REPORT TO

IMPERIAL METALS CORPORATION

GEOTECHNICAL REVIEW, DRAINAGE ASPECTS

MAIN EMBANKMENT DAM

TAILINGS STORAGE FACILITY

MT. POLLEY PROJECT, BRITISH COLUMBIA

Geotechnology

MAJM Corporation Ltd.
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1.0 INTRODUCTION

MAJM Corporation Ltd. has been retained by Imperial Metals Corporation to review aspects of the design of the Main Embankment Dam of their Tailings Storage Facility, particularly from the standpoint of the proposed basin liner and various drainage provisions comprising underdrains and internal drainage in the Main Embankment Dam.

The work involved a site visit on August 26, 1996, in the company of Representatives of Imperial Metals Corporation; the Designers, Knight Piésold Ltd.; and Mr. George Headley, P.Eng. of the British Columbia Ministry of Employment and Investment, Mine Review and Permitting Branch. At the time of the visit, construction of Stage Ib of the Main Embankment Dam and the basin liner were underway, while the Seepage Collection Pond and Reclaim Barge channel were largely completed. The site visit provided an opportunity to view the site as a whole as well as construction activities relative to earthworks for the Main Embankment Dam. It also provided on opportunity to examine other components of the overall Facility such as the Basin Liner; Seepage Collection Pond and Reclaim Barge Channel, and to see first-hand samples of the various foundation strata.

Following the site visit, a meeting was held at the Offices of Knight Piésold Ltd. in Vancouver which was attended by Mr. George Headley; Representatives of Knight Piésold and Imperial Metals Corporation, including Mr. Brian Kynoch, P.Eng. of the latter Organization. A variety of items were discussed and are confirmed herein. As indicated later in this Report, a number of the recommendations arising out of the meeting have been carried out in the interval. Prior to, and during the site visit and meeting in Vancouver, References were made available to this writer and are listed in Section 9.0 herein. Photographs selected from among those taken by this writer during the site visit, are included in Appendix I to this report.

Working meetings were held at the Offices of Knight Piésold Ltd. on February 28 and March 10, 1997, at which time excerpts from the Supplementary Design Report were presented (Ref. 9.10) and two additional References were provided, namely the Groundwater Monitoring Program (Ref. 9.11) and The Operation, Maintenance and Surveillance Manual for Stage 1a (Ref. 9.12). The working meetings provided an update on a number of changes to the original plans and Schedule. Basically, these included construction of a designated Stage 1a embankment to el. 927m in December, 1996, at which time there was a shutdown for Winter freezeup. The intent is that the Stage 1a embankment will initially function as a water storage dam and store sufficient runoff and makeup water to enable milling operations to commence. Raising of the embankment was resumed during the Winter and is currently underway to the crest of Stage 1b (el. 934m) to allow for tailings discharge into the impoundment in June, 1997. The Stage II (crest el. 937m) expansion is scheduled for completion in 1998.

1.0 INTRODUCTION

It is timely to review in summary fashion the available background data pertinent to the proposed Basin liner and proposed drainage provisions, for convenience of reference. This is done in the section which follows. It will be noted that comments on the stability of the Dam at its various stages of raising are not made, since these were not within our terms of reference. It is understood that a Supplementary Design Report is in preparation incorporating changes to the original Design Report (Refs. 9.1 and 9.2) based on additional geotechnical and other factual data, and revisions to design details and the Schedule. The comments given herein are subject to review when the formal Supplementary Report is available.

2.0 BACKGROUND

2.1 Geology

Ref. 9.1 indicates that the Mt. Polley site is located in an alkalic intrusive complex in the Quesnel Trough. The rock units are segmented into blocks by several faults, including an inferred north westerly trending normal fault which extends along Polley Lake.

The topography is generally subdued and has been glaciated. Surficial deposits of well-graded dense till material are common throughout the region and are typically present in greater thicknesses in topographic lows. Bedrock exposures are common at higher elevations.

In the Tailings Impoundment Area, Ref. 9.1 indicates that "*well-graded low permeability glacial till extends over most of the tailings basin except at the lower basin and at the Main Embankment where saturated glacial lacustrine fine sand and silt are exposed at surface. These materials are typically dense to very dense and have been heavily over-consolidated by glaciers. ... The glaciolacustrine Sediments are typically saturated. The water table was encountered at or near ground surface.*"

Ref. 9.10 provides significant additional data on the detailed geological conditions at the site. It identifies three main overburden units, namely **(1)** a low permeability surficial (ablation) till which is generally not fissured and whose thickness is inferred to exceed 2m throughout much of the Basin, **(ii)** an often highly consolidated glaciolacustrine/glaciofluvial unit primarily comprised of glaciolacustrine layers (silt, some clay) with lesser finer grained glaciofluvial deposits (sand), and **(iii)** a massive, highly consolidated, low permeability basal till below the glaciolacustrine/glaciofluvial sequence, and composed of well graded silt and sand, some gravel and a trace of clay. At the Main Embankment Dam, bedrock is less than 1m below surface at the top of the right (West) abutment, while in the left abutment area, bedrock surface occurs at depths greater than 30 m. Within the Basin, bedrock is identified as predominantly a sedimentary conglomerate which is moderately to highly weathered near the surface.

2.0 BACKGROUND - Continued

2.2 Seismicity

As indicated in Ref. 9.1, the Mt. Polley project is situated within the interior of British Columbia, an area that historically is of low seismicity.

2.3 Geotechnical Conditions

The soil conditions at the site were developed in several stages. The results of field investigation and laboratory testing programs in 1989, 1990, and early 1995 are included in Ref. 9.2. The results of six condemnation boreholes put down in 1989 in the overall Tailings Area are provided together with a series of Test Pits excavated in 1989 and 1995. Generalized stratigraphic cross-sections along the alignment of the Main Embankment Dam, and across the Tailings Basin, are also given on Drawing No. 1623.103. This indicates that natural ground level in the valley bottom is at about els. 910^{m} to 915^{m} and that ground level rises to about els. 940^{m} to 950^{m} in the areas of the east and west abutments, respectively. Ground level in the Tailings Basin rises gradually towards the North-west from a low at the Main Embankment Dam to the proposed final el. 960^{m} of the System of Tailings Retention Dams, and then rises comparatively steeply to the North-West to about el. 1070^{m}.

At the Main Embankment Dam, the inferred generalized stratigraphic cross-section from data in Ref. 9.2 indicates a thin veneer of topsoil and glacial till underlain by glaciofluvial/glaciolacustrine deposits to about el. 880 in the centre of the valley, below which is bedrock of various types including volcanic conglomerate, mudstone, sandstone and basalt. Bedrock surface rises rapidly towards the West abutment area where the glaciofluvial/ glaciolacustrine deposits are inferred to pinch out at about el. 930m with glacial till located directly above bedrock. Groundwater levels are shown as at or near ground surface in the Valley bottom and West abutment area, and at about el. 920m at the East abutment. Results of packer permeability tests are also given for the two main overburden formations, and the bedrock.

Ref. 9.1 elaborates on geotechnical site investigation programs conducted in the area of the Tailings Storage Facility in 1989/90 and 1995, and provides results of test work on the tailings. In Ref. 9.3, Knight Piésold indicate (in response to review comments by Mr. C.O. Brawner, P.Eng.), that three additional holes would be drilled during the initial stages of construction as part of the embankment instrumentation and monitoring requirements. They also indicate that in early October, 1995, 34 and 6 additional test pits, respectively, were excavated and logged in the Main Embankment and Seepage Collection Pond Areas. The work is described as follows, in summary:

2.0 BACKGROUND - Continued

2.3 Geotechnical Conditions

- *"The test pits were typically 6 m deep.*

- *Test Pit excavations started in the centre of the valley and progressed toward the left (east) abutment at 25 m centres. These test pits encountered 2 to 3 m of dense, moist to wet till overlying stiff to very stiff, overconsolidated silt and silty sand (glaciolacustrine sediments). No sections of loose wet sediments were identified.*

- *Test pits were then excavated progressively toward the right (west) abutment at a 25 m spacing. Similar stratigraphy was encountered for approx. 125 m. At TPME-15 loose wet sand was encountered below the fill. This material extended on the embankment centreline for approx. 125 m, to TPME-20. Over this area, the till cap varied from 1.7 m to 3 m thick, with loose glaciofluvial sediments underlying the till. At the upstream toe of the embankment this zone was approx. 100 m wide. It was approximately 130 m wide at the Stage Ib and Final downstream toe locations.*

- *The test pits excavated at the Seepage Collection Pond area were required to define the limits of the fine till and glaciolacustrine sediments in which the pond could easily be excavated. It was found that only the southwest corner was underlain by loose sediments. The rest of the pond has stiff silt and silty sand (glaciolacustrine sediments) below a till cap. Both of these materials are suitable for excavation of the pond. The pond will be relocated to avoid construction in any area with loose sediments."* .

The glaciofluvial/glaciolacustrine sediments are typically described as comprising *"alternating layers of fine sand/silt/fine sand/coarse sand"*. The sand was sometimes described as *"running"* in the excavation below the overlying till, while the silt layers *"show evidence of overconsolidation"*. In the area of the *"loose wet sand condition encountered between Test Pits TPME-15 and -20"* mentioned above, collapsing of the Trench walls was experienced. However, the Trench walls were generally stable in the other Trenches. There is reference to possible *"basal till"* being encountered beneath the glaciofluvial/glaciolacustrine formation, e.g. at Trench TPME 20. These points are discussed further later herein.

The Preliminary results from the geotechnical investigations carried out in 1996, (provided during the site visit) are given on nine work sheets in Ref. 9.8. This information, which was generated from three geotechnical boreholes with installed piezometers, and a variety of Test Trenches, added considerable detail to be available geotechnical data on near-surface overburden conditions immediately upstream of Stage Ib of the Main Embankment, in the abutment

2.3 Geotechnical Conditions - Continued

areas (particularly the West abutment), as well as along the Reclaim Barge Channel. Along the alignment of the Main Embankment Dam, the stratigraphic refinement included the surface till layer previously identified, then glaciofluvial sands and gravels followed by dense to very dense basal till underlain by bedrock. The data confirmed that the glaciolacustrine deposit pinched out in the West abutment area at about el. 934, i.e. the current crest elevation for Stage Ib of the Main Embankment Dam.

Samples which were understood to be representative of the various overburden strata were viewed at the materials testing laboratory located on the site.

The geotechnical conditions described earlier in this Section have been supplemented to a significant extent by additional detail developed in the interval since the site visit. This information is described in the text of Ref. 9.10 and summarized on ten Knight Piésold Ltd. Draft Drawings titled "Tailings Storage Facility, Geological Investigations" Sections 1 to 9 and 11, respectively. The information provides a good graphic picture of the pattern of occurrence of the various overburden units, and particularly the glaciolacustrine/glaciofluvial sequence. It identifies the basal till unit and, significantly, indicates that the unit immediately under the surficial till in the East abutment area is primarily very stiff glaciolacustrine silt rather than the more pervious glaciofluvial sands and gravels as inferred from previously available data.

2.4 Hydrogeology

The hydrogeology of the site area is described in Ref. 9.4 based on studies which were initiated in 1989. In the course of the subject studies for the Tailings Area, bedrock permeabilities were evaluated using in-situ pump-in packer tests, while overburden permeabilities were evaluated using a combination of pump-in packer tests and falling head tests conducted in standpipes.

As indicated therein, "*the Tailings Area is located in the Northeast Edney Creek Tributary. Due to construction of the embankment along the ridge tops and subsequent filling of the tailings facility, there is a potential for seepage into the two adjacent watersheds, Hazeltine Creek and Southwest Edney Creek Tributary. Previous investigations have shown that the groundwater aquifers .... consist of ..... a confined glaciofluvial/alluvial deposit at the tailings storage area. Static groundwater levels were determined to be relatively near surface for both areas .... .*"

2.0 BACKGROUND - Continued

2.4 Hydrogeology - Continued

The following excerpt is also taken from Ref. 9.4.

"A small pond and two swampy areas exist within the tailings storage area. Surface discharges from these areas are ephemeral and are considered to be the result of groundwater discharges.

Subsurface stratum at the site consists of a 5 to 30 metre thick veneer of dense grey glacial till that is underlain by a glaciofluvial/alluvial deposit at the bottom of the catchment. The glacial till is locally overlain by wet organic rich deposits in localized topographic lows. Bedrock consists of a volcanic conglomerate which is heavily fractured and weathered. This unit becomes harder and more competent with depth and is underlain by a competent basalt. Some sedimentary sequences were identified in the conglomerates along the east ridge of the tailings basin.

The hydrogeology of the tailings storage area has been previously evaluated and it was determined that the tailings area groundwater table is sub-parallel to the surface topography, with groundwater flows directed northeast towards Northeast Edney Creek Tributary..... . Groundwater flows occurred predominantly in the sandy glaciofluvial/alluvial deposit and at the bedrock contact. A slight upward gradient was encountered in the lower topographic areas.

In-situ hydraulic conductivity measurements have been obtained for both the overburden and bedrock strata. Bedrock hydraulic conductivities were found to range from 9×10^{-8} cm/s to 5×10^{-4} cm/s, with a geometric mean of 4×10^{-6} cm/s. The lower values were measured in competent bedrock, while the higher values were associated with highly fractured rock. In addition, hydraulic conductivities generally decreased with depth as weathering and fracturing diminish. Falling head hydraulic conductivities ranging from 1×10^{-6} to 2×10^{-5} cm/s were measured. A mean in-situ hydraulic conductivity of 9×10^{-6} cm/s was obtained for the grey surficial till. Samples of this material were also tested with an air entry permeameter, which produced a hydraulic conductivity of 2×10^{-8} cm/s."

Ref. 9.4 also indicates that in 1989, six groundwater monitoring wells were installed at the Tailings Area. Wells MP89 - 234 and MP89-236 located in this Area "*exhibited artesian conditions and had a static groundwater table of approximately 15 cm above the existing ground surface. The third well MP89-232 was found to have a water table located at the surface.*"

Groundwater contours provided on Figure 2.3 of Ref. 9.4 show a gradual rise (roughly paralleling the ground surface) from el. 915m immediately upstream of the Main Embankment Dam to el. 940 along the high ground forming the western limit of the Tailings Area.

2.0 BACKGROUND - Continued

2.4 Hydrogeology - Continued

Additional data of relevance to the hydrogeology of the Basin is given in Ref. 9.10 and should be read as a supplement to the above.

Ref. 9.11 provides an update on Groudwater Monitoring Well installations at the Mine generally, including six such wells installed in late 1996 around the perimeter of the Tailings Storage Facility. Three of the Wells are immediately downstream of the Main Embankment Dam, each of which penetrated the glaciolacustrine/glaciofluvial sequence.

2.5 Tailings Properties

The physical properties of the tailings, as established by laboratory testing, are given in Ref. 9.2. Properties of particular interest to this review are **(i)** a specific gravity of the tailings solids of 2.78; **(ii)** a gradation size range consisting of 6 percent clay, 64 percent silt, and 30 percent fine sand; **(iii)** the results of undrained and drained settling tests, and **(iv)** permeability tests on drained and settled tailings.

3.0 WALKOVER RECONNAISSANCE

A number of features pertinent to this review were noted and photographed during a walkover type reconnaissance of the overall Tailings Area and initial construction at the Main Embankment Dam, Seepage Collection Pond, and Reclaim Barge Channel. The following comments supplement the captions for the Photos given in Appendix I hereto.

(i) Photos 1 and 2 are taken from the high ground at about the Westerly limit of the Tailings Area at final elevation.

(ii) The base of Stage Ib of the Main Embankment Dam is shown under construction in Photos 3 to 5, inclusive. The Basin liner already in place is visible in the right hand side of Photos 3 and 5.

(iii) The base of Zone B of Stage Ib of the Main Embankment Dam is visible in Photos 6 and 7.

(iv) Part of an embankment foundation drain can be seen in Photo 7.

(v) Overall views of the Seepage Collection Pond are given in Photos 8 and 9. These show that excavation has been for the most part in the upper glacial till formation, with occasional exposures of a bluish-grey material which is

3.0 WALKOVER RECONNAISSANCE - Continued

(v) Cont'd.

probably the glaciofluvial/glaciolacustrine formation, from which slight seepage appeared to be taking place (see Photo 10). The majority of the water in the Pond (Photos 8, 9 and 12), however, appears to originate from discharge from the Drain Monitoring Sump outlet, as shown in Photo 11. The top of the Monitoring Sump is shown in Photo 13, and inspection of the interior showed flow from each of the drain pipes entering the Sump.

(vi) Field permeability testing on the Basin Liner was underway at the time, as shown in Photo 14.

(vii) Views of the surface and internal structure of the basin Liner under construction are given in Photos 15 and 16. The Westerly edge of the Liner at its junction with a former natural stream is shown in Photo 17.

(viii) Photos 18 to 22, inclusive, were taken in the Barge Reclaim Channel beginning with its extremity closest to the Main Embankment Dam and moving westwards. Excavation is shown to be largely in the surface glacial till stratum with seepage from the sides and bottom in isolated areas, and local exposure of a bluish-grey formation inferred from Ref. 9.8 to be the glaciofluvial/glaciolacustrine deposit with a possibly locally high gravel content.

(ix) Photo 23 shows artesian flow from a well adjacent to the perimeter road along the West side of the Tailings Area, (probably Monitoring Well MP89-236). (Ref. 9.4).

4.0 MAIN EMBANKMENT DAM; Earthworks

There are a number of features with respect to the basic design of the Main Embankment Dam which are particularly pertinent to this report, including the following:

(i) As shown on the Drawings in Ref. 9.1, the Main Embankment Dam will be about 50m in maximum height. The first Stage, (designated Stage 1b and currently under construction) was originally planned to be built to el. 931m and thus be about 20m in maximum height.(Current (1997) plans are for a Stage 1b crest at el. 934m, as already mentioned.) Stage 1b will have side slopes of 2H:1V and consist of two zones (Zone "S" and Zone "B") each built using local glacial till borrow but with different specified density in place. Above el. 931m (revised to el. 934m), the Dam will be raised in seven increments of generally 4m each, to el. 960m in stages designated Ic; and II to VII inclusive. Each stage of raising will be zoned in the following fashion:

4.0 MAIN EMBANKMENT DAM; Earthworks

(i) Cont'd.

- a central core of compacted glacial till inclined in the upstream direction at 2H:3V.
- a downstream shell zone, inclined at 2H;1V, composed of compacted glacial till (or other acceptable "random fill").
- a "blanket" drain against the upstream face of the inclined central core.
- a zone of cycloned sand in the form of a berm founded on the tailings beach.

In the original design presented in Ref. 9.1, it was intended that the Stage 1b Embankment and surface runoff ditches would be constructed in the summer of 1995 so that one full year of run-off, including the 1996 freshet, would be in the Tailings Storage Facility prior to Mill start-up, then scheduled for late 1996 or early 1997. The Stage 1b Embankment was intended to also provide storage for the first year of tailings deposition. The Stage 1b Embankment would thus have functioned as a water retaining structure only, during at least the first year of its service life. The first stage of raising (Stage 1c) was originally planned for the latter half of 1997, and for this purpose the necessary tailings beach would have been built up at the Stage 1b Embankment.

Ref. 9.9 indicates that the current plans call for storing water within the impoundment during the upcoming spring freshet (April) with deposition of tailings beginning in mid-May, 1997. As already mentioned herein in Section 1.0 in more specific terms, initial raising was to Stage 1a crest elevation of 927m and raising to el. 934m (Stage 1b crest) is currently underway. Discharge of tailings into the impoundment is scheduled to begin in June, 1997, so that the Embankment will function only as a water retaining structure for about two months.

(ii) A Basin Liner of compacted glacial till placed over glaciofluvial sediments exposed in the Tailings Basin or in areas where the in-situ glacial till was less than 2m thick. The total thickness of the Liner (as given on Drawing 1625.102 in Ref. 9.1) is 1.1m made up of 450mm thick lower part (3-150mm compacted lifts) plus a 650mm lift for frost protection. The approximate limits of the Basin Liner (as defined by initial Exploration Trenches) are shown on Drawing 1625.102. Final plan limits of the Basin Liner are given on Drawing 1627-001 in Ref. 9.10.

5.0 THE EMBANKMENT DAM; Drainage Measures

The drainage measures at the Main Embankment Dam consist of underdrains (foundation drains) and also drains within the Embankment itself (internal drains) and these are discussed separately below.

5.1 Underdrains

The system of underdrains consists of several different components as follows:

(a) The original design included "groundwater drains" under the Basin Liner, as shown on Figure 6.6 and Drawing 1625.102 in Ref. 81. In Ref. 8.3, it is indicated that these were originally deemed necessary for control of groundwater during construction of the partial Basin Liner and for long term monitoring, and later eliminated based on the results of the 1995 Test Pit program.

(b) The Key Plan on Drawing 1625.102 in Ref. 8.1 shows two "Embankment Foundation Drains" running for most of the length of the Stage 1b embankment. One of the drains is located at about the juncture of Zones "S" and "B" of the Stage 1b Embankment while the other is located near the downstream toe of the latter. These drains are shown as Im wide and 1m deep below "prepared subgrade" and backfilled with "drain gravel" wrapped in geotextile fabric. These drains are also provided with a 100mm dia. perforated CPE pipe, and discharge into the Seepage Collection Pond through connecting drains via the Drain Monitoring Sump.

(c) Ref. 9.6 indicates that the original configuration of foundation drains was changed to include four pressure relief wells and three pressure relief trenches each extending into the glaciofluvial sediments and connected to the foundation drains and through the Drain Monitoring Sump to the Main Embankment Seepage Collection Pond. The pressure relief wells are located at chainages 18+00; 19+40; 21+00; and 22+80 under the Stage 1b centreline. One pressure relief trench is similarly located under the centreline at chainage 18+75 while the other three are under the downstream foundation drain at chainages 21+50; 19+25; and 18+25, respectively. The two pressure relief wells and three pressure relief trenches appear to have been located between chainages 18+00 and 19+25 because of the prominent zone of loose wet sand encountered beneath the till cap in this area during the 1995 investigation by exploratory Test Pits (Ref. 9.1) as already mentioned on Page 4 herein.

5.0 THE EMBANKMENT DAM; Drainage Measures

5.1 Underdrains - Cont'd.

The configuration of foundation drians, pressure relief wells, and pressure relief trenches is also shown in Figures 1 and 2 of Ref. 9.10. However, specifics of the Wells and Trenches are not available at time of this writing.

5.2 Internal Drains

No internal drains, or toe drainage zones, were originally incorporated within the Stage 1b Embankment itself. Instead, an additional two foundation drains of the type described under Item 5.1(b) above were located under future extensions of the downstream shell of the Main Embankment Dam. (Figures 6.6 and 6.7, Ref. 9.1).

Internal drainage is, however, incorporated in the raised stages consisting of:

(i) the "blanket" drain on the upstream side of the glacial till core zone.

(ii) at the base of the blanket drain a "toe drain" located at the upstream shoulder of the Stage 1b Embankment and composed of filter sand and incorporating a 150mm perforated CPT pipe (as per Detail "A", Drawing 1625.111, Ref. 9.1). The CPT pipe is connected to 150mm perforated CPT "riser pipes" located within the blanket drain at 50m centres.

Additional "toe drains" will be added within the blanket drain at the elevation of the crests of the Stages IV and VI raisings.

It is understood that only Detail "A" has been used, rather than Detail "B" as per Drawing 1625.111. The pipework of the "toe drains" is connected through the abutments to buried Toe Drain Conveyance Pipes located downstream of the eventual toe of the Main Embankment Dam and discharging into the Drain Monitoring Sump.

As a result of discussions during the site visit and recommendations made at meetings last August (Ref. 9.7), a filter sand chimney drain extending to el. 931m was incorporated into Zone "B" of the Stage 1b Embankment. The base of the chimney drain incorporates a special longitudinal drain which discharges via three outlet drains at the downstream toe of Zone "B", as shown on Figure 1 of Ref. 9.7. Additional details on the Chimney and outlet drains are given on Knight Piésold Ltd. Drawings Nos. 1625.207 and 510-14-02-1625.211 in Ref. 9.10.

5.0 THE EMBANKMENT DAM; Drainage Measures

5.2 Internal Drains

(ii) Continued

Ref. 9.1, Figure 6.7 illustrates graphically two phreatic surfaces assumed for the Main Embankment Dam at Stage VII, i.e. for proposed maximum crest elevation 960m. These include a common phreatic surface corresponding to the base of Zone "B" of the Stage 1b Embankment Dam downstream of the centreline of the latter. Figure 6.14 (Ref. 9.1) however shows a somewhat different configuration for the phreatic surface assumed for the Stage VII analyses, in which the phreatic surface within Zone "B" slopes downwards from about el. 920m at the Stage 1b centreline to ground level (about el. 910m) at the downstream toe of Zone "B". A similar phreatic surface was assumed for the Stage 1b stability analyses, with a pond level at el. 925m. Figures 6.7 and 6.14 of Ref. 9.1 are however dated May, 1995, and would thus have been prepared before the results of the October, 1995, Trench exploration program were available.

It is assumed that the phreatic surfaces would be reviewed in the light of the additional drainage measures incorporated within and below the Main Embankment Dam.

6.0 MONITORING MEASURES

The proposed instrumentation program for the Tailings Storage Facility as a whole is shown in general form on Drawing 1625.120 of Ref. 9.1. It consists principally of **(i)** piezometers to measure pore pressures in the foundations; the various Zones within the Main Embankment Dam during its stages of raising (and particularly in Stage 1b); and in the stored tailings, **(ii)** surface movement monitoring, and **(iii)** groundwater monitoring wells.

Data on proposed monitoring measures is also given on Drawing 510-77-01-1625.220 (Rev.6) in Ref. 9.10, and it is understood that it is planned to measure depths of frost penetration in the area this Winter, and in-situ temperatures of winter-placed earth fill in the Embankment. Additional monitoring measures are recommended particularly for the period of initial retention of water only and until tailings beach is formed adjacent to the Stage 1b crest, as discussed later.

7.0 DISCUSSION

The discussion which follows is based on observations during the site visit, discussions at the subsequent meetings in Vancouver in 1996 and 1997, and on the Reference documentation listed in Section 9.0, and particularly the additional factual geological and geotechnical data which has been obtained in the interval to supplement the preliminary data (e.g. Ref. 9.8). It is understood that a Supplementary Design Report is being prepared. The schedule for initial impoundment of water behind the Stage 1b Embankment, and start of filling with tailings, has been changed significantly from the initial plans, as already mentioned. In particular, tailings will be introduced into the Tailings Area sooner than previously envisaged, after start of impoundment of water. It is assumed that initial discharge of tailings would still be from the crest of the Stage 1b Embankment. Ref. 9.10 indicates that the minimum water level would be at about el. 925m at start of tailings deposition.

In the interval since the site visit, earthwork construction of the Stage 1b Embankment has continued and has included work under winter conditions, when favourable. Raising of the Stage 1b Embankment is still in progress at time of this writing. The comments given herein, are thus subject to review on the basis of final "as-built" data and the formal Supplementary Design Report.

The overall drainage measures fall into two basic categories, namely:

(1) measures to control water losses, uplift pressures, prevention of piping, and the like, due to seepage through the pervious elements of the foundation soil and bedrock, and

(2) measures to control seepage losses through the various stages of the Main Embankment Dam as well as the phreatic surface with the Dam and the tailings in storage. These are discussed separately below.

7.1 Control of Underseepage

The current filling plan calls for a short period of initial impoundment of water by the Stage 1b Embankment Dam prior to discharge of the tailings from this Dam. From the standpoint of underseepage, the most significant foundation overburden stratum is a stratified silt and sand which is reportedly of glaciofluvial/glaciolacustrine origin. The measures for control of underseepage through this stratum as provided in the design of the Main Embankment Dam rely primarily on the existence of a naturally occurring low permeability glacial till cap which covers the stratified sands and silts for the most part, and virtually all of the proposed Tailings Area. In places, such as the base of the valley adjacent to the Main Embankment Dam, the till cap is

either locally absent or less than 2m in thickness. At this location, the design calls for provision of an engineered low permeability blanket of compacted, select, glacial till. The data from which the thickness and continuity of the surface cap of glacial till is inferred has been established from an investigation program of exploratory boreholes and test pits and appears reasonable based on geological evidence and observations during the walkover reconnaissance of the area. As indicated on Page 6 herein, artesian conditions were encountered in two groundwater monitoring wells installed in the Tailings Area near the Main Dam, and there are two swampy areas and a pond which appear to be fed by groundwater discharges. The latter are, however, a considerable distance from the Main Dam, and at surface elevations of 924m or higher. They also appear to be underlain by formations of low permeability in accordance with data in Ref. 9.10.

It is recognized, of course, that the tailings in storage will become increasingly effective as a seal to the base of the Tailings Area as their deposited thickness increases, and in due course they will probably comprise the main seal. There is, however, an initial period of impoundment of water only where the drainage measures will have to control seepage losses to within the desired limits; maintain seepage and uplift pressures within the limits assumed in design; and provide the necessary resistance to piping. This applies even considering the currently proposed shorter period between impoundment of water and start of tailings deposition. The main seepage control measure initially is the combination of natural and engineered till linings to the base of the Tailings Area. This will be subjected to high hydraulic gradients, particularly near the Main Embankment Dam where the natural till cap is of least thickness, and where the underlying sequence of glaciolacustrine/glaciofluvial silts and sands was encountered. It is clearly important that the integrity of the Basin Liner, and the natural till is assured, not only during the initial filling period, as mentioned above, but for the longer term as well. The following comments are made in this context:

(a) Exploration methods used for establishing the thickness of the till cap (such as test pits or trenches), should be checked for effectiveness of the backfilling which is understood to have been carried out with glacial till. Where doubtful, they should be re-excavated and backfilled. It is understood that this has been done, and that specific details will be provided.

The till cap appears to have been completely removed locally in the base of the Reclaim Barge Channel (Ref. 9.8 and Photo 19, Appendix I). It was also recommended that these local areas be checked and sealed, as required. Similarly the local area, (probably a former stream bed) at the upstream edge of the Basin Liner. (Photo 17 in Appendix I).

7.0 DISCUSSION

7.1 Control of Underseepage (cont'd)

(b) The engineered Basin Liner is 450mm thick and as originally designed (Ref. 9.1) was protected by 650mm of moderately compacted random fill (presumably also glacial till). Ref. 9.12, Drawing 510-15-01-1625.202 (Rev.5) indicates that only 300mm of frost protection was provided and then only in the right abutment area. The depth of frost penetration should be checked to verify whether there has been frost penetration into the Basin Liner proper, and if so, whether the Liner will be affected adversely (by softening or cracking, for example). The Liner should also be checked routinely for the same reason, in any event.

(c) The foundation drains at the base of the Stage 1b Embankment, as originally designed, do not extend into the glaciolacustrine/glaciofluvial silts and sands underlying the till cap. They would thus have functioned primarily as part of the internal drainage system of the Embankment itself. However, with the addition of pressure relief wells and trenches, as indicated in Refs. 9.5 and 9.10, they would have the added function of assisting to control uplift pressures from seepage under the Dam through the more pervious stratified sands/silts zone. The relief wells and trenches, as shown, are located under the Dam and thus would, for all practical purposes, not be accessible for future maintenance and repairs. The scheme is also not supported by analyses used in establishing the locations, spacings, and other details of the relief wells and trenches, nor are details of the latter (other than plan locations) available to the writer at this time.

The relief wells and trenches would probably be of most value for pressure relief under the Stage 1b Embankment Dam during the initial stages of filling of the Tailings Area, when primarily water is being impounded. It is recommended that the possibility of incorporating an additional appropriately engineered relief system adjacent to the downstream toe of the Stage 1b Embankment (particularly in prominent zones of alluvium below the till cap) be considered on the basis of the detailed findings of the foundation exploration boreholes, test pits and trenches, and as a contingency measure in any event since they would also provide added security against possible piping. Whereas the need for such a system might be based on results of monitoring e.g seepage quantities, visual evidence of piping, and piezometric levels in the sand/silt stratum during initial filling of the Tailings Area, consideration should be given to the time required for installation, as well as the fact that installation would be more readily carried out before excessive uplift pressures built up in the stratum these measures are designed to relieve. Careful selection of filter material would also be required, given the wide range of grain sizes present in the glaciofluvial/glaciolacustrine formation. The most

suitable form of such measures would probably be a trench

7.0 DISCUSSION

7.1 Control of Underseepage (cont'd)

(c) Cont'd.
intersecting the sands/silts sequence, filled with filter-graded material and equipped with a perforated pipe eventually connecting to the Seepage Collection Pond.

(d) It was recommended in 1996 that the results of the detailed exploration of the foundation stratum of sands/silts be reviewed with a view that, particularly, in the locations where the this stratum was found to be prominent, additional low permeability material be placed over the liner adjacent to the upstream toe of the Stage 1b Embankment and immediately upstream of the latter. This would apply particularly at the base of the valley where the hydraulic gradients across the liner and through the pervious stratum would be a maximum and there would be the greatest vulnerability to piping. It is understood that some such measures have been approved and that specific details will be provided. Consideration should similarly be given, as a contingency measure, to increased low permeability earth cover over the liner at locations of selected former exploration trenches, where still accessible and not already done.

(e) If practicable from the standpoint of constraints due to weather and other earthworks committments, consideration could also be given, to placing a berm on the downstream side, forming a portion of the toe of the Stage 1c raising. This would provide added resistance to possible piping in areas underlain by the sands/silts sequence.

(f) From an operational standpoint, it is recommended that to the extent practicable, (i) initial tailings discharge be directed to give coverage of the low part of the valley and the right bank adjacent to the Stage 1b Dam, and (ii) the depth of water be kept to a minimum until there is a reasonable build up of tailings in storage (to a selected elevation of say el. 920m at least) against the Dam. .

(g) It is recommended that the currently planned monitoring program also be reviewed in the light of the findings of the detailed subsurface investigation along the alignment of the Main Embankment Dam, and also from the standpoint of monitoring of the Stage 1b Dam during filling so that contingency measures can be applied, if necessary, in timely fashion.

7.0 DISCUSSION

7.1 Control of Underseepage (cont'd)

(g) Cont'd.

The currently planned monitoring program for the Main Embankment as a whole is described in various References, e.g. Ref. 9.10, Drawing 510-77-01-1625.220 (Rev.6) showing Instrumentation and Ref. 9.12, the Operation, Maintenance and Surveillance Manual for the Stage 1a Embankment. Whereas these documents give comprehensive coverage of such measures intended to avert problems of a stability nature or excessive leakage, it is recommended that additional measures be provided to detect potential problems due to excessive uplift and/or piping in timely fashion so that contingency action can be taken. These measures should focus, in particular, on foundation areas containing the sands/silts sequence and include piezometers; means for monitoring seepage flows; and visual inspection to detect evidence of piping. A check should also be made on uplift pressures under the Basin Liner in the right abutment area to ensure that detrimental uplift pressures do not develop.

It is also recommended that arrangements be made between Imperial Metals Corporation and Knight Piésold Ltd. for close monitoring of the Main Embankment Dam and environs, both visually and through instrumentation, particularly during the stage of initial filling with water and until tailings in storage provide the main seal to seepage through and under the Embankment. Also, in respect to contingency measures which could be applied if deemed necessary. These points are referred to further herein in Section 8.0.

(h) It is assumed that the previous seepage and stability analyses would be updated in the Supplementary Design Report.

7.2 Drainage Within the Dam

These measures consist of foundation drains in the engineered fill zones of the Main Embankment Dam, as well as the chimney drain system in the Stage 1b Dam as shown in Refs. 9.7 and 9.10.

The internal drainage system which is proposed above the elevation of the crest of the Stage 1b Dam has a number of different components as shown on Drawing 1625.111, Ref. 9.1, including pipework; a special low permeability core zone; an inclined "blanket" drain; and berms of compacted cycloned tailings sand founded on a coarse bearing layer on the tailings beach. Construction of the various elements will require considerable care not only

7.2 Drainage Within the Dam - Cont'd.

from the standpoint of the detail involved, but also because it will have to be done in conjunction with operations of the Tailings Area (discharge of tailings, etc.) from the crest of each stage of raising. It is understood, however, that Knight Piésold have experience in successful operational precedent elsewhere for the proposed raising scheme.

The proposed system includes an initial "toe drain" comprising a suitably designed sand filter enclosing a 150mm perforated CPT pipe to which are attached similar "riser pipes" at 50m centres within the "blanket drain". The toe drains would run the length of the Dam and be under the cycloned berms. They would have an exit pipe at each abutment and through additional pipework eventually drain to the Drain Monitoring Sump. The purpose of this drainage is understood to be to develop vertical seepage to enhance the density of the tailings in the beach area, particularly during the construction spigotting periods. After cessation of tailings placement, the phreatic surface is expected to depress within the tailings upstream of the Main Embankment Dam, as shown in Ref. 9.1.

This system of seepage management appears satisfactory, in principle. However, it is important that, in addition to careful construction control, the drains be designed so that they can be inspected and cleaned effectively using appropriate techniques similar to sewer inspection and cleaning. They should also be provided with means to accommodate anticipated deformations in the Dam such as expansion sleeves installed at all joints to control problems of joints pulling apart. Finally, the system should incorporate suitable redundancy.

It is recommended that additional detail be provided on this drainage scheme for purposes of review of the final design and also the Operation, Maintenance and Surveillance Manual, where the latter will relate to this item. Additional details should include such items as:

- anticipated pattern(s) of deformation of the Embankment and foundations as they will influence the components of the drainage system involving pipes, and means for accommodating the anticipated deformations.

- methods of accessing the more critical elements of the network of pipes (such as at the locations where they penetrate the abutments), together with the methodology proposed for inspection, cleaning and maintenance.

7.0 DISCUSSION

7.2 Drainage Within the Dam (cont'd)

- the extent to which redundancy is built into the pipe network system at present, and means whereby which additional features can be incorporated into the design of the pipework and "drainage Blanket", to ensure that the desired lowering of the phreatic surface takes place (as assumed in the design) even in the event of malfunction of or within the network of pipe drains.

- anticipated geotechnical properties of the tailings in the beach area, such as size gradation, permeability and relative density.

- details of the site setting, designs, and operating experience at other Projects where this type of drainage system has successful precedent.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 This Report has been based on Reference data as identified in Section 9.0 herein, and discussions at meetings with Imperial Metals Corporation and Knight Piésold Ltd. Consulting Engineers. It is subject to review when the Supplementary Design Report is available in respect to such items as the following. It is noted, however, that many of these items have been covered in preliminary form at the Meetings mentioned earlier, and through References received recently.

(i) Final results of geological, hydrogeological and geotechnical studies, etc. for the Tailings Area as a whole, and particularly for the site of the Main Embankment Dam and associated works such as the Seepage Collection Pond; Basin Liner; and Barge Reclaim Channel. In this respect, the specifics of the more pervious foundation formation (glaciolacustrine/glaciofluvial sands and silts) are of main interest.

(ii) Specific "as-built" details for the Main Embankment Dam, Stage 1a and 1b, plus associated works, (particularly the Basin Liner) including foundation drainage and measures already in place to control under-seepage. Also detailed results of verification testing and QA/QC work.

(iii) Monitoring measures already in place and progress results where available.

(iv) The revised plans for impoundment of water and placement of tailings, particularly for the Stage 1a and 1b Embankments.

Analyses of seepage through the Embankment and Basin Liner and underseepage through the foundation formations, for the natural ground and "as-built" conditions and revised operating plans.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Cont'd.

(iv) Cont'd.

Similarly, the updated stability analyses, evaluation of potential leakage from the reservoir base and sides through the natural formations and other aspects, where revised from the original Design Report.

(v) Evaluation of the Test Pits and Test Trenches for the Basin Liner; Main Embankment Dam; and Seepage Collection Pond, as potential problem areas from the standpoints of leakage losses, piezometric pressures and piping potential. Repair measures were carried out during construction.

(vii) The Designer's assessment of potential problems and risks from seepage and stability standpoints, particularly during the phase when the Stage 1a and 1b Embankments will be retaining primarily water, together with:

- plans for inspection prior to placement into service, and during the initial filling period.
- monitoring measures (pore pressures; leakage/seepage; piezometric levels, etc.).
- contingency plans and measures, and management of risks generally.

8.2 (a) The design of the Retention Structures for the Tailings Area, and particularly the Main Embankment Dam, relies heavily on the effectiveness of a low permeability liner to the Basin, composed of a combination of natural glacial till made continuous with an engineered glacial till liner at locations where the natural liner is considered too thin or is absent altogether.

(b) The Natural Basin Liner is thinnest, or absent locally, adjacent to the Main Embankment Dam, where hydraulic gradients across the Liner will be a maximum.

(c) The natural and engineered Basin Liners are generally underlain by a heterogenous (but generally stratified) formation of glaciofluvial/ glaciolacustrine origin, containing zones of reportedly loose sand in the area of the Main Embankment Dam in particular. This formation is also currently under artesian pressure at some locations.

8.2 (d) It is not known with certainty that the natural till lining is continuous throughout the Basin. In addition, Test Pits and Test Trenches have been excavated through it locally at the Reclaim Barge Channel and beneath the Main Embankment Dam and upstream and downstream of Stage 1b of the latter, including the area of the engineered Basin Liner.

The engineered Basin Liner is comparatively thin and may be vulnerable to cracking, particularly at its juncture with the Embankment Dam. If may have been affected by frost action. Such features constitute a potential risk against seepage losses, piezometric levels in the pervious foundation formation, and piping.

(e) In view of the factors mentioned above, it is considered important to monitor the Facility in comprehensive fashion, particularly during the initial filling period and to have contingency plans which are either applied prior to filling or can be subsequently put into effect in timely fashion.

A variety of contingency measures are pertinent, such as:

- additional low permeability fill on the upstream side of the Stage 1b Dam, particularly at the Dam-to-Liner juncture, to supplement that already in place in accordance with recommendations made earlier.

- addition of an engineered pressure relief trench on the downstream side of the Dam to supplement the pressure relief wells and trenches already in place.

- placement of low permeability fill over inlets of areas which may be sources of high seepage flows and piping potential e.g. former test trenches.

- other potential measures as mentioned in the Report.

To facilitate identification of potential contingency measures and their implementation, if required, it is recommended that relevant data be assembled to supplement that already documented, such as "as-builts" for the test pits and trenches in the Basin Liner area and repairs to such features; details of the additional earth cover placed at the Basin Liner to Embankment contact; zones of the embankment placed at below-freezing weather; details of the glaciolacustrine/glaciofluvial formation in the environs of the Main Embankment Dam; water levels

8.2 (e) Cont'd.

at the right abutment below the Basin Liner; details of frost penetration, if any, in the Basin Liner; details of ponding upstream and downstream of the Main Embankment to date; sources of low permeability earth borrow for sealing purposes and granular material for weighted filter purposes, if required, and the like.

8.3 The internal drainage system proposed above the Stage 1b crest incorporates several components and relies to an important extent on a network of horizontal and vertical pipes. The system of seepage management as a whole appears satisfactory in principle. However, it is considered important that the pipe drains can be satisfactorily accessed, inspected, and cleaned, and that provision is also incorporated in design to control problems due to joints pulling apart, as well as for suitable redundancy. Data verifying that such requirements are met by the proposed seepage management system, together with case histories of successful pertinent precedent elsewhere, should be provided for review.

Pending such a review, it is recommended that consideration be given to providing additional redundancy by suitable more pervious zones of granular material in the "drainage blanket" with, perhaps, multiple finger drain outlets of suitable granular material connecting to the base of the "blanket", along the lines used for chimney drains in more conventional earth dams.

8.4 Other items on which recommendations are made, or which are considered of particular relevance to this study, are discussed in the Report.

There would be merit in a further site visit after initial impoundment of water to maximum pond level as currently planned. At the same time, monitoring measures in place, contingency plans, and the like, could be reviewed along with the various items on which further data is recommended, as outlined above. It would be appreciated if you would advise on this.

The writer trusts that the Report is in accord with your requirements in the meantime. Kindly call in the event that elaboration on any point is required.

Respectfully submitted,

MAJM Corporation Ltd.

M.A.J. (Fred) Matich, FEIC, FCAE, P.Eng.(Ont.)

Ref: 7960

9.0 REFERENCES

9.1 Knight Piésold Ltd. Imperial metals Corp., Mt. Polley Project. Tailings Storage Facility, Design Report. Volume I - Main Report. May 26, 1995.

9.2 Knight Piésold Ltd. Imperial Metals Corp., Mt. Polley Project. Tailings Storage Facility, Design Report (Ref. No. 1625/1). Volume II. Appendices. May 26, 1995.

9.3 Knight Piésold Ltd. Imperial Metals Corporation. Mt. Polley Project. Response to Review Comments on Tailings Embankment Design. January 25, 1996.

9.4 Knight Piésold Ltd. Imperial Metals Corporation. Mt. Polley Project. Groundwater Monitoring Program. (Ref. No. 1624/2). June 3, 1996.

9.5 Knight Piésold. Site Memorandum from Ken Embree to Dennis Romanchuk, North American. Re: Revisions to Foundation Drain System. August 7, 1996.

9.6 Knight Piésold. Interoffice Correspondence. Memo from D. Harper to Ken Embree. Re: MPC 4-Foundation Drains. August 14, 1996.

9.7 Knight Piésold Ltd. Memo from Ken Brouwner to Ken Embree. Re: Embankment Chimney Drain. August 29, 1996.

9.8 Knight Piésold Ltd. Nine work sheets as follows:

(a) Part Plan showing basin liner details and exploratory trenches/test pits near South end of Dam. August 21, 1996.

(b) Part Plan showing similar detail to (a) but with Reclaim Barge Channel added. (Undated)

(c) Part Plan showing similar detail to (a) and (b) but including North end of Dam and borrow area.

(d) Work Sheet showing Section 7/1625.201, Ch. 24 + 80 and Section 8/1625.201, Ch. 25 + 90.

(e) Work Sheet showing Section 5/1625.201, 0 + 400m upstream of Dam Centreline, and Section 6/1625.201, 0 + 200m upstream.

(f) Work Sheet showing Section 4/1625.201.

(g) Work Sheet showing Section 3/1625.201, July 24, 1996. (Section at 050° through main embankment centreline).

9.0 REFERENCES

9.8 Continued

(h) Work Sheet showing Section 2/1625.201, July 24, 25, 1996 (Section at 190° looking East through Swamp.)

(j) Work Sheet showing Section 1/1625.201. (Section at about 110°, located through swamp and main embankment.)

9.9 Knight Piésold Ltd. Memo from Mr. Ken Brouwer re Mt. Polley Tailings Facility. January 18, 1997.

9.10 Handout at Working Meeting of February 28, 1997. Excerpts from Draft of Knight Piésold Ltd. Supplementary Design Report.

9.11 Knight Piésold Ltd. 1996 Report on Groundwater Monitoring Program (Ref. 1628/4) February 7, 1997.

9.12 Knight Piésold Ltd. Operation, Maintenance and Surveillance Manual for Stage 1a, El. 927m. March 11, 1997.

APPENDIX I

PHOTOGRAPHS

(Taken by M.A.J. Matich during site visit of August 26, 1996)

Imperial Metals Corporation
Mt. Polley Project, British Columbia
Site Inspection, August 26, 1996

APPENDIX	**I**
FIGURE	**1**
PROJECT	**7960**



Photo 1 Overall View of Tailings Storage Facility Site from West Side, Looking South-East towards Main Embankment Area.

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 2 PROJECT 7960



Photo 2. As for Photo 1 but Looking North towards Perimeter Embankment Area

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 3 PROJECT 7960



Photo 3. Base of Stage 1b of Main Embankment. Looking North-East

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 4 PROJECT 7960



Photo 4. Base of Stage 1b of Main Embankment. Looking South-West.



Photo 5. Base of Stage 1b of Main Embankment and Adjoining Basin Liner. Looking South-West.

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 5 PROJECT 7960



Photo 6. Base of Zone B of Stage 1b of Main Embankment near Seepage Collection Pond. Looking North-East.



Photo 7. Base of Zone B of Stage 1b of Main Embankment. A Foundation Drain visible. Looking South-East.

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 6 PROJECT 7960



Photo 8. Panoramic View of Main Embankment Seepage Collection Poind. Looking West.

Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 7 PROJECT 7960



Photo 9. East Side of Main Embankment Seepage Collection Pond. Looking North.



Photo 10. Base of Main Embankment Seepage Collection Pond near South-East Corner.

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 8 PROJECT 7960

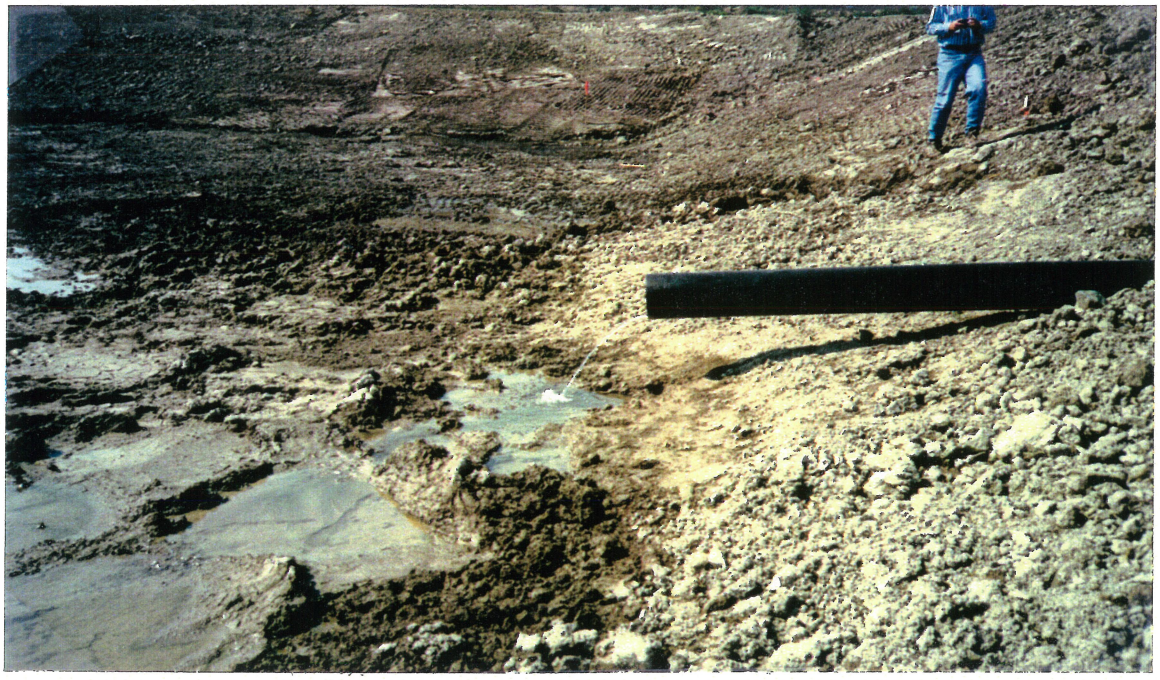


Photo 11. Outlet from Drain Monitoring Sump Discharging into Main Embankment Seepage Collection Pond.



Photo 12. Decant from Main Embankment Seepage Collection Pond in South-West Corner.

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 9 PROJECT 7960

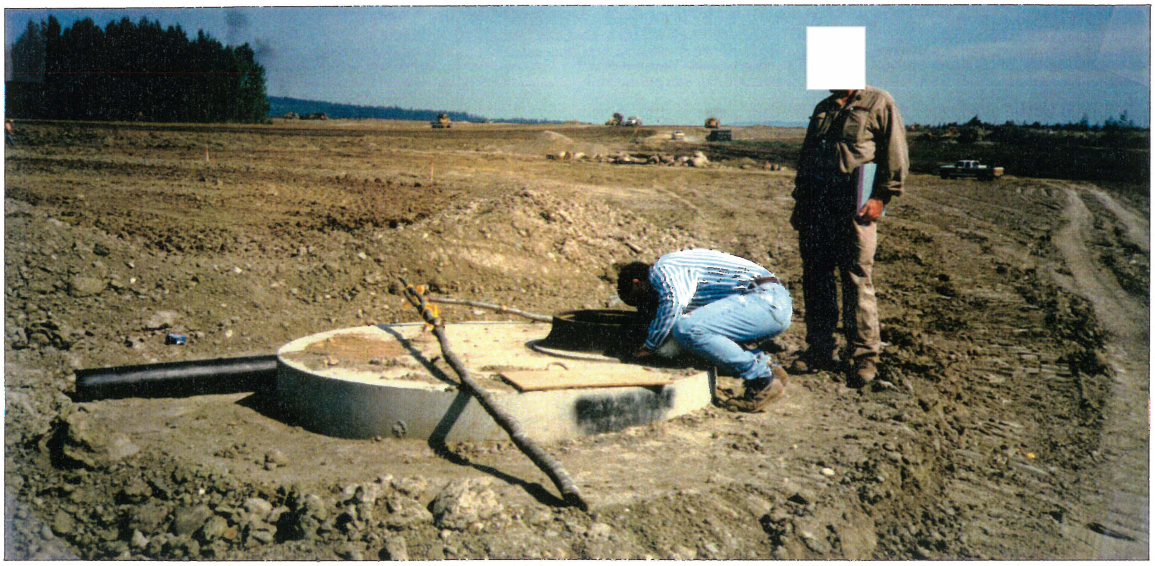


Photo 13. Top of Drain Monitoring Sump at Main Embankment.

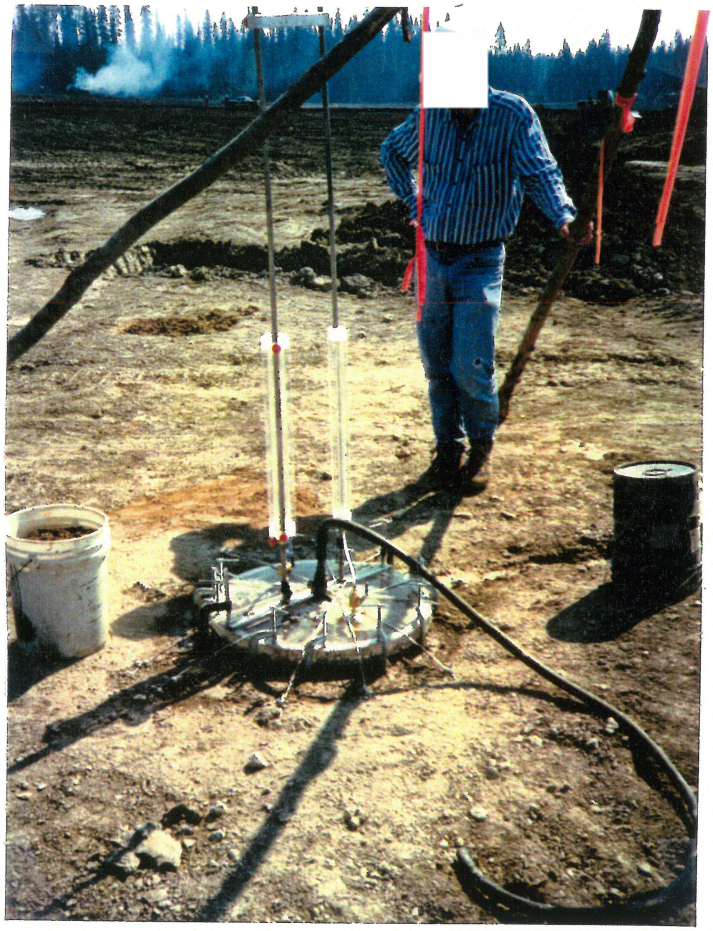


Photo 14. View of Field Air Entry Permeameter Testing of Basin Liner.

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Photo 15. Surface of Basin Liner. Looking East.



Photo 16. Exploration Trench Near South-West Edge of Basin Liner.

Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 11 PROJECT 7960



Photo 17. Previous Stream and Trail of Juncture with West Edge of Basin Liner. Looking North-West.



Photo 18. South end of Reclaim Barge Channel. Looking North-West.

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 12 PROJECT 7960

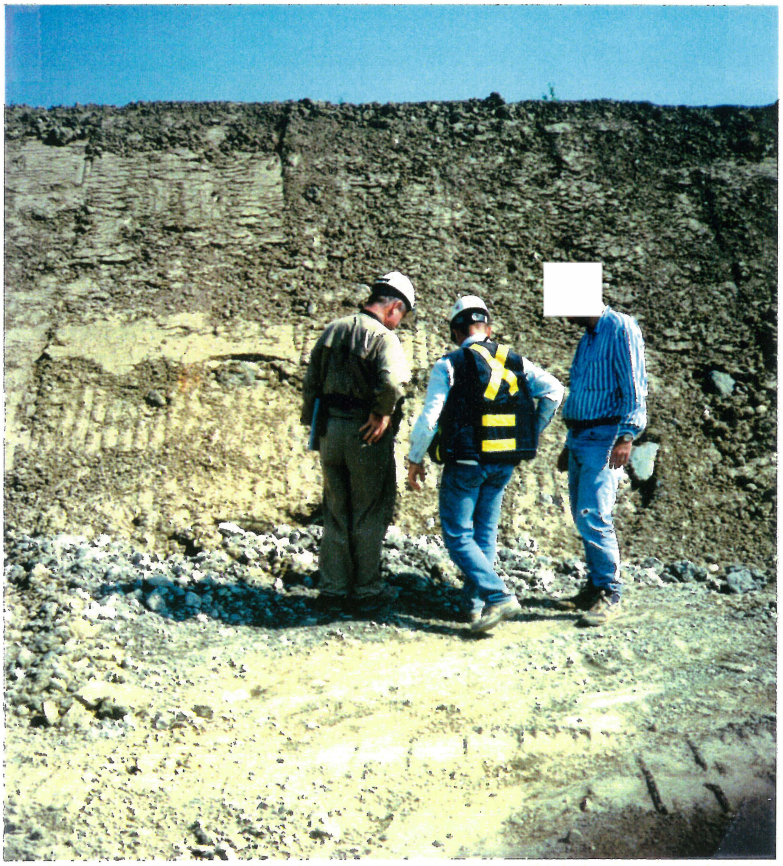


Photo 19. Exposure in base of Reclaim Barge Channel, East Side, Near South end.



Photo 20. North Side of Reclaim Barge Channel at About Mid-Length.

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 13 PROJECT 7960



Photo 21. As for Photo 20 but at a Location Further West.



Photo 22. West End of Reclaim Barge Channel at the Time. Looking East Towards Main Embankment.

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Imperial Metals Corporation Mt. Polley Project, British Columbia Site Inspection, August 26, 1996	APPENDIX I FIGURE 14 PROJECT 7960



Photo 23. Flow from a Cased Borehole Near Junction of West Perimeter Road and Proposed South Embankment.