how critical stewardship requirements by MPMC were repeatedly ignored over a period of years for the operational maintenance of its TSF impoundment.

With Knight Piésold's underlying expectation of the tailings impoundment to last an eternity, the ongoing, paradoxical state of client carelessness may have created a complex, uneasy tension with its engineers, expanding like hot air blown into a party balloon, ready to burst.



In a way, as reported by Knight Piésold in its 2010 TSF inspection report, this was a different and more ominous sort of "tension crack" developing than the physical one discovered by an employee on the crest of the Perimeter Embankment in June 2010.

The tone and parade of concerns catalogued in Knight Piésold's final TSF Inspection report of 2010 were remarkably dissimilar to those recorded in its two previous annual reports for 2008 and 2009. [80] Those intonations and concerns may, in part, account for why Knight Piésold eventually abandoned ("opted out") its long-held role as MPMC's Engineer of Record in February 2011. And, if the engineering consulting

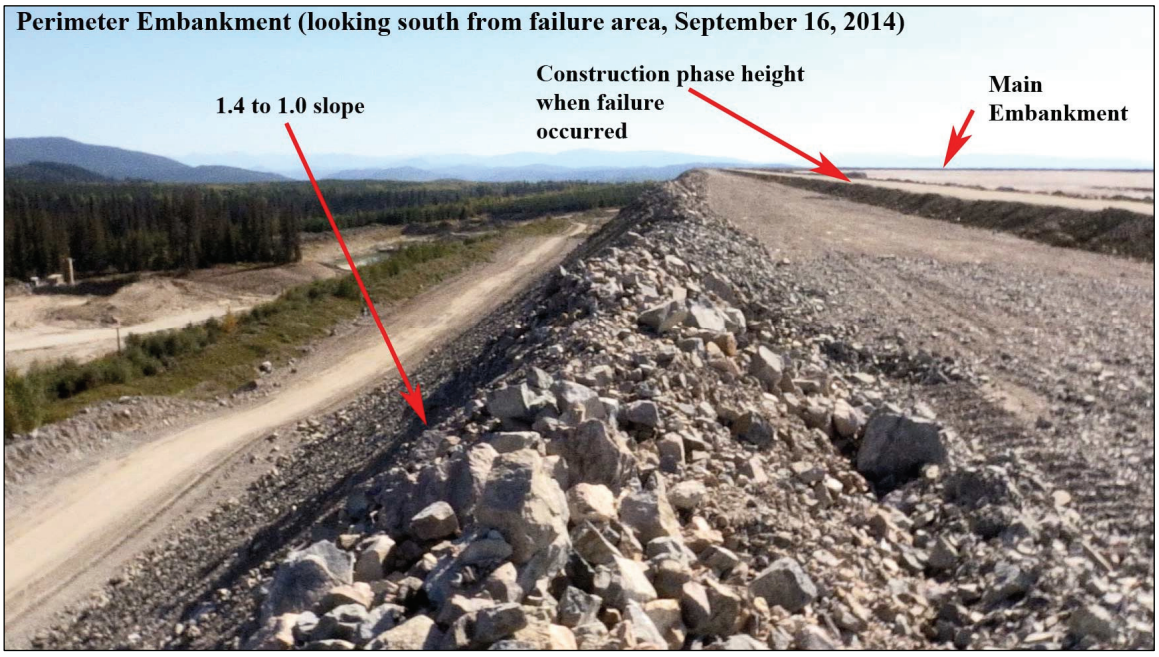
[80] Previous Knight Piesold annual Mount Polley TSF inspection reports of 2001, 2002, 2004, 2005 and 2007 are still unavailable for review.

group had been given access to a magic crystal ball on the catastrophic events that would transpire some three and a half years later, perhaps the wording of that 2010 report would have contained some more enhanced and spicy comments.

As stated in the *Executive Summary* and *Summary and Recommendations* sections, and within the main text sections of the 2010 annual report, were the following findings and concerns:

1. The discovery of a "tension crack" on the crest of the southern leg of the Perimeter Embankment by an equipment operator in August 2010 was not immediately, nor subsequently, reported to Knight Piésold by MPMC management, but should have been. Such an occurrence could indicate a "plane of weakness in fill materials." The consultants recommended that MPMC complete a "stability assessment for this area."

2. Knight Piésold reminded MPMC that the downstream slopes of the TSF's embankments were far too steep ("over-steepened slope"), angled at a degree slope of 1.4 (horizontal) to 1.0 (vertical). It was stated that this steep angle **had not been designed to be the final slope angle** of the TSF's embankments, but were merely "interim slopes" and "short-term slope configurations." Knight Piésold's recommendation was for MPMC to "evaluate" only the "downstream slope of the Main Embankment," but **nothing was stated by Knight Piésold** that MPMC evaluate the Perimeter Embankment's slope for "flattening."



3. Because of slight deviations in the Main Embankment monitored by an inclinometer a few years previous, it resulted in a "stability assessment" recommendation to construct a buttress "downstream of the Main Embankment." MPMC, however, failed to implement Knight Piésold's recommendation to do so before MPMC's construction schedule to raise the TSF crest from elevation 954 meters to elevation 958 meters, "which did not happen."

4. Knight Piésold noted that MPMC was "single point discharging tailings near the northwest corner of the TSF" during the inspection day of October 7, 2010. As described in the Blooper-Natant chapter of this report, the single-point discharging was "migrating" the

supernatant pond "towards the Main and South Embankments where there is a lack of beach development." Knight Piésold kindly reminded MPMC that because the supernatant pond was next to the crests of the two Embankments, that dangerous proximity would interfere with the strategic role of the impoundment's "modified centreline construction," namely its function as "competent foundation." Knight Piésold stated that where those abutments of the TSF's Embankments came in "contact [with] natural ground," MPMC had to maintain a "minimum" of 20 meters beach width. And, should the supernatant pond come into proximity with or outer edge of that minimum 20 meter beach zone, MPMC had to commit due diligence in conducting weekly monitoring of "piezometers and foundation drains." After similar recommendations contained in the annual reports of 2008 and 2009, Knight Piésold stated that MPMC was still without a "tailings management strategy."

Photo from August 4, 2014 helicopter flight, showing a close-up of one of the many tailings spigots, this one located on the South Embankment.

5. Knight Piésold stated that MPMC was not in compliance with the TSF's *Operation, Maintenance and Surveillance (OMS) Manual* (described as a "live document"), with respect to inspecting "upstream toe drains and foundation drains." Such "weekly" inspections, which MPMC reportedly "measured only once since June 2009," include "a visual check on flow clarity, and an estimate of the drain flows."

6. Knight Piésold stated that MPMC was, yet again, not in compliance with the TSF's *Operation, Maintenance and Surveillance (OMS) Manual*, failing to make minimum monthly readings of the TSF's piezometers, "and weekly [readings] during periods of construction." **MPMC made no such readings in the entire 2010 operating year**, including the construction period of 2010 when the TSF crest was raised from elevation 954 to 958 meters. The Engineer of Record kindly reminded MPMC that the piezometer readings "provide valuable input to the design and operation of the TSF." And, Knight Piésold reminded MPMC that out of the total 92 installed piezometers, which provide four separate monitoring functions, "approximately 60% are still functioning."

7. Knight Piésold reported that the Mount Polley mill site water balance (described as a "complex model"), which is managed by MPMC, was "not reviewed by the TSF design engineer in 2010." Though no data was provided in the TSF annual inspection report, Knight Piésold stated that MPMC "reported" that Mount Polley site was "currently operating with a water surplus, as total inflows from precipitation and surface runoff exceed losses from evaporation, void retention in the tailings mass in the TSF, and seepage loss." Knight Piésold inferred that MPMC was not "employing good practice" by withholding a review "of the water balance model." Knight Piésold kindly reminded MPMC, "the site water balance is an important component of the operation of the mine as it not only provides key inputs to planning, design and operation of the TSF, it also tracks site water to ensure the mine is in compliance with water storage and discharge permits."

Left: Photo and caption excerpt from PricewaterhouseCoopers LLP annual BC Mining Survey publication, *Seize the Day: The Mining Industry in British Columbia 2010.*

Imperial Metals Corp. chairman Pierre Lebel measures the success of agreements his company signs with local First Nations by the amount of dust they collect.
"The best agreement is the agreement that you negotiate, sign and put in a drawer and never look at again because you've created a partnership, you've created an environment of shared values," Mr. Lebel says. "True partnerships are like that. Really good partners; they probably misplace the contract and couldn't find it if they tried."
Each agreement is unique and includes provisions for First Nations education and training, employment and contracting opportunities, as well as communication around environmental responsibility.
"Communities are much more concerned about environment protection, monitoring, jobs, how contracts are met and, of course, benefit sharing is important as well," Mr. Lebel says.
"There are various ways we can add value to the community," Mr. Lebel says.
The benefits mining operations bring to communities can often serve as a model for other companies, and industries, Mr. Lebel says.
"We are all engaged in this process together and we all have to understand the impact on each and every one of us," Mr. Lebel says.
"It's not just the community that's impacted by a project, it's the entire province. We take these benefits for granted at the peril of not having them in the future."
Mr. Lebel is reminded of his industry's duty to provide community benefits by a comment a now-retired mill manager once made to him.
"He said, 'Pierre, if we don't come to work to get better, why the hell do we come to work anyway?"
I've never forgotten about that," says Mr. Lebel. "I think about him once a week."

(*Source:* Common Ground, by Brenda Bouw, in Up Front magazine, April 30, 2013)

For mining and processing operations tailings typically represent the most significant environmental liability, which obligates a polluting party to pay for any and all damage it causes to the environment. The environmental liability that mining companies and their insurers may be exposed to is highlighted by the 1998 Aznalcollar-Los Frailes spill and an excellent summary is provided by WISE (2013) using Spanish media reports. The spill occurred on 25 April 1998, and in August 2002 it was estimated that the Andalusian Government and the Spanish Environmental Ministry had spent 276 million Euros on the cleanup. To date they have received no compensation from Boliden and are still trying to obtain at least 134 million Euros from this mining company. In the meantime, Boliden has tried to claim damages of the order of 115 million Euros from the constructors (and their insurers) of the failed dam and an additional 134 million Euros to cover environmental damages. Since December 2011 the Spanish Supreme Court has declared that the construction companies are not guilty of wrongdoing and that Boliden is responsible for the spill, although it is yet to pay anything. For comparison, the Baia Mare cleanup cost around 190 million Euros and compensation was paid to the inhabitants of Baia Mare, but nobody else (Banerjee, 2014).

Evidently owners, operators and constructors of tailings dams may be exposed to huge environmental liability and associated economic losses and, therefore, risk may be transferred via insurance (Willis, 2012). In addition, tailings dam failures may lead to further losses arising from business and supply chain interruption, particularly when large third party material damage or casualties occur and authorities close down an operation (e.g., Mahrla, 2011). The impact of business interruption for Boliden's Los Frailes mine was huge. After the spill in April 1998 mining ceased for a year and subsequently mining and milling operations shut down completely in September 2001, with the dismissal of all 425 employees. Moreover, estimates are as high as 5,000 for other jobs lost in connection with agriculture, fishing, tourism and nature conservation in the region affected (Koziell and Omosa, 2003).

(*Mine Tailings Dams: Characteristics, Failure, Environmental Impacts, and Remediation*. D. Kossoff, et. al., in Applied Geochemistry 51 (2014). pages 229-245)

11. Post Mortem: Dark Clouds on the Horizon

Hon. Barry Penner
Minister of Environment
Government of British Columbia

Dear Mr. Penner
Re: Mount Polley Mining Corporation - Application to Amend Effluent Permit
I am writing to register my opposition to this proposed permit amendment. I am a long-time property owner on Quesnel Lake and find it incredible that anyone would propose turning Hazeltine Creek into an industrial sewer and Quesnel Lake into a cesspool.
Hazeltine Creek is a very small stream. During the summer its flow is something like 20 gallons per minute. The MPM Corp. are asking for permission to increase the flow by approximately 5,000 gpm. So the content of the Creek would be virtually straight mine effluent, to the peril of all those creatures that live in it and drink it.
Hazeltine Creek discharges into Quesnel Lake, a large, pristine body of water. It is the source of drinking water for most of the local residents and contaminating it with mine effluent is unthinkable. In addition, the Lake is a huge salmon-rearing area. The B.C. salmon fishery is already in trouble and must not be further imperilled by dumping mine effluent into the Lake.
I urge you to reject this permit application. MPM Corp. got themselves into this situation and it is up to them to get out of it without contaminating Hazeltine Creek and Quesnel Lake. [81]

"The current mine life for Mount Polley is to the end of 2025, not including the processing of low-grade stockpiles." [82]

The discharge restrictions create challenges because the volume of free mine water that has accumulated on site is stressing the available storage capacity within the tailings management facility (TMF). ***Expanding the TMF is challenging due to geotechnical considerations****.* [83] [Bold emphasis]

Extended Mine Life Projections: More Tailings, More Storage, More Problems

New exploration discoveries on its Mount Polley mining lease in 2006 drove Imperial Metals to announce its plans to extend the operating life of the mine site three and a half years past December 2011, now to May 2015. More exploratory drilling continued, and in January 2008 Imperial Metals announced the mine life would continue to advance by another seven months, to December 2015. And by January 2011, when Knight Piésold was about to submit its 2010 TSF annual inspection report, new ore reserves boosted Mount Polley's operating mine life to the third quarter of 2016.

[81] Pdf page 50, *Consultation Report, Mount Polley Mining Corporation, PE-11678 Amendment Application*, July 2009. October 18, 2007 letter from C.H. Morrison, Powell River, BC.
[82] Imperial Metals Corporation, Annual Information Form, March 31, 2014.
[83] *Mount Polley Water and Load Balance*, by SRK Consulting (Canada), December 2013, Appendix O, in Mount Polley Mining Corporation's 2013 *Annual Environmental and Reclamation* Report.

That latest forecast, in anticipation of more ore discoveries on the horizon, undoubtedly led Knight Piésold to state the following 'parting words' in its 2010 TSF inspection report:

> *A preliminary design of the TSF, completed by Knight Piésold in 2005, considered an* ***ultimate embankment crest elevation of 965 m and provided storage for approximately 85 Mt*** [million tonnes] ***of tailings.*** *The MPMC mine plan is evolving as new resources are discovered and* ***it is possible that the ultimate mineable resource will exceed the ultimate storage capacity of the TSF as defined in the 2005 study. It is recommended that the tailings storage requirements be re-evaluated to assess whether modifications are required to the TSF layout. Additionally, the closure and reclamation plan for the TSF should be updated to reflect the increased resource and tailings storage requirements****. The TSF should be designed for closure and defining the ultimate storage requirements along with the closure and reclamation plan for the TSF are key considerations for future design phases.* [Bold emphases] [84]

The 2005 TSF design amendment report, *Mount Polley Mine, Design of Tailings Storage Facility to Ultimate Elevation*, which was not obtained by this report's author, and as cited in Appendix B, was submitted to the BC Chief Inspector of Mines on March 17, 2005. That report apparently provided a ceiling or "ultimate" limit to both the crest height and the volume of tailings to be stored in the TSF, a limit that also included a stated maximum volume for the supernatant waters which included enough anticipated vertical elevation room for freeboard.

According to Mount Polley Mine Corporation's annual reporting for 2013, by December 2013 a total 82,350,753 tonnes of ore had been milled to date (see Appendix K). [85]

From a two year - November 2008 to October 2010 - analysis of Mount Polley annual Water Balance data for two cumulative volume categories - total tailings mass (cubic meters) and interstitial (pore) waters (cubic meters) in the tailings mass - the mining operation was producing an annual average 2,645,166 cubic meters of tailings mass, and 2,365,461 cubic meters of interstitial water, for a combined annual average accumulation of 5,010,627 cubic meters of saturated tailings mass in the TSF. [86]

Annual Report 2010
Table F.1-1
Tailings Storage Facility

Volume of Tailings into basin
Cum. Volume of Tailings into basin
Water Surplus (Deficit) After Recycle to Process
Total Water and Solids added to tailings
Cum Volume of Tailings in basin since startup
Volume of Water retained in solids mass
Cum. Supernatant Volume
Total Volume of tailings and Water in basin

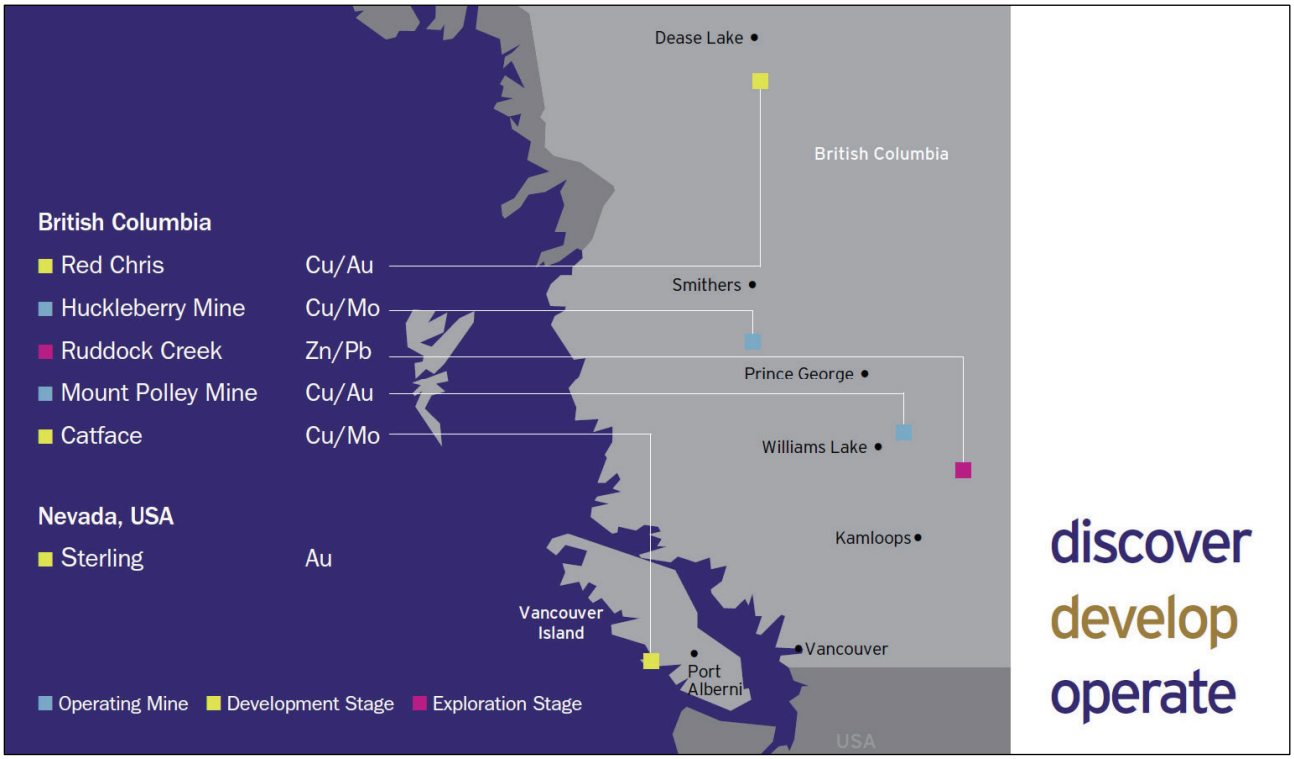
Tailings and Water
Plus storm and freeboard

Given the later projections by Imperial Metals for mining operations to continue well beyond 2014 to the end of 2025, as stated in its 2014 Annual Information Form, i.e., "The current mine life for Mount Polley is to the end of 2025, not including the processing of low-grade stockpiles," the mine could possibly generate an additional, conservatively estimated, 55 million cubic meters of combined tailings mass and interstitial waters. That figure is slightly less than the cumulative figures cited in the annual Water Balance report by September 2013, an accumulated total mine life

[84] *TSF Report on 2010 Annual Inspection*, page iii.
[85] The author has been unable to find answers on whether or not, or how, this figure relates to the "85 million tonnes of tailings" maximum storage for Knight Piesold's ultimate design of the Tailings Storage Facility.
[86] These two years were chosen because it appears as though the water balance data for 2012 (which includes the latter months of 2011) has strange inconsistencies, and was therefore excluded from averaging analysis.

(1997 - 2013) volume of 59,199,830 cubic meters. That would mean that MPMC's extended mine life would essentially double the tailings mass output to date.

The added projection of 55 million cubic meters of additional heavy metals and interstitial (pore) water waste would therefore mean that Imperial Metals would either have had to build a second Tailings Storage Facility somewhere on its site, or, would have to significantly reinforce and elevate the existing TSF.



Above: From Imperial Metals Corporation 2010 Annual Report, with its promotional logo: Discover, Develop, Operate.

Serious Water Balance Issues

$$\textit{Site Wide Runoff Coefficient} = \frac{\textit{Net Annual Runoff Collected (mm)}}{\textit{Total Annual Precipitation (mm)}}$$

According to the *2013 Environmental and Reclamation Report*, by the end of October 2013 MPMC was seeking further government and public approval to discharge 3.0 million cubic meters of treated effluent annually into Polley Lake in order to significantly reduce the unmanageable stockpile of mine waters that had accumulated at Mount Polley over a period of many years. As MPMC explained in its 2013 annual report, this option was being promoted because it was unable to fulfill the Ministry of Environment's amended and permitted annual discharge capacity of 1.4 million cubic meters of dilution mine waste effluent into Hazeltine Creek because of severely low flows and "water quality constraints" in Hazeltine Creek.

> *Given that approximately 7,000,000 m^3 of water was stored on site in the Cariboo Pit and TSF at the end of 2013, the fact that after 2014 the Cariboo Pit will no longer be able for water storage, and the geotechnical constraints of TSF, MPMC has developed a Short-term Water Management Strategy with the goal of reducing the existing water surplus on site over the next three to five years.*

MPMC is in the process of applying for a permit to discharge approximately 3,000,000 m^3 per year of treated water into Polley Lake to reduce TSF geotechnical requirements and return water to local watersheds. MPMC is looking to move forward with the permit application for implementation and startup in 2014. The proposed design parameters are an annual discharge of 3,000,000 m^3 over twelve months into Polley Lake (at the old water intake pipe location) with treated water meeting the BCWQG for aquatic life. Activities carried out as of December 31, 2013 are:

- *October 24, 2013: MPMC notified MOE of intent to apply for an amendment to Permit 11678.*
- *October 24, 2013: MPMC started discussions through Implementation Committee meeting with First Nations around Water Management Strategies (also met November 28th, January 23rd, and March 12th).*
- *November 6, 2013: Consultation with Public Liaison Committee Meeting.*
- *November 18, 2013: Official conversation held with MOE to start application process.*
- *December 4, 2013: Environmental Protection Notice posted and published.*

Due to mine-influenced water collection systems, the site has a projected annual water surplus of 1,500,000 m^3 of water. Currently Permit 11678 allows 1,400,000 m^3 to be discharged into Hazeltine Creek; however, currently this cannot be achieved due to a lack of flow in the permitted water source (dam-filtered water), and to a lesser extent water quality constraints. With the goal of having a neutral site water balance, additional water sources will be identified and continued research, including further development of the site passive treatment system, will be carried out to work towards improving the quality of potential discharge water sources.

Cover photo from SRK Consulting's Appendix O, *Mount Polley Water and Load Balance*. The Mount Polley TSF shows no beach development in this photo, which was taken from the South Embankment, looking northward to the Perimeter Embankment.

In the *2013 Environmental and Reclamation Report*, the seriousness of the latent water balance issues were summarized by SRK Consulting in Appendix O, *Mount Polley Water and Load Balance*. The company's assignment was "to develop and assess short term (next two years) and long term (beyond two years) water management options for the Mount Polley mine:"

A screening level water balance model based on annual precipitation, evaporation and runoff was prepared for the Mount Polley Mine site. The water balance model quantifies and forecasts the annual net input of water to the Tailings Management Facility (TMF). Results of the model indicate that the annual site-wide free water volume generated over the last year is approximately 0.8 Mm^3. Runoff from progressively larger areas has been diverted to the TMF since it re-opened in 2005, and will increase over next few years as runoff from the northwest portion of the site is diverted to the TMF. The annual site-wide free water volume generated on site

is expected to increase to 1.7 Mm³ of water under average hydrologic conditions, or 3.2 Mm³ of water under a wet hydrologic year with similar precipitation as measured in 2008 (621 mm), because of the expanded footprint.

There are no specific sources that contribute a disproportionate quantity of constituent loadings to the TMF. Rather, waste rock areas, tailings and developed mine areas in general appear to contribute loadings at similar rates. Increases in selenium, molybdenum, nitrate and sulphate have been trending up since the mine operation resumed in 2005. These increases are expected to continue until solubility limits are reached or when mine development and ore processing end.

Copper and uranium concentrations in the TMF do not increase because they precipitate in the milling process. When processing stops after closure, it is possible that the concentrations will increase in the TMF. [87]

$$Discharge\ Flow\ \left(\frac{m^3}{s}\right) = \frac{\left(Backgr.Conc\left(\frac{mg}{L}\right) - Permit\ Conc\left(\frac{mg}{L}\right)\right) Upstream\ flow\left(\frac{m3}{s}\right)}{Permit\ Conc\left(\frac{mg}{L}\right) - Effluent\ Conc.\left(\frac{mg}{L}\right)}$$

Molybdenum, selenium and sulphate concentrations in the TMF have increased over time similar to nitrate. The concentrations of these parameters are expected to continue to increase over the short to medium term of the mine's development. The concentrations of molybdenum, selenium and sulphate in mine water and in the TMF water are similar, which suggests that mine water runoff (pit water, waste rock runoff, etc.) and tailings slurry contribute loadings equally to the TMF. Because loadings originate all over the mine site it is not possible to reduce loadings by targeting a few sources.

Figure 12 and Figure 13 show concentrations of total and dissolved copper at the site. Concentrations of dissolved copper generally are lower in the TMF than in the mine water on site. The lower concentrations in the TMF likely result from increasing the pH in the mill circuit. The increased pH causes copper and other metals such as zinc, nickel, cadmium and lead to precipitate as metal hydroxides. The mill therefore effectively functions as a water treatment plant for metal removal. However, concentrations of dissolved metals are likely to increase during closure when the mill no longer operates.

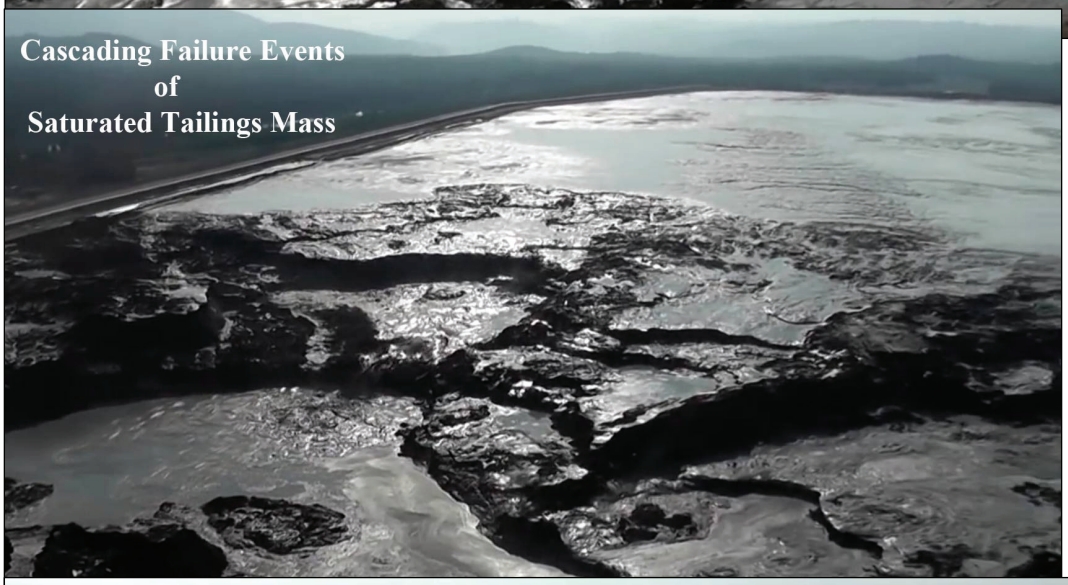
Figure 13 shows historical concentrations of cadmium. Cadmium concentrations were below the analytical detection limit in most samples collected and the detection limits in many cases are much greater than the downstream standard. It is possible that this can be remedied by requesting that the external laboratory use a lower analytical detection limit, but it is also possible that the samples contain other parameters (such as molybdenum) in concentrations that interfere with the ability to measure low cadmium. [88]

[87] Page iii.
[88] Page 16.

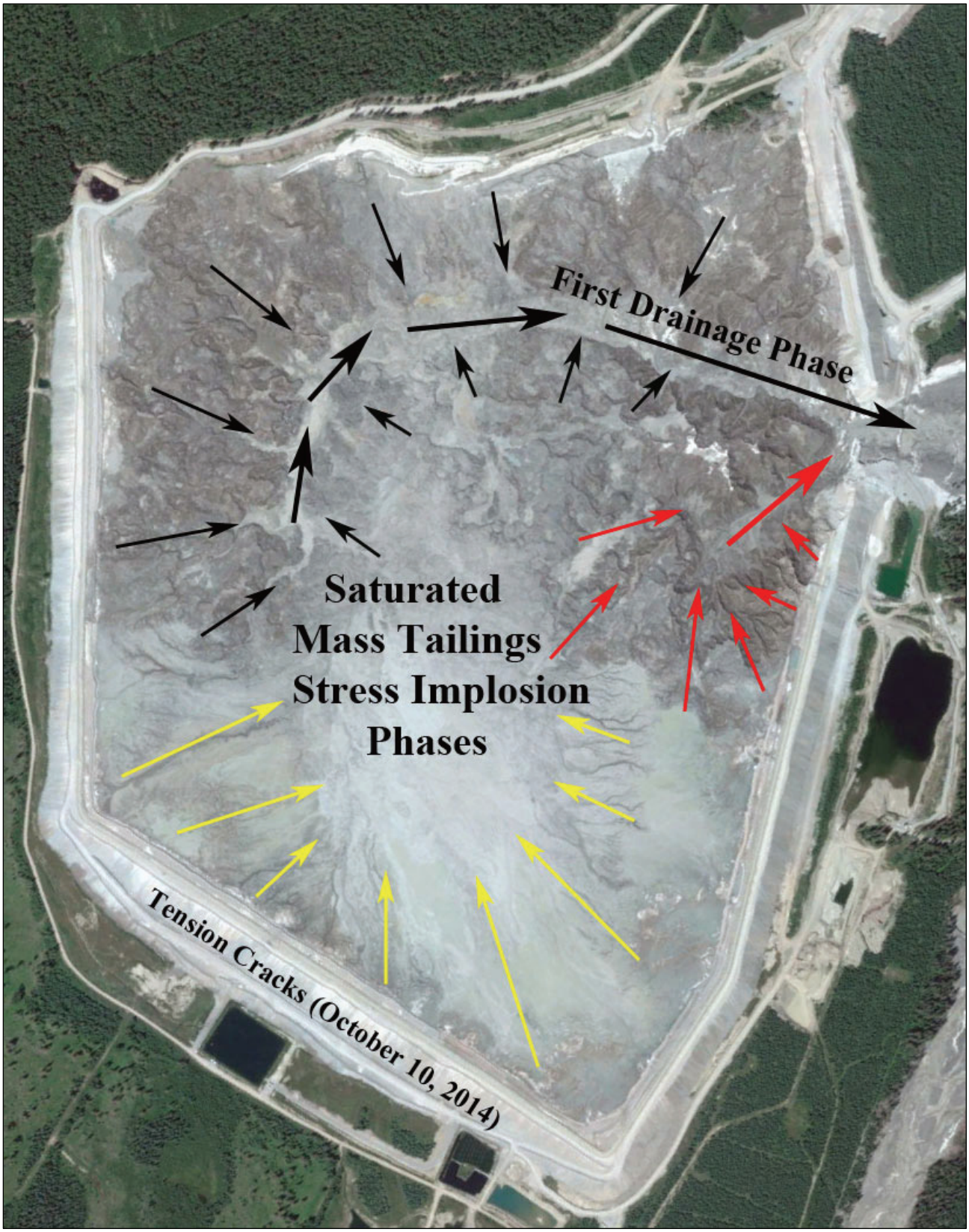
Serious Dam Integrity Issues

Amongst Imperial Metals Corporation's ominous self-inflicted misfortunes, embarrassingly pressing follow-up duties, and menacing multiple liabilities following the tailings catastrophe of August 4, 2014, is a rather serious health and safety state issue of its severely wounded Tailings Storage Facility. Namely, that the integrity of the TSF as a safe containment for tailings to last in perpetuity is in dire question. And, to address that tricky question would require substantial capital and extra heavy duty equipment to adequately reinforce the entire outer embankment structures.

August 4, 2014 helicopter flight images. *Above:* initial breach flow path (black arrows) along 930 meter contour, with subsequent breach flow in red. *Left:* tension cracks surrounding abandoned grader on Perimeter Embankment. *Below:* three stages of breach drainage flows: white arrows, first stage; red arrows, second stage; black arrows, third, slower drainage stage.



Images from August 4, 2014 helicopter flight. They show the state of the disaster about 5 hours after the breach occurred, during the second phase of draining, cascading physical collapsing of the saturated tailings mass, the forces of which affected the integrity of the 3 embankments.



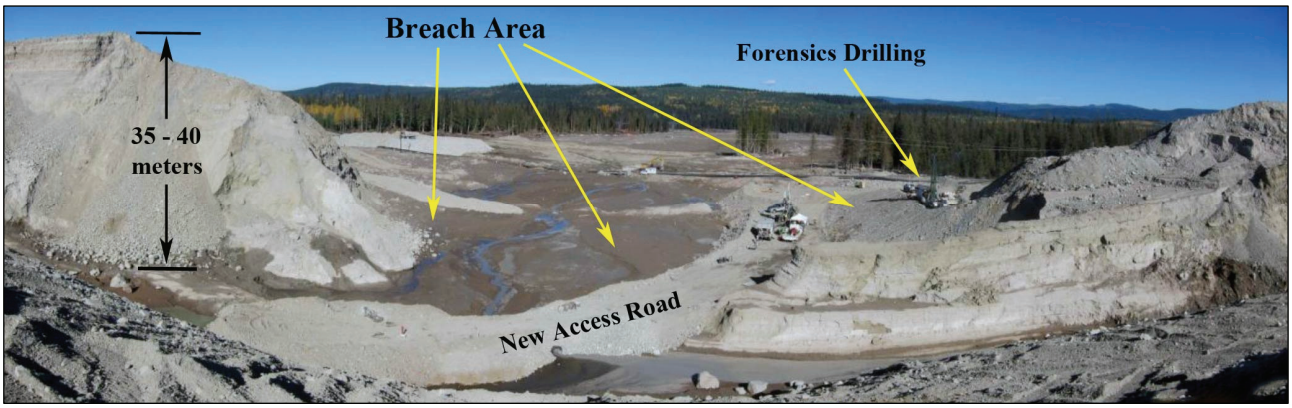
August 9, 2014 Google Earth Satellite Imagery showing a much-interstitial-water drained Mount Polley TSF. The black arrows indicate the initial burst phase and mass tailings movement, which primarily drained along the original curved 930 meter land base elevation contour line. The red arrows indicate the second mass tailings phase, after the initial phase subsided, causing more cascading events of the heavily laden saturated tailings. As both phases of the draining TSF evolved, the third phase, yellow arrows, began draining the farthest reaches of the tailings mass situated about 1.4 kilometres distant by the Main Embankment, the stresses of which most likely initiated tension cracks on its crest.

Above: The photo above shows a 150-meter-long tension crack first discovered on the crest of the Main Embankment on October 10, 2014. The pink-flagged and spray-bombed spikes are "extensometer pins" to physically measure movement changes made to the separation growth or lateral expansion of the tension crack. The originating cause of this tension crack was undoubtedly due to the imploding, dramatic stress forces made to the former equilibrium state of the saturated (pore water) tailings mass, forces of which may have physically altered the stage-phased structural Upstream-method layered integrity of the three embankments. It is not known how deep this tension crack is, or if it is an indication of a more serious and convoluted internal structural concern. According to additional information in the October 11, 2014 *Tailings Storage Facility Breach Mitigation* update by BGC Engineering Inc., "additional cracks were observed between chainage 2+119 and 2+162" meters.
Below: Recent oblique photo of the Mount Polley TSF by Terrasaurus, used here to show the lateral and downward stress forces from retreating and drained interstitial / pore waters.

Photoshop rendering of Google Earth satellite image of Mount Polley TSF, using “neutrals” variable settings in “selective color” adjustment in Photoshop, to better highlight the saturated mass tailings implosion flow exit paths, dendritic drainage patterns, and lateral stress forces. The darker brown areas denote the depleted and collapsed tailings mass, while the lighter zone on the top half shows the compressed tailings mass.

Forensics As Scapegoat?

Through originating orders by BC's Chief Inspector of Mines sometime in September 2014, a "forensics drilling" investigation began of the breach site, located at the northwest sector of the Perimeter Embankment. After initial road access was constructed on the eastern downstream side of the breach gap area and towards the centre of the breach area, the drilling equipment set out to determine, through numerous core samplings that are presently being assessed, if the foundation material of the Perimeter Embankment may or may not have been the root case of the tailings disaster.



Given the very high stakes of who might ultimately be to blame for the tailings disaster, if it could be determined that the disaster had nothing to do with the company's mismanagement of the TSF over time, then everyone gets off the proverbial hook.

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Appendix A

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Delta, B.C. V4K 4G6
(604) 940-0424 Fax 946-5344

RESUME

THOMAS C. (TOM) GRIFFING, Ph.D.

Has extensive academic training and experience as an environmental scientist and science educator.

Has been in the environmental consulting business operating from British Columbia since 1971.

Has had senior leadership responsibilities for a wide range of multi disciplinary environmental projects including:

- Permitting programs for industrial and land developments
- Environmental and socio-economic impact assessments
- Feasibility studies
- Site selection for hazardous waste disposal facilities
- Spill control and contingency planning
- Litigation proceedings and public hearing participation
- Waste handling and treatment systems
- Reclamation and revegetation programs
- Monitoring of environment and emissions
- Public and community participation
- Surveys and inventories

Has corporate management experience that includes a progression from scientist to laboratory manager, to a manager of people, programs, marketing, sales and resources. This included responsibilities as an executive, member of the board of directors and as part owner of a diversified professional services firm.

Has developed a diverse and strong record of professional service in the following sectors.

- Mining
- Electric Utilities
- Oil and Gas
- Forest Products
- Chemicals
- Land Development and Management
- Transportation
- Marine Facilities
- Government Agencies

Has a proven reputation as a project manager, and for providing team leadership and motivation in solving environmental problems.

.../2

A brief summary of his education and work experience includes these highlights:

1960	**UNIVERSITY OF ILLINOIS,** B.Sc.,Zoology
1963	**THE UNIVERSITY OF MICHIGAN,** M.Sc., Zoology (Ecology)
1965	**THE UNIVERSITY OF MICHIGAN,** Ph.D., Zoology (Ecology)
1965-71	**UNIVERSITY OF NOTRE DAME, Notre Dame,** Indiana, Assistant Professor of Biology. Teaching and Research Faculty including joint program with Civil/Sanitary Engineering. Pollution Limnology and Bog Lake Ecosystems.
1971-74	**BEAK CONSULTANTS,** Vancouver, B.C. Senior Scientist, Laboratory Manager then Western Vice-President. Environmental Science and Engineering Consulting.
1974-83	**IEC INTERNATIONAL ENVIRONMENTAL CONSULTANTS INC.** Vancouver, B.C. Co-Founder and Principal. An international, diversified, consulting company that provided professional services in environmental science, engineering and socioeconomics.
1983-Present	**GRIFFING CONSULTANTS INC.,** A firm that conducts environmental and management service projects with specialized and highly personalized attention by the principal.

Awards and notable recognition he has received include:

1979	Participant - Canadian Electrical Utility Trade Mission to Beijing, P.R.C.
1973-74	Expert witness and Technical Council to Vermont Attorney General in environmental litigation heard directly by the U.S. Supreme Court.
1973	Elected Member - New York Academy of Science
1970	Past President - North American Benthological Society

G C I

GRIFFING CONSULTANTS INC.

GRIFFING CONSULTANTS INC. has operated since 1983 and provides specialized professional environmental services. The group was assembled around the leadership of Dr. Thomas C. Griffing, a senior environmental scientist with more than 20 years of consulting experience in the Vancouver area, and is supported by a team of experienced professional scientists and engineers representing a diversity of environmental disciplines.

SERVICES OFFERED INCLUDE:

ECOLOGICAL INVESTIGATIONS

- Fisheries Studies
- Ecosystem Interactions
- Limnological Investigations
- Population Dynamics
- Biological Resource Management
- In Stream Survey Analysis
- Productivity Assessments
- Biological Monitoring
- Habitat Classifications

HYDROMETRIC MONITORING

- Stream Gauging
- Flow and Discharge Determinations
- Hydrograph Construction
- Bathymetric Chart Preparation
- Mass Balance Modelling
- Marine Current Analysis
- Regional Data Compilation and Analysis

RESOURCE INVENTORIES

- Field Data Gathering
- Map Preparation
- Habitat Identification
- Harvest Dynamics
- Life History Studies
- Wetlands Management Programs

WATER QUALITY SURVEYS

- Surface Water and Ground Water Sampling
- Data Summarization and Analysis
- Concentration Dynamics
- Nutrient Loading
- Marine Monitoring
- Dispersion Characterization
- Toxicity Interpretation
- Water Supply Studies
- Benthic Monitoring
- Phytoplankton & Zooplankton Studies

PERMITTING PROGRAMS

- Mining
- Energy Developments
- Resource Utilization
- Land Use
- Marine Construction
- Road and Linear Developments
- Mine Closure Plans
- Reclamation Programs
- Habitat Replacement and Compensation

IMPACT ASSESSMENTS

- Bio-Physical Impacts
- Community Impacts
- Remediation Assessments
- Site & Route Selection
- Compensation/Mitigations
- Habitat Enhancement
- Pollution Abatement
- Disaster Assessments

PUBLIC PARTICIPATION

- Public Hearing Preparations
- Community Consultation
- Workshops and Dialogues
- Awareness Programs
- Public Education

SPECIAL SERVICES

- Project Coordination
- Strategic Planning
- Technical Writing
- Editing and Report Preparation
- Environmental Audits
- Technical Counsel
- Expert Witness Testimony
- Specialized Management Services
- Employee Training

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Additional details are available in response to specific requests.

G C I

GRIFFING CONSULTANTS INC.

PARTIAL LIST OF CLIENTS

- Alberta Power Ltd.
- Amax of Canada Ltd.
- British Columbia Hydro & Power Authority
- Bonneville Power Administration
- Carolin Mines Ltd.
- Cheni Gold Mines Inc.
- Chevron Canada Limited
- Cominco Engineering Services Ltd.
- Consolidated Cinola Ltd.
- Department of the Army Corps of Engineers, Chicago District
- Environment Canada
- Fording Coal Limited
- Genstar - I.T. Corporation
- Imperial Metals Corporation
- Klohn Leonoff Consulting Engineers
- Klondike Placer Miners' Association
- Lornex Mines Ltd.
- Luscar Ltd.
- Manalta Coal Ltd.
- MacMillan Bloedel Ltd.
- Monenco
- Noranda Exploration Inc.
- Pacific Petroleum Ltd.
- Panarctic Oils Ltd.
- Petro-Canada Resources
- Portland General Electric
- Proctor and Gamble
- Quinsam Coal Ltd.
- Saskatchewan Power Corporation
- Scott Paper Ltd.
- St. Regis Paper Co. Ltd.
- State of Vermont, Office of the Attorney General
- Syncrude
- Teck Mining Group Ltd.
- TransAlta Utilities
- Union Oil Company
- Wright Engineers Limited
- West Kootney Power
- Yukon Electric Company Ltd.

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Appendix B: Chronological Report and Letter References from Ministry of Mines Permit M-200 re the Tailings Storage Facility

Tailings Storage Facility Design Report, Volumes I and II, Knight Piesold Ltd., May 26, 1995

Tailings Storage Facility Site Inspection Manual, by Knight Piesold Ltd., dated May 26, 1995

(Letter) *Mt Polley Project - Tailings Storage Facility* together with drawings by Knight Piesold Ltd. dated June 14, 1996

Letter report entitled *Borehole Logs for PRW 96-1 to 4* by Knight Piesold, dated July 30, 1996

Letter report entitled *Geotechnical Information Obtained from 1996 Borehole Investigation* by Knight Piesold, dated July 26, 1996

Letter report entitled *CPT Investigations @ Main Embankment* by Knight Piesold, dated July 30, 1996

Letter report entitled *CPT Investigation* by Knight Piesold, dated July 29, 1996

Report on *On-Going Construction Requirements (Ref. No. 10162/9-3)* by Knight Piesold Ltd., dated December 2, 1997

Operation, Maintenance and Surveillance Manual for Stage Ib Embankment (El. 934m) by Knight Piesold Ltd., dated November 24, 1997

Report on Stage *Ia/Ib Construction (Ref. No. 1016217-5)* by Knight Piesold Ltd., dated August 14, 1997

Application letter dated May 25, 2000 for an amendment to the conditions of the permit approving the work system entitled *Mt. Polley Tailings Storage Facility Application to Construct to Elevation 944 Metres Amendment to Permit M-200*, including Drawings 11162-13-210, -215, -130, and 11162-12-120, -125

Report entitled, *Tailings Cyclone Sands Geochemical Evaluation prepared by Mount Polley Mining Corporation*, dated December 2, 1998

Report entitled, *Tailings Storage Facility, Evaluation of Cycloned Tailings for Embankment Construction* prepared by Knight Piesold Ltd., dated June 16, 1999

Report entitled, *Report on Cycloned Sand Construction of Stage 3 and On-going Stages of the Tailings Storage Facility*, Volumes I and II prepared by Knight Piesold Ltd., dated December 13, 1999

Report entitled, *Tailings Cyclone Sands Geochemical Evaluation Update prepared by Mount Polley Mining Corporation*, dated February, 2000

Report entitled, *Addendum to Report on Cycloned Sand Construction of Stage 3 and Ongoing Stages of the Tailings Storage Facility* prepared by Knight Piesold Ltd., dated May 11, 2000.

Application letter dated April 30, 2001 for an amendment to the conditions of the permit approving the work system entitled *Mt. Polley Tailings Storage Facility Application to Construct to Elevation 945 Metres Amendment to Permit M-200*, including Drawings 11162-13-100 Rev. 3, -102 Rev. 3, -104 Rev. I, -120 Rev. 3, -125 Rev. 3, -127 Rev. 1, -130 Rev. 3, -210 Rev. 4, -215 Rev. 4, -250 Rev. 2, -251 Rev. 2, -254 Rev. 2, -256 Rev. 3, -258 Rev. 2, and -259 Rev. 3 was submitted to the Chief Inspector of Mines on May 16, 2001

Application dated March 14, 2005 including a report and plan of the work system entitled *Mount Polley Mining Corporation, Mount Polley Mine, Design of the Tailings Storage Facility to Ultimate Elevation*, by Knight Piesold was filed with the Chief Inspector of Mines (Chief Inspector) on March 17, 2005 in accordance with Section 10(6) of the Mines Act

Letter from Knight Piesold entitled *Mount Polley Mining Corporation, Mount Polley Mine, Design of the Tailings Storage Facility to Ultimate Elevation* dated April 14, 2005.

Reporting
(a) An as-built report shall be submitted within six months of completion of Stage 4 construction.
(b) An annual dam safety inspection report shall be prepared and to be submitted by July 31, 2006.
(c) A formal dam safety review shall be completed in 2006 and at an interval of 7 years based on the high consequence classification.

Application dated June 12, 2006 including a report and plan of the work system entitled *Mount Polley Mining Corporation, Mount Polley Mine, Stage 5 Design of the Tailings Storage Facility*, by Knight Piesold Limited was filed with the Chief Inspector of Mines (Chief Inspector) on June 23, 2006 in accordance with Section 10(6) of the Mines Act

Reporting
(a) An as-built report shall be submitted within six months of completion of Stage 5 construction.
(b) An annual dam safety inspection report shall be prepared and to be submitted by July 31, 2007.
(c) A formal dam safety review shall be completed in 2006 and at an interval of 7 years based on the high consequence classification.

Application letter dated July 4, 2007, entitled *Stage 6 Design Report for the Tailings Storage Facility - Mount Polley Mine*, by the Mount Polley Mining Corporation was submitted to the Chief Inspector of Mines (Chief Inspector) on July 25,2007 in accordance with Section 10(6) of the Mines Act
Report by Knight Piesold entitled *Stage 6 TSF Design of the Tailings Storage Facility* dated June 18, 2007

Letter from Knight Piesold dated December 19, 2007, entitled *Mount Polley Stage 6 TSF Design*

An application for an amendment of Permit M-200, entitled *Mine Permit Amendment Application* dated November 1, 2010 was filed with the Chief Inspector of Mines (Chief Inspector) on November 9, 2010 in accordance with Section 10(6) of the *Mines Act*

Revised Mine Permit Amendment Application, dated November I, 2010, by Mount Polley Mining Corporation

Mount Polley Mining Corporation - *Item I - Tailings Storage Facility Calculation*, undated, submitted December 22, 2010

Mount Polley Mining Corporation - *Mount Polley Water Balance 2010 Update*

Mount Polley Mining Corporation - *Permit Conditions Response*, undated, December 22, 2010

Mount Polley Mining Corporation - *Detailed Site Plan* undated, December 2010

Mount Polley Mining Corporation (email response) - *RE: Permit amendment application - geochem questions*, received May 5, 2011

Mount Polley Mining Corporation (email response) - *FW: Permit Amendment 5 questions*, received May 12, 2011

Application for an amendment to permit M-200 entitled, *Mount Polley Mine - 2012 Tailings Construction*, dated April 3, 2012, was submitted to the Chief Inspector of Mines (Chief Inspector) in accordance with Section 10(6) of the Mines Act

Report by AMEC Environmental & Infrastructure entitled *Tailings Storage Facility - Stage 8 2012 Construction Monitoring Manual*, and dated March 30, 2012

Letter report by AMEC Environmental & Infrastructure entitled *2012 Stage 8A Tailings Storage Facility Construction Drawings and Stability Analyses for Embankment Raise to El. 965 m*, and dated September 10, 2012

Letter application seeking an approval to process a total of 15,000 tonnes of ore from Dome Mountain, dated February 26, 2013, was submitted via email to the Chief Inspector of Mines on February 26, 2013. This amendment approves the milling of approximately 15,000 tonnes of ore from the Dome Mountain and the deposition of tailings into the Mount Polley Tailings Impoundment.

Report entitled *A Review of the Proposed Northwest Dump and the Tailings Pond: Mount Polley Mine*, prepared by Golder Associates Ltd., and dated March 28, 2013

Application to construct the Stage 9 dam raise on the TSF was submitted to the Chief Inspector of Mines (Chief Inspector) in accordance with Section 10(6) of the Mines Act on April 18, 2013

AMEC Environmental & Infrastructure report entitled *Tailings Storage Facility - Stage 9 2013 Construction Monitoring Manual*, dated April 11, 2013

2013 OMS Manual, submitted by Mount Polley Mining Corporation on July 29, 2013

2013 Site Water Balance, submitted by Mount Polley Mining Corporation on May 21, 2013

APPENDIX C: MINFILE RECORD SUMMARY - MINFILE No. 093A 008

Note: This file was created: 24-Jul-85 by BC Geological Survey (BCGS). Last edited: 03-Jun-13 by Nicole Barlow (NB)

Capsule Geology

The Cariboo-Bell or Mount Polley copper deposits are located approximately 57 kilometres northeast of Williams Lake. Copper was first discovered on Mount Polley in 1964.

In the period from 1966 to 1972, Cariboo-Bell Copper Mines Limited completed 18,341 metres of diamond drilling and 8,533 metres of percussion drilling in 215 holes. In 1981, E & B Explorations Inc. optioned the property from Highland Crow and that year completed 1,746 metres of diamond drilling, 1,295 metres of rotary drilling and a soil geochemical survey. Work completed from 1982 to 1987 included 3,585 metres of diamond drilling and 4,026 metres of reverse circulation overburden drilling, as well as soil geochemistry, geological mapping, magnetics, ground geophysics and induced polarization. In 1988 Imperial Metals Corporation completed an induced polarization survey and trenching, plus an additional 99 diamond drill holes totalling 8,878 metres. In 1989, a further 139 holes totalling 18,639 metres of diamond drilling were completed to detail reserves in the Central and West zones. A total of 535 percussion, rotary and diamond drill holes, comprising of 62,482 metres of drilling, were completed to the end of 1989.

The deposits occur within felsic Jurassic-Triassic Polley stock rocks which have intruded Nicola Group volcanic rocks. The Nicola Group in the area comprises a sequence of alkali basalt breccias and flows of Upper Triassic (Norian) age overlain by polylithic breccias characterized by the presence of felsic clasts of Lower Jurassic (Pliensbachian(?)) age. The stock which hosts the copper mineralization is a complex of several intrusive phases ranging in composition from diorite to syenite. Pyroxenite and gabbro have been intersected in drill holes while nepheline syenite dated at 201 Ma occurs to the west (the Bootjack stock) and presumably represents a more differentiated phase of the Cariboo-Bell intrusions.

Alteration is zonal with an outer propylitic zone, consisting of a calcite-epidote-chlorite-pyrite assemblage, surrounding a potassic zone characterized by secondary biotite and pink orthoclase with diopside. Between the inner potassic zone and the outer propylitic zone is an intermediate garnet-epidote zone. Zeolites are ubiquitous within altered rocks and, although some may be the result of metasomatism associated with hydrothermal fluids, most zeolitic alteration, especially in the outer alteration zone, may be the result of burial metamorphism of regional extent.

Copper-gold mineralization occurs within a variety of breccias and extends into the surrounding volcanic rocks. The two dominant breccia types are crackle breccias, typical of porphyry systems, and intrusion breccias. Six zones of significant mineralization have been defined within the breccias.

Hypogene minerals in ore zones include chalcopyrite (1 to 3 per cent), magnetite (4 to 8 per cent) and minor pyrite while supergene minerals include malachite, native copper, cuprite, chalcocite, neodigenite and covellite. Gold occurs as microscopic inclusions in chalcopyrite. The abundance of copper-gold mineralization is reported to be proportional to the intensity of brecciation.

The two main zones of interest are the Central and West zones. The tabular sill-like Central zone is 1,100 metres in length and up to 450 metres in width. This zone strikes north and dips east. The circular West zone has been drilled to 275 metres depth and is 450 metres in diameter. It plunges to the west and is open at depth below 275 metres.

The Mount Polley deposit was first discovered as a result of follow-up prospecting of an aeromagnetic anomaly highlighted on a government aeromagnetic mapsheet issued in 1963. Mastodon Highland Bell Mines Limited and Leitch Gold Mines first staked claims in 1964. In 1966, the two companies merged to

form Cariboo-Bell Copper Mines Limited. The property was mapped, soil and geochemical surveys and, airborne and ground based geophysical surveys were conducted, followed by bulldozer trenching and drilling. In 1969, Teck Corporation assumed control of Cariboo-Bell.

During the period from 1966 to 1972, a total of 18,341 metres of core drilling and 8,553 meters of percussion drilling was completed in 215 holes. In 1970, magnetic, seismic and induced polarization (IP) surveys were conducted. Teck continued to work the property in 1972, 1973 and 1975. In 1978, Highland Crow Resources, an affiliate of Teck, acquired control. In 1979, Teck completed six percussion holes for 354 metres.

In 1981 E&B Explorations Inc. optioned the property from Highland Crow and completed 1,746 meters of core drilling, 1,295 meters of rotary drilling, and soil geochemical and ground control surveys. In 1982, E&B acquired a 100 per cent interest and continued to work the property with joint venture partners Geomex Partnerships and Imperial Metals Corporation. From 1982 to 1987, E&B completed soil geochemistry, magnetic, VLF-EM and IP surveys, geological mapping, 3,585 meters of core drilling and 4,026 meters of reverse circulation drilling In 1987, Imperial Metals merged with Geomex Partnerships and purchased the remaining interest in the property from Homestake Canada and others. (E&B had merged with Mascot Gold Mines that subsequently merged with Corona Corporation and finally became Homestake Canada).

During the period between 1988 and 1990, Imperial Metals Corporation conducted a comprehensive exploration program consisting of 238 core holes totalling 27,566 meters, the collection of six bulk samples from surface trenches totalling 130 tonnes, geological mapping and IP surveys. In 1990 Wright Engineers completed a positive feasibility study that incorporated new ore reserve calculations, metallurgical testing, geotechnical evaluations, and environmental impact assessments.

Drilling outside the main pit area has identified four other areas of interest. Of these, the Northwest Extension zone was tested by one drillhole. The hole intersected 67 metres grading 0.33 per cent copper and 0.3428 gram gold (Property File - Imperial Metals Corp. Annual Report, 1991). The Road Zone (093A 202) occurs north of the pit area and several hundred metres south of the Lloyd-Nordik (093A 160) mineralization. It consists of magnetite and chalcopyrite-bearing breccia that may resemble Lloyd 2 mineralization.

Pit S-19 measured geological reserves are 48,983,400 tonnes grading 0.38 per cent copper and 0.54 grams per tonne gold. Inferred (geological) reserves at Mount Polley are 230,403,400 tonnes grading 0.25 per cent copper and 0.34 gram per tonne gold (George Cross News Letter #45, 1991).

In 1992, Imperial Metals Corp. received a mine development certificate from the B.C. Ministry of Energy, Mines and Petroleum Resources for a 13,700 tonne-per-day open pit mining operation and covers all elements of the mining plan including the open pit, processing plant, water supply, tailings pond and a power transmission line. The mine development recommended by Fluor Daniel Wright Engineers in its feasibility study calls for 13,700 tonnes-per-day based on an initial 10-year mining reserve of 48,983,400 tonnes grading 0.38 per cent copper and 0.54 gram per tonne gold to produce 13,608,000 kilograms of copper per year. Gold production will exceed 3,428,000 grams per year initially and gradually decline to 1,714,000 grams per year in year 10 (George Cross News Letter #199, October 15, 1992).

In 1994, Gibraltar Mines Ltd., under an option agreement with Imperial Metals drilled seven core holes for 1,216 metres. Upon evaluation of the project Gibraltar declined further participation. Following a merger with Bethlehem Resources Corporation in 1995, Imperial completed an in-house feasibility study. Financing was arranged with Sumitomo Corporation through a joint venture with SC Minerals Canada that culminated in the formation of Mount Polley Mining Corporation (MPMC) in April 1996.

In 1995, Imperial Metals Corporation with support from the Explore B.C. Program carried out an exploration diamond drilling program consisting of 230.1 metres in 2 holes on the Kay Lake Basin zone, 806.2 metres in 4 holes on the Road zone and 737.0 metres in 5 holes on the Pit areas as well as 935.4 metres of rotary

drilling in 7 holes on other geochemical and geophysical targets in an effort to increase the resource base. This program confirmed the existence of mineralization which require further definition by induced polarization survey and drilling (Explore B.C. Program 95/96 - M35).

Imperial Metals Corporation and Sumitomo Corporation completed soil stripping on the mill site, road access route and tailings dam site, in anticipation of construction start-up in the spring of 1996. Production will commence in the fall of 1997 (Information Circular 1996-1, page 10). Mineable reserves are reported to be 82,300,000 tonnes grading 0.30 per cent copper and 0.417 gram per tonne gold at a stripping ratio of 1.16 to 1 (Information Circular 1997-1, page 14). This includes the Central pit with 43,022 tonnes grading 0.501 gram per tonne gold and 0.285 per cent copper; the North pit with 9428 tonnes grading 0.329 gram per tonne gold and 0.260 per cent copper; and the West pit with 29,875 tonnes grading 0.324 gram per tonne gold and 0.333 per cent copper. The total geological resource stands at 133 million tonnes grading 0.36 gram per tonne gold and 0.27 per cent copper (Northern Miner June 24, 1996). Annual production, at a daily throughput of 18,000 tonnes is estimated to give Mount Polley a mine life of between 12 and 15 years.

Approximately 750,000 tonnes of ore and waste have been mined from the starter pit, located between the Cariboo and Bell pits. The concentrator/service/office complex and crusher building are roofed and clad (October 18, 1996). Fine-tuning of the mill is underway, while processing close to 800 tonnes of ore per hour. Concentrate has been trucked daily from the site for several weeks to Vancouver. The 1190 bench is nearly complete and drilling on the 1180 bench has begun.

In 1996, seven core holes for 992 meters were drilled in areas peripheral to the proposed pits, such as the Road Zone, the Northwest Zone and the S Zone. Lithogeothemical samples were collected from road cuts and new bedrock exposures.

The mine officially opened on September 13th, 1997. The deposit will be mined in three pits: Cariboo (first), Bell and Springer (T. Schroeter, personal communication, 1997).

In 1997, fifteen core holes for 1,614 meters were drilled to define the margins of the Cariboo Pit and 17 percussion boles for 702 meters were drilled to provide better ore definition for mine planning. Surface and pit wall geological mapping east of and in the Cariboo Pit were conducted concurrently. Three water well holes for 351 meters were drilled to provide source water for milling and mining operations. Rock chip samples from new road cuts were collected and analyzed.

Imperial Metals Corporation (February 1998 merger of Imperial Metals and Princeton Mining) operates the Mount Polley mine. The mine is owned 52.5 per cent by Imperial and 47.5 per cent by SC Minerals Canada Limited, a wholly owned subsidiary of Sumitomo Corporation of Japan.

During 1998, 12.6 million tonnes of material were mined from the Cariboo Pit, of which over 6.0 million tonnes was ore. The bulk of the ore originated from the southern, high oxide, high gold, high value portions of the Cariboo Pit. In the latter half of 1998 it was decided to mine the north portion of the Cariboo Pit that provides better metal recoveries but is generally lower grade material; the intention is to preserve some of the higher grade material in the southern zones for better market conditions.

During 1998, nine core holes for 1,993 meters were drilled within and along the margins of the Cariboo Pit. These holes were designed to prove continuity of mineralization to depth, to determine the orientation of mineralization, to provide definition in under-drilled areas and to determine rock quality for pit design. Core from previously drilled holes within the Cariboo Pit area was relogged and reinterpreted.

Exploration in 1999 included drilling in the Bell Pit and at the south end of the Cariboo Pit. In the Bell Pit, immediately north of the Cariboo Pit, diamond drilling totalling 1946 metres in eight holes tested the Bell deposit to depth and along the north and east limits. Immediately south of the Cariboo Pit, five diamond-drill holes totalling 1011 metres were completed in the recently discovered C-2 zone and an additional five holes

totalling 1110 metres were drilled under the south end of the Cariboo Pit to test the Deep Cariboo zone. Finally, 33 short percussion-drill holes totalling 1385 metres were drilled south and east of the Cariboo Pit. Reserves are reported as 76,470,300 tonnes grading 0.47 gram per tonne gold and 0.3 per cent copper in 1999 (Imperial Metals Corporation, 1999).

During 1999, 15.04 million tonnes of material was mined from the Cariboo Pit, of which over 6.65 million tonnes were ore. In addition 99,417 tonnes of material was mined from the upper bench of the Bell Pit, of which 89,353 tonnes were ore. At the end of 1999 a total of 896,793 tonnes of low grade material had been stockpiled for future processing (Imperial Metals Corporation Annual Report 1999, page 6).

In 2000, a total of 226 percussion holes for 10,652.5 meters and twenty-six core holes of 4,875.3 meters were completed. The areas that received work were the 207, Bell, C2, Cariboo, MP-071, Road/Rad, Southeast and Springer. This drilling was successful in defining previously discovered copper and gold mineralization in the C2, 2O7 and Southeast zones, and in discovering high-grade copper mineralization north of the proposed Springer Pit that has been named the North Springer Extension zone. At year end in 2000, Imperial Metals Corporation completed an agreement with Sumitomo Corporation that resulted in a restructuring of the mine's long term debt and Imperial acquiring 100 per cent ownership of Mount Polley Mine.

In June 2001, Imperial Metals Corporation announced that mining and milling operations at Mount Polley mine would be suspended in September 2001 due to continued depressed copper and gold prices. The mine would be maintained on standby pending an improvement in metal prices. In 2001, the Mount Polley Mining Corporation drilled 6696 metres in 41 NQ2 holes and 9421.4 metres in 170 percussion holes.

Total probable ore reserves as of April 30, 2001 are 30,245,122 tonnes grading 0.36 per cent copper and 0.374 gram per tonne gold with a strip ratio of 1.96. This total includes 1,687,227 tonnes grading 0.269 per cent copper and 0.487 gram per tonne gold with a strip ratio of 0.48 at the Cariboo Pit; 5,099,907 tonnes grading 0.355 per cent copper and 0.37 gram per tonne gold with a strip ratio of 1.88 at the Bell Pit; and 23,457,988 tonnes grading 0.367 per cent copper and 0.367 gram per tonne gold with a strip ratio of 2.09 at the Springer Pit (Imperial Metals Corporation 2000 Annual Report). In 2000, reverse-circulation drilling on the Southeast zone was successful in identifying potentially economic mineralization.

As of September 30, 2001 the probable reserve of the Bell pit is 3,422,940 tonnes at 0.365 per cent copper and 0.364 grams per tonne gold. This reserve is calculated using a strip ratio of 1.620, a copper price of US$0.75 per pound and a gold price of US$325 per Troy ounce. As of September 30, 2001 the probable reserve of the Springer pit is 15, 272,770 tonnes at 0.404 per cent copper and 0.390 grams per tonne gold. This reserve is calculated using a strip ratio of 2.140, a copper price of US$0.75 per pound and a gold price of US$325 per Troy ounce.

In 2003, Imperial Metals drilled four holes to test the potential below the current planned pit on the unmined Springer zone. The first hole, which was vertical, was mineralized over its entire 466.3 metre length. It averaged 0.61 per cent copper and 0.49 grams per tonne gold for the 267.5 metres it extended beneath the existing pit design depth (Exploration and Mining in BC 2003, page 26). The company recently raised $10 million (Canadian) to support an expanded exploration drill program on the Wishbone (093A 164) area, and to further explore the potential for economic mineralization beneath both the Springer zone and the Bell pit. The Cariboo pit has been mined out. If column leach testing of high oxide copper mineralization from the upper part of the Springer zone is successful it may lead to development of a heap leach facility at the mine.

Late in the 2004, Imperial announced that it will reopen the 20,000 tonne per day Mount Polley copper-gold mine in the first quarter of 2005. The Northeast zone (093A 164), which will be called the Wight Pit when developed, is an integral part of the mine restart. The present reserve base for the three zones (Bell, Springer and Northeast) is 40.7 million tonnes grading 0.432 per cent copper and 0.309 grams per tonne gold (Exploration and Mining in BC 2004, page 46,47).

Imperial Metals Corporation reopened its Mount Polley copper-gold mine in March, 2005, after a 3.5 year hiatus. Imperial Metals also undertook the largest exploration program in the Cariboo in 2005 on and adjacent to its Mount Polley mining lease. By mid-year close to 40 000 metres of diamond drilling had been completed. It further appraised the Northeast and Southeast zones and tested the Pond showing. The the Northeast zone, a highgrade 'end member' of the alkalic porphyry copper-gold system at Mount Polley, is now in production as the Wight pit.

As of January 1, 2006 the overall Mount Polley reserves and resources were revised (Press Release, January, 23, 2006). Total proven and probable reserves in the Wight, Bell, Springer and Southeast open pits are 40.9 million tonnes, grading 0.448% copper and 0.318 g/t gold, which contain 405 million pounds of copper and 419 thousand ounces of gold. Measured and indicated resources (which are additional to proven and probable reserves) increased to 79.2 million tonnes, from 68.5 million tonnes in 2005, grading 0.35% copper and 0.28 g/t gold (a copper equivalent grade of 0.58%) containing 615 million pounds of copper and 732 thousand ounces of gold. Inferred resources of 27 million tonnes, primarily contained in the Springer deposit, grade 0.30% copper and 0.29 g/t gold (a copper equivalent grade of 0.53%) containing 179 million pounds of copper and 254 thousand ounces of gold.

In 2010 Imperial Metals Corp. released updated reserve and resource estimates for Mount Polley incorporating the Southeast, C2, Pond, Boundary and Springer pits. The combined proven and probable reserves are 40.5 million tonnes grading 0.318 per cent copper, 0.282 gram per tonne gold and 0.606 gram per tonne silver. Combined measured and indicated resources are 167.7 million tonnes grading 0.317 per cent copper and 0.293 gram per tonne gold. Inferred resources are 3.7 million tonnes grading 0.302 per cent copper and 0.168 gram per tonne gold (Press Release, Stockwatch, May 17, 2010).

In 2012 Imperial Metals Corp. released an updated combined measured and indicated resource estimate of 361.14 million tonnes grading 0.284 per cent copper, 0.297 gram per tonne gold and 0.846 gram per tonne silver and an updated inferred resource estimate of 33.28 million tonnes grading 0.188 per cent copper, 0.242 gram per tonne gold and 0.592 gram per tonne silver (Press Release, Imperial Metal Corp., May 29, 2012). Imperial Metals Corp. also completed a drill program on the Springer zone in 2012. Highlights of this program include drillhole SD12-152 which returned 67.5 metres grading 1.27 per cent copper and 0.90 grams per tonne gold (Press Release, Imperial Metals Corp., February 5, 2013).

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EMPR MAP 65 (1989); 67

EMPR OF 1991-10; 1992-1; 1994-1; 1998-8-F, pp. 1-60; 1998-8-G, pp.1-30

EMPR PF (Miscellaneous Notes and Sketches from A. Sutherland Brown's files, various dates; Geological Map, date unknown; Base Map, date unknown; Claim Grouping Sketch and Grid, Mastodon Highland Bell Mines Ltd., 1965; Geochemical Survey, 1966; Plan of 2nd Trial Pit, 1966; Plan of Trial Pit used for calculating reserves, 1966; Claim Location Map, 1967; Composite map of Geology, IP anomalies and ore zones, 1968; Proposed Drill holes [sections], 1968; Geochemistry Map 1968, Composite Geology Map, 1968; Highland-Bell Annual Report 1968; Cariboo-Bell Copper Mines Ltd. 3rd Annual Report 1968; A Report on the Exploration and Preliminary Development of the Company's Copper Property, 1968; Magnetic Survey 1968,1969; Surface Drill hole assay map, Geological plan, Surface Assay Plan, Drill hole plan, IP Survey, Magnetometer Survey, Cariboo-Bell Copper Mines Ltd. 1969; Dujardin, R.A., 1969, Report of Field Examination and Preliminary Report on Cariboo- Bell Property; Surface Assay Plan, 1969; Geochemistry Plan,1969; Percussion Drill Program Location Map, 1970; Aeromagnetic Survey, 1970; Claim Map, 1970; Bailey, D.G., (1974): Ph.D. Thesis Proposal-The Geology of the Cariboo-Bell Area, Central British Columbia; Wright Engineers Report, 1975, Central Region: Forecast of Developments in the Mineral sector; Mascot Gold Mines Ltd. excerpt from prospectus Aug.1984; Pesalj & Nickic, (1989): Snapshot Review of Mount Polley; Excerpt from Imperial Metals Corp MDRP Prospectus, June 1989; Imperial Metals Corp., 1991 Annual Report; Mount Polley property description, Jan.28, 1992, Z.T. Nikic, R. Pesalj and D. Gorc; Mount Polley Gold Mine To Go Ahead, News Release (April 26, 1996), Imperial Metals Corporation; *Imperial Metals Corporation - Information folder containing 1996 Annual Report, brochures, phamphlets and News Releases; Imperial Metals Corporation Third Quarter Report for period ending Sept.30, 1997; Imperial Metals

APPENDIX C

OVERVIEW OF 2006 DAM SAFETY REVIEW

General

A Dam Safety Review (DSR) for the Tailings Storage Facility at Mount Polley Mine was completed by AMEC in October 2006. The results of the DSR were issued in a report to Imperial Metals Corporation in December 2006. The DSR indicated that "the three embankments that impound the Mount Polley Tailings are well designed and well constructed entities from a dam safety perspective. Each of the three dams has demonstrated similar good performance behaviour with little indication of potential concerns in the future provided the design, continuance of past construction practices, and inspection procedures remain in place".

However, there were a few operational issues raised in the DSR, as discussed below:

1. *Operating criteria for pond and beach management are presently at odds with the optimal dam seepage performance and stated closure objectives, with the latter issue being of greatest concern.*

A beach width of at least 20 m is to be maintained along the abutments of the embankments (where the embankment contacts natural ground) and at least 10 m width elsewhere to keep the pond away from the embankments. Knight Piésold has recommended that MPMC develop a plan and schedule to enable the minimum target beach widths to be re-established within a 2 week period should they be infringed upon. MPMC shall increase the frequency of measurements to at least once per week for embankment instrumentation systems (piezometers and foundation drains - flow rate and turbidity) during any periods that ponded water encroaches within the minimum target beach widths.

The use of tailings sand is currently being used as upstream Zone U construction material. Zone U forms the upstream shell zone immediately adjacent to Zone S (low permeability core zone) and is required to provide upstream support of the Zone S material during modified centerline construction. The sand cell construction method involves discharging tailings into constructed cells along the upstream side of the embankment. Prolonged discharge of tailings from the Perimeter Embankment has resulted in the tailings pond migrating over to the Main Embankment, which has resulted in increased flows reporting to the Main Embankment upstream toe drain. MPMC has recently purchased additional HDPE pipe to facilitate the deposition of tailings from around the entire facility without having to relocate the tailings pipeline. This will allow MPMC to quickly develop tailings beaches in response to the pond encroaching on the embankments.

The current mine plan has the mine operating at 20,000 tpd for the next 8 years. It is recognized that improvements in tailings deposition will be beneficial for optimizing beach development round the facility but this is only a minor consideration for closure planning. The current tailings deposition practices are not particularly relevant for the closure plan unless one considers sudden pre-mature mine closure during the next few months which is extremely unlikely (impossible?) given current metal prices and excellent operating performance of the Mount Polley Mine. This

concern, expressed in the DSR with respect to satisfying closure objectives are not particularly relevant during the current stage of mine operations. The closure objectives for the TSF are currently under review by MPMC. The tailings pond will continue to be managed in accordance with the TSF closure objectives in the later years of the mine life.

2. *As the facility has no operating spillway, the selection of the 24-hour PMP event may not be appropriately conservative. The amount of wave induced freeboard being allowed for is likely excessive by a factor of two.*

The previous design basis required the TSF to have sufficient live storage capacity for containment of runoff from the 24-hour PMP volume of 679,000 m^3 at all times, which would result in an incremental rise in the tailings pond level of approximately 0.4 m. The 24-hour PMP allowance was in addition to regular inflows from other precipitation runoff, including the spring freshet. The TSF design also incorporated an additional allowance of 1 meter of freeboard for wave run-up, for total freeboard requirement of 1.4 m.

The design basis has been updated to include storm water freeboard for the 72-hour PMP event. The volume of water associated with the 72-hour PMP event is approximately 1,070,000 m^3, which would result in an increase in the TSF pond elevation of approximately 0.6 m. The freeboard requirement for wave run-up has been reduced to 0.7 m, for total updated freeboard requirement of 1.3 m, which is consistent with the previous freeboard requirement. However, MPMC has elected to maintain the previous freeboard requirement of at least 1.4 m for the remaining mine life. The freeboard requirement post closure will be reviewed as part of the closure and reclamation plans as they are updated.

3. *The lack of potential of the nature of pre-shearing in the glaciolacustrine foundation leads to uncertainty in terms of present and post closure stability. There is an uncertainty in the need, or lack thereof, of the closure berm.*

Knight Piésold has been studying the lacustrine unit at the Main Embankment and investigating the potential for a weak layer within this unit since the initial design of the TSF embankments. The upper portion of this unit was investigated thoroughly by Knight Piésold during the excavation of the Main Embankment Seepage Collection Pond during the initial construction program in 2006, and no evidence of a pre-shear or a weak layer within this unit was discovered. The Lacustrine unit was also investigated in 1996 (CPT drilling) and in 2001 and 2006 when the inclinometers were installed. The results of the investigations indicate that the lacustrine unit is typically comprised of very stiff silt and clay. However, this does not prove that a pre-sheared or weak layer could not exist within the unit and it is therefore prudent to incorporate suitable contingency features in the design of the embankment. This has resulted in the installation of five inclinometers (of which four are still functioning) at the Main Embankment and the inclusion of a downstream closure buttress. The inclinometers are read on a regular basis during construction programs with an inclinometer probe and no deviations have been observed to date. The results of the readings for the inclinometers are shown in Appendix B.

The Stage 6 design of the TSF includes provisions to ensure stability in the event that a weak layer exists in the lacustrine material. A buttress at the Main Embankment has been included in the design to ensure that the integrity of the Main Embankment is not compromised by a

potentially weak layer in the lacustrine unit, even though there is no direct evidence that indicates that such a feature is present.

A study comparing the drained residual strength to the clay content, liquid limit, and effective normal stress was completed by Stark and Eid (1995). The results of the study indicate that the residual strength of a material with a clay content ranging from 25 to 50%, with a liquid of 40%, and an effective normal stress of 700 kPa is in the order of 24 degrees. Samples of the lacustrine material have recently been collected for direct shear testing, as recommended in the DSR, however the testing had not been completed at the time this report was issued. The results of the direct shear tests will be reviewed once received and the design of the Stage 6 buttress will be adjusted if required.

4. *The hazard classification of the TSF embankments is "HIGH" and is based on the economic and social loss category. The classification based on the Loss of Life and Environmental Loss Categories is LOW. The DSR recommends that the hazard classification be reviewed assuming that the owner's costs are not included.*

The classification of the TSF has been assessed using the Canadian Dam Association and the British Columbia Dam Safety Regulation guidelines. These guidelines look at the consequences of failure and consider life safety, economic and social losses, and environmental and cultural losses. The life safety category considers the potential for multiple loss of life after ascertaining the degree of development within the inundation area. The economic and social loss category considers damage to infrastructure, public and commercial facilities that are in and beyond the inundation area. This includes damage to railways, highways, powerlines, residences etc. The environmental and cultural loss considers damage to fish habitat at the regional, provincial, and national level, wildlife habitat, including water quality, and unique landscapes or sites of cultural significance.

Previous assessments of the TSF have resulted in a "HIGH" hazard classification (or consequence category) based on the economic and social loss category. The classification for the life safety and environmental and cultural loss categories is "LOW", as there is low potential for loss of life, the inundation area is typically undeveloped, and there is unlikely to be loss or significant deterioration of provincially or nationally important fish habitat. However, the estimated costs associated with repairing any damage to the TSF, loss of service to the mine, and the potential economic impact on Imperial Metals, could exceed $1,000,000, which placed the TSF into the "HIGH" economic and social losses category under the British Columbia Dam Safety Regulation guidelines.

The hazard classification of the TSF was discussed with MPMC and it was agreed that the owner's costs should not be included in the classification of the TSF embankments. The hazard classification for the TSF embankments has therefore been reduced to "LOW", based on the Canadian Dam Association and the British Columbia Dam Safety Regulation guidelines.

The maximum design earthquake (MDE) for the TSF with a LOW hazard classification is the 1 in 1000 year event. This corresponds to a peak ground acceleration of 0.096, based on the 2005 National Building Code Seismic Hazard Classification.

5. *There were "about the right" number of piezometers installed in the embankment dams, however there is nothing in the way of much redundancy and any lost instrument locations need to be re-established with a new installation.*

A total of 57 vibrating wire piezometers have been installed at the TSF as of the end of the Stage 4 construction program. The piezometers are grouped into tailings, foundation, embankment fill and drain piezometers. A total of 22 piezometers were accidentally destroyed during the Stage 4 construction program, and six additional piezometers have previously stopped functioning. MPMC and Knight Piésold attempted to locate and splice the damaged piezometers and successfully repaired five of them. The number of functioning piezometers at the end of the Stage 4 construction program was 34. Additional piezometers will be installed in the tailings and embankment fill materials and tailings during the Stage 5 construction program, which is currently in progress.

No unexpected or anomalous pore pressures have been observed while monitoring the vibrating wire piezometers during the TSF construction programs. The timeline plots for the piezometers on planes A through I are provided in Appendix A. The timeline plots indicate that the pore pressures increased slightly in piezometers A2-PE2-03, B2-PE2-03, and B2-PE1-02, which are fill piezometers installed in the Zone S glacial till. These pore pressure increases were expected as these piezometers have shown similar trends in previous construction programs where the pore pressures have increased during fill placement activities and subsequently decreased following the construction programs as the pore pressures dissipate. The pore pressures have also increased in the piezometers installed in the tailings, which is a direct result of the increase in elevation of the tailings pond. There has been no increase in the pore pressures in the foundation piezometers.

Although a number of piezometers are no longer functioning at the TSF, replacing all of them is not practical nor considered necessary at this time as there are functioning piezometers in the vicinity of most that were damaged. However, five of the damaged piezometers were foundation piezometers at the Main Embankment, where there are slight artesian conditions (less than 3.0 m). Additional piezometers will be installed in the Main Embankment foundation materials during Stage 6 to offset those that are no longer functioning. The foundation piezometers at the Main Embankment will have a trigger level of 15 m above ground, which corresponds to the elevated pore pressure that reduces the factor of safety to 1.1.

PROVINCE OF
BRITISH COLUMBIA

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MINISTRY OF WATER,
LAND AND AIR PROTECTION

PERMIT

PE-11678

Under the Provisions of the *Environmental Management Act*

Mount Polley Mining Corporation

200-580 Hornby Street

Vancouver, British Columbia

V6C 3B6

is authorised to discharge effluent to the land and surface water from a copper-gold mine and mill located near Likely, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

This permit supersedes and amends all previous versions of Permit PE-11678, issued under Part 2 Section 10 of the *Environmental Management Act*.

1. AUTHORISED DISCHARGES

1.1 This section applies to the discharge of effluent from a **COPPER-GOLD MINE AND ORE CONCENTRATOR** to a tailings impoundment. The site reference number for this discharge is E225309.

1.1.1 The monthly average maximum authorised rate of discharge of slurry is 54, 500 m^3/d.

1.1.2 The characteristics of the discharge shall be typical concentrator tailings from the milling of ore or metal contaminated soil, mill site runoff, rock disposal site runoff, open pit water, and septic tank effluent from a copper-gold mine and mill complex.

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1.1.3 The works authorised are a septic tank; tailings discharge line; open pits; tailings impoundment; seepage collection and recycle system; mine, mill, and rock disposal site runoff collection ditches and sumps; tailings supernatant and sediment pond supernatant recycle systems; and related appurtenances located approximately as shown on the attached Site Plans.

1.1.4 The authorised works must be complete and in operation when discharge commences.

1.1.5 The location of the facilities from which the discharge originates is within the entire facility (excluding the Tailings Storage Facility) on Mineral Leases No. 345731 and No. 410495 and Mineral Claim CB-20 and PM-11, Cariboo Mining Division, Cariboo Land District.

1.1.6 The location of the point of discharge (Tailings Storage Facility) is five kilometres southeast of Mount Polley, on Mineral Claim CB-20, Cariboo Mining Division, Cariboo Land District.

1.2 This section applies to the discharge of **TAILINGS IMPOUNDMENT SUPERNATANT** to the Cariboo Pit. The site reference number for this discharge is E247302.

1.2.1 The maximum authorised rate of discharge of supernatant and runoff water to the Cariboo Pit shall be 100, 000 m^3/year This discharge shall not occur while tailings slurry from the mill is being discharged to the tailings impoundment.

1.2.2 The characteristics of the supernatant shall be typical of mine tailings impoundment supernatant.

1.2.3 The works authorised include a supernatant reclaim system, pump(s), piping and related appurtenances located approximately as shown on the attached Site Plans.

1.2.4 The authorised works must be complete and in operation when discharge commences.

1.2.5 The location of the facilities from which the discharge originates is on Mineral Lease No. 345731, Cariboo Mining Division, Cariboo Land District and five kilometers southeast of Mount Polley, on Mineral Claim CB-20, Cariboo Mining Division, Cariboo Land District.

1.2.6 The location of the point of discharge (Cariboo Pit) is on Mineral Lease No. 345731, Cariboo Mining Division, Cariboo Land District.

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1.3 This section applies to the discharge of effluent from the **MAIN EMBANKMENT SEEPAGE POND** to an unnamed tributary of Edney Creek. The site reference number for this discharge is E224221.

1.3.1 The total maximum authorised rate of discharge of effluent from the main embankment seepage pond shall be 2000 m^3/d.

1.3.2 The characteristics of the discharges shall be equal to or better than:

Water Quality Characteristic:	Maximum Concentration:
non-filterable residue	25 mg/L
96 hour LC_{50} toxicity (rainbow trout)	not less than 100% V/V
48 hour LC_{50} toxicity (Daphnia Magna)	not less than 100% V/V
nitrate (as N)	10 mg/L
orthophosphorus (as P)	0.05 mg/L
dissolved sulphate	200 mg/L
total Copper	0.020 mg/L
total Iron	1.0 mg/L
total Selenium	0.01 mg/L

1.3.3 The works authorised are the main seepage collection and recycle systems; tailings impoundment foundation, toe and chimney drain system, outfall; and related appurtenances located approximately as shown on the attached Site Plans.

1.3.4 The authorised works must be complete and in operation when discharge commences.

1.3.5 The location of the facilities from which the discharge originates and the point of discharge (Tailings Storage Facility site) is five kilometers southeast of Mount Polley, on Mineral Claim CB-20, Cariboo Mining Division, Cariboo Land District.

1.4 This section applies to the discharge of miscellaneous groundwater sources from the **Wight Pit** dewatering system to Polley Lake. The site reference number for this discharge is E258923.

1.4.1 The maximum authorised rate of discharge is 75,000 cubic meters for the initial two weeks of operation and thereafter a continuous rate not to exceed 13,750 cubic meters per day (2,500 gallons per minute).

1.4.2 The authorised discharge period is continuous during operation of the Wight Pit.

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1.4.3 The sources authorised are groundwater dewatering (monitoring) well(s) located within the interface of Polley Lake and Wight Pit.

1.4.4 The authorised works are wells, submersible pumps, common pipe manifold connecting the wells, discharge pipe and diffuser.

1.4.5 The authorised point of discharge is Polley Lake

2. GENERAL REQUIREMENTS

2.1 Maintenance of Works and Emergency Procedures

The Permittee shall inspect the pollution control works regularly and maintain them in good working order. In the event of an emergency or condition beyond the control of the Permittee which prevents continuing operation of the approved method of pollution control, the Permittee shall notify the Regional Manager, Environmental Protection:

a) by telephone (250-398-4530) if the condition occurs between the hours of 08:00 and 16:30, Monday to Friday on normal working days; and,

b) by facsimile transmission (250-398-4214) if the condition occurs at any other time.

All such reports must be received within 24 hours of detection of the occurrence.

In addition, emergencies involving spills to the environment (as defined in the Spill Reporting Regulation), or spills to the effluent treatment facilities that have the potential to impair the treatment process, shall be reported immediately to the Provincial Emergency Program (1-800-663-3456).

2.2 Bypasses

The discharge of effluent which has bypassed the designated treatment works is prohibited unless the approval of the Director is obtained and confirmed in writing.

2.3 Process Modifications

The Regional Manager, Environmental Protection, shall be notified prior to implementing changes to any process that may adversely affect the quality and/or quantity of the discharge.

2.4 Surface Runoff and Mine Drainage Control

2.4.1 To the maximum extent possible, seepage and runoff from the open pits, rock disposal sites, and from down gradient of the tailings impoundment shall, when the mine or mill is operating, be collected and conveyed to the tailings impoundment, mill or open pits. Recycling of on-site water shall be practised to the maximum extent practicable.

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2.4.2 Surface runoff from undisturbed areas shall be diverted so that it does not flow to the tailings impoundment, or to the mine and mill area. Water quality shall be maintained during construction and operation from these areas when being diverted to natural watercourses.

2.4.3 Surface runoff control works shall be provided for all areas disturbed by roads, open pits, rock disposal sites, and the mill and ore storage area. The surface runoff control system shall convey all flows up to a 1 in 10 year 24-hour storm event, and shall withstand all flows up to a 1 in 100 year 24-hour storm event without significant damage.

2.4.4 The tailings impoundment shall provide 1.0 meter of freeboard plus storage for the Probable Maximum Precipitation (PMP), and all other effluent storage ponds, seepage ponds, and surface runoff ponds shall provide at least 0.5 metre of freeboard, up to a 1 in 100 year 24-hour storm event. If at any time the freeboard in the tailings impoundment is reduced to less than 1.0 metres plus the PMP, or less than 1.0 metre in any other pond, the Permittee shall notify the Regional Manager, Environmental Protection following procedures in Section 2.1 of this permit. After initially reporting such an occurrence, the Permittee shall report the freeboard weekly until such time as the required freeboard is re-established. Freeboard is defined as the difference in elevation between the contained liquid level and the top of the berm structure at its lowest point. The lowest point does not include spillways where a discharge is authorised or where the supernatant overflows to a downstream collection pond that is part of the authorized works.

2.4.5 Sedimentation of watercourses shall be prevented during construction and operation of any mine structures or facilities. The Director may specify and require implementation of measures to prevent sedimentation of watercourses caused by construction or operational activity at the site.

2.4.6 All ponds, ditching, and other runoff or seepage collection and diversion works shall be inspected at least twice per year, once in the spring after freshet and once in the fall before freeze-up.

2.5 Spill Contingency Plan

The Permittee shall maintain a "Spill Contingency Plan" for responding to environmental emergencies at the Mt. Polley Mine Project area. The Permittee shall keep this plan up-to-date and appropriate mine personnel shall be made aware of its contents. Any future updates to the plan shall be submitted to the Regional Manager, Environmental Protection within 30 days of adoption of the changes by the Permittee.

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2.6 Security

The Permittee shall maintain security with the Minister of Finance and Corporate Relations, as a condition of the Permit Approving Work System and Reclamation Program issued by the Ministry of Energy and Mines pursuant to the *Mines Act*.

2.7 Metal Contaminated Soil Milling

Tailings from the mill processing of metal contaminated soil from off minesite sources may be discharged to the tailings impoundment provided the Permittee has obtained written approval from the Director prior to receiving at the minesite, any metal contaminated soils.

3. MONITORING AND REPORTING REQUIREMENTS

3.1 Water Sampling and Analysis

The Permittee shall collect grab samples from the locations and at the frequencies listed in Table 1 of this permit and have the samples analysed for the parameters listed in Table 2 of this permit. The minimum detection limit for analysis shall be as shown in Table 2 of this permit.

3.2 Biological Monitoring and Lake Sampling Program

The Permittee shall develop a biological monitoring program, in accordance with the Metal Mining Effluent Regulations (pursuant to Subsections 34(2), 36(5) and 38(9) of the *Fisheries Act*), to assess impacts on the receiving environment.

An annual lake sampling program for Polley and Bootjack Lakes shall include;

- Dissolved oxygen (MDL 0.1 mg/L), temperature and conductivity profile sampling in late winter (lake surface safely frozen) and at spring and fall overturn
- water chemistry sampling (lake surface and at 2.0 meters above lake bottom) during spring and fall overturn, and
- Secchi disk measurements two times a month, occurring between spring and fall overturn.

The lake sampling locations shall include sites known as P1 and P2 on Polley Lake and B1 and B2 on Bootjack Lake. Lake samples that are collected shall be analysed for the parameters listed in Table 2 of this permit. The lake sampling program shall be conducted in accordance with the lake sampling and biological monitoring protocols that shall be included in the approved Quality Assurance Manual required in Section 3.7 of this permit.

3.3 Flow Measurement

The Permittee shall provide and maintain suitable measuring devices and record staff gauge measurements, during the non-freezing period, at surface water stations W1a, W4, W5, W8, and W12, located approximately as shown on the site plan. These staff gauge readings shall be taken at the same time as water samples are collected at the same or associated sites.

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The Permittee shall provide and maintain a suitable flow measuring device and record continuously during the non-freezing period the flow at surface water station W7. The water elevation shall be measured in all groundwater wells each time they are sampled for water quality. The Permittee shall provide and maintain a suitable flow measuring device and record daily, the volume of tailings slurry discharged to the tailings impoundment. The Permittee shall provide and maintain suitable flow measuring devices and record once per week, the rate of flow discharging from the main embankment seepage pond to the environment. The Permittee shall provide and maintain suitable flow measuring devices and record once per week, during the non-freezing period, the rate of flow into the mill site sump and into the southeast sediment control pond. A stage discharge curve shall be developed for all staff gauges, and all staff gauges and flow measuring devices shall be checked and calibrated once per year, after spring freshet.

3.4 Climate Monitoring

The Permittee shall maintain a meteorological station and measure continuous daily precipitation; daily maximum, minimum and mean temperature; and daily open pan evaporation.

3.5 Sampling Procedure

At sites where sampling is required, the Permittee shall install a suitable sampling facility and obtain samples in accordance with procedures described in "British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples 2003 Edition (Permittee)", or most recent edition, or by suitable alternative procedures as authorized by the Director. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

A copy of the above manual may be purchased from the Queen's Printer Publication Centre, P.O. Box 9452, Stn. Prov. Govt, Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409), and also available for inspection at all Environmental Protection Program Offices.

3.6 Analytical Procedures

Analyses are to be carried out in accordance with procedures described in the "British Columbia Laboratory Methods Manual for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air Samples (2003 Permittee Edition)", or the most recent edition, or by suitable alternative procedures as authorized by the Director.

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The 96 hour LC_{50} rainbow trout toxicity test shall be carried out in accordance with the procedures described in "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout," Report EPS 1/RM/13 July 1990. The 48-hour LC_{50} Daphnia Magna toxicity test shall be conducted in accordance with the procedures described in "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia Magna," (Reference method EPS 1/RM/14), July 1990.

3.7 Quality Assurance

The Permittee shall, to the satisfaction of the Director, maintain a "Quality Assurance Manual" consistent with "British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples 2003 Edition (Permittee)", or most recent edition, or by suitable alternative procedures as authorized by the Director. The Permittee shall ensure that all data submitted as a requirement of this permit is produced in accordance with the Quality Assurance Manual approved by the Director. Any future updates to the manual shall be submitted to the Regional Manager, Environmental Protection within 30 days of adoption of the changes by the Permittee.

Analysis of samples for parameters designated under the Environmental Data Quality Assurance Regulation shall be at a laboratory registered for the designated parameter under the Regulation. In addition, the Permittee shall participate in quality assurance audits as required by the Regulation.

3.8 Reporting

Maintain water sample analysis and field measurement data for inspection and submit the data, suitably tabulated, to the Regional Manager, Environmental Protection once every three months. All reports shall be submitted within 45 days of the end of the three-month period during which the data was collected. The data shall be submitted in an electronic format suitable for entry into the provincial database system known as EMS (Environmental Monitoring System).

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The Permittee shall submit a comprehensive annual report, in a format suitable for public release, to the Regional Manager, Environmental Protection and to the Likely Public Library, by April 30th of each year. The annual report shall include:

a) the flow measurement, quality assurance, and climate data;
b) an updated water balance spreadsheet for the minesite and tailings impoundment;
c) an annual report on the construction and performance of the tailings impoundment and dam, including a review of the results and analysis of hydrogeological data from the previous year;
d) a summary of all water quality data for the previous calendar year, employing tables and graphs, and including an assessment of relevant quality assurance data;
e) the results of ongoing mine drainage chemistry studies;
f) the results of the ongoing progress in developing site specific water quality objectives and discharge standards for the closure of the tailings impoundment and mine site;
g) an update on progress on reclamation and any updating of the reclamation plan; and,
h) an evaluation of the impacts of the mining and milling operation on the receiving environment from the previous year, including results of any lake and/or biological monitoring that may have been done.

The Director may require modifications to the monitoring program based on the evaluation of the annual report and on any other information collected by Environmental Protection in connection with this discharge.

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TABLE 1

Site Code	EMS Code	Site Name	Sample Frequency
E1	E225309	tailings impoundment supernatant	monthly
E4	E224221	main embankment seepage pond	monthly, except RBT and Daphnia bioassay shall be quarterly
E5	E232862	tailings impoundment main embankment drain composite	monthly
W1	E225084	lower Morehead Cr.	quarterly
W3a	E216893	Mine Drainage Cr. u/s Bootjack Lake	quarterly
W4	E225124	North Dump Cr. u/s Polley Lk FSR	monthly + 5 weekly in spring and fall
W5	E208039	Bootjack Cr. above Hazeltine Cr.	quarterly
W7	E208038	upper Hazeltine Cr.	quarterly
W8	E216743	NE Edney Cr. Trib.	monthly + 5 weekly in spring and fall
W8z	E223292	SW Edney Cr. Trib.	monthly + 5 weekly in spring and fall
W11	E224223	lower Edney Cr. u/s Quesnel Lk.	2 times/year (spring and fall)
W12	E216744	6K Creek at road	quarterly
W13	E247623	9.5 K Creek u/s Bootjack Lake	quarterly
GW96-1a	E229679	tailings impoundment north well (deep)	2 times/year (spring and fall)
GW96-1b	E229680	tailings impoundment north well (shallow)	2 times/year (spring and fall)
GW96-2a	E229681	tailings impoundment east well (deep)	2 times/year (spring and fall)
GW96-2b	E229682	tailings impoundment east well (shallow)	2 times/year (spring and fall)
GW96-3a	E229683	tailings impoundment SE well (deep)	2 times/year (spring and fall)
GW96-3b	E229684	tailings impoundment SE well (shallow)	2 times/year (spring and fall)
GW96-4a	E229685	tailings impoundment SW well (deep)	2 times/year (spring and fall)
GW96-4b	E229686	tailings impoundment SW well (shallow)	2 times/year (spring and fall)
GW96-5a	E229687	tailings impoundment background well (deep)	2 times/year (spring and fall)
GW96-5b	E229688	tailings impoundment background well (shallow)	2 times/year (spring and fall)
GW96-6	E229689	SE RDS well	Once a year (spring)
GW00-1b	E242384	tailings impoundment west well (shallow)	2 times/year (spring and fall)
GW00-1a	E242385	tailings impoundment west well (deep)	2 times/year (spring and fall)
GW00-2b	E242386	tailings impoundment west well (shallow)	2 times/year (spring and fall)
GW00-2a	E242387	tailings impoundment west well (deep)	2 times/year (spring and fall)
GW00-3b	E242388	tailings impoundment west well (shallow)	2 times/year (spring and fall)
GW00-3a	E242389	tailings impoundment west well (deep)	2 times/year (spring and fall)
GW96-7	E229690	south east sed pond well	Once a year (spring)
GW96-8a	E229691	Bootjack Lake FSR well @ 11 k (deep)	Once a year (spring)
GW96-8b	E229692	Bootjack Lake FSR well @ 11 k (shallow)	Once a year (spring)
GW96-9	E229693	tailings impoundment south well	Once a year (spring)
95-R-4	E229694	Springer pit well	Once a year (spring)
95-R-5	E229695	Lower SE RDS well	Once a year (spring)
GW05-1	E258923	Wight Pit/Polley Lake interface well(s)	quarterly

Douglas Hill, P. Eng.
for Director
Environmental Management Act
Cariboo Region

Date Issued: May 30, 1997
Date Amended: MAY 0 4 2005
(most recent)

TABLE 2

Parameter	Sites	MDL*
field pH	all sites	0.1 pH units
field temperature	all sites	0.1 °C
field specific conductivity	all sites	1 µS/cm
96 hour LC_{50} rainbow trout toxicity	E4, during mine operation	10% mortality
48 hour LC50 Daphnia Magna toxicity	E4, during mine operation	10 % mortality
alkalinity	all sites	1 mg/L
sulphate	all sites	1 mg/L
nitrate plus nitrite - N	all surface water and effluent sites, GW96-6,7,8a, 8b, 95-R-4, 5	0.005 mg/L
ammonia - N	all surface water and effluent sites, GW96-6,7,8a, 8b, 95-R-4, 5	0.005 mg/L
total nitrogen	all surface water sites	0.005 mg/L
ortho-phosphorus	all surface water and effluent sites	0.001 mg/L
total phosphorus	all surface water sites	0.001 mg/L
total dissolved phosphorus	all surface water and effluent sites	0.001 mg/L
non-filterable residue	W3a, W4, W5, W7, W8, W8z	10 mg/L
filterable residue	W3a, W4, W5, W7, W8, W8z	5 mg/L
turbidity	W3a, W4, W5, W7, W8, W8z	0.1 NTU
dissolved organic carbon	all surface water sites	0.5 mg/L
hardness	all sites	0.1 mg/L
aluminum	dissolved = all sites	0.001 mg/L
arsenic	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.0001 mg/L
barium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.01 mg/L
calcium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.05 mg/L
copper	dissolved = all sites; t&d = all surface water and effluent sites	0.0001 mg/L
iron	dissolved = all sites; t&d = all surface water and effluent sites	0.03 mg/L
lead	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.00005 mg/L
magnesium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.05 mg/L
manganese	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.0005 mg/L
molybdenum	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.00005 mg/L
nickel	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.001 mg/L
potassium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.1 mg/L
selenium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.001 mg/L
silicon	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.5 mg/L
sodium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.02 mg/L
strontium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.0001 mg/L
zinc	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.001 mg/L

* may use higher MDL where results are 10 times MDL used

t&d = total and dissolved

Douglas Hill, P. Eng.
for Director
Environmental Management Act
Cariboo Region

Date Issued: May 30, 1997
Date Amended:
(most recent) MAY 0 4 2005

SITE PLAN

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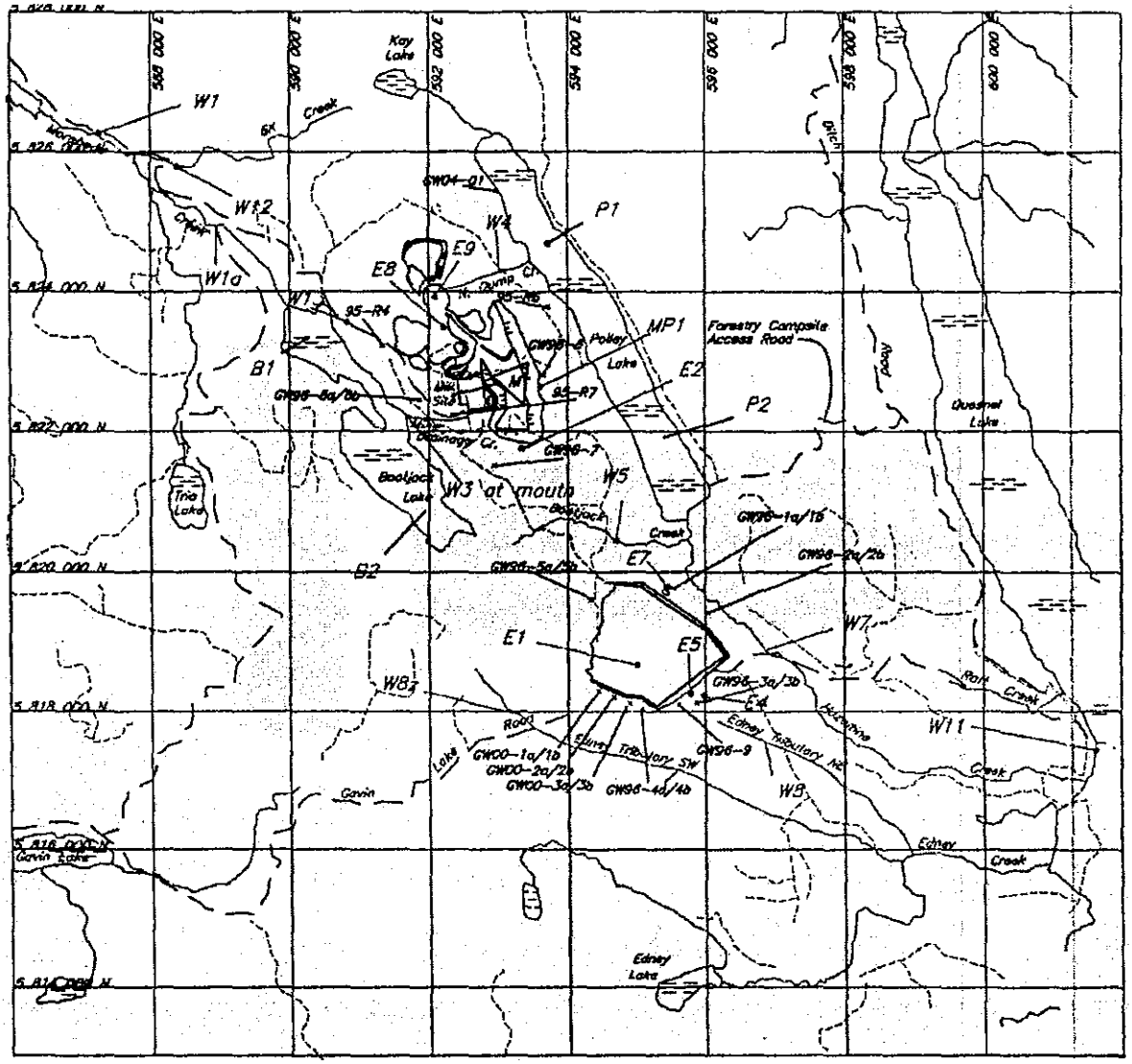

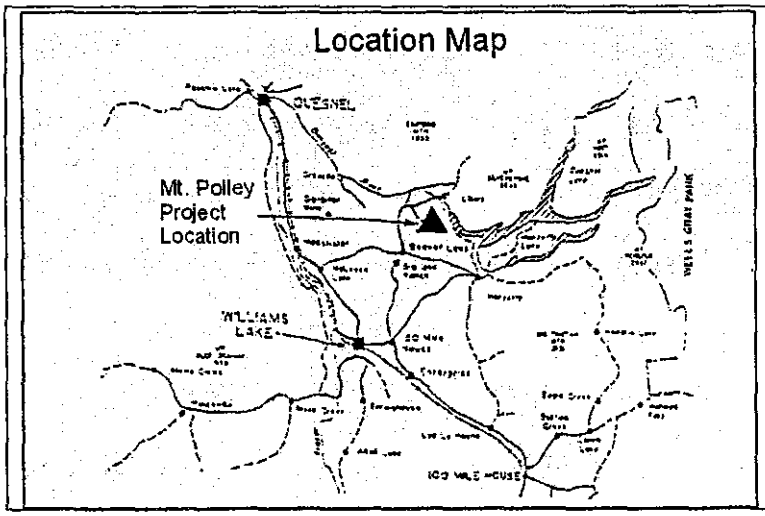

Permit: PE-11678

Date: MAY 0 4 2005

Douglas Hill, P. Eng.

for Director
Environmental Management Act
Cariboo Region

APPENDIX F - Mount Polley Tailings Storage Facility - Year 2008
Embankment Locations and Identifications of Installed Piezometers
(Source: 2008 Annual TSF Inspection Report, pdf pages 40-43)

Embankment	Plane Name	Piezometer I.D.	Embankment	Plane Name	Piezometer I.D.
Main (22 installed)	A	A0-PE2-03	Main	C	C2-PE2-05
		A2-PE2-09			C2-PE2-03
		A2-PE2-10			C1-PE1-01
		A1-PE1-05			C2-PE2-02
		A0-PE1-01			C2-PE2-01
		A2-PE1-02			C1-PE1-02
		A1-PE1-04			C2-PE1-01
		A0-PE2-02			C2-PE2-08
		A0-PE2-01			C1-PE1-04
		A2-PE2-04			C2-PE2-07
		A2-PE2-05			C2-PE2-06
		A2-PE2-03			C2-PE1-03
		A1-PE1-03	Main (6 installed)	E	E0-PE2-01
		A1-PE1-01			E2-PE2-03
		A2-PE2-02			E2-PE2-04
		A2-PE2-01			E1-PE1-01
		A1-PE1-02			E2-PE2-01
		A2-PE1-01	**Total - 65**		E2-PE2-02
		A2-PE2-08	Perimeter (9 installed)	D	D0-PE2-01
		A2-PE2-07			D2-PE2-03
		A2-PE2-06			D2-PE2-04
		A2-PE1-03			D1-PE1-04
Main (18 installed)	B	B0-PE2-03			D2-PE2-01
		B2-PE2-08			D1-PE1-02
		B2-PE2-07			D1-PE1-03
		B1-PE1-04			D2-PE1-01
		B0-PE1-01			D2-PE2-02
		B2-PE1-02	Perimeter (4 installed)	G	G0-PE2-01
		B0-PE2-02			G2-PE2-01
		B0-PE2-01			G2-PE2-02
		B2-PE2-03			G1-PE1-01
		B1-PE1-01	Perimeter (4 installed)	H	H0-PE2-01
		B2-PE2-04			H2-PE2-01
		B1-PE1-03			H2-PE2-02
		B2-PE2-05	**Total - 17**		H1-PE1-01
		B2-PE2-02	South (5 installed)	F	F0-PE2-01
		B2-PE2-01			F2-PE2-02
		B1-PE1-02			F1-PE1-01
		B2-PE2-06			F2-PE2-03
		B2-PE1-01			F2-PE2-01
Main (19 installed)	C	C0-PE2-03	South (5 installed)	I	I0-PE2-01
		C2-PE2-09			I2-PE2-01
		C2-PE2-10			I2-PE2-02
		C0-PE1-01			I1-PE1-01
		C2-PE1-02	**Total - 10**		I2-PE2-03
		C0-PE2-02			
		C0-PE2-01			

BRITISH COLUMBIA

October 6, 2014

Honourable Bill Bennett
Minister of Energy and Mines
Room 301
Parliament Buildings
Victoria, BC V8V 1X4

Dear Minister Bennett:

As you are aware, as Chief Inspector of Mines, I am conducting an independent investigation under the *Mines Act* to determine the root cause of the breach of the tailings pond at Mount Polley mine. My investigative team has been at the mine site examining every aspect of the failure – collecting information, conducting geotechnical studies and interviewing individuals associated with operation of the mine. All documents related to the history, design, construction, operation, and monitoring of the tailings facility are being thoroughly reviewed. The team has already interviewed over 50 individuals and compiled many volumes of information. This investigation is expected to take several more months.

The Conservation Officer Service, an independent law enforcement body, is conducting their own independent investigation with the authority to forward any recommendations for charges if warranted directly to the provincial Crown Counsel.

Government must protect the integrity and independence of these investigations to ensure we determine how the breach occurred, and that we do not compromise the integrity of the collection of information and evidence. For that reason, I have advised the Ministry of Energy and Mines as has the Ministry of Justice, not to release or comment on materials directly or indirectly related to the Mount Polley investigation, including annual dam safety inspection reports (Reports) submitted by Imperial Metals in accordance with the Health, Safety and Reclamation Code for Mines in British Columbia.

I share the concern with the Ministry of Justice that the public release of information related to the tailings facility at Mount Polley may impact investigations by tainting evidence of persons yet to be interviewed or re-interviewed. Published Reports may also adversely affect our investigation techniques and procedures. In addition, releasing the Reports may adversely impact any ensuing prosecutions by tainting the evidence of witnesses who may testify and by rendering the issues before the court more difficult.

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Ministry of Energy and Mines
Chief Inspector of Mines

Mines and Mineral Resources Division

Mailing Address:
PO Box 9320, Stn Prov Govt
Victoria, BC V8W 9N3
Ph: (250) 952-0494
Facsimile: (250) 952-0491

Location:
6th Floor
1810 Blanshard Street
Victoria

It is important to note that upon completion of the investigations, and within the law, it is my intent that findings and other appropriate documentation will be made available to the public and media.

Sincerely,

Al Hoffman
Chief Inspector of Mines

pc: David Nikolejsin
Deputy Minister

David Morel
Assistant Deputy Minister

Ministry of Energy & Mines

GUIDELINES FOR ANNUAL DAM SAFETY INSPECTION REPORTS

Reference:

Health, Safety and Reclamation Code for Mines in British Columbia (Code) Section 10.5.3: *The manager shall submit an annual dam safety inspection report prepared by a professional engineer on the operation, maintenance and surveillance of the tailings and water management facilities and associated dams to the chief inspector.*

This Code reference applies to every operating and closed mine in BC.

The report shall provide the following information:

1. Executive Summary

   (a) Classification of the dam(s) in terms of Consequence of Failure in accordance with Table 2-1 of the CDA Dam Safety Guidelines (2007).

   (b) Significant changes in instrumentation and/or visual monitoring records.

   (c) Significant changes to dam stability and/or surface water control.

   (d) For major impoundments, as defined in Part 10 of the Code, a current Operation, Maintenance and Surveillance (OMS) Manual is required. The annual report shall indicate the latest revision date of the OMS manual.

   (e) For tailings dams classified as High, Very High, or Extreme Consequence, an Emergency Preparedness Plan (EPP) is required. The annual report shall indicate the latest revision date of the EPP document.

   (f) Scheduled date for the next formal Dam Safety Review in accordance with Table 5-1 of the CDA Dam Safety Guidelines (2007). Formal Dam Safety Reviews are required every 5 to 10 years (depending on consequence classification) and differ from annual dam safety inspections. The requirements for Dam Safety Reviews are included in Section 5 of the CDA Dam Safety Guidelines. Dam Safety Reviews may be conducted by the Engineer of Record with third party review, or by an independent third party with involvement of the Engineer of Record.

2. Summary of past years' construction (if any) with a description of any problems and stabilization.

3. Plan and representative cross sections.

4. Site photographs.

5. Review of climate data.

6. Water balance review.

7. Freeboard and storage availability (in excess of the design flood).

8. Water discharge system, volumes, and quality.

9. Seepage occurrence and water quality.

10. Surface water control and surface erosion.

11. Instrumentation review including:

    (a) Phreatic surfaces and piezometric data.

    (b) Settlement.

    (c) Lateral movement.

The report shall be submitted by a qualified geotechnical engineer registered as a Professional Engineer (P.Eng.) in British Columbia. The professional engineer will be deemed the Engineer of Record for the facility unless another engineer is identified within the Dam Safety Inspection report as having this responsibility.

Note, this document modified from the original by George Warnock, P.Eng. (Manager, Geotechnical Engineering) in August 2013. Original prepared by Chris Carr, P.Eng. (former Manager) in February 2002.

APPENDIX I: TAILINGS STORAGE FACILITY MONTHLY DATA - TAILINGS, INTERSTITIAL, AND SUPERNATANT VOLUMES (2007-2013)

(Note: The data in this table was retrieved from annual Water Balance reports and tables. There appear to be errors made in the 2012 annual report. It is not known how monthly data was collected and estimated for interstitial water volumes in tailings mass.)

Month/Year	Monthly Tailings Discharge Volume (cubic meters)	Cumulative Volume of Tailings Mass (cubic meters)	Cumulative Interstitial Water Volume in Tailings Mass (cubic meters)	Supernatant Volume - End of Month (cubic meters)
2007				
November	194,502	16,689,835	14,199,224	4,168,662
December	175,472	16,865,307	14,352,947	4,279,179
2008				
January	175,472	17,040,779	14,506,670	4,451,796
February	163,245	17,204,024	14,665,004	4,483,452
March	233,962	17,437,986	14,869,968	4,735,637
April	223,868	17,661,854	15,072,627	5,168,483
May	224,604	17,886,458	15,269,392	5,424,813
June	236,415	18,112,873	15,474,356	5,407,433
July	238,057	18,350,929	15,682,907	5,216,762
August	222,264	18,573,194	15,877,623	3,400,000
September	215,057	18,792,250	16,075,926	3,350,199
October	226,413	19,018,665	16,280,890	3,254,289
November	235,299	19,253,964	16,490,978	3,155,854
December	154,379	19,408,343	16,628,816	3,166,975
2009				
January	172,170	19,580,513	16,782,539	3,081,512
February	218,082	19,798,595	16,977,255	2,938,465
March	207,752	20,006,346	17,162,748	2,817,691
April	244,860	20,251,206	17,381,373	2,771,178
May	230,134	20,481,340	17,586,849	2,659,566
June	229,560	20,710,899	17,791,813	2,338,441
July	231,281	20,942,181	17,998,314	1,924,279
August	206,604	21,148,785	18,182,782	1,528,308
September	222,673	21,371,458	18,381,597	1,299,677
October	246,203	21,617,660	18,601,421	1,180,821
November	227,830	21,845,491	18,804,841	1,041,874
December	204,717	22,050,208	18,987,624	898,414
2010				
January	241,566	22,291,774	19,203,308	637,715
February	206,038	22,497,811	19,387,270	531,684
March	245,543	22,743,355	19,606,505	335,696
April	240,566	22,983,921	19,821,297	249,759
May	273,736	23,257,657	20,065,704	209,732
June	257,094	23,514,751	20,295,252	880,000
July	265,559	23,780,310	20,532,358	645,464
August	264,377	24,044,687	20,768, 409	529,650
September	250,551	24,295,238	20,992,116	448,119

Month/Year	Monthly Tailings Discharge Volume (cubic meters)	Cumulative Volume of Tailings Mass (cubic meters)	Cumulative Interstitial Water Volume in Tailings Mass (cubic meters)	Supernatant Volume - End of Month (cubic meters)
October	249,057	24,544,295	21,221,900	568,467
November	232,336	24,776,631	21,429,343	780,168
December	253,820	25,029,450	21,655,075	850,374
2011				
January	208,226	25,237,677	21,840,991	990,486
February	163,774	25,401,450	21,987,217	1,171,670
March	239,811	25,641,262	22,201,335	1,409,071
April	250,042	25,891,303	22,242,586	1,883,922
May	228,113	26,119,416	22,628,258	2,443,699
June	250,642	26,370,058	22,852,046	2,488,853
July	253,849	26,623,907	23,078,696	2,537,533
August	263,208	26,887,114	23,313,703	3,000,000
September	266,830	27,153,945	23,551,944	2,858,821
October	252,713	27,406,658	23,785,102	2,734,557
Errors in 2012 Water Balance Report ???				
November	236,677	27,904,172	22,666,692	1,401,497
December	255,168	28,159,340	22,835,533	1,341,922
2012				
January	246,891	28,406,230	23,017,796	1,287,585
February	222,961	28,629,192	23,194,146	1,242,769
March	250,809	28,880,001	23,353,404	- 302,475
April	275,448	29,155,448	23,532,553	4,166,182
May	267,326	29,422,775	23,729,302	4,441,340
June	266,636	29,689,411	23,920,249	4,897,493
July	256,565	29,945,976	24,103,510	4,664,533
August	266,248	30,212,224	23,157,076	4,775,854
September	244,288	30,456,512	23,331,568	5,015,529
				New category entered for reporting year on “elevation”
October	238,872	30,695,385	23,502,191	4,595,774
November	253,975	30,949,360	23,683,601	4,596,847
December	250,071	31,438,303	23,862,223	4,802,198
2013				
January	248,768	31,687,070	24,039,915	5,252,278
February	224,417	31,911,487	24,200,212	5,593,696
March	264,382	32,175,869	24,389,057	5,778,586
April	247,109	32,422,978	24,565,563	6,723,329
May	259,123	32,682,102	24,750,651	6,721,065
June	244,371	32,926,472	24,925,202	7,097,651
July	259,961	33,186,433	25,110,888	6,918,513
August	264,818	33,451,252	25,300,044	6,753,258
September	261,645	33,712,897	25,486,933	6,526,815

APPENDIX J: Ministry of Energy, Mines and Petroleum Resource Information Letter, June 1992.

MINE DEVELOPMENT ASSESSMENT PROCESS
MOUNT POLLEY COPPER/GOLD PROJECT
INFORMATION LETTER NO.1 (JUNE 1992)

IN'I'RODUCI'ION

Imperial Metals Corporation Group proposes to develop the Mount Polley Copper/Gold project, located 150 km northeast of Williams Lake, near Likely, British Columbia.

The purpose of this Information Letter is to provide:

- background information on the Mount Polley Copper/Gold project;
- background information on the province's Mine Development Assessment Process;
- a summary of the review of the company's application for a Mine Development Certificate, based on the company's Stage I submission and subsequent correspondence; and
- an outline of further public consultation to be undertaken prior to a decision by government on project approval.

PROJECT DESCRIPTION

The Mount Polley project contains 51,402,000 tonnes of ore grading 0.38% copper and 0.55 g/tonne gold. The open pit mine and conventional milling facilities, to be located onsite, will process approximately 13,700 tonnes of ore per day over the 14-year mine life. Milling will consist of a standard froth flotation process, producing approximately 160 tonnes of ore concentrate per day.

Tailings from the mill will be deposited by gravity flow behind an impervious dam constructed of glacial till. Surface run-off from the waste dumps and mill site as well as pit water, will be collected in sediment ponds, tested and if environmentally acceptable, released to the environment. Water not meeting water quality guidelines will be sent to the tailings pond, or treated before release.

Freshwater requirements for the mill and for regulation of downstream fisheries requirements will be stored behind a one-metre dam at the outlet of Polley Lake. The development plans include maximum water conservation in order to minimize the water requirements from Polley Lake.

Project capital costs are estimated to be approximately $132,000,000, with an average annual operating cost of about $33,000,000. Project construction workforce will peak at 200 persons, with 162 persons required to operate the mine. The workforce is expected to be recruited from the local area and region.

MINE DEVELOPMENT ASSESSMENT PROCESS

In August 1991, the Province proclaimed the *Mine Development Assessment Act*, which formalized the province's long-standing Mine Development Review Process.

The new Mine Development Assessment Process (MDAP) facilitates the development of technically sound and environmentally acceptable mining ventures in British Columbia. Under the *Mine Development Assessment Act*, the assessment process sponsors and implements a comprehensive procedure for project review and approval by providing a one-window point of contact, early identification of issues, and a stakeholder consultation program.

The MDAP consists of two phases: pre-application and application. To facilitate the preparation and review of an application, proponents are expected to submit a prospectus in the pre-application phase. This document contains a brief description of the project, its potential environmental and socio-economic impacts, and a proposed stakeholder consultation program. Applications should contain a detailed plan of the proposed mine development, as well as a detailed assessment of impacts and mitigation programs to address issues raised in the prospectus review. A Mine Development Certificate is issued by the Minister of Energy, Mines and Petroleum Resources, with the concurrence of the Minister of Environment, Lands and Parks, when all policy and technical issues have been identified and are known to be resolvable at the permitting stage. Once a Mine Development Certificate has been issued, a mine proponent proceeds to the permitting phase, where all necessary statutory permits, licenses and approvals to construct and operate a mining project are applied for and received as project development progresses.

Opportunities for input by local governments, aboriginal groups and the public are provided at all stages of the process. Consultation programs are flexible and designed to meet public needs on a project-specific basis.

SUMMARY OF REVIEW TO DATE

Imperial Metals Corp. submitted a prospectus in June 1989, under the former Mine Development Review Process. Following the review of the prospectus by provincial, federal and local governments, aboriginal groups and the public, a compendium of review comments was provided to the company in September 1989. The review concluded that a more detailed Stage I report would be required for review prior to a decision on project approval-in-principle. The compendium of prospectus review comments provided the terms of reference for the Stage I submission.

The company submitted its Stage I submission in July 1990. These reports were distributed to provincial, federal and local governments and aboriginal groups for review. The reports were also made available for public review at selected locations throughout the project area.

The review of Imperial Metals' Stage I submission, now considered an application for a Mine Development Certificate under the Mine Development Assessment Process, focussed on the following key issues: socio-economic impacts, archaeological resources, water supply, management of fisheries and wildlife, potential for acid mine drainage, groundwater, the tailings pond and the load out facility.

All issues, with the exception of the load out facility, have been addressed to the satisfaction of provincial and federal review agencies, and any remaining concerns are deemed to be resolvable

during the permitting process, where the company must apply for and obtain all applicable statutory permits, licenses and approvals as project development proceeds. The company is currently working with representatives of B.C. Rail to locate and design an acceptable load out facility.

A Public Liaison Committee has been recommended to provide opportunities for ongoing communication between public groups, key government permitting agencies and the company as project development proceeds.

FURTHER PUBLIC CONSULTATION

Imperial Metals Corporation conducted a series of public open houses and meetings during the review of the 1989 prospectus and 1990 Stage I submission. However, several of the issues raised during both this consultation process and the initial review by government required lengthy iterations and further planning and assessment by both government and the company. The results of this further assessment are now being made available to the public for review. A public meeting, sponsored by the province's MDAP Management Committee, will be held in the near future to discuss the Mount Polley project. The Management Committee will also meet with identified stakeholder groups to discuss their concerns.

An interim report entitled: Mount Polley Copper/Gold Project - A Report Summarizing the Technical Review and Outlining Commitments, and Permit, License and Approval Requirements is available for review at the following locations: Williams Lake City Hall, Williams Lake Public Library, Williams Lake Government Agent’s Office, Quesnel Government Agent’s Office, Likely Chamber of Commerce.

Details of a further public meeting, to be held in mid-July, will be announced through the local media in the near future.

Appendix K: Mount Polley - Annual Gold, Copper, Silver Production and Milled Ore Accounting, Tailings Storage Facility and Crest Elevation (1997 - 2013)

Year	Copper (pounds)	Gold (ounces)	Silver (ounces)	Ore Milled (tonnes)	Ore Milled per Day (tonnes)	TSF Crest Elevation (meters)
1997 (Startup - August 1)	8,653,000	19,382	16,235	2,422,000	15,830 (153 days)	934
1998	23,855,000	101,831	54,079	5,829,701	15,972	936
1999	37,100,000	99,585	91,729	7,090,465	19,426	937
2000	34,181,000	83,194	91,198	6,949,600	18,988	941
2001 (ending September 30)	29,968,000	66,593	72,984	5,149,703	18,863 (273 days)	942.5
2005 (Startup - March 8)	30,328,771	30,635	234,355	4,814,083	16,209 (297 days)	944 - 949
2006	55,548,194	38,164	422,568	6,235,221	17,083	949
2007	51,506,144	34,833	370,731	6,444,112	17,655	949 - 951
2008	60,305,759	47,001	522,340	6,848,983	18,713	951 - 954
2009	33,860,500	49,412	202,992	7,045,737	19,303	954
2010	34,842,611	46,771	206,812	7,894,596	21,629	954 - 958
2011	26,450,426	42,514	95,786	7,716,856	21,142	960.5
2012	33,789,600	52,236		8,121,878	22,191 Feb - Dec 8,056,240 dry tonnes of tailings	963.5
2013	38,501,165 lbs. $3.32	45,823		7,956,738	21,799	965
TOTAL	**425,920,770**	**756,356**	**2,055,584**	**82,350,753**		
2014	44,000,000 (forecast)	47,000 (forecast)	120,000 (forecast)			970 (under construction)

Imperial Metals

Press Release

Imperial Completes $115 Million Non-Brokered Private Placement of Convertible Debentures

Vancouver – **September 3, 2014 | Imperial Metals Corporation (III-TSX)** (the "Company" or "Imperial") announces the closing of a non-brokered private placement of $115.0 million Face Value of 6% 6-year senior unsecured convertible debentures (the "Convertible Debentures"), which is a $15.0 million increase from the $100.0 million Convertible Debenture Face Value offering previously announced on August 14, 2014. The Convertible Debentures provide additional financing to complete and commission the Red Chris mine, fund costs of remediating the effects of the tailings dam breach at the Mount Polley mine, and to fund ongoing operations.

As announced, Edco Capital Corporation ("Edco") and The Fairholme Partnership, LP ("Fairholme") have each purchased $40.0 million, or 34.8%, of the Convertible Debentures. Subject to adjustment, each $12.00 of Face Value is convertible into one common share of Imperial upon at least 61 days advance notice. The Convertible Debentures are not callable unless the closing price of Imperial's common shares exceeds 125% of the conversion price for at least 30 consecutive days. Interest will be payable semi-annually, with the first payment due on June 30, 2015. At the option of the Company, subject to the separate approval of the TSX and compliance with all applicable securities laws, such interest may be paid through the issuance of additional Convertible Debentures or Imperial's common shares.

Edco is owned by N. Murray Edwards, a significant shareholder of the Company. Fairholme and parties related to it are also significant shareholders of the Company. The issue of Convertible Debentures to Edco and Fairholme constitute "related party transactions" within the meaning of Multilateral Instrument 61-101 - *Protection of Minority Security Holders in a Special Transaction* ("MI 61-101"). The Convertible Debentures purchased by Edco and Fairholme are exempt from the formal valuation and minority approval requirements of MI 61-101 pursuant to section 5.5(a) and 5.7(1)(a) of MI 61-101, respectively, as they represent less than 25% of the Company's market capitalization.

Mr. Edwards announces that, through Edco, he can now acquire up to an additional 3,333,333 common shares of Imperial in the event of conversion pursuant to the terms and conditions of its $40.0 million Convertible Debenture. Assuming the conversion of the entire $40.0 million Convertible Debenture, as well as the exercise of all warrants currently held by Mr. Edwards and his affiliates, Mr. Edwards would then beneficially own 31,101,815 common shares, representing approximately 39.3% of the then issued common shares of the Company. Mr. Edwards indicated that Edco's acquisition of the Convertible Debenture was for investment purposes and that he may acquire additional common shares, debentures, warrants or other securities of Imperial from time to time, depending on market conditions. A copy of Mr. Edwards' early warning report may be obtained from the persons set forth below.

The material change report in relation to this transaction will be filed less than 21 days before closing as the Company completed this transaction on September 3, 2014 since all necessary approvals had been received and the Company wished to complete the transaction as soon as was commercially feasible after such approvals were received.

This announcement does not constitute an offer of securities for sale in the United States of America. These securities may not be offered or sold in the United States absent registration or an exemption from registration. Any public offering of securities to be made in the United States will be made by means of a prospectus that may be obtained from the Company and that will contain detailed information about the Company and management, as well as financial statements.

About Imperial

Imperial is an exploration, mine development and operating company based in Vancouver, British Columbia. The Company operates the Mount Polley copper/gold mine in British Columbia and the Sterling gold mine in Nevada. Imperial has 50% interest in the Huckleberry copper mine and has 50% interest in the Ruddock Creek lead/zinc property, both in British Columbia. Imperial is in development of its wholly owned Red Chris copper/gold property in British Columbia.

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Appendix M: IEI Energy Inc. History (Source: Rider Resources Inc. and IEI Energy Inc. Information Circular and Proxy Statement, Appendix G, January 20, 2003)

IEI ENERGY INC.

General

IEI Energy Inc. ("IEI") was incorporated on December 10, 1959 under the name "Imperial Metals and Power Ltd." (Non-Personal Liability), was converted to a limited company under the name "Imperial Metals and Power Ltd." on November 19, 1969 and was amalgamated with Risby Tungsten Mines Ltd. and Invex Resources Limited on December 1, 1981 to form Imperial Metals Corporation.

IEI's head office is located at Suite 1700, 333 – 7th Avenue S.W., Calgary, Alberta, T2P 2Z1 and its registered office is located at 1400 First Canadian Place, 350 - 7th Avenue S.W., Calgary, Alberta, T2P 3N9.

Recent Developments

IEI, previously named Imperial Metals Corporation ("Old Imperial"), was reorganized under a Plan of Arrangement (the "Imperial Plan") initiated on November 23, 2001. Under the Imperial Plan, completed on April 30, 2002, the operations of Old Imperial were divided into two distinct businesses, one focused on oil and natural gas and the other focused on mining. The Imperial Plan also satisfied a major portion of the debt of Old Imperial through a cash payment of $1 million and the issuance of approximately 77 million common shares ("Old Imperial Shares"). The Old Imperial Shares were then consolidated on the basis of one IEI Share for each 10 Old Imperial Shares, including all Old Imperial Shares issued to the creditors of Old Imperial under the Imperial Plan, such that IEI now has approximately 15,769,000 IEI Shares issued and outstanding. As part of the Imperial Plan, IEI was also continued into Alberta under the *Business Corporations Act* (Alberta). The Imperial Plan was widely supported and was approved by a majority of more than 95% of the creditors and shareholders who voted on March 7, 2002.

All of the mining assets of Old Imperial, including the name Imperial Metals Corporation, were transferred to a new company ("New Imperial") which was listed for trading on the Toronto Stock Exchange on April 25, 2002 under the symbol "III". The shareholders of Old Imperial received one common share of New Imperial ("New Imperial Share") and one IEI Share for each one Old Imperial Share, after consolidation. IEI is now a Calgary based oil and natural gas company.

Historical Developments

In April 1998, Old Imperial completed a plan of arrangement with Princeton Mining Corporation ("Princeton"), which resulted in the acquisition by Old Imperial of the mining assets of Princeton in consideration of 12,498,763 Old Imperial Shares. The mining assets of Princeton included a 60% equity interest in Huckleberry Mines Ltd., the owner of the Huckleberry Mine located near Houston, British Columbia, and a 100% equity interest in Similco Mines Ltd., the owner of the Similco Mine located near Princeton, British Columbia.

In April 1999, Old Imperial exercised an option to increase its interest in the Sterling Mine, located near Beatty, Nevada, from 10% to 50% through property expenditures, and on December 31, 1999, Old Imperial increased its interest in the Sterling Mine to 100% as part of a debt settlement with Cathedral Gold Corporation.

Effective December 31, 2000, Old Imperial acquired an additional 47.5% interest in the Mount Polley Mine from Sumitomo Corporation, increasing Old Imperial's interest in the Mount Polley Mine to 100% by restructuring of the outstanding term debt associated with the Mount Polley Mine. The outstanding term debt was converted to a $10.5 million non-recourse and non-interest bearing loan, with $4.5 million repaid in cash by March 31, 2001 and the balance repayable over a period of up to 10 years at a maximum rate each year of 10 monthly payments of $116,667 each, conditional on the Mount Polley Mine continuing to operate.

Corporate Strategy

Historically, the main assets of Old Imperial, which were held either directly or through subsidiaries, were several mining and exploration properties and the related buildings and mining equipment. Old Imperial also held interests in various marketable securities and non-operated oil and gas properties in Alberta and Saskatchewan.

Intercorporate Relationships

IEI has one wholly owned subsidiary, Minexco Energy Ltd. ("Minexco"). IEI also holds an 87.2% interest in Minexco Energy Limited Partnership No. 1 ("Minexco LP1"), an Alberta limited partnership, and an 87.4% interest in Minexco Energy Limited Partnership No. 2 ("Minexco LP2"), an Alberta limited partnership. Minexco is the general partner of each of Minexco LP1 and Minexco LP 2 and holds a 12.8% and 12.6% interest, respectively, in such limited partnerships. Minexco LP1 and Minexco LP2 hold interests in a number of minor oil and gas properties.

IEI and its subsidiary currently have no employees but utilize the services of professionals, as required from time to time, on a contract or consulting basis.

BUSINESS AND PROPERTIES

General

Prior to the Imperial Plan, Old Imperial was principally engaged in exploring, developing, mining, processing and marketing base and precious metals in North America and owned mining and processing facilities in British Columbia and Nevada. For a description of the principal properties of Old Imperial as at December 31, 2001 prior to giving effect to the Imperial Plan, see "Business and Properties" at pages 3 to 16 of the Annual Information Form of IEI dated May 17, 2002 for the fiscal year ended December 31, 2001 (the "IEI 2001 AIF"). Pursuant to the Imperial Plan, all of the mining assets of Old Imperial were transferred to New Imperial and Old Imperial, which retained the oil and natural gas assets and the marketable securities, renamed "IEI Energy Inc.", refocused its business on the oil and natural gas sector.

Rider Shareholders can obtain a copy of the IEI 2001 AIF from the Corporate Secretary of Rider at 2100, 330 – 5th Avenue S.W., Calgary, Alberta, T2P 0L4, or by accessing IEI's disclosure documents available through the internet on the SEDAR website which can be accessed at www.sedar.com.

Principal Properties

The following is a brief description of the principal oil and natural gas properties which IEI holds an interest. IEI also holds some very minor oil and natural gas interests in Saskatchewan. Information is as at December 31, 2002, except where indicated otherwise.

Beaverhill Lake, Alberta

The Beaverhill Lake area is located approximately 55 kilometres southeast of the city of Edmonton. IEI has an average working interest of 5.84% in 1,824 (102 net) hectares of land and 3 producing and 6 shut-in gas wells in the area. Dominion Exploration Canada Ltd. is the operator.

Bolloque, Alberta

The Bolloque area is located approximately 100 kilometres north of the city of Edmonton. IEI has a working interest of 5.98% in Bolloque Gas Unit No. 1, comprising 592 hectares (35 net) of land. There are currently 3 producing gas wells and 3 shut-in gas wells. Viking Energy Acquisitions Ltd. is the operator.

IEI also has an average working interest of 7.34% in 1,024 (75 net) hectares of land, 3 producing and 1 shut-in gas well and a 0.66% overriding royalty interest in 512 hectares of land outside of the Bolloque Unit No. 1 in the area.

Cache, Alberta

The Cache area is located approximately 107 kilometres northeast of the city of Edmonton. IEI has a 0.21% overriding royalty interest in 256 hectares of land and 1 producing gas well and a 0.07% overriding royalty interest in 2,560 hectares of land in the area. Canadian Natural Resources Limited is the operator.

Dinant, Alberta

The Dinant area is located approximately 68 kilometres southeast of the city of Edmonton. IEI has an average working interest of 5.74% in 1,344 (77 net) hectares of land and 2 producing gas wells in this area. Dominion Exploration Canada Ltd. is the operator.

Edmonton, Alberta

The Edmonton area is located approximately 35 kilometres southwest of the city of Edmonton. IEI has an average working interest of 12.24% in 1,920 (112 net) hectares of land and 1 shut-in gas well in this area. In addition, IEI has a 7.23% royalty interest in 1 shut-in oil well. ConocoPhillips Canada Resources Corp. is the operator.

Haddock, Alberta

The Haddock area is located approximately 50 kilometres north of the town of Hinton. IEI has a 1.14% gross overriding royalty in the 07-24-056-16W5 gas well operated by ISH Energy Ltd.

House, Alberta

The House area is located approximately 100 kilometres southwest of the town of Fort McMurray. IEI has a 5% working interest in 3,840 (192 net) hectares of land.

Joarcam, Alberta

The Joarcam area is located approximately 25 kilometres southeast of the city of Edmonton. IEI has an overriding royalty interest of 0.45% in 320 (1 net) hectares of land in the Joarcam Viking Gas Cap Unit. There are 107 producing oil wells in the Joarcam Viking Gas Cap Unit, which is operated by Enermark Inc..

Medicine Hat, Alberta

The Medicine Hat area is located approximately 25 kilometres north of the city of Medicine Hat. IEI has an average working interest of 24.42% in 1,088 (263 net) hectares of land and 23 producing gas wells in this area. Direct Energy Resources is the operator.

Peco, Alberta

The Peco area is located approximately 110 kilometres northwest of the town of Rocky Mountain House. IEI has an average 12.5% working interest in 256 (32 net) hectares of land, 1 producing oil well, as well as 1 producing gas well. ConocoPhillips Canada Limited is the operator.

Sousa-Virgo, Alberta

The Sousa-Virgo area is located approximately 60 kilometres northeast of the town of Rainbow Lake. IEI has an average working interest of 4.91% in the Sousa-Bluesky-Gething Gas Unit, comprising 4,544 hectares (223 net) of land and 40 producing and 1 shut-in gas wells in this area. In addition, IEI has an average working interest of 7.69% in 18,688 (1,466 net) hectares of land and 21 shut-in gas wells. Encana Oil & Gas Ltd. is the operator.

Sylvan Lake, Alberta

The Sylvan Lake area is located approximately 15 kilometres west of the city of Red Deer. IEI has a working interest of 7.5% in 256 (19 net) hectares of land and 1 producing gas well and 1 producing oil well in this area. NCE Resources Group Inc. is the operator.

Tomato, Alberta

The Tomato area is located approximately 168 kilometres north of the city of Edmonton. IEI has a working interest of 10% in 1,152 (115 net) hectares of land and 1 producing gas well in the area. In addition, IEI has an average net profits interest of 2.65% in 3,904 (103 net) hectares of land. Canadian Natural Resources Ltd. is the operator.

Trout Lake, Alberta

The Trout Lake area is located approximately 158 kilometres northeast of the town of Peace River. IEI has an average working interest of 18.86% in 256 (48 net) hectares of land and 4 producing oil wells in this area.

Summary of Certain Financial Information

The following is a summary of certain unaudited financial information relating to IEI's oil and gas operations. See also the historical and pro forma financial statements of IEI attached as Appendix H and Appendix I to the Circular, respectively.

Description	Nine Months ended September 30, 2002 ($)	Nine Months ended September 30, 2001 ($)	Year Ended December 31, 2001 ($)	Year Ended December 31, 2000 ($)	Year Ended December 31, 1999 ($)
Revenue, net of royalties	690,756	1,155,202	1,388,761	597,931	551,674
Operating costs	128,659	163,424	213,376	164,536	188,760
Operating margin	562,097	991,778	1,175,385	433,395	362,914

Marketable Securities and Investments

IEI also holds a portfolio of junior resource company shares with a book value of $1,236,147 and a market value on December 31, 2002 of $3,520,432 comprised of the following investments:

Description	Share Amount	Unit Book Value ($)	Book Value ($)	Market Value Per Share on December 31, 2002[(1)] ($)	Market Value on December 31, 2002[(1)] ($)
Cathedral Energy Services Ltd. (CET.UN)	173,782	0.34	59,535	1.25	217,228
Miramar Mining Corp. (MAE)	1,147,800	0.76	872,328	1.95	2,238,210
Viceroy Resource Corporation (VOY)	2,535,700	0.12	304,284	0.42	1,064,994
			1,236,147		3,520,432

Note:

(1) Based on their year-end closing trading prices.

At December 31, 2002, IEI owed $2,748,746 on the margin loan advanced against the marketable securities listed above.

Oil And Natural Gas Reserves

IEI has internally evaluated effective January 1, 2003, the oil and natural gas reserves attributable to all of the principal properties of IEI (the "IEI Evaluation"). The following table summarizes management's evaluation of IEI's interest in such reserves and estimated future net production revenue from these reserves. **All evaluations of future net production revenues set forth in the table are stated prior to any provision for income tax and indirect costs. It should not be assumed that the present worth of estimated future net production revenue**

MANAGEMENT'S DISCUSSION AND ANALYSIS

This discussion and analysis, provided by the management of IEI, should be read in conjunction with the financial statements of IEI contained in Appendix H to this Information Circular. All references to IEI below shall be considered to be a reference to Old Imperial, where applicable.

Comparison of the Nine Months Ended September 30, 2002 and 2001

For the purposes of the discussion that follows for the comparison of the nine months ended September 30, 2002 and 2001, all amounts for the nine months ended September 30, 2001 have been adjusted to reflect the discontinuance of IEI's mining operations which occurred pursuant to the Imperial Plan.

Results of Operations

Financial Results

Net revenues decreased to $691,000 for the nine months ended September 30, 2002 compared to $1,155,000 for the nine months ended September 30, 2001. The decrease is primarily due to lower natural gas prices in the period ended 2002.

Interest expense of $321,000 for the nine months ended September 30, 2002 did not substantially change from $305,000 for the same period in 2001.

For the nine months ended September 30, 2002, IEI recorded net income of $876,000 ($0.06 per share) from continuing operations compared to a net income of $254,000 ($0.03 per share) for the same period last year. The net income figures include a gain on the sale of marketable securities of $907,000 for the nine months ended September 30, 2002. In 2001, losses of $241,000 on security transactions and losses in this former affiliates of the Company are included in net income.

Liquidity & Capital Resources

Cash Flow from Operations

Cash flow from operations for the nine months ended September 30, 2002 decreased to $178,000 from $623,000 in the prior period.

Working Capital

At September 30, 2002, IEI had a working capital deficiency of $574,000. This has improved when compared to the working capital deficiency of $2,314,000 at September 30, 2001 due to proceeds on the sale of marketable securities.

Property Expenditures

Property development expenditures totalled $212,000 for the nine months ended September 30, 2002 compared to $1,046,000 at September 30, 2001.

Comparison of the Fiscal Years Ended December 31, 2001 and 2000

General

After year-end, IEI, previously named Imperial Metals Corporation was reorganized under the Imperial Plan. The Imperial Plan was approved by creditors and shareholders of IEI on March 7, 2002 and by the Supreme Court of British Columbia on March 8, 2002, and implemented in April 2002.

Under the Imperial Plan, IEI divided its operations into two distinct businesses, one focused on oil and natural gas and the other focused on mining. All of IEI's oil and natural gas assets and investment assets were retained in IEI and all of IEI's mining assets including associated debt and the name "Imperial Metals Corporation" were transferred to New Imperial that focuses exclusively on the mining business.

Prior to the completion of its reorganization in April 2002 IEI was an established mine development and operating company. It operated and held a 100% (2000 – 52.5%*)* interest in the Mount Polley Mine and a 50% interest in the Huckleberry Mine both located in central British Columbia. IEI also owned the Similco and Goldstream copper mines, both of which were suspended in 1996, and various exploration properties, the most advanced of which are Silvertip in Northern British Columbia and Sterling in Nevada.

This management discussion and analysis reviews the operations of IEI up to the reporting date of December 31, 2001 when the primary focus of IEI was mining, a business that IEI no longer carries on. Now that the reorganization of IEI has been completed, future reports will provide analysis of the oil and natural gas and related initiatives of IEI.

Results of Operations

Financial Results

Operating revenues increased to $112.0 million for the year ended December 31, 2001 from $94.4 million in the year ended December 31, 2000. Inclusion of 100% of the revenues from the Mount Polley Mine as a result of the December 31, 2000 acquisition of the remaining interest accounted for an increase of $28.5 million however this increase was largely offset by lower metal prices as the average realized metals prices in the year 2001 fell from the price levels recorded in the year 2000.

Cash flow from operations (before net change in working capital) was unfavourably impacted by these factors, as it fell to $7.9 million from $8.9 million in the year ended December 31, 2000.

Mining and milling operations at the Mount Polley Mine were suspended in September 2001 because of low metal prices. The costs associated with the suspension of mining operations at the Mount Polley Mine and the writedown of the Mount Polley Mine carrying value along with writedowns of mineral exploration properties resulted in a net loss of $19.4 million ($0.24 per share pre consolidation - $2.40 per share post consolidation) compared to net loss of $2.5 million ($0.03 per share pre consolidation - $0.30 per share post consolidation) in the prior year.

Mineral Operations

Mineral revenues increased to $109.4 million in 2001 from $91.8 million in the prior year. After deduction of mineral production, treatment and transportation costs but before financing charges, depletion and depreciation, IEI recorded cash flow of $9.7 million from its former mining operations in 2001 compared to cash flow of $15.6 million in 2000. In the six months ended June 30, 2000 the Mount Polley Mine and the Huckleberry Mine operated under an Economic Plan from the Job Protection Commission of BC and realized benefits of approximately $1.6 million during that period. The Economic Plans for the two mines expired in June 2000.

Administration and Capital Taxes

Administration expenses declined to $0.8 million from $1.3 million in 2000 as a result of cost reductions. Capital taxes remained unchanged at $0.2 million.

Interest Expense

Interest expense on long term debt decreased substantially from $9.8 million in 2000 to $5.6 million due to the debt reduction on the Mount Polley Mine effective December 31, 2000 as a result of the purchase of Sumitomo Corporation's interest in the Mount Polley Mine and lower borrowing rates in 2001 compared to 2000. Interest

expense on short-term debt increased by *$0.5* million to $1.5 million as a result of higher average levels of short-term debt and interest on provincial sales tax assessments.

Foreign Exchange Losses

During both 2001 and 2000, the majority of IEI's former long-term debt was denominated in US Dollars. At December 31, 2000, the Mount Polley debt was converted to Canadian Dollar denominated debt as part of the purchase of Sumitomo Corporation's interest in the Mount Polley Mine. In the year ended December 31, 2001, the Canadian Dollar weakened against the US Dollar similar to the year 2000. The larger current portion of long term debt at December 31, 2001 compared to December 31, 2000 served to magnify the amount of the losses which totalled $1.8 million in 2001 compared to $1.4 million in 2000. The exchange rate on the date of repayments will be used in calculating the ultimate foreign exchange gain or loss on the debt. The December 31, 2000 settlement and conversion of the debt owed to Sumitomo Corporation from a US$ denominated debt to a Cdn$ denominated debt on acquisition of Sumitomo Corporation's interest in the Mount Polley Mine reduced exposure to US$ denominated debt by about 50% from the level throughout most of the year 2000.

Other foreign exchange losses increased to $0.7 million from $0.5 million resulting from a higher loss on US Dollar denominated accounts receivable due to a combination of factors including the volatility of the exchange rate, a higher level of receivables, and timing of cash receipts.

Equity Losses in Affiliates and Gains on Sales of Investments

Colony Pacific Explorations Ltd. ceased to be an affiliate early in 2001 on the completion of a merger with zed.i. solutions inc. and during 2000, Cathedral Gold Corporation acquired Directional Plus Ltd. in a share exchange transaction and changed its name to Cathedral IEI Services Ltd. Both these transactions reduced the percentage of common shares held by IEI in these companies to less than 20% and accordingly IEI ceased to equity account for these investments after the dates of the transactions. The equity loss in affiliates totalled $0.1 million in 2001, down from a loss of $0.4 million in 2000.

Starting in the year 2000, IEI reduced its ownership in Cathedral IEI Services Ltd. by selling most of the shares of Cathedral it owned, realizing gains of $0.3 million in the year 2000 and $0.8 million in the year 2001. The proceeds from these sales were used to reduce short-term debt.

Mount Polley Mineral Property Writedown

IEI recorded a writedown of $3.1 million on the Mount Polley Mine producing mining property, plant and equipment, net of related cost reductions as a result of suspension of mining operations effective September 30, 2001. Note 7 of the financial statements of IEI for the year ended December 31, 2001 which are contained in Appendix H to the Circular provides further details on the components of this writedown.

Writedown of Marketable Securities

The decline in equity markets for mining companies reduced the market value of IEI's portfolio of marketable securities requiring a writedown of $1.0 million in 2001 compared to a writedown of $1.5 million in 2000.

Taxes

A tax expense of $0.5 million was recorded in the year ended December 31, 2001 on a pretax loss of $18.6 million, compared to a tax expense of $0.5 million on pretax loss of $2.0 million in the prior year. The effective tax recovery rates were significantly less than the expected 44.6% in 2001 and 45.6% in 2000 due to the non-recognition of operating loss carry forwards and BC mineral and Federal large corporation taxes. Because of the uncertainty surrounding the timing of realizing the benefit of the future income tax assets, a valuation allowance has been provided at both December 31, 2001 and 2000.

Liquidity & Capital Resources

Cash Flow from Operations

As a result of lower operating margins cash flow from operations (before net change in non-cash operating balances) fell to $7.9 million in 2001 from $8.9 million in 2000.

Working Capital

Working capital, excluding current portion of former long-term debt of $31.5 million, increased slightly to $1.7 million at year end compared to $1.5 million at December 2000. After year-end, all of IEI's mining assets including associated debt and the name "Imperial Metals Corporation" were transferred to New Imperial. Refer to Note 21 to the financial statements of IEI for the year ended December 31, 2001 which are contained in Appendix H to the Circular for further details on the proforma working capital of the two companies.

Property Expenditures

Property acquisition and development expenditures totalled $8.5 million in 2001 versus $13.1 million in the year 2000. Expenditures on exploration properties totalled $0.7 million in 2001 compared to $0.6 million in 2000. Oil and natural gas property additions increased to $1.0 million in 2001 from $0.1 million in 2000 as IEI purchased an interest in three producing properties for $0.6 million. The balance of expenditures in both years were for Mount Polley and Huckleberry Mine ongoing capital projects, including tailings dam construction and in 2000, the grinding improvement project at the Huckleberry Mine.

Acquisitions

Effective December 31, 2000 IEI acquired Sumitomo Corporation's interest in the Mount Policy Mine. Refer to Note 4 to the financial statements for further details.

Debt and Equity Financing

During the year ended December 31, 2001, IEI had three short-term credit facilities. A revolving $7.0 million concentrate advance facility for the Mount Polley Mine assisted IEI with financing its former Mount Polley Mine working capital requirements. There was no balance outstanding on this facility at year end. Two revolving credit facilities totalling $4.4 million provided support for IEI's day-to-day non-mine corporate operations. At December 31, 2001, a total of $4.4 million was drawn on these facilities. The maturity date on these facilities was extended to June 30, 2003 and the balances reclassified to long-term debt. A portion of this debt, $1.4 million, was settled and paid with common shares as part of the Imperial Plan as further described in Note 2 and 21 to the financial statements of IEI for the year ended December 31, 2001 which are contained in Appendix H to the Circular.

All of the long-term project debt on IEI's balance sheet at December 31, 2001 was assumed by New Imperial pursuant to the Imperial Plan. This debt was non-recourse to IEI as it was secured by the mining properties on which the funds were invested. All of energy's mining properties have now been transferred to New Imperial. Long-term debt additions from the reclassification of the short-term debt totalled $4.1 million during the year ended December 31, 2001, compared to an increase of $1.8 million from new debt raised in 2000.

In 1998, declining metal prices reduced profitability and cash flow and in mid-1998 an Economic Plans were established by the Job Protection Commission of British Columbia for both the Mount Policy and Huckleberry Mines. Among other provisions of the Economic Plans, repayment of the long term project debt was rescheduled to more closely match repayment obligations to cash flow from the mines. During 2001, $5.9 million in long-term project debt was repaid compared to $4.2 million in 2000. Other debt of $4.4 million was repaid on the rollover of long-term debt maturing during in the year 2001.

Declines in metal prices toward the end of 1998 negatively impacted the ability of the Huckleberry Mine to repay its long term project debt. In December 1998, Huckleberry could not meet all of its obligations for payment of interest on long term project debt and it became apparent that Huckleberry would be unable to fully satisfy its loan payments as then scheduled and would require additional funding. A financial restructuring package for Huckleberry was completed in June 1999 and this resulted in a deferral of repayment of all principal and interest payments during the period 1999 to 2001 on the majority of Huckleberry's debt. For the years 2000 and 2001 payments of principal and interest on the Huckleberry debt were dependent on available cash. Repayment of long term project debt and related accrued interest was further deferred by the lenders after December 31, 2001. As a result of the Imperial Plan, the Huckleberry project debt will no longer be carried on the balance sheet of IEI.

Concurrent with the acquisition of the Mount Polley Mine effective December 31, 2000, IEI issued $4.7 million of 8% subordinated secured convertible debentures (the "8% Debentures"). These funds were used to repay short term bridge financing loans on the acquisition of the Mount Polley Mine. All of the debt and accrued interest associated with the 8% Debentures was settled by the issuance of shares upon the Imperial Plan becoming effective in April 2002. IEI has no further obligations with respect to the 8% Debentures. Refer to Notes 2 and 21 of the financial statements of IEI for the year ended December 31, 2001 which are contained in Appendix H to the Circular for further details.

Restructuring of the project debt owing to Sumitomo Corporation on the Mount Policy Mine at December 31, 2000 reduced the Mount Polley project debt at that date from US$33.2 million to Cdn$ 10.1 million. Payments of $5.2 million were made on this debt in 2001 with the remaining amounts repayable over a period of up to 10 years at a maximum rate each year of 10 monthly payments of $116,667 each, conditional on the mine continuing to operate. The suspension of operations at the Mount Polley Mine has deferred all payments due for the month of October 2001 and beyond until the mine is back in production. As a result of the Imperial Plan, the Mount Policy project debt will no longer be carried on the balance sheet of IEI.

Oil & Natural Gas Assets

Subsequent to December 31, 2001 and upon completion of the Imperial Plan, the asset base of IEI consists of 11 producing and 3 non-producing oil and natural gas properties located across the Western Canadian Sedimentary Basin together with a portfolio of marketable securities and investments.

IEI's oil and natural gas properties are presently producing an average of 140 boe/d based upon a 6 mcf of natural gas to 1 boe conversion ratio. The major portion of this production consists of natural gas, which is presently averaging 763 mcf7d. Revenues over the last 4 years were as follows:

	Years Ended December 31			
	2001	**2000**	**1999**	**1998**
Revenue, net of royalties	$1,388,761	$597,931	$551,674	$534,364
Operating costs	$213,376	$164,536	$188,760	$187,540
Operating margin	$1,175,385	$433,395	$362,914	$346,824

IEI's primary objective is to expand its producing oil and natural gas property portfolio in Western Canada through asset and corporate acquisitions that present high quality exploitation, development and exploration opportunities.

Completion of the Imperial Plan and transformation of IEI into an oil and natural gas exploration, development and production company with profitable operations together with the existing cash and other non-cash resources of Old Imperial, should be sufficient to meet IEI's operating and capital needs for the coming year.

Comparison of the Fiscal Years Ended December 31, 2000 and 1999

General

IEI's interests in its producing mines changed as follows:

1. After acquiring the 47.5% of the Mount Polley Joint Venture owned by Sumitomo Corporation, effective December 31, 2000, IEI owned 100% of the Mount Polley Mine.

2. On July 31, 1999, IEI's ownership interest in the Mount Polley Joint Venture decreased from 55% to 52.5% as IEI sold a 2.5% joint venture interest to allow IEI to meet its loan payment obligations on the Mount Polley debt.

3. On June 30, 1999, IEI's ownership interest in the Huckleberry mine decreased from 60% to 50% as part of a restructuring plan for Huckleberry Mines Ltd.

4. Since December 31, 1999, IEI has owned indirectly, 100% of the Sterling Mine.

5. On March 31 and December 31, 1999, IEI increased its indirect ownership in the Sterling Mine Joint Venture by 40% and 50% respectively as a result of the inability of its affiliate, Cathedral Gold Corporation, to meet its joint venture obligations.

Results of Operations

Financial Results

Operating revenues decreased to $94.4 million for the year ended December 31, 2000 from $98.1 million in the year ended December 31, 1999. Although metal prices were higher in 2000 than in 1999, price gains were more than offset by IEI's lower average ownership interest in the two major operating mines and the reduced production and sale of metals resulting from the lower grade of ore mined in the current year.

Cash flow from operations before net change in non cash operating balances was significantly impacted by these factors, as it fell to $8.9 million from $18.0 million in the year ended December 31, 1999.

A $9.0 million gain on restructuring of interest in the Mount Polley Mine and long term debt contributed to reducing the loss in the year 2000. In the year ended December 31, 2000, IEI recorded a net loss of $2.5 million ($0.03 per share) compared to net loss of $6.1 million ($0.08 per share) in the prior year.

Set forth below is the sensitivity of IEI's 2001 operating income to the following price changes:

If the Gold price changes by US$10 per ounce:	$1,090,000
If the Copper price changes by US$0.01 per pound:	$935,000
If the US/Cdn Dollar Exchange Rate changes by US$0.01:	$654,000

Mineral Operations

Mineral revenues decreased to $91.8 million in 2000 from $95.9 million in the prior year. After deduction of mineral production, treatment and transportation costs and depletion and depreciation but before financing charges and writedowns, IEI recorded an operating income of $2.2 million from its mining operations in 2000 compared to an operating income of $7.0 million in 1999.

Administration and Capital Taxes

Administration expenses declined slightly to $1.3 million from $1.4 million in 1999. Capital taxes decreased to $0.2 million in 2000 from $0.5 million in 1999 as a result of the lower capital base due to the reduction in the long term debt on the Mount Polley Mine.

Interest Expense

Interest expense on long term debt increased from $8.5 million in 1999 to $9.8 million due to higher interest rates in 2000 versus 1999 and interest on the deferred principal and interest owing by Huckleberry Mines Ltd. Interest expense on short term debt increased slightly as a result of higher average levels of short term debt.

Foreign Exchange Losses

To December 31, 2000, most of IEI's long term debt was denominated in US Dollars. The increase in 2000 in the value of the US Dollar against the Canadian Dollar resulted in a larger foreign exchange loss on long term debt for 2000 totalling $1.4 million compared to $0.3 million in 1999. The exchange rate on the date of repayments will be used in calculating the ultimate foreign exchange gain or loss on the debt. The December 31, 2000 settlement and conversion of the debt owed to Sumitomo from a US$ denominated debt to a Cdn$ denominated debt on acquisition of Sumitomo's interest in the Mount Polley Mine has reduced IEI's exposure to US$ denominated debt by about 50%.

Operations of Affiliates

During 2000, Cathedral Gold Corporation acquired Directional Plus Ltd. in a share exchange transaction and changed its name to Cathedral Energy Services Ltd. The transaction reduced the percentage of common shares held by IEI in Cathedral to less than 2%. Accordingly, IEI ceased to equity account for this investment after the date of the transaction. The equity loss in affiliates totalled $0.4 million in 2000 compared to the $0.1 million recorded in 1999. Colony Pacific Explorations Ltd. ceased to be an affiliate early in 2001.

Loss on Sale of Interest in Joint Venture

During the year 1999, in order to continue to meet debt repayment obligations on its Mount Polley project, IEI sold a 2.5% interest in the Mount Polley project to its joint venture partner for proceeds of $1.4 million recording a loss of $0.9 million on the transaction.

Writedown of Marketable Securities

The decline in equity markets for mining companies reduced the market value of IEI's portfolio of marketable securities requiring a writedown of $1.5 million in 2000 versus $0.2 million in 1999.

Taxes

Effective January 1, 2000, IEI retroactively adopted the new accounting recommendations for income taxes whereby IEI accounts for income taxes using the future income tax method of accounting. A tax expense of $0.5 million was recorded in the year ended December 31, 2000 on a pretax loss of $2.0 million, compared to a tax expense of $0.6 million on pretax loss of 5.4 million in the prior year. In both years the effective tax recovery rates were significantly less than the expected 45.6% due to the non-recognition of operating loss carry forwards and mineral taxes. Due to the uncertainty surrounding the timing of realizing the benefit of the future income tax asset a valuation allowance has been provided at both December 31, 2000 and 1999.

Liquidity and Capital Resources

Cash Flow from Operations

As a result of lower operating margins cash flow from operations before net change in non cash operating balances fell to $8.9 million in 2000 from the $18.0 million in 1999.

Working Capital

Working capital, excluding current portion of long term debt of $5.8 million, amounted to $1.5 million at year end compared to $4.8 million at December 1999. The decrease in working capital is primarily the result of the accounts payables and accrued liabilities assumed on December 31, 2000 on acquisition of the Mount Polley Mine interests from Sumitomo Corporation.

Property Expenditures

Property acquisition and development expenditures totalled $13.1 million in 2000 versus $11.9 million in the year 1999. Expenditures on exploration properties totalled $0.6 million in 2000 compared to $0.9 million in 1999. The balance of expenditures in 2000 were for Mount Polley and Huckleberry mine ongoing capital projects, including tailings dam construction and the grinding improvement project at the Huckleberry mine.

Acquisitions

Effective December 31, 2000 IEI acquired the balance of the Mount Polley Mine from Sumitomo by assuming certain Mount Polley Joint Venture assets and liabilities and negotiating reduced and rescheduled debt obligations. Refer to the notes to the financial statements of IEI for the year ended December 31, 2000 which are contained in Appendix H to the Circular for further details.

During 1999, IEI made two acquisitions totalling $2.2 million, paid for by the issuance of 1.9 million common shares of IEI at an ascribed value of $0.50 per share and for the settlement of amounts owed to IEI.

Debt and Equity Financing

During the year ended December 31, 2000, IEI had four short term credit facilities. A revolving $7.0 million concentrate advance facility for the Mount Polley Mine assists IEI with financing its Mount Polley Mine working capital requirements. A balance of $0.4 million was outstanding at year end on this facility. Three revolving credit facilities totalling $4.7 million provided support for IEI's day to day non-mine corporate operations. At December 31, 2000, a total of $4.7 million was drawn on these facilities and the maturity date was extended to January 1, 2002 and the balances reclassified to long term debt. At December 31, 1999, Huckleberry had a short term advance of $2.4 million against concentrate receivables that was repaid early in 2000 upon collection of accounts receivable.

All of IEI's long term project debt is non-recourse to IEI as it is secured by the mining properties on which the funds were invested. Long term debt additions totalled $1.0 million during the year ended December 31, 2000, compared to an increase of $4.6 million in 1999.

In 1998, declining metal prices reduced profitability and cash flow and in mid-1998 IEI negotiated an economic plan for both the Mount Polley and Huckleberry mines sponsored by the Job Protection Commission of British Columbia. Among other provisions of the economic plans, repayment of the long term project debt was rescheduled to more closely match repayment obligations to cash flow from the mines. During 2000, IEI repaid $4.2 million in long term project debt compared to $6.8 million in 1999.

Declines in metal prices toward the end of 1998 negatively impacted the ability of the Huckleberry mine to repay its long term project debt. In December 1998 Huckleberry could not meet all of its obligations for payment of interest on long term project debt and it became apparent that Huckleberry would be unable to fully satisfy its loan payments as then scheduled and would require additional funding. A financial restructuring package for Huckleberry was completed in June 1999 and this resulted in a deferral of all principal and interest payments during the period 1999 to 2001 on the majority of Huckleberry's debt. For the year 2001 payments of principal and interest on the Huckleberry debt are dependent on available cash. All lone term project debt and related accrued interest deferred pursuant to the financial restructuring package is due on January 1, 2002. As Huckleberry may be unable to generate sufficient free cash flow to make this payment, the lenders may choose to exercise their security or make a

new loan restructuring arrangement. This could result in IEI forfeiting, reducing or otherwise changing its economic interest in the Huckleberry mine.

On June 30, 1999 IEI sold a 10% ownership interest in Huckleberry to the lenders for nominal value to hold 50% of Huckleberry after that date. As part of the arrangement to restructure Huckleberry, IEI also loaned Huckleberry $2.5 million at that time.

Concurrent with the acquisition of the Mount Polley Mine effective December 31, 2000, IEI issued $4.7 million of 8% subordinated secured convertible debentures. These funds were received in April 2001 and used to repay short term bridge financing loans on the acquisition of the Mount Polley Mine.

Restructuring of the project debt owing to Sumitomo on the Mount Polley Mine has reduced the Mount Polley project debt from US$33.2 million to Cdn$ 10.1 million. Payments of $4.5 million were made on this debt in early 2001 with the remaining amounts repayable over a period of up to 10 years at a maximum rate each year of 10 monthly payments of $116,667 each, conditional on the mine continuing to operate.

Business Risks

The business of exploration, development and production of crude oil and natural gas involves a number of business risks. These risks include the uncertainty of replacing current production and finding new hydrocarbon reserves on an economic basis. Financial risks include fluctuations in commodity prices, interest rates and currency exchange rates. Operational risks include uncertainty over future reservoir performance, environmental and safety issues and completion within the industry.

IEI is exposed to commodity price risk with respect to its production of petroleum and natural gas. To manage this risk, IEI may, from time to time, employ financial instruments to protect the downside risk of commodity prices.

IEI carries insurance coverage to protect itself against potential losses due to accidental destruction of assets, well blowouts, business interruption and environmental damages. IEI also follows closely all government regulations. Maintaining an experienced and highly skilled staff of petroleum and natural gas professionals further minimizes the business risk.

PRINCIPAL SHAREHOLDERS

As at the date of the Circular and to the knowledge of the directors and senior officers of IEI, no person or company beneficially owns, directly or indirectly, or exercises control or direction over, voting securities of IEI carrying more than 10% of the voting rights attached to any class of voting securities of IEI issued except as set forth below:

Name and Municipality of Residence	Type of Ownership	Number of Common Shares	Percentage of Common Shares Outstanding
N. Murray Edwards Calgary, Alberta	Direct and Indirect	5,930,333	37.6%

DIRECTORS AND OFFICERS

The following table sets forth the name, municipality of residence, principal occupation for the last five years of the current directors and senior officers of IEI as well as the period continuously served as a director of each of the current directors of IEI. The term of office of each director will expire at the end of the next annual meeting of shareholders of IEI or upon earlier resignation.

Name and Municipality of Residence	Position Held	Principal Occupation During the Past Five Years
Pierre B. Lebel North Vancouver, British Columbia	Director since 1986	President of Imperial Metals Corporation (formerly, New Imperial before giving effect to the Imperial Plan)
John A. Brussa Calgary, Alberta	Director since March 7, 2002 and Corporate Secretary	Partner, Burnet, Duckworth & Palmer LLP, Barristers & Solicitors
Larry G.J. Moeller Calgary, Alberta	Director since March 7, 2002 and President	Vice President, Finance of Edco Financial Holdings Ltd., a private investment company

Notes:

(1) All of the directors are members of the Audit Committee.
(2) IEI does not have an executive committee of its Board of Directors.

As of the date hereof, the directors and officers of IEI, as a group, beneficially own, directly or indirectly, 1,029,976 IEI Shares or approximately 6.5% of the issued and outstanding IEI Shares. No company, while any of the above-noted individuals was a director, officer or promoter thereof, has been struck off the register of companies by the Registrar or other similar authority.

No director, officer, promoter or other member of management of IEI is, or within the five years prior to the date of the Circular has been a director, officer or promoter of any other issuer that, while that person was acting in that capacity, was

(a) the subject of a cease trade or similar order or an order that denied the issuer access to any statutory exemptions for a period of more than 30 consecutive days, or

(b) declared bankrupt or made a voluntary assignment in bankruptcy.

No director, officer, promoter or other member of management of IEI has, within the five years prior to the date of the Circular, been declared bankrupt or made a voluntary assignment in bankruptcy, made a proposal under any legislation relating to bankruptcy or insolvency, or been subject to or instituted any proceedings, arrangement or compromise with creditors, or had a receiver, receiver manager or trustee appointed to hold the assets of that individual.

Within the past 10 years, none of the directors, officers or promoters of IEI has been the subject of any penalties or sanctions by a court or a securities regulatory authority relating to trading in securities, the promotion, formation or management of a publicly traded company or involving theft or fraud.

EXECUTIVE COMPENSATION

For the purposes of this statement "executive officer" of IEI means the Chairman and any Vice-Chairman of the board of directors, where that person performs the functions of such officer on a full time basis, the President, and any Vice President in charge of a principal business unit such as sales, finance or production, and any officer of IEI or of a subsidiary who performs a policy making function in respect of IEI whether or not such officer is also a director of IEI or its subsidiaries. "Named Executive Officer" means the chief executive officer of IEI and each executive officer who earned over $100,000 in total salary and bonus during the most recently completed financial year for services rendered to IEI or a subsidiary of IEI.

Compensation of Named Executive Officers

The following table sets forth compensation information for the Named Executive Officers of IEI for the three fiscal years ended on or before December 31, 2001.

Summary Compensation Table

		Annual Compensation			Long-Term Compensation			
					Awards		Payouts	
Name and Position of Principal	Year	Salary	Bonus	Other Annual Compensation	Securities Under Options/ SARs Granted (#)	Restricted Shares/ Units Awarded (#)	LTIP [1] Payouts ($)	All Other Compensation ($)[2]
N. Murray Edwards	2001	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Chairman	2000	Nil	Nil	Nil	100,000	Nil	Nil	Nil
	1999	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Pierre B. Lebel [3]	2001	$131,813	Nil	Nil	Nil	Nil	Nil	Nil
President	2000	$113,250	$15,000	Nil	200,000	Nil	Nil	Nil
	1999	$107,959	$15,000	Nil	Nil	Nil	Nil	Nil
Jack H.L. Miller	2001	$123,333`	Nil	Nil	Nil	Nil	Nil	$2,100
Vice President,	2000	$120,000	Nil	Nil	300,000	Nil	Nil	$4,200
Operations	1999	$120,000	Nil	Nil	Nil	Nil	Nil	Nil
J. Brian Kynoch	2001	$132,440	Nil	Nil	Nil	Nil	Nil	$2,030
Senior Vice President	2000	$110,780	$52,500	Nil	700,000	Nil	Nil	Nil
and Chief Operating	1999	$105,560	$52,500	Nil	Nil	Nil	Nil	Nil
Officer								
Andre H. Deepwell [4]	2001	$100,667	Nil	Nil	Nil	Nil	Nil	$1,715
Chief Financial Officer,	2000	$96,938	$3,750	Nil	100,000	Nil	Nil	$3,281
Vice President, Finance	1999	n/a	n/a	n/a	n/a	n/a	n/a	n/a
and Corporate Secretary								

Notes:

(1) "LTIP" or "long term incentive plan" means any plan which provides compensation intended to serve as incentive for performance to occur over a period longer than one financial year, but does not include option or stock appreciation right plans.

(2) Contributions by IEI to its then existing Employee Share Purchase Plan.

(3) The salary amount includes $17,278 paid in 2001, $14,576 paid in 2000 and $13,559 paid in 1999 pursuant to an individual pension plan.

(4) Mr. Deepwell did not earn over $100,000 prior to 2000.

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Continuity Nbr.: VA07-00362

March 14, 2007

Mr. Ron Martel
Mount Polley Mining Corp.
P.O. Box 12
Likely, B.C. V0L 1N0

Dear Ron,

Re: Mt. Polley Mine - Upstream Toe Drain Seepage Estimations

The Tailings Storage Facility (TSF) at Mount Polley Mine includes the Perimeter, Main, and South Embankments. The TSF embankments consist of zoned, earthfill structures that are progressively raised during operations using the modified centreline construction method. Embankment drainage provisions have been incorporated into the design of the TSF to facilitate drainage of the tailings mass, dewater the foundation soils, and to control the phreatic surface within the embankments. The components of the drainage systems consist of foundation drains, chimney drains, longitudinal drains, outlet drains, and upstream toe drains. The TSF currently has two upstream toe drains installed in the TSF embankments; one located in the Main Embankment at elevation 936 m, and one located in the Perimeter Embankment at elevation 945 m. A third toe drain may be installed on the South Embankment during Stage 6 construction program. The purpose of the upstream toe drains is to drain and consolidate the tailings mass near the embankments. The upstream toe drains also remove a certain amount of filtered water from the impoundment that is currently being recycled back into the TSF but may be a potential source of water available for discharge should the water quality objectives be met. The location of the upstream toe drains currently installed along the Main and Perimeter embankments are shown on Figure 1.

The Mount Polley Mine Site is currently operating in a water surplus condition with the excess water being stored in the TSF. Mount Polley Mining Corporation (MPMC) has requested that Knight Piésold review the current flow data from the upstream toe drain at the Main Embankment (the Perimeter Embankment upstream toe drain that was installed during the Stage 5 construction program has not yet started to flow) and provide future flow estimates from the upstream toe drains installed at each of the embankments.

UPSTREAM TOE DRAIN FLOW RATES

The upstream toe drain at the Main Embankment flows into the sump at the Main Embankment Seepage Collection Pond where the flows are measured. The flow rates have been measured since July 2000; however the flow rates from the drains were not monitored during the Care and Maintenance Period as the drain outlets were submerged within the sump. This condition was anticipated during the Care and Maintenance Period, as flow monitoring is only possible during operations when the seepage pond level has been pumped down. The seepage pond was pumped down in December 2005 and flow measurements were taken. The monitored flows were consistent with the flows measured in 2000. The flows from the Main Embankment upstream toe drain have increased since 2005, with the current flows ranging from 9 to over 12 l/s. The flow rates for the Main Embankment upstream toe drain are shown on Figure 2.

The flow rates were also modelled with the finite element computer program SEEP/W. The results of the modelling indicate that the flow rates for the upstream toe drain at the Main Embankment are impacted by the tailings beach profile along the embankment, the distance the supernatant pond is from the embankment, the location of tailings discharge point or points, and the degree of tailings consolidation above the toe drain. The most significant factors contributing to the flow rates in the upstream toe drain are the size of the tailings beach and the distance of the supernatant pond from the embankment. The tailings beach and pond location for October 31, 2006 are shown on Figure 3.

Stage 4 construction of the TSF embankments included using compact tailings sand as construction material in the upstream Zone U shell zone. This was accomplished by developing sand cells upstream of the core zone and discharging tailings into the cells. The coarse tailings settled out into the sand cells with the finer tailings exiting the cells via culverts installed in the upstream confining berms. This proved to be a successful construction technique for building Zone U but the prolonged discharging of tailings at the Perimeter Embankment resulted in the migration of the supernatant pond towards the Main Embankment, with the pond coming into direct contact with the Main Embankment at certain locations. This has resulted in higher flow rates for the upstream toe drain at the Main Embankment.

MPMC is currently in the process of procuring the HDPE pipe required to expand the tailings discharge pipeline around the entire facility. Evenly discharging the tailings from around the facility optimizes the development of tailings beaches and keeps the supernatant pond clear of the embankments, thereby increasing seepage paths and reducing seepage rates at the upstream toe drains. Beached tailings, when left to drain and consolidate, form the competent foundation needed for the modified centreline construction of embankment raises. The current flow rates from the Main Embankment upstream toe drain are considered to be elevated based on the proximity of the supernatant pond and will likely decrease, possibly by as much as 50%, with the development of a tailings beach in this area.

The estimated upstream toe drain flow rates for the Main, Perimeter, and South Embankments are shown on Figure 4. The flow estimates for the Perimeter and South Embankment upstream toe drains have been based on extrapolating the current measured flows in the Main Embankment upstream toe drain over the differential length of their drains. The figure also shows the estimated upper and lower flow boundaries (+/- 50%) for all three drains. The lower bound value is the conservative flow value and should be the value used in site water balance calculations. The upper bound value is a conservative flow value for the design of the settling ponds and associated pipe works. The lower bound values for the three upstream toe drains are as follows:

- Main Embankment 6 l/s (500 m^3/day);
- Perimeter Embankment 7 l/s (640 m^3/day);
- South Embankment 4 l/s (360 m^3/day);
- The total lower bound flow rate assuming all drains in operation is estimated to be: 17 l/s (1500 m^3/day).

The upper bound values for the three upstream toe drains are as follows:

- Main Embankment 17 l/s (1500 m^3/day);
- Perimeter Embankment 22 l /s (1920 m^3/day);
- South Embankment 13 l/s (1080 m^3/day);
- The total upper bound flow rate assuming all drains in operation is estimated to be: 52 l/s (4500 m^3/day).

The estimated flow rates from the upstream toe drains assume that all three are in operation and working effectively. The time line for the flow rates also assumes that the flows will appear in the Perimeter Embankment drain in April or May 2007 pending pumping of the Cariboo Pit water and that the upstream toe drain planned for the South Embankment during Stage 6 will be producing water in August 2008.

The upstream toe drain flow rates will vary at each embankment depending on the location of the supernatant pond. However, the overall flow rates from the TSF upstream toe drains are likely to remain fairly constant as increased flow rates resulting from the tailings pond having moved closer to one embankment will likely be offset by the reduction in flow rates from the opposite embankment that the tailings pond has subsequently moved away from.

It is important to reiterate that the main purpose of the upstream toe drains is to drain and consolidate the tailings mass near the embankments, not to remove large quantities of water from the TSF. It is therefore very important to continue measuring the flow rates from the upstream toe drains at regular intervals, along with the location of the supernatant pond, to determine whether the flow rates are significant enough or if other sources of water for discharge need to be considered.

We trust that the estimated flow rates from the upstream toe drains meets your current needs for updating the site water balance and sizing the settling ponds and associated pipe works. Please feel free to contact us if you have any questions.

Yours truly,

KNIGHT PIESOLD LTD.

Eric Coffin
Staff Engineer

Ken Brouwer, P.Eng.
Managing Director

Encl:
	Figure 1 Rev 0	Upstream Toe Drain Locations
	Figure 2 Rev 0	Main Embankment Upstream Toe Drain Flows
	Figure 3 Rev 0	Tailings Beach Profile
	Figure 4 Rev 0	Long Term Upstream Toe Drain Flow Estimations

/ec

APPENDIX O: Overview Function of the Tailings Storage Facility and the Role of Water Management

Mount Polley Mine
Technical Assessment Report for a Proposed Discharge of Mine Effluent

Report Prepared by:

The Mount Polley Mining Corporation
Box 12
Likely, British Columbia
V0L 1N0

In Support of an Application
for the Discharge of Mine Effluent
Under the Waste Discharge Regulation
of the British Columbia
Environmental Management Act

July 2009

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trial was designed and implemented to assess the feasibility of leaching the copper oxide cap that covered the Springer Pit mineralization.

2.3.3 Waste and Water Management

Waste from the rougher/scavenger circuit (tailings slurry) is conveyed by gravity through a seven km pipeline system (24" diameter HDPE [high density polyethylene] pipes) to the Tailings Storage Facility (TSF) located to the southeast of the mill (Figure 1.2). The TSF covers a total area of 200 hectares and, as of December 31st, 2008, contained 52,000,000 tonnes of tailings (36 million m^3). The TSF also receives site runoff (which is collected and directed to the TSF) and direct precipitation. TSF embankments are graded earthfill and rockfill and have been raised in stages by a combination of centreline and modified centreline construction techniques. Tailings are distributed along the tailings embankment crest to maintain uniform tailings beaches. A foundation drain and pressure relief system are located downstream of the main embankment to prevent the build-up of pore pressure in the foundation and to collect seepage from the base of the TSF. As solids settle out of the tailings slurry, process fluids are collected and recycled back to the mill for re-use in the milling process. The reclaim system consists of a seven kilometre 24" diameter HDPE pipeline from a reclaim barge in the TSF to the process water tank at the mill. Water is pumped from the reclaim barge located in an excavated channel in the TSF and is boosted at a booster pump house. Seepage through the main embankment is directed to a decant manhole near the Main Embankment Seepage Collection Pond (MESCP) and collects in this pond. Seepage through the perimeter embankment also collects in the Perimeter Embankment Seepage Collection Pond (PESCP). Water in the Main and Perimeter Embankment Ponds (seepage, runoff and precipitation) are pumped back to the TSF as required.

During care and maintenance (2001 to 2005), water from the MESCP was permitted to discharge into Edney Creek (Permit # PE-11678 under the British Columbia *Environmental Management Act*; Appendix B). Approximately 265,000 m^3 of water from the MESCP discharged to Edney Creek from initiation in July 2002 to termination in February 2005.

Mount Polley has been raising dam levels every year to accommodate tailings and the accumulation of water. Annual dam raisings ensure that there is surplus containment for dry tailings, freeboard and storm events for the following year. It is anticipated that dam raises will continue to an elevation of 965 m, which will provide containment for approximately 85 million dry tonnes of tailings. The potential for the TSF to influence local groundwater is monitored in a series of groundwater wells installed around the TSF.

Waste rock is stored in five rock disposal sites: the East Rock Disposal Site (ERDS), the North Rock Disposal Site (NRDS), the Northeast Rock Disposal Site (NERDS), the North Cariboo Pit backfill and the Wight Pit backfill (Figure 1.2). Waste rock from the Cariboo Pit was hauled to the ERDS and North Cariboo Backfill, whereas waste rock from the Bell Pit was disposed of in the NRDS and North Cariboo Backfill. Waste rock from the Wight Pit is placed in the NERDS, resulting in the southward expansion of this RDS. Waste rock from the Springer Pit is placed in the NRDS and the North Cariboo Backfill. Waste rock from the Southeast Pit is placed in the Wight Pit. Waste rock is mostly diorite, monzonite, plagioclase porphyry and augite porphyry dykes (Imperial Metals 2004). The acid generating capacity of the waste rock is continuously characterized by Mount Polley's onsite laboratory. Some components of the waste rock are Potentially Acid Generating (PAG) due to elevated levels of pyrite. Only a small zone of PAG was identified in the Wight Pit and was managed by sub-aqueous disposal in the Cariboo Pit (which currently contains approximately 2.5 million m^3 of PAG). PAG from the Southeast Zone is disposed of into the Wight Pit. Mount Polley has adopted a policy (Best Management Practice) of disposing of all waste rock with Total Inorganic Carbon / Acid Potential (TIC/AP) < 2 sub-aqueously in the Cariboo and Wight Pits. The volume of waste rock with TIC/AP < 2 is approximately 5%.

Water management at Mount Polley includes a number of activities as outlined in the Mount Polley water balance (Figure 2.3; KPL 2009a; Appendix C). Briefly, water is collected from disturbed areas of the mine, including the pits, the rock disposal sites, general surface runoff and groundwater (including seepage) and is directed to the TSF (which currently contains approximately 3.1 million m^3 of water). Water in the TSF is recycled to the mill for use in the milling process (approximately 11.5 million cubic metres per year; Figure 2.3). Water is also collected at the Mill Site Sump (MSS) and at the Southeast Sediment Control Pond (SESCP) and serves to provide additional water to the mill by collecting drainage from the Mill Site and ERDS, respectively. Excess water is predominantly stored in the TSF which has a water storage capacity of in excess of approximately 3.5 million cubic metres and in the Cariboo Pit which has a water storage capacity in excess of three million cubic metres (to elevation 1094 m). Excess water is used at site to suppress dust (approximately 300,000 m^3/year; Figure 2.3). Despite application of water recycling and the use of water in dust suppression, the Mount Polley Mine has an excess of approximately 1.4 million cubic metres of water per year.

2.3.4 Environmental Management Systems

Environmental management systems at the Mount Polley Mine have been developed to meet all statutory requirements, industry requirements and due diligence for environmental

APPENDIX P: Knight Piésold's 2004 and 2008 Water Balance Timelines

MOUNT POLLEY MINE WATER BALANCE
TABLE 1

MOUNT POLLEY MINING CORPORATION
MT. POLLEY PROJECT

WATER MANAGEMENT TIMELINE

Print 8/13/2009 13:50

S:\Projects\2120 - Mount Polley Discharge\Mount Polley 2008\Technical Assessment Report\REPORT\Appendices\App C - Water Balance\[Part 2 - Mount Polley Working Water Balance PRINT A Rev'd 7/28/2004

Year	
0 2004	* Bell Pit is already partly developed. * Springer Pit has a small starter pit. * The East RDS is developed to it's ultimate surface area. * The North RDS is partly developed. * The Cariboo Pit is already storing water (2.5 million m^3).
1 2005	* The Bell and Wight Pits are developed. Their ultimate surface area is disturbed. * Development starts on the Northeast RDS. * Waste from the Bell Pit is placed in the Cariboo Pit necessitating some water removal. * Water from the Cariboo Pit is pumped to the Mill and ends up in the TSF for storage (approximately 2 million m^3 over 4 years) * Surface runoff and groundwater from the Bell and Wight Pits is pumped to the Mill and ends up in the TSF.
2 2006	* Development of the Springer Pit starts. The ultimate surface area is disturbed. * Development continues on Bell and Wight Pits. * Waste from the Bell and Springer Pits is placed in the Cariboo Pit necessitating some water removal. * Water from the Cariboo Pit is pumped to the Mill and ends up in the TSF for storage (approximately 2 million m^3 over 4 years) * Surface runoff and groundwater from the Bell, Wight, and Springer Pits is pumped to the Mill and ends up in the TSF.
3 2007	*Development of Bell and Wight Pits is completed. * Development of the Northeast RDS is completed. * Waste from the Bell and Springer Pits is placed in the Cariboo Pit necessitating some water removal. * Water from the Cariboo Pit is pumped to the Mill and ends up in the TSF for storage (approximately 2 million m^3 over 4 years) * Surface runoff and groundwater from the Bell, Wight and Springer Pits is pumped to the Mill and ends up in the TSF.
4 2008	* Development of the Springer Pit continues. * Filling of Wight Pit with water commences as groundwater and surface runoff is allowed to accumulate. * Runoff from the Northeast RDS is diverted to the Wight Pit to accelerate pit filling. * Waste from the Springer Pit is placed in the Cariboo and Bell Pits. * Water from the Cariboo Pit is pumped to the Mill and ends up in the TSF for storage (approximately 2 million m^3 over 4 years) * Reclamation of the Northeast RDS is initiated and finished by year end. * Surface runoff and groundwater from the Springer Pit is pumped to the Mill and ends up in the TSF. * Runoff and groundwater from the Bell Pit is no longer pumped to the TSF. Water is allowed to fill the voids in the waste rock.
5 2009	* Development of the Springer Pit continues. * Runoff from the reclaimed Northeast RDS area is not collected. * Surface runoff and groundwater from the Springer Pit is pumped to the Mill and ends up in the TSF.
6 2010	* Development of the Springer Pit continues. * Surface runoff and groundwater from the Springer Pit is pumped to the Mill and ends up in the TSF.
7 2011	* Development of the Springer Pit is completed. * Development of the North RDS is completed. * Surface runoff and groundwater from the Springer Pit is pumped to the Mill and ends up in the TSF.
Closure	* The TSF is drained by pumping water to the Springer Pit, accelerating pit filling.

MOUNT POLLEY MINE WATER BALANCE
TABLE 2

MOUNT POLLEY MINING CORPORATION
MT. POLLEY PROJECT

UPDATED WATER MANAGEMENT TIMELINE

Print 8/13/2009 13:50
Rev'd 10/26/2008

Year	
2008	* Bell Pit is completed. * Wight Pit is complete at year end. * Mining Springer Pit. * Stopped Cariboo Pit pumping to TSF in 4Q. * Wight pumped to the mill for 3 Q, started pumping to Cariboo in 4Q * The Northeast RDS is mostly developed. * North Dump being developped * Installed new barge pumps. * Stage 6a complete to 954.0 m
2009	* The Wight Pit is completed * Springer pit water pumping rate 150 gpm to Cariboo Pit * Cariboo Pit Water elevation starting at 1070m * Pond Zone being developped at 60gpm * Commenced TSF water transfer of 2,300,000 m3 at a rate of 1000 gpm (starting January ,2009 for 14 months) * Bell pit being filled (void space = 700,000 m3 to elevation 1106 m) * East and NE dump runoff to TSF via long ditch * North Dump Discharge to Wight Pit * Wight pumped to Cariboo Pit (for an estimated 3 months, then allowed to fill) * Dam Building Differed ***(good until April 2010)*** TSF water inventory at December 31…1.5Mm3
2010	* Development of the Springer Pit continues. (260gpm to the Dam). * North Dump Discharge to the Wight Pit * Wight Pit allowed to fill. * Stopped TSF water transfer to the Cariboo Pit after the transfer of 2,300,000 m3. * 950,000 cubic meters of water in TSF prior to spring runoff. * Stage 6 b completed (ie 3 m to 957 m)
2011	* Development of the Springer Pit continues. (300gpm). * South Bell Dumped capped with soil to mitigate infiltration and water collected in Springer pit. * Springer Dump, East dump and NE dump runoff to TSF. * North Dump Discharge to the Wight Pit * Stage 7 completed (ie 3 m to 960 m) * 800,000 cubic meters of water in TSF prior to spring runoff. * Wight Pit allowed to fill @ 350gpm
2012	* North Dump Discharge to Wight Pit * Development of the Springer Pit continues. (300gpm). * Springer Dump, East dump and NE dump runoff to TSF. * Transfer water from Cariboo/Bell to TSF at a rate of 2000gpm for 9 months (3.2Mm3) * Approximately 1M to 4.0 Mm3 stored in TSF due to transfer from Cariboo/Bell pits * Stage 8 completed (ie 3.0 m to 963 m) * Wight Pit allowed to fill @ 150 - 200gpm
2013- 2015	* Development of the Springer Pit continues. (500gpm). * Springer Dump, East dump and NE dump runoff to TSF. * North Dump Discharge to Wight Pit * Approximately 4.0 M to 6.0 Mm3 stored in TSF * Stage 9 completed (ie 2.5 m to 965.5 m) * Stage 10 completed (ie 2.0 m to 967.5m)
Closure	* The TSF is drained by pumping water to the Springer Pit, accelerating pit filling.

S:\Projects\2120 - Mount Polley Discharge\Mount Polley 2008\Technical Assessment Report\REPORT\Appendices\App C - Water Balance\[Part 2 - Mount Polley Working Water Balance PRINT ALL HIGHLIGHTED PAGES.XLS]2 REV Timeline 2008 to 2015