IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

REPORT ON GEOTECHNICAL INVESTIGATIONS AND DESIGN OF OPEN PIT, WASTE DUMPS AND TAILINGS STORAGE FACILITY

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SECTION 1.0 - INTRODUCTION

1.1 GENERAL OVERVIEW

The Mt. Polley Project is located in central British Columbia approximately 56 kilometres north-east of Williams Lake. The nearest settlement is the community of Likely, which is located on the northern tip of Quesnel Lake.

The project derives it name from Mt. Polley, a low mountain with a peak elevation of 1260 metres, approximately 300 metres above the surrounding terrain. Mt. Polley is situated between Polley Lake to the east, and Bootjack Lake to the south-west. The site is presently accessible by paved road from Williams Lake to Morehead Lake, near Likely, and then by gravel forestry road for the final 10 kilometres to the site.

The project involves the mining by open pit methods of an estimated 48.8 million tonnes of copper and gold ore contained in three adjacent orebodies, at a nominal rate of 13,700 tonnes per day. An additional 26.2 million tonnes of low grade ore will also be stockpiled during operations for processing in the later stages of mine life. In addition to the ore, mining will produce 59.7 million tonnes of waste rock, which will be stored in waste rock dumps adjacent to the open pit, along with the 26.2 million tonnes of low grade ore.

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After processing of the ore to produce a copper/gold concentrate, the tailings will be discharged as a slurry into a tailings storage facility designed to provide environmentally secure storage of the solids waste, with collection and recycling of all process solutions. No discharge of process solutions from the site is required or anticipated.

1.2 SCOPE OF REPORT AND ACKNOWLEDGEMENTS

This report presents the design for the open pit, waste dumps and tailings storage facility. The evaluation is based on the results of field investigations and laboratory testwork. Specific design items which are addressed in the report are:

- Site characteristics including hydrometeorology, regional geology and seismicity.
- The results of geotechnical investigations carried out in the open pit, waste dumps and tailings facility locations.
- Results of waste characterization testwork on waste rock and tailings, and physical testwork on the tailings.
- Assessment of open pit geology, rock characteristics, hydrogeology, dewatering requirements and recommendations for open pit slopes.
- Preliminary layouts of the waste rock dumps and an assessment of the hydrogeologic impacts.
- Identification of construction materials for the tailings storage facility.

- General design features of the tailings storage facility, including initial construction requirements, water balance, operating requirements, on-going construction and final reclamation.

- Capital and on-going construction costs for the tailings storage facility based on preliminary engineering.

These items are discussed in the following sections of the report and are intended to provide input for the Stage I Report, permit applications and to become part of the overall Project Feasibility Study.

All field geotechnical work was carried out under the direction of Knight and Piesold Ltd. personnel with active involvement of Imperial Metals Corporation field personnel.

A comprehensive review of geotechnical data pertaining to the open pit was carried out by Professor C.O. Brawner. The results of the review and recommendations for open pit slope design are contained in Section 4.0 of this report, which was authored by Mr. Brawner.

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SECTION 2.0 - SITE CHARACTERISTICS

2.1 HYDROMETEOROLOGY

Long and short term climate records are available for a number of locations in the general mine site area, as shown on Figure 2.1. Two recently established stations (Likely with 6 years of record and Horsefly with 11 years) are located within 40 km of the site and in similar terrain. The project area is subjected to a relatively temperate climate with warm summers and cool winters. The precipitation is well distributed throughout the year.

Climatological summaries for weather stations within the project area are included in Appendix A.

The mean annual temperature at Likely, the nearest station to the site, is 4.0°C with an extreme maximum of 33.9°C and an extreme minimum of -37°C. At Quesnel, with approximately 70 years of record, extremes are 40.6°C and -46.7°C. Frost free days in the area range from 199 at Horsefly Lake (elevation 788 m) to 244 at Barkerville (elevation 1244 m).

A preliminary estimate of the total annual and monthly distribution of precipitation for the site has been made using data from a number of stations in the area. The mean annual precipitation at Likely is 699.7 mm and at Barkerville (with over 70 years of record) is 1043.9 mm. Precipitation for the site can be expected to fall within this range. Based on a linear interpolation of data for these and other stations, the average annual precipitation at the assumed site elevation of 1000 m has been estimated as 800 mm. As data is gathered from the site, improved estimates of precipitation will be made. Data for Likely, Barkerville and the site are presented in Table 2.1.

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Short term storm intensity, duration, return period curves have been plotted using data obtained from the rainfall frequency atlas for Canada, and are shown on Figure 2.2. Probable maximum precipitation for the site has also been calculated from data contained in this atlas and is shown on Table 2.2.

Evaporation data and estimated evaporation for the site have been computed using potential evapotranspiration by AES using the Thornwaite model and available data for Quesnel and Williams Lake. This data is shown in Table 2.3. Canadian Climate Normals, Volume 9 contains lake evaporation data for Mica Creek and Blue River which are at similar latitude to the mine site but are judged to be too distant to be relevant.

2.2 REGIONAL GEOLOGY

The Mt. Polley site is located in an alkalic intrusive complex in the Quesnel Trough, a 35 km wide north-west trending volcanic sedimentary belt of regional extent.

The rock units are segmented into blocks by several faults, including an inferred north-westerly trending normal fault which extends along Polley Lake. The predominant structure of the region is north-west trending and dipping steeply to the north-east. Localized geology in the vicinity of the open pit is shown on Figure 2.3.

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

2.3 SEISMICITY

The Mt. Polley site is situated within an area with very low seismic activity. A seismic risk calculation based on a Cornell type probabilistic model has been developed by the Pacific Geoscience Centre. The results for the Mt. Polley site are included as Table 2.4 and are summarized as follows:

Return Period (yrs)	Probability of Exceedence in 50 years (%)	Peak Ground Acceleration (g)	Peak Ground Velocity (m/s)
100	40	.021	.043
475	10	.037	.077
1000	5	.046	.094

The project is located in a NBCC Acceleration Zone 0, and Velocity Zone 1 for structural design requirements.

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SECTION 3.0 - GEOTECHNICAL INVESTIGATIONS AND TESTING

3.1 GENERAL

The geotechnical investigation programs were developed to determine design constraints for the proposed open pit, waste dumps and tailings storage facility. The field program consisted of field mapping, test pit excavations, and diamond drilling with permeability testing. The diamond drilling program was designed as an extension to the exploration and condemnation drilling program conducted by Imperial Metals Corporation.

Laboratory and geotechnical testwork for the different areas of the project included the following:

(i) Open Pit

- Detailed logging of joint and fracture data in oriented drill core from angle drill holes and unoriented drill core from vertical exploration holes.
- Selected laboratory testwork on fault gouge material.
- Permeability testing of vertical drill holes
- Installation of pneumatic and standpipe piezometers

(ii) Waste Dumps

- Laboratory studies on the acid generation potential of waste rock

- Condemnation drilling in the vicinity of the proposed waste dumps.

(iii) Tailings Facility Storage

- Laboratory studies of the physical and geochemical characteristics of a representative tailings sample.

- Test pitting and visual classification of surficial soils from three alternative tailings storage areas.

- Detailed logging of overburden and bedrock in vertical geotechnical/-condemnation drill holes in selected area.

- Permeability testing of drill holes.

- Installation of pneumatic and standpipe piezometers.

- Laboratory testwork on selected overburden materials.

3.2 OPEN PIT

3.2.1 Geotechnical Drilling

The exploration program conducted by Imperial Metals Corporation was expanded to provide additional information on the rock structure within the proposed open pit areas. Geotechnical drill logs were developed in addition to the geologic logs for 36 drill holes. The drill hole locations are shown on Figure 3.1. The following parameters were routinely recorded:

- RQD (rock quality designation)

- Discontinuity spacing and description of surface roughness

- Discontinuity orientation with respect to the core axis

- Discontinuity infilling materials

- Point load test results

Three additional inclined geotechnical drill holes, numbered MP89-152, MP89-153 and MP89-154, were also drilled. The inclined drill holes enabled oriented drill core to be obtained using an eccentrically weighted core tube which obtained impressions of the core at the top of each drill run. The drill core was obtained in a NQ double tube core barrel. The true orientation of rock discontinuities was determined from the oriented drill core.

Stereonet plots of the joint and fracture orientations measured in each of the three inclined holes have been developed by the Schmidt contouring method and are presented in Figures 3.2, 3.3 and 3.4. A combined plot of all discontinuity data is included in Figure 3.5. A summary of rock types, RQD, fracture index and unconfined compressive strength data for the three inclined geotechnical drill holes are included in Appendix B. Detailed logs of geotechnical boreholes have not been included in this report for brevity. These logs are in the possession of Imperial Metals Corporation.

The predominant rock types encountered consisted of intrusion breccia, syenodiorite and monzonite with occasional dyke rock. Several fracture zones were identified and occasional clayey or sandy zones of fault gouge were also encountered. Two samples of fault gouge were analyzed in the laboratory as follows:

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Drill Hole	MP89-143	MP89-152
Depth	38 m (125 ft)	90 m (245 ft)
Gradation		
Gravel	6 percent	7 percent
Sand	28 percent	16 percent
Silt	46 percent	23 percent
Clay	20 percent	54 percent
Atterberg Limits		
L.L.	57 percent	86 percent
P.L.	26 percent	36 percent
P.I.	31 percent	50 percent
Pocket Penetrometer	disturbed	4.5 tons/ft^2
Natural moisture content	23.5 percent	26.5 percent

In general, the rock quality of the proposed open pit walls is variable. Highly fractured zones up to 100 m in thickness were encountered in several drill holes. Also, zones of very weak and highly altered rock were recognized at various intervals in most drill holes. The uniaxial compressive strength of intact rock varied from very high (>200 MPa) to very low, (<5 MPa) as indicated in Appendix B. Zones of increased fracturing and more intense alteration are recognized to be generally associated with faulting and also with the contacts between the intrusive geologic units.

The discontinuities in the rock mass generally reflect the regional trend as the dominant joint set strikes about 167 degrees and dips about 74 degrees to the north-east. A weaker joint set is approximately orthogonal to the main set and strikes about 030 degrees and dips at about 18 degrees to the north-west. The discontinuities were generally rough and often healed with calcite and chlorite. However, smooth, polished and slickensided joints were also identified. The discontinuity data is discussed further in Section 4.2.

3.2.2 Permeability Testing

Permeability testing was completed in the five vertical exploration holes shown on Figure 3.1. The test apparatus consisted of a NQ double packer wireline system developed by Longyear and included a flow meter and pressure gauge for accurate monitoring of test conditions.

The test results are included on Table 3.1. In general, the measured formation permeabilities are less than 1 x 10^{-5} cm/s, but occasional zones of high permeability (10^{-4} cm/s to 10^{-3} cm/s) were encountered. These high permeability zones are often associated with zones of intensely fractured bedrock, but were also observed in zones of relatively intact core. The geometric mean of all the permeability tests is 8.4 x 10^{-6} cm/s.

3.2.3 Groundwater Monitoring

Groundwater instrumentation installed in the open pit area included the installation of three 40 mm diameter standpipe piezometers for water level measurement and groundwater sampling and two multiple installations of pneumatic piezometers for measurement of water levels and hydraulic gradients. Additional water level measurements were obtained in a few open drill holes at the site. In general, the groundwater table was measured at depths of about 30 m in the higher elevation boreholes and at about 3 to 10 m at the lower elevations. The hydraulic gradient measured in the multiple installations appears to be approximately hydrostatic. However, temporary artesian flows were encountered in a few boreholes during drilling. Water level measurements are included on Table 3.2.

The standpipe piezometers were initially sampled for water quality analyses on August 10, 1989. Water quality analyses are included on Table 3.3, which indicates that the water is of potable quality.

3.3 WASTE DUMPS

3.3.1 Waste Characterization

A detailed program of acid/base accounting has been completed on potential waste rock materials from the open pit. This program involved the collection of random samples of drill core and subsequent analyses for:

- total sulphur
- neutralization potential
- total acid generation potential (calculated on the basis of total sulphur)

Acid generation testwork was conducted in two stages. In the first stage, composite samples of specific types of waste rock were collected at selected intervals from drill holes. These tests were carried out by Envirochem Services Ltd. of North Vancouver, B.C. In the second stage, additional waste rock samples were analyzed from various elevation increments. These tests were carried out by Coastech Research, also of North Vancouver, B.C.

The results of the waste characterization tests are included in Appendix C for 94 samples tested. The testwork indicates that the waste rock will not be acid generating, and only two samples, both from drill hole MP89-134 indicate a net acid generation potential. These samples were specifically selected from pyritic drill core.

Humidity cell results, tested by Coastech Research Inc., are also included in Appendix C. The test sample consisted of a composite material obtained from five drill holes in the north pit area, and included the pyritic samples from MP89-134. The sample was selected to provide a worst case representation of the waste rock. Test results indicate that the sample exhibited very low reactivity, with very low sulphate, acidity and conductivity values, and the pH remained stable at above 8.1.

The rock units in the area are generally alkaline and significant calcite infill of fractures and cavities in the rock mass results in a net neutralization potential of the waste materials. The samples tested by Coastech Research Inc. included some ore material which was not differentiated. Since all of the samples tested by Coastech have a net neutralization potential, the ore material is also considered to have a net neutralization potential.

3.3.2 Surficial Materials

The proposed sites are shown on Drawing No. 1621.100. In general, the sites are characterized by gently undulating topography.

The north dumps are situated on and adjacent to a relatively flat area with bedrock knobs and ridges. Colluvium, glacial till and forest litter were encountered along the flat areas, to a maximum thickness of approximately 20 metres as shown on Drawing No. 1621.100.

The south dumps are situated along the crest of a broad ridge. The topography is relatively flat and undulating. A veneer of colluvium, glacial till and forest litter is present over most of the area. Bedrock was encountered in drill holes at depths ranging from approximately 3 to 7.6 metres as shown on Drawing No. 1621.100. The central pit will also be used for waste rock disposal when development of the west pit proceeds during the later stages of operation.

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Groundwater in the vicinity of the waste dumps is generally shallow with flow directions governed by the surface topography.

3.4 TAILINGS STORAGE FACILITY

3.4.1 Tailings Physical Characteristics

Tailings samples were obtained from preliminary metallurgical testwork conducted by Coastech Research Inc. on samples of drill core. A laboratory testing program was conducted on the tailings materials to provide design information for the preliminary layout of the tailings storage facility. Detailed results are included in Appendix D and selected information is summarized below.

The tailings are comprised of predominantly silt (64 percent) and fine sand (30 percent) with a trace of clay (6 percent). It is non-plastic, yellow grey in colour and has a particle specific gravity of 2.78.

A series of settling tests were completed at slurry solids contents ranging from 25 to 45 percent. The tailings particles settled rapidly and a pronounced segregation of coarse to fine material was observed. The colloidal clay fraction remained suspended in the supernatant water for several days.

The tailings initially settled to relatively low densities generally in the range of 0.9 to 1.1 tonnes/m^3. Consolidation caused by evaporative drying resulted in final densities of approximately 1.3 tonnes/m^3.

The volume of initial water recovered from the tailings depends on the initial solids content of the slurry. At 35 percent solids, the initial water recovery was about 64 percent of the total water in the slurry.

The vertical permeability of the settled tailings was found to range between 1.0 x 10^{-5} and 2.0 x 10^{-5} cm/s. The horizontal permeability is expected to be significantly greater due to the pronounced segregation of the soil particles. In practice, the permeability of deposited tailings will be reduced due to on-going consolidation.

Particle settling velocities were measured as part of the hydrometer test on the silt and clay sized fraction. The data is presented in Appendix D and is required when calculating friction losses in slurry pipelines.

3.4.2 Tailings Geochemical Characteristics

Geochemical testwork was carried out by Coastech Research Inc. on a locked cycle tailings sample, and included the following testwork:

- Determination of net acid generating potential
- Special Waste Test using acetic acid
- ASTM waste extraction test using carbonic acid

Detailed results of the testwork are included in Appendix E.

The acid base accounting procedures used were based on recommendations by the U.S. Environmental Protection Agency. The method includes an evaluation of the balance between acid producing components (primarily pyrite) and acid consuming components (carbonates and other rock types with neutralizing capabilities). The results of this testwork are as follows:

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Sulphur (percent)	Paste pH	Acid Potential ($kgCaCO_3/t$)	Neutralization Potential ($kgCaCO_3/t$)	Net Neutralization Potential ($kgCaCO_3/t$)
0.02	8.22	0.6	24.6	24.0

These results indicate that the tailings are not acid producing and have a significant net neutralization potential.

A special waste classification test was conducted in accordance with the procedure published by the B.C. Ministry of the Environment, entitled "B.C. Special Waste List". The results of this testwork are included in Appendix E and summarized on Table 3.4. The test indicates that the tailings from the locked cycle tests do not exceed the B.C. Waste Management Branch regulations for special wastes. The analysis of pore water shown on Table 3.4 gives an indication of the supernatant water quality.

In addition to the special waste test, an ASTM waste extraction test using carbonic acid at pH 5.5 was carried out. The test uses carbonic acid for leaching of the tailings and is a more realistic indication of actual long term water leachable constituents under slightly acidic rainfall. Details of the test are included in Appendix E, with the results summarized on Table 3.5. The test showed very low levels of water leachable constituents in the extract, all at concentrations below the lower range concentration from the pollution control objectives for final effluent discharge. Higher concentrations of various constituents in the pore water compared to those on Table 3.4 are attributed to aging of the sample in the laboratory and are not considered representative.

The tailings water quality was also analyzed during the pilot scale test program. These test results are compared to analyses of groundwater at the proposed tailings area as discussed in Section 6.5 and as shown in Table 6.7.

3.4.3 Surficial Materials

Three potential tailings areas, designated A, B and C, were identified as part of the initial site evaluation process. An initial test pitting program was carried out at each of the sites, as shown on Drawing Nos. 1621.001, 1621.002 and 1621.003. Subsequent selection of Site B focused the investigations on this area.

A total of 18 test pits were excavated in Tailings Area B with a CAT 225 backhoe during August 27th and 28, 1989 in and around the proposed tailings area. Test pit logs for these holes are included in Appendix F. In general, the area is underlain by extensive deposits of dense to very dense, low permeability glacial till. This till material is an excellent construction material and adequate quantities are available within the basin for construction of starter dams. Materials for on-going embankment construction are available in the immediate vicinity. Bedrock was not encountered in any of the test pits and only minor perched groundwater flows were encountered in a few of the excavations.

The foundation conditions at the main dam site are generally good. Soils encountered in the lowest part of the broad valley consist of a thin organic peat layer overlying dense, over-consolidated glaciolacustrine silts which would make an excellent low permeability foundation material. Some alluvial sands were encountered below a surface layer of glacial till on the south-west abutment (TPB11 and TPB12). An additional test pit (TPB16) was excavated on the north-west end of this ridge, where competent low permeability glacial till materials were encountered. Further exploration is required to determine the extent of the alluvial deposits.

The foundation materials at the small dam in the topographic depression at the north-east end of Area B consist of a relatively thin layer of saturated peat overlying dense, low permeability glacial till (TPB18).

3.4.4 Laboratory Tests on Till Overburden

Laboratory tests were carried out on samples of glacial till taken from selected test pits in Area B.

Grain size distributions of minus 20 mm samples of the glacial till material are included in Figure 3.6. Cobbles and boulders generally comprise less than 10 percent of the bulk material. Additional laboratory information is as follows:

TEST PIT	TPB-1	TPB-13, 14, 16
Atterberg Limits		
LL	28.6 percent	30.0 percent
PL	18.9 percent	16.3 percent
PI	9.7	13.7 percent
Natural Moisture content	14.0 percent	-
Specific Gravity	-	2.76
Modified Proctor		
Max Dry Density	-	1935 kg/m^3
Optimum Moisture	-	13.3 percent
Laboratory Permeability	-	1.6 x 10^{-8} cm/s

Falling head permeability tests were conducted in the standpipe piezometers installed in holes MP89-232, 233, and 235. A summary of the results is given on Table 3.7, and the permeability values range from 1.4 x 10^{-6} cm/s to 2.4 x 10^{-5} cm/s. These values confirm the packer test results as they have a similar range of values. Clearly, the permeability of the till can vary by at least an order of magnitude, depending on the exact composition of the material.

Table 3.8 presents a summary of phreatic surface readings taken in the 6 holes with piezometer installations. The piezometer readings indicate that the vertical component of groundwater flow in the majority of the tailings area is artesian and discharging upwards to the surface. Hole MP89-235, located on the ridge at the south abutment of the main dam, has a downward vertical component of flow indicating an area of local groundwater recharge.

Standpipe piezometers were sampled for water quality testing in November, 1989. Results of the analyses are shown on Table 3.9.

3.4.7 Summary of Hydrogeological Regime

The surficial glacial till blanketing the area is a low permeability unit with a mean measured permeability of 9 x 10^{-6} cm/s, and ranging in thickness from 5 to approximately 30 metres over most of the area. The measured field permeabilities may be anomalously high, as the laboratory permeability of 1.6 x 10^{-8} cm/s, as reported in Section 3.4.4, is considerably lower. Also, it was observed that ponded water remained on the surface of the glacial till for long periods after rain storms. Excavation into soils below the surface ponds indicated that the wetting front had progressed only a few centimetres.

Additional field permeameter or percolation tests are recommended prior to final design to determine the in-situ permeability of the surficial till.

Artesian groundwater pressures were encountered in sandy materials underlying the surficial glacial till. The overburden/bedrock contact is expected to have a permeability approximately ten times that of the surficial till, based on field observations and on the single test completed in this zone. At depth, the bedrock becomes less permeable with a geometric mean of the measured permeabilities of 4×10^{-6} cm/s.

Groundwater contours are shown on Drawing No. 1621.002.

Simplified geological cross-sections through the tailings area are shown on Drawing No. 1621.004. On the basis of the inferred hydrogeology and measured permeabilities, the estimated total groundwater flux beneath the tailings facility is in the order of 4 to 8 L/s (50 to 100 Igpm) in a south-easterly direction.

3.5 CONCRETE AGGREGATE

3.5.1 Sources of Sand and Gravel

Concrete aggregate quality sand and gravel are exposed at Hydraulic at the east end of Little Lake in the B.C. Government owned highway maintenance pit. Extensions of this deposit on private land most probably exist north westward along the road on elliptical hills on the valley floor (drumlins). Road distance from these deposits to the mill site is less than 15 km.

A second source of relatively clean sand and gravel was identified just north of Highway 115 at the Beaver Creek crossing, some 32 km by road south-west of the mill site.

1.5 to 2 m (5 to 6 ft) apart. It is preferable if this pre-shear line is drilled at an angle of 70-75 degrees below the horizontal rather than vertical. It is also desirable to drill the line holes double bench depth to do away with a small bench lip which could develop half way up a double benched slope. To minimize wall damage it is preferable that the explosive in the line holes be decoupled laterally and/or air decked to spread the explosive more throughout the length of the hole. Rock excavation should be to the line holes and not beyond.

Two or three lines of buffer holes are recommended, drilled in front of the line holes with the spacing equal to about one-half that between the production holes. The first line of buffer holes should be angled. The others may be vertical. They should use the same diameter as the line holes. In order to drill the angle holes, it will be necessary to purchase or lease a drill which drills this size of hole and can be angled at angles up to about 25 degrees. Tamrock have drills with angled capacity. The amount of explosives per buffer hole will be approximately one-quarter that in the production holes. All buffer holes should be delayed.

Production holes may use larger diameter drills. Every hole of a production blast within one hundred feet of the final wall must be delayed singly.

Blasting should be developed towards a free face with that free face perpendicular to the wall. A typical trial blast pattern is shown in Figure 4.4. Figure 4.2 shows an excellent blast control program at Gortrum Mines in Ireland. Figure 4.3 is a plot of damage to rock, related to the weight of charge per delay, and the blast distance to the final wall. This graph emphasizes the utmost importance of using delays to reduce seismic acceleration forces to minimize wall damage.

The best blast design will result from trial test blast patterns in the field. The most beneficial program will develop where the open pit will be developed initially as a small pit and a subsequent set back will be developed. This initial pit can be developed with variable test slopes and test blast patterns to develop the best blast design for the final wall. Test trial blasts will be required wherever the rock conditions change substantially.

It is recommended that double benching be used at the final wall. In order for this procedure to be successful, the upper bench face must be scaled prior to drilling the buffer holes on the next lower bench elevation. It is also important that blast holes be staggered so the bottom of the hole does not intercept the crest of the bench below. Otherwise, very fragmented bench crests will develop leading to considerable ravelling and a greater berm width.

It is recommended that the operators of front-end loaders or shovel loaders who excavate this final face be given a seminar on structural geology, particularly the identification of small planar blocks and small wedges which could fail. By recognizing these in advance, they can dig them out so that ravelling at a later date will be reduced. By minimizing this ravelling the bench width can be narrowed to increase the overall slope angle.

Do not place piles of loose rock at the outer side of berms to catch ravelling rock. This requires an excessive bench width and results in overall flatter slope angles. Berms are to catch ravelled rock. They are not intended for later access.

4.5 MONITORING

The development of slope movement will be indicated by the development of a tension crack or cracks. It is most important that periodic inspections along the crest and bench locations be performed periodically to locate such cracks.

When tension cracks are observed the initial monitoring program requires the installation of surface movement hubs or gages which will allow measurement of both vertical and horizontal displacement. This is required to evaluate the type of movement that is occurring - circular, planar, toppling etc.

If larger scale movements appear to be developing, an electronic distance measuring (EDM) prism monitoring system should be developed. Three or four prisms should be installed on a line down the center of the slide with readings taken daily from a fixed station across the pit. Movement records should be plotted daily to determine if there is an acceleration of the movement. Plots should be made of a total movement vs time. At this point in time a decision as to whether the slide will be stabilized or whether it will simply be monitored and allowed to fail will then be made. If it is to be allowed to fail, continued monitoring of the acceleration will allow the date of failure to be predicted several days in advance. Mining would be discontinued at this time.

From a practical standpoint, where failure volumes involve 500,000 cubic yards or more, experience is that a failure will not occur within the next 24 hours if the amount of daily movement is less than about three inches.

Any failures involving one or more benches should be back analyzed. The location, structural geology, face failure geometry, failure surface roughness, seepage and blasting details etc. should be recorded. This allows the most accurate evaluation of the shear strength along the failure surface to be determined, to be used in re-design. Photographs should be taken and described.

4.6 BENCH DESIGN

For final pit wall bench design it is proposed that controlled blasting be used to develop a relatively steep bench face (70 to 75 degrees) which should be scaled with excavating equipment and a drag chain or equivalent from the top. Double benching is recommended. The scaling will reduce subsequent ravelling and reduce the catch width required for berms. Where the rock face stands up well, a 6 metre (20 foot) wide bench is suggested. If the rock is very fractured and considerable ravelling occurs the bench will have to be widened to about 8 metres (25 feet).

If areas of heavily fractured rock or faulted rock are encountered in the final slopes, more stable bench faces can frequently be developed using bulldozers and rippers rather than blasting along the final line holes. By utilizing this procedure the slope angles at Bougainville, in Papua New Guinea, for example, were steepened some 8 degrees.

4.7 PRELIMINARY PIT SLOPE DESIGN

East Facing Slope - A revised geological interpretation provided by Imperial Metals Corporation indicates the geologic structure is reasonably uniform over all three pits. Planar failures will occur locally where the structure dip is flatter than the bench face angle.

The slope angle can be developed with bench face angles of 70 degrees. The overall angle will depend on berm width, bench height and whether single or double benching will be used. See Table 4.1 and Figures 4.5 and 4.6.

West Facing Slopes - Based on existing structural geologic data the structure dips into the west facing slopes at about 45 to 75 degrees. Where the structure dip is less than about 60 degrees and does not cross major faults the bench faces can be developed at 75 degrees. The overall angle will depend on berm width, bench height and single or double benching. Where the dip angle is steeper than about 60 degrees the potential for toppling failure exists. The bench faces should be flattened to 70 degrees and berm widths should be increased by 2.0 metres.

The overall slope angles for various conditions are shown in Table 4.1 and Figures 4.5 and 4.6.

It is very important that these slopes be drained.

South Facing Walls - The fault structures generally dip N-S and will not materially influence slope stability. The joints dip into the slope which is a stable condition. Accordingly bench faces can be developed at 75 degrees with minimum berms widths. The overall slope angle will depend on the use of single or double benches. See Table 4.1 and Figures 4.5 and 4.6.

North Facing Walls - The fault structures will have similar influence as in the south facing walls. The two joint sets prevalent at the site will intersect to form shallow wedges. Some local bench size failures can be expected. Bench faces should be developed at 70 degrees with wider catch berms. The overall slope angles for various conditions are given in Table 4.1 and Figures 4.5 and 4.6.

Note that the slope angles recommended do not include haul roads.

Pit Noses - The preliminary design of the west pit and central pit has created a north and a south nose. Such noses usually suffer from excessive ravelling and instability. It is recommended the overall slopes in any such area be flattened 10 degrees by using wider catch benches.

Ramps - It is desirable to locate haul roads on the most stable pit wall - in this instance along the west facing slopes.

Fault Intersections - Where faults intersect the walls at shallow angles (<30 degrees) local wedge failures will occur. Extra scaling will be required.

SECTION 5.0 - WASTE DUMP LAYOUTS

5.1 WASTE ROCK PRODUCTION

The total volume of waste rock to be removed from the proposed open pits is approximately 75 million tonnes. The greatest proportion of waste rock will be removed from the west pit which is scheduled to be developed last.

Testwork carried out to determine the geochemical characteristics of the waste rock has been reported in Section 3.3.1 for 94 samples of waste rock tested, all showed a net neutralization potential except for 2 samples from Hole MP89-134 located in the north pit. These samples contained 1.5 and 2.9 percent sulphur and had net acid generating potentials of 55.0 and 13.2 kg $CaCO_3$/tonne respectively. These are very low numbers and do not imply that acid generation will occur.

5.2 WASTE DUMP LOCATIONS AND CONSTRUCTION

Several waste dump sites have been selected as shown on Drawing No. 1621.100. The dumps have been located to optimize waste rock hauling. The main north dump will contain waste from the north pit and will include the waste rock, if any, which is deemed to have a net acid generation potential.

Routine acid-base accounting will be utilized to delineate any waste rock materials which have a net acid generation potential. Any waste rock which is deemed to be potentially acid producing will be blended into the north waste rock and encapsulated by similar acid consuming materials. On-going operational monitoring will include routine water quality analyses on any springs or seeps in the vicinity of the waste dumps.

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The waste dumps are generally situated on relatively flat topography and will be underlain by glacial till and bedrock. Sufficient quantities of suitable topsoil and glacial till will be stripped and stockpiled for final reclamation of the dumps.

The waste dumps have been located with sediment drainage features to control surface runoff. Small perimeter ditches will collect runoff from the dumps and will direct it into sediment control structures as shown on Drawing No. 1621.100.

The ultimate waste dumps shown on Drawing No. 3156.100 include final reclaimed slopes of 2h:1v. During operations, the waste rock will be placed in individual benches as required to control surface erosion with the surface of the dump sloped to control runoff.

The existing groundwater table at the waste dump sites is generally within a few metres of the ground surface and the phreatic surface is similar to the general topographic surface. Natural segregation of waste rock during placement will result in coarser particles along the base of the dump. This will preclude the development of a phreatic surface within the dump.

5.3 STABILITY ANALYSES

Stability analyses of the waste dump have been carried out for a range of natural ground conditions and the maximum height of the dumps. A typical stability analyses is shown on Figure 5.1.

Strength parameters for the rockfill have been assumed from published information on the shearing strength of rockfill by Leps (1970), and recommended values from the U.S. Forest Service Intermountain Region, Dump Stability Performance Objectives and Evaluation Criteria. These are summarized on Figure 5.2. Strength parameters for the foundation material assume either an in-situ layer of till or unstripped topsoil and wood debris.

The stability analyses were carried out for base translational failure along the waste rock/foundation contact using a non-circular analyses. The analyses were completed for both the operational angle of repose dump slopes and for the final reclaimed slopes of 2h:1v. The results are summarized on Figure 5.3 which indicates that a minimum factor of safety of 1.2 can be achieved for the final dump slopes on all terrain at the site regardless of topsoil stripping.

5.4 RECLAMATION

Final reclamation of the waste dumps will involve spreading of topsoil and glacial till and seeding or planting as required.

SECTION 6.0 - TAILINGS STORAGE FACILITY

6.1 SITE SELECTION

A selection and evaluation of alternative tailings disposal sites was initially carried out and included a comparative assessment of the following factors:

- Capacity and filling characteristics
- Surface hydrology and downstream water usage
- Hydrogeology and groundwater flows
- Aesthetics and visual impact
- Foundation conditions and construction requirements
- Closure and reclamation requirements
- Capital and operating costs

Three possible tailings disposal sites were identified and designated as Areas A, B and C respectively. The site locations and conceptual layouts are included on Figure 6.1. A preliminary site investigation program was conducted at each site, to evaluate the environmental impacts as well as design and construction constraints. The initial site investigations included surface mapping, surficial exploration by test pitting, and evaluation of surface and groundwater regimes. Surficial soils at each of the alternative tailings locations are shown on Drawing Nos. 1621.001, 1621.002 and 1621.003.

The foundation conditions at each of the proposed tailings areas are good, as a natural liner of low permeability glacial till and/or muskeg is present. Bedrock exposures in Area A consist of competent rock, which may result in some additional foundation preparation at the embankment locations particularly where the bedrock profile is steep. Foundation preparation at Area B is expected to minimal, with a possible exception at the south-west abutment of the main dam where sandy materials were encountered.

In Area C, small confining berms with small dewatering sumps on either side of the foundation excavations would likely be adequate to enable embankment foundation preparation to be completed economically.

The dense competent glacial till materials encountered at all sites are suitable as foundation materials for the embankments. In general it will not be necessary to excavate to bedrock, as the in-situ glacial till is preferred for the dam foundations. It likely has a lower permeability than the underlying fractured bedrock and in combination with glacial till materials in embankment core zones, will provide an effective seepage barrier for the impoundment.

A drawback to Area A development is the lack of sufficient quantities of suitable construction materials in the immediate vicinity. During pre-production development, borrow pits would likely be required in Area B to the south-east. This would result in higher fill placement costs due to a higher transport distance as compared to the other two options. Also, Area A embankment fill quantities are considerably higher, which further decreases its economic viability.

Site A, immediately south-east of Bootjack Lake is the closest to the mill site. This site was recognized to be the least favourable from both construction and environmental viewpoints due to its location straddling the Bootjack Lake and Bootjack Creek watersheds. Sites B and C are more distant from the mill site, but are isolated from established creeks and therefore have a much lower potential for any impact and pose a much lesser threat to surface waters. Site B is situated within the upper catchment of the Edney Creek tributary and Site C is situated in the 6 k creek swamp. A mantle of glacial till, identified at all three sites, is expected to provide an excellent low permeability barrier to preclude any adverse impacts on groundwater.

On the basis of the comparative evaluation, Area B was selected for the tailings disposal facility for both environmental and practical considerations. Serious consideration was given to Area C, since it has the advantage of being completely isolated from the Quesnel Lake catchment area and is potentially the most economical site. However, the main drawback to this site is that Imperial Metals Corporation has been unable to obtain the land from the current owners and the cost of obtaining the land was unknown.

6.2 GENERAL DESIGN FEATURES

The principal objectives of the design for the tailings storage facility are to ensure complete protection of the regional groundwater and surface water flows both during operations and in the long-term and to achieve a tailings surface suitable for effective reclamation at mine closure.

The principal requirements of the design are as follows:

(i) Permanent secure and total confinement of all solid waste materials within an engineered disposal facility.

(ii) Control, collection and removal of all free draining liquids from the tailings during operations for recycling as process water.

(iii) The inclusion of monitoring features for all aspects of the facility to ensure performance goals are achieved.

General features of the proposed tailings storage facility at Area B are shown on Drawing Nos. 1621.101, 1621.102, 1621.103 and 1621.104.

Initial construction of the facility will include a 23 m high main embankment at the south end, and a small 4 m high perimeter embankment along the east side. The embankments will be constructed from glacial till material excavated from within the basin. They will include a system of drainage pipework along the upstream toe and face to provide underdrainage to the tailings and control the phreatic surface.

Underdrainage water will be conveyed to collection ponds outside the embankment prior to recycling back into the tailings facility. The collection ponds will be lined with HDPE liners.

The tailings basin will be shaped during initial construction to concentrate the supernatant water and surface runoff towards a reclaim pump barge. Tailings deposition will be in a controlled rotational pattern from a series of spigots located along the crest of the tailings embankments. Sandy tailings beaches will develop immediately adjacent to the embankment face and the slimes will be deposited nearer the supernatant pond. Supernatant water will be recovered via reclaim pumps situated on a floating pump barge. A permanent booster pumpstation will transfer the reclaim water back to the mill site for reuse in the process.

Most of the tailings basin is covered with a mantle of dense, low permeability till that will provide an effective seal beneath the tailings and reduce seepage rates to minimal practical levels. Borehole permeability testing in the till gave permeabilities in the range of 5×10^{-6} cm/s to 1×10^{-5} cm/s. These values may be high due to inherent difficulties in seating the packer in the till material, especially in view of the fact that laboratory tests on reworked samples of till gave a permeability of 1.6×10^{-8} cm/s.

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The reclaim water pipeline and tailings discharge pipeline will be placed along a common access route which will include a collection ditch for control of spills as shown on Drawing No. 1621.104.

An average tailings solids content of 35 percent has been assumed throughout this report. This does not include a tailings thickener, which could result in a significant reduction in tailings pipework costs and reclaim water pumping requirements and the following benefits:

- Improved water clarity. Settling tests indicate that a significant turbidity persists in supernatant water for several days.
- Reduced segregation of tailings solids.
- Increased tailings densities.
- Reduced evaporation and seepage water losses.

6.3 RATE OF FILLING AND STAGED CONSTRUCTION

The depth area/capacity relationship for the proposed layout is plotted on Figure 6.2. This figure shows the projected filling rate and rate of rise of the tailings for a production rate of 13,400 tpd of tailings at a average final dry density of 1.25 t/m^3. It is evident that after approximately 3 years of operation, the tailings surface area is sufficiently large that the on-going rate of rise is less than 3 metres per year.

The tailings embankments have been designed for staged development during operations, in order to minimize initial capital expenditures and maintain an inherent flexibility to allow for variations in operation and production throughout the life of the mine.

The initial embankment will be constructed to El.935 metres to provide adequate storage for approximately 2 years of operation. This will allow for uncertainties in the actual start-up date and ensures that adequate freeboard will be maintained throughout the construction program in the following year.

On-going requirements for embankment construction are included on Figure 6.3 and on Drawing No. 1621.102. Each of the embankment raises provides storage capacity for approximately 2 years of operation. The Stage II raises will be constructed by centreline methods. 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. The low rate of rise, approximately 2 m/yr, the relatively arid environment, and the provision of underdrainage at the upstream toe of the embankment will ensure that tailings beach is fully drained and consolidated. Building upstream raises on the tailings will therefore be simple and result in a stable embankment. Final embankment slopes will be designed as part of the final engineering process.

Rotational discharge of tailings over the large exposed beaches will result in evaporative drying and consolidation of exposed beaches. Tailings deposition will, however, also be managed to prevent wind erosion and dust problems by wetting the tailings surface as required.

6.4 WATER BALANCE

The annual month by month water balances for the tailings facility have been calculated for Yrs. 1 and 10 of operations for the following conditions:

- Average Rainfall Year - average monthly precipitation at the millsite.

- Wet Rainfall Year - average monthly precipitation at the millsite plus one standard deviation.

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6.5 HYDROGEOLOGICAL IMPACT

The impact of the tailings facility on the hydrogeologic regime is expected to be minimal. It is estimated that approximately 2.5 L/s (35 Igpm) will seep from the ultimate tailings facility into the local groundwater system. This seepage water will be diluted by groundwater flows which are estimated to be about 4 to 8 L/s (50 to 100 Igpm).

The quality of the seepage water is good and only marginally worse than the existing groundwater quality. The baseline groundwater quality data is compared to the anticipated tailings seepage water quality, on Table 6.7.

6.6 MONITORING PROGRAM

Geotechnical and environmental monitoring systems are essential for proper management of the tailings storage facility. The monitoring program will include the following:

(i) Measurement of the rate of tailings accumulation.

(ii) Operational monitoring of tailings characteristics and recoveries.

(iii) Measurement of piezometric levels in standpipe and pneumatic piezometers installed in the foundation of the facility.

(iv) Monitoring of piezometers installed in the tailings mass, underdrainage system and embankment zones.

(v) Sampling of process water in the tailings pond and underdrainage ponds for water quality analyses.

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beach sands and fine tailings slimes. This procedure promotes consolidation of the deposit during operations and limits the localized accumulation of large depths of unconsolidated tailings slimes.

Final reclamation of the tailings surface will involve initial fertilization and seeding with grass or grain seed. Underdrainage water recovered from the deposit will be recirculated for irrigation of the agricultural crops. The embankment slopes will be reclaimed incrementally during operation with a suitable shrub/grassland seed mixture. Experience gained with reclamation procedures during operations will enable the most effective reclamation method to be implemented at final closure.

A storm water spillway will be constructed at the north-west corner of the tailings impoundment at closure. The spillway will extend onto the tailings surface and will be designed to remain operational in perpetuity. The final layout of the tailings storage facility is shown on Drawing No. 1621.103.

SECTION 7.0 - TAILINGS FACILITY COST ESTIMATE

7.1 INITIAL CONSTRUCTION

A cost estimate for the initial construction of the tailings facility is included on Table 7.1 based on the preliminary engineering. The total capital cost for the initial construction program is estimated to be $9.0 million exclusive of any contingency factor. A suitable contingency factor should be applied to the projected costs, to account for design and construction uncertainties.

The estimated costs for the tailings pipework and reclaim water system are based on a tailings slurry at 35 percent solids. The pumps and pipework have been sized accordingly in the cost estimate.

7.2 ON-GOING CONSTRUCTION AND OPERATIONS

The projected costs for on-going construction of the tailings facility are included on Table 7.2. Construction materials for on-going construction of the tailings embankments are assumed to be available from local borrow areas and from waste rock hauled from the open pit.

The annual operating costs for the tailings facility are presented in the Mt. Polley Feasibility Report by Wright Engineers Ltd.

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TABLE 2.1

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

MEAN MONTHLY AND ANNUAL PRECIPITATION

Location:	Likely B.C.	Mine Site	Barkerville
Elevation:	724 m	1000 m	1265
Location:	52° 36'N	52° 30'N	53° 4'N
	121° 32'W	121° 35'W	121° 31'W

	Mean (mm)	Std. Dev. (mm)	Mean (mm)	Std. Dev. (mm)	Mean (mm)	Std. Dev. (mm)
Jan	74.2	27.0	84.9	27.0	103.0	44.4
Feb	60.2	27.7	68.8	27.7	85.6	42.5
Mar	37.8	13.5	43.2	13.5	85.3	29.1
Apr	42.2	20.9	48.2	20.9	61.8	24.5
May	36.6	15.4	41.8	15.4	65.9	28.9
June	66.3	29.7	75.8	29.7	89.2	28.8
July	47.0	27.4	53.7	27.4	81.7	31.0
Aug	82.0	35.7	93.8	35.7	102.3	53.0
Sept	50.4	27.1	57.6	27.1	85.4	39.9
Oct	61.6	42.3	70.4	42.3	88.4	37.4
Nov	58.4	18.8	66.8	18.8	86.6	28.2
Dec	83.0	36.9	95.0	36.9	108.7	42.5
Annual	699.7	116.4	800	116.4	1043.9	112.7

Source:

Canadian Climate Normals, 1951-1980, Temperature and Precipitation Atmospheric Environment Service, Environment Canada.

TABLE 2.2

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

PROBABLE MAXIMUM PRECIPITATION

1 hour PMP	= 78 mm	= 78 mm/hour
6 hour PMP	= 87.6 mm	= 14.6 mm/hour
24 hour PMP	= 163.3 mm	= 6.8 mm/hour

Source:

Rainfall frequency Atlas for Canada, W.D. Hogg, D.A. Carr, Supply and Services Canada 1985.

TABLE 2.3

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

ESTIMATED PAN EVAPORATION AT SITE

	Quesnel	Williams Lake	Site
May	98	88	93
June	130	124	127
July	151	144	148
August	131	129	130
September	81	77	79
October	39	38	38
Total	630	600	615

Source:

Based on computed potential evapotranspiration data by AES using Thornthwaite model, increased by an empirical factor of 1.25 to bring into line with pan evaporation data.

TABLE 2.4

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

SEISMIC RISK CALCULATION

ENERGY, MINES AND
RESOURCES CANADA
GEOLOGICAL SURVEY OF CANADA

ENERGIE, MINES ET
RESSOURCES CANADA
COMMISSION GEOLOGIQUE DU CANADA

SEISMIC RISK CALCULATION *

CALCUL DE RISQUE SEISMIQUE *

REQUESTED BY/ DEMANDE PAR Jeremy Haile / Knight & Piesold Ltd. mJ

SITE Mt. Polley, B.C.

LOCATED AT/ SITUE AU 52.55 NORTH/NORD 121.63 WEST/OUEST

PROBABILITY OF EXCEEDENCE PER ANNUM/ PROBABILITE DE DEPASSEMENT PAR ANNEE	0.010	0.005	0.0021	0.001
PROBABILITY OF EXCEEDENCE IN 50 YEARS/ PROBABILITE DE DEPASSEMENT EN 50 ANS	40 %	22 %	10 %	5 %
PEAK HORIZONTAL GROUND ACCELERATION (G) / ACCELERATION HORIZONTALE MAXIMALE DU SOL (G)	0.021	0.028	0.037	0.046
PEAK HORIZONTAL GROUND VELOCITY (M/SEC) / VITESSE HORIZONTALE MAXIMALE DU SOL (M/SEC)	0.043	0.056	0.077	0.094

* REFERENCES

1. NEW PROBABILISTIC STRONG SEISMIC GROUND MOTION MAPS OF CANADA: A COMPILATION OF EARTHQUAKE SOURCE ZONES, METHODS AND RESULTS. P.W. BASHAM, D.H. WEICHERT, F.M. ANGLIN, AND M.J. BERRY EARTH PHYSICS BRANCH OPEN FILE NUMBER 82-33, OTTAWA, CANADA 1982.

2. ENGINEERING APPLICATIONS OF NEW PROBABILISTIC SEISMIC GROUND-MOTION MAPS OF CANADA. A.C. HEIDEBRECHT, P.W. BASHAM, J.H. RAINER, AND M.J. BERRY CANADIAN JOURNAL OF CIVIL ENGINEERING, VOL. 10, NO. 4, P. 670-680, 1983.

3. NEW PROBABILISTIC STRONG GROUND MOTION MAPS OF CANADA. P.W. BASHAM, D.H. WEICHERT, F.M. ANGLIN, AND M.J. BERRY, BULLETIN OF THE SEISMOLOGICAL SOCIETY OF AMERICA, VOL. 75, NO. 2, P. 563-595, 1985.

4A. SUPPLEMENT TO THE NATIONAL BUILDING CODE OF CANADA 1985, NRCC NO. 23178. CHAPTER 1: CLIMATIC INFORMATION FOR BUILDING DESIGN IN CANADA. CHAPTER 4: COMMENTARY J: EFFECTS OF EARTHQUAKES.

4B. SUPPLEMENT DU CODE NATIONAL DU BATIMENT DU CANADA 1985, CNRC NO 23178F. CHAPITRE 1: DONNEES CLIMATIQUES POUR LE CALCUL DES BATIMENTS AU CANADA. CHAPITRE 4: COMMENTAIRE J: EFFETS DES SEISMES.

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TABLE 2.4 (Continued)

SEISMIC RISK CALCULATION

SITE Mt. Polley, B.C.

ZONING FOR ABOVE SITE/ ZONAGE DU SITE CI-DESSUS

1985 NBCC/CNBC: ZA = 0; ZV = 1; V = 0.05 M/S

ACCELERATION ZONE/ ZONE D'ACCELERATION ZA=0
ZONAL ACCELERATION/ ACCELERATION ZONALE 0.00 G

VELOCITY ZONE/ ZONE DE VITESSE ZV=1
ZONAL VELOCITY/ VITESSE ZONALE 0.05 M/S

1985 NBCC/CNBC **
SEISMIC ZONING MAPS/ CARTES DU ZONAGE SEISMIQUE

PROBABILITY LEVEL: 10% IN 50 YEARS
NIVEAU DE PROBABILITE: 10% EN 50 ANNEES

G OR M/S	ZONE	ZONAL VALUE/ VALEUR ZONALE
0.00		
	0	0.00
0.04		
	1	0.05
0.08		
	2	0.10
0.11		
	3	0.15
0.16		
	4	0.20
0.23		
	5	0.30
0.32		
	6*	0.40

* ZONE 6: NOMINAL VALUE/ VALEUR NOMINALE 0.40;
SITE-SPECIFIC STUDIES SUGGESTED FOR IMPORTANT PROJECTS/
ETUDES COMPLEMENTAIRES SUGGEREES POUR DES PROJETS D'IMPORTANCE.

** FOR NBCC APPLICATIONS, CALCULATED ZONE VALUES AT A SITE SHOULD BE REPLACED BY EFFECTIVE ZONE VALUES [ZA(EFF) OR ZV(EFF)] AS SHOWN BELOW/ POUR APPLICATIONS SELON LE CNBC, ON DOIT REMPLACER LES VALEURS ZONALES CALCULEES POUR UN SITE PAR LES VALEURS EFFECTIVES [ZA(EFF) OU ZV(EFF)] COMME MONTRE CI-DESSOUS:

1. IF/SI (ZA - ZV) > 1, ===> ZA(EFF) = ZV + 1.

OR/OU

2. IF/SI (ZA - ZV) < 1, ===> ZA(EFF) = ZV - 1.

OR/OU

3. IF/SI ZV=0 AND/ET ZA > 0, ===> ZV(EFF) = 1.

(SEE REFERENCE 2 CITED ABOVE, PAGE 677)
(VOIR PAGE 677 DE LA REFERENCE 2 CI-DESSUS)

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TABLE 3.1

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

SUMMARY OF PERMEABILITY TESTING IN OPEN PIT

Hole No.	Depth Interval (ft)	Measured Permeability (cm/s)
MP89-145	40-60	1.0×10^{-6}
	70-90	4.6×10^{-6}
	100-120	5.0×10^{-7}
	130-150	3.5×10^{-6}
	160-180	1.3×10^{-5}
	190-210	$< 3.0 \times 10^{-6}$
	220-240	8.7×10^{-7}
MP89-146	60-80	8.8×10^{-6}
	90-110	5.0×10^{-7}
	120-140	6.9×10^{-7}
	150-170	3.1×10^{-6}
	180-200	1.5×10^{-5}
	210-230	5.7×10^{-6}
	240-260	2.2×10^{-6}
	270-290	3.7×10^{-6}
	300-320	1.1×10^{-5}
	330-350	1.6×10^{-4}
	360-380	1.5×10^{-6}
	390-410	$< 1.5 \times 10^{-6}$
	420-440	6.9×10^{-7}

TABLE 3.1 (Continued)

Hole No.	Depth Interval (ft)	Measured Permeability (cm/s)
MP89-146 (Con't)	460-480	9.8×10^{-7}
	480-520	1.0×10^{-6}
	520-560	2.5×10^{-6}
	600-640	4.8×10^{-6}
	640-700	2.0×10^{-6}
MP89-147	20-50	3.2×10^{-4}
	50-80	6.8×10^{-6}
	80-120	2.6×10^{-6}
	120-160	4.0×10^{-5}
	160-200	1.4×10^{-4}
	200-240	1.8×10^{-5}
	240-280	6.2×10^{-6}
	280-320	1.8×10^{-5}
	320-360	7.5×10^{-7}
	360-400	7.5×10^{-7}
MP89-148	20-60	1.0×10^{-4}
	60-100	6.6×10^{-4}
	100-140	3.0×10^{-3}
	140-180	4.2×10^{-4}
	180-220	4.8×10^{-5}
	220-260	3.0×10^{-5}
	260-300	7.2×10^{-6}
	300-340	4.9×10^{-4}

TABLE 3.1 (Continued)

Hole No.	Depth Interval (ft)	Measured Permeability (cm/s)
MP89-155	20-50	2.8×10^{-5}
	50-90	1.6×10^{-5}
	90-130	3.4×10^{-4}
	130-170	4.7×10^{-6}
	170-210	$< 1.0 \times 10^{-7}$
	210-250	$< 1.0 \times 10^{-7}$
	250-290	1.0×10^{-7}
	290-330	1.7×10^{-6}
	330-370	9.4×10^{-7}
	370-410	4.5×10^{-6}
	410-450	1.5×10^{-7}
	450-490	6.8×10^{-3}
	490-530	1.4×10^{-4}
	530-570	3.6×10^{-5}
	570-610	2.7×10^{-4}
	610-650	$< 1.0 \times 10^{-7}$
	650-700	$< 1.0 \times 10^{-7}$
Geometric Mean of all tests:		8.4×10^{-6} cm/s

TABLE 3.2

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT
GROUNDWATER LEVELS IN PROPOSED OPEN PIT AREA

DEPTH TO GROUNDWATER TABLE (m) IN MONITORING WELLS

Date	MP89-107	MP89-146	MP89-151
August 16, 1989	28.0	14.7	35.5
November 8, 1989	10.0	10.5	31.0

DEPTH TO PHREATIC SURFACE (m) IN MULTIPLE PNEUMATIC PIEZOMETERS

	MP89-147A	-147B	-147C	MP89-155A	-155B
Tip Depth (m)	27.6	59.0	88.8	7.8	157.7
Date					
August 2, 1989	3.2	2.6	4.5	-	-
August 15, 1989	3.5	2.4	4.6	-	-
November 12, 1989	2.2	1.6	9.2	2.7	*

* Reading beyond capacity of read-out box.

TABLE 3.3

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

GROUNDWATER QUALITY IN PROPOSED OPEN PIT AREA

Physical Tests		MP89-107 Aug 10/89	MP89-107 Nov 25/89	MP89-146 Aug 10/89	MP89-146 Nov 25/89	MP89-151 Nov 25/89
pH		7.90	7.83	7.03	6.97	7.50
Conductivity (Mmho/cm)		339.	380.	118.	81.	150.
Turbidity	NTU	36.5		173.		
Suspended Solids		96.0		340.		
Dissolved Solids		300.		100.		
Hardness	($CaCO_3$)	186.	167.0	47.1	30.6	71.2
Tot. N		0.26		0.49		
TOC		4.1		3.5		
DOC		4.1		3.3		
Anions and Nutrients						
Alkalinity	($CaCO_3$)	198.		60.5		
Sulphate	SO_4	1.5		3.7		
Chloride	C1	0.6		0.5		
O-Phosphate	P	0.014		0.036		
T-Phosphorus	P	0.24		1.82		
Nitrate	N	<0.005		<0.005		
Nitrite	N	0.002		<0.001		
Ammonia	N	<0.005		0.009		
Total Metals						
Aluminum	Al	4.66	0.14	13.9	0.37	0.74
Arsenic	As	0.0013	0.0004	0.0058	0.0015	0.0013
Cadmium	Cd	0.0002	<0.0002	0.0005	0.0002	<0.0002
Chromium	Cr	<0.001	0.001	0.004	0.001	0.003
Cobalt	Co	0.002	<0.001	0.003	<0.001	<0.001
Copper	Cu	0.043	0.018	0.75	0.26	0.13
Iron	Fe	1.34	<0.03	6.01	0.28	1.80

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TABLE 3.3 (Continued)

Physical Test		MP89-107 Aug 10/89	MP89-107 Nov 25/89	MP89-146 Aug 10/89	MP89-146 Nov 25/89	MP89-151 Nov 25/89
Lead	Pb	0.010	<0.001	0.018	0.003	0.010
Manganese	Mn	2.08	1.24	0.10	0.011	0.038
Mercury	Hg	<0.00005	0.00005	0.00036	0.00005	0.0007
Molybdenum	Mo	0.003	0.005	0.012	0.010	0.009
Nickel	Ni	0.004	<0.001	0.004	0.001	0.004
Silver	Ag	<0.0001	0.0002	<0.0001	<0.0001	<0.0001
Zinc	Zn	0.020	<0.005	0.028	<0.005	<0.005
Dissolved Metals						
Aluminum	Al	0.064	0.010	0.36	0.065	0.058
Arsenic	As	0.0006	0.0002	0.0016	0.0010	0.0003
Cadmium	Cd	<0.0002	<0.0002	0.0003	<0.0002	<0.0002
Calcium	Ca	56.3	54.8	15.6	10.4	23.9
Chromium	Cr	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	Co	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	Cu	0.014	0.013	0.070	0.21	0.025
Iron	Fe	<0.03	<0.03	0.11	<0.03	0.03
Lead	Pb	0.001	<0.001	0.002	0.001	0.001
Magnesium	Mg	10.7	7.08	1.93	1.10	2.73
Manganese	Mn	2.03	1.17	0.036	0.007	<0.005
Mercury	Hg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	Mo	0.003	0.002	0.012	0.003	0.006
Nickel	Ni	<0.001	<0.001	<0.001	<0.001	<0.001
Potassium	K	0.68	0.60	0.89	0.59	0.42
Silver	Ag	<0.0001	0.0001	<0.0001	<0.0001	<0.0001
Sodium	Na	3.87	2.44	7.18	4.64	2.24
Zinc	Zn	0.014	<0.005	0.021	0.005	0.025

Notes:

All units in mg/L except where noted otherwise.

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TABLE 3.4

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

TAILINGS SPECIAL WASTE TEST (ACETIC ACID)

Element	Concentration in Pore Water (ug/L)	Concentration in Extract (ug/L)	Concentration Dewatered Sample (ug/g)	B.C. Waste Management Regulations (as ug/g of Dewatered Sample)
Antimony	3.0	36.0	0.73	10
Arsenic	10.6	190.0	3.82	10
Bismuth	<4	<4	<0.09	-
Cadmium	<1	2	<0.04	1
Chromium	<2	<2	<0.04	10
Cobalt	<2	8	<0.16	-
Copper	6	1360	27.21	30
Lead	8	16	0.34	10
Mercury	<0.2	1	<0.02	1
Nickel	<2	46	<0.92	10
Zinc	10	56	1.14	500

Test Conditions:

Sample: Locked Cycle Tailings

Paste pH = 9.3

Volume of 0.5N acetic acid required to maintain at pH 5.0 = 58.0 ml.

Volume of water plus acetic acid added = 2.0 litres

Weight of solids = 100.0 gm

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TABLE 3.5

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

TAILINGS WASTE EXTRACTION TEST (CARBONIC ACID)

Element	Concentration in Pore Water (ug/L)	Concentration in Extract (ug/L)	Concentration Dewatered Sample (ug/g)	Objectives for Final Effluent Discharge (1) (ug/L) Range
Antimony	36	16	0.13	250-1000
Arsenic	363	97.3	1.06	100-1000
Bismuth	<1	<1	<0.01	-
Cadmium	<1	<1	<0.01	10-100
Chromium	<10	<10	<0.06	50-300
Cobalt	<2	<2	<0.01	500-1000
Copper	2	6	0.03	50-300
Lead	2	<2	<0.01	50-200
Mercury	<0.1	<0.1	<0.00	0-5
Nickel	<2	<2	<0.01	200-1000
Zinc	4	8	0.04	200-1000

Test Conditions:

Sample: Locked Cycle Tailings

Paste pH:	9.2
Carbonic Acid pH:	5.5
Weight of solid:	117.0 g
Volume of dilution water added:	0.45 L
Volume of extract:	0.43 L

(1) Pollution Control Objectives for the Mining, Smelting and Related Industries of British Columbia (1979).

TABLE 3.6
IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

TAILINGS AREA B SITE INVESTIGATION
SUMMARY OF WIRELINE PACKER PERMEABILITY TEST RESULTS

Hole No.	Depth Interval (m)	Permeability (cm/s)	Material Description
MP89-231	9 to 12	6.4×10^{-6}	Overburden
	30 to 37	1.6×10^{-6}	Soft Volcanics
	37 to 43	2.9×10^{-7}	Competent Rock
MP89-232	15 to 18	7.7×10^{-6}	Overburden
	32 to 37	3.2×10^{-6}	Fractured Volcanics
	43 to 46	1.0×10^{-5}	Competent Rock
MP89-233	12 to 18	1.1×10^{-5}	Overburden
	30 to 37	2.2×10^{-5}	Soft Rock
	37 to 46	1.6×10^{-5}	Broken Rock
	49 to 55	1.7×10^{-5}	
MP89-234	6 to 12	1.4×10^{-5}	Overburden
	30 to 37	3.2×10^{-7}	Competent Bedrock
	46 to 49	3.3×10^{-6}	Competent Bedrock
MP89-235	6 to 12	5.1×10^{-4}	Heavily Fractured Bedrock at Contact with Overburden
	12 to 18	8.6×10^{-8}	Very Competent Bedrock
	18 to 30	4.0×10^{-7}	Competent Bedrock
	30 to 43	1.1×10^{-5}	Slightly Fractured Bedrock
MP89-236	8 to 12	2.7×10^{-5}	Bedrock
	14 to 24	2.7×10^{-6}	Bedrock
	24 to 37	2.0×10^{-6}	Bedrock
	35 to 46	7.7×10^{-7}	Bedrock

TABLE 3.7

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

TAILINGS AREA B SITE INVESTIGATION
SUMMARY OF FALLING HEAD PIEZOMETER TEST RESULTS

Hole No.	Depth Interval (m)	Permeability (cm/s)	Material Description
MP89-232	3 to 15	2.4×10^{-5}	Overburden
MP89-233	16 to 30	1.4×10^{-6}	Overburden
MP89-235	3 to 32	7.7×10^{-6}	Bedrock and Overburden

TABLE 3.8

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

TAILINGS AREA B SITE INVESTIGATION
SUMMARY O PIEZOMETER RESULTS

Hole No.	MP89-231		MP89-232	MP89-233	MP89-234		MP89-235		MP89-236	
Piezometer type*	P	S	S	S	P	S	P	S	P	S
Tip Depth (m)	117	35	15	30	82	41	119	32	116	32
Date	DEPTH TO PIEZOMETRIC SURFACE (m)									
November, 1989	-1.5	0[1]	2.1	17	2.4	0[1]	3	1.8	8.8	0[2]

P = pneumatic piezometer

S = standpipe piezometer

Notes

1. Flowing at approximately 0.06 l/s (1 gpm)
2. Flowing at approximately 0.1 l/s (1.5 gpm)

TABLE 3.9

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

GROUNDWATER QUALITY IN PROPOSED TAILINGS STORAGE AREA

Physical Tests		MP89-231 Nov 25/89	MP89-232 Nov 25/89	MP89-233 Nov 25/89	MP89-234 Nov 25/89	MP89-235 Nov 25/89	MP89-236 Nov 25/89
pH		7.73	7.40	7.65	8.0	7.28	8.24
Conductivity (Mmho/cm)		1226	289.	393.	422.	4280.	574.
Turbidity	NTU						
Suspended Solids							
Dissolved Solids							
Hardness	($CaCO_3$)	182.	96.7	197.	80.2	432.	177.
Tot. N							
TOC							
DOC							
Anions and Nutrients							
Alkalinity	($CaCO_3$)						
Sulphate	SO_4						
Chloride	C1						
O-Phosphate	P						
T-Phosphorus	P						
Nitrate	N						
Nitrite	N						
Ammonia	N						
Total Metals							
Aluminum	Al	7.88	34.1	15.4	4.77	13.1	9.80
Arsenic	As	0.0085	0.0004	0.0088	0.073	0.0079	0.014
Cadmium	Cd	<0.0002	0.015	0.0003	<0.0002	0.0003	0.0003
Chromium	Cr	0.005	0.047	0.040	0.007	0.029	0.012
Cobalt	Co	0.006	0.013	0.009	0.002	0.010	0.007
Copper	Cu	0.030	0.069	0.048	0.019	0.052	0.075
Iron	Fe	11.9	29.3	20.9	4.47	14.0	15.3

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TABLE 3.9 (Continued)

Physical Test		MP89-231 Nov 25/89	MP89-232 Nov 25/89	MP89-233 Nov 25/89	MP89-234 Nov 25/89	MP89-235 Nov 25/89	MP89-236 Nov 25/89
Lead	Pb	0.003	0.013	0.009	0.004	0.006	0.011
Manganese	Mn	0.99	0.72	0.45	0.14	0.66	0.45
Mercury	Hg	0.00008	0.00020	0.00012	0.00013	0.00012	0.00013
Molybdenum	Mo	0.005	0.002	0.012	0.003	0.010	0.005
Nickel	Ni	0.015	0.062	0.036	0.005	0.023	0.011
Silver	Ag	0.0003	0.0003	0.0005	<0.0001	0.0004	0.0002
Zinc	Zn	0.044	0.066	0.078	0.024	0.064	0.039
Dissolved Metals							
Aluminum	Al	0.045	0.13	0.027	0.029	0.015	0.014
Arsenic	As	0.0018	0.0024	0.0015	0.066	0.0008	0.0008
Cadmium	Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	Ca		33.4	46.6	16.1	128.	39.7
Chromium	Cr	0.002	0.002	0.001	<0.001	0.001	0.001
Cobalt	Co	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Copper	Cu	0.006	0.007	0.001	<0.001	0.009	<0.001
Iron	Fe	2.08	0.35	<0.03	<0.03	<0.03	<0.03
Lead	Pb	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	Mg	14.0	3.15	19.2	9.50	26.6	18.6
Manganese	Mn	0.78	0.21	0.13	0.036	0.43	0.066
Mercury	Hg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005
Molybdenum	Mo	0.005	0.002	0.009	0.003	0.006	0.003
Nickel	Ni	0.006	0.013	0.007	<0.001	0.004	<0.001
Potassium	K	4.00	1.13	1.10	1.78	4.27	2.05
Silver	Ag	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001
Sodium	Na	180	7.97	8.30	66.0	686.	42.9
Zinc	Zn	0.025	0.011	<0.005	<0.005	<0.005	<0.005

Notes:

All units in mg/L except where noted otherwise.

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TABLE 4.1

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

PRELIMINARY PIT SLOPE DESIGN

Location	Section Design	Single Bench - 10 m				Double Bench - 20 m		
		Bench Face Angle	Top Berm Width	Bottom Berm Width	Overall Slope Angle	Bench Face Angle	Berm Width	Overall Angle
East Facing Walls 9500N - 10250 N	A	70^{o}	6.5m	6.5m	45^{o}	60^{o}	8.5m	45^{o}
East Facing Walls 10250N - North end North Facing Walls West Facing Walls Structural Dip $>60^{o}$	B	70^{o}	5m	6.5m	48^{o}	70^{o}	8.5m	52^{o}
South Facing Walls West Facing Walls Structural dip $<60^{o}$	C	75^{o}	5m	6.5m	50^{o}	75^{o}	8.5m	55^{o}

Note - The preliminary design slopes are based on

1 - Control of Ground water pressures with horizontal drains
2 - Use of controlled blasting within 30 meters of the final wall
3 - Haul roads on more stable west facing walls.

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TABLE 6.1
IMPERIAL METALS CORPORATION
Mt POLLEY PROJECT

TAILINGS STORAGE FACILITY

MONTH BY MONTH WATER BALANCE FOR
TAILINGS MASS AND WATER DISTRIBUTION
YEAR - 1 : AVERAGE YEAR

Assumptions :-

Dry Solids to Tails	=	13425 t/day	Initial Dry Density	=	0.90 t/cu.m
Tailings % Solids	=	35%	Final Dry Density	=	1.10 t/cu.m
Tailings S.G.	=	2.78	Operating Days/Year	=	365
Beach Runoff Coeff.	=	90%	* Maximum Recycle	=	667350 cu.m/month
Catchment Runoff coef.	=	24%	Initial Stored Vol	=	0 cu.m
Total Catchment	=	230 hectares	Evap Factor	=	0.80

	MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
A	Rainfall (mm/mon)	0.0	0.0	0.0	0.0	0.0	0.0	48.2	41.8	75.3	53.7	93.8	57.6	370.9
B	#Snowfall (mm/mon water equiv)	70.4	66.8	95.0	84.9	68.8	43.2	0.0	0.0	0.0	0.0	0.0	0.0	429.1
C	Pan evaporation (mm/mon)	38.0	0.0	0.0	0.0	0.0	0.0	0.0	88.0	124.0	144.0	129.0	77.0	600.0
D	Tailings beach area (ha)	4.0	5.0	13.0	18.0	25.0	35.0	45.0	50.0	60.0	65.0	70.0	75.0	
E	Outside catchment area (ha)	226.0	225.0	217.0	212.0	205.0	195.0	185.0	180.0	170.0	165.0	160.0	155.0	
	- <WATER IN> (cu.m)													
1	With slurry	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	9100232
2	Prec. runoff (beach)	2534	3006	11115	13754	15480	13603	19521	18810	40932	31415	59094	38880	268149
3	Prec. runoff (outside beach)	0	0	0	0	0	0	21401	203429	30926	21265	36019	21427	334468
4	Infiltration from precipitation	282	334	1235	1528	1720	1512	2169	2090	4548	3490	6566	4320	29794
5	Recovery from Pit	0	0	0	0	0	0	0	0	0	0	0	0	0
6	>>>> Total Water Input	761169	761693	770703	773635	775553	773473	801443	982681	834759	814523	860032	822980	9732643
	- <WATER OUT> (cu.m)													
	Supernatant Recovery													
7	(+) Int. recovery from tailings	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	5418284
8	(-) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
9	(-) Evap. from entire beach	1215	0	0	0	0	0	0	35200	59520	74880	72240	46200	289256
10	(+) Total precipitation runoff	2534	3006	11115	13754	15480	13603	40922	222239	71853	52680	95113	60307	602616
11	(+) Consolid. to final density	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	989924
12	Sub-total (Water Recovered as S/N)	477236	478923	487032	489671	491397	489525	516839	662956	488255	453717	498791	490025	6024368
	Underdrainage Recovery													
13	(+) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
14	(+) Rainfall infiltration	282	334	1235	1528	1720	1512	2169	2090	4548	3490	6566	4320	29794
15	(-) Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70723
16	Sub-total (Water Recovered as U/D)	52488	52540	53441	53734	53926	53718	54375	54296	56754	55697	58772	56526	656266
17	Water retained in tailings	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	2692024
18	Evaporation from tailings	1215	0	0	0	0	0	0	35200	59520	74880	72240	46200	289256
19	Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
20	Sub-total (Unrecoverable Water)	231445	230229	230229	230229	230229	230229	230229	265429	289749	305109	302469	276429	3052008
21	>>>> Total Water Accounted For	761169	761693	770703	773635	775553	773473	801443	982681	834759	814523	860032	822980	9732643
22	Total water added to tails surface	529723	531463	540473	543405	545323	543243	571214	717252	545010	509414	557563	546551	6680635
23	Water recycled to mill from tails	529723	531463	540473	543405	545323	543243	571214	667350	594912	509414	557563	546551	6680635
24	Monthly water surplus/deficit (-)	-137627	-135887	-126877	-123945	-122027	-124107	-96136	49902	-122341	-157937	-109788	-120800	-1327570
25	Cumulative surplus	0	0	0	0	0	0	0	49902	0	0	0	0	0
26	Makeup water required at mill**	228629	226889	217879	214947	213029	215109	187139	91002	163441	248939	200790	211802	2419598

\# Snowfall is given in equivalent depth of rainfall and is assumed to accumulate on outside catchment until May when it melts with 24% recovery
* Maximum allowable recycle from tailings area is equiv to 88 % of water associated with incoming tail slurry at assumed solids content.
** Makeup water at mill is total nonrecycled water (including that in ore) required to produce a tailings slurry at assumed solids content.

DATE 15-Feb-90
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TABLE 6.2
IMPERIAL METALS CORPORATION
Mt POLLEY PROJECT

TAILINGS STORAGE FACILITY

MONTH BY MONTH WATER BALANCE FOR
TAILINGS MASS AND WATER DISTRIBUTION
YEAR - 1 : WET YEAR

Assumptions :-

Dry Solids to Tails =	13425 t/day		Initial Dry Density =	0.90 t/cu.m
Tailings % Solids =	35%		Final Dry Density =	1.10 t/cu.m
Tailings S.G. =	2.78		Operating Days/Year =	365
Beach Runoff Coeff. =	90%	*	Maximum Recycle =	667350 cu.m/month
Catchment Runoff coef. =	24%		Initial Stored Vol =	0 cu.m
Total Catchment =	230 hectares		Evap Factor =	0.80

	MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
A	Rainfall (mm/mon)	0.0	0.0	0.0	0.0	0.0	0.0	69.1	57.2	105.5	81.1	129.5	84.7	527.1
B	#Snowfall (mm/mon water equiv)	112.7	85.6	131.9	111.9	96.5	56.7	0.0	0.0	0.0	0.0	0.0	0.0	595.3
C	Pan evaporation (mm/mon)	38.0	0.0	0.0	0.0	0.0	0.0	0.0	88.0	124.0	144.0	129.0	77.0	600.0
D	Tailings beach area (ha)	4.0	5.0	13.0	18.0	25.0	35.0	45.0	50.0	60.0	65.0	70.0	75.0	
E	Outside catchment area (ha)	226.0	225.0	217.0	212.0	205.0	195.0	185.0	180.0	170.0	165.0	160.0	155.0	
	- <WATER IN> (cu.m)													
1	With slurry	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	9100232
2	Prec. runoff (beach)	4057	3852	15432	18128	21713	17861	27986	25740	56970	47444	81585	57173	377939
3	Prec. runoff (outside beach)	0	0	0	0	0	0	30680	281880	43044	32116	49728	31508	468956
4	Infiltration from precipitation	451	428	1715	2014	2412	1984	3109	2860	6330	5271	9065	6352	41993
5	Recovery from Pit	0	0	0	0	0	0	0	0	0	0	0	0	0
6	>>>> Total Water Input	762861	762633	775500	778495	782478	778198	820128	1068833	864697	843183	898731	853386	9989121
	- <WATER OUT> (cu.m)													
	Supernatant Recovery													
7	(+) Ini. recovery from tailings	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	5418284
8	(-) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
9	(-) Evap. from entire beach	1216	0	0	0	0	0	0	35200	59520	74880	72240	46200	289256
10	(+) Total precipitation runoff	4057	3852	15432	18128	21713	17861	58666	307620	100014	79559	131313	88681	846895
11	(+) Consolid. to final density	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	989924
12	Sub-total (Water Recovered as S/N)	478759	479769	491350	494045	497630	493778	534583	748337	516411	480596	534990	518398	6268647
	Underdrainage Recovery													
13	(+) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
14	(+) Rainfall infiltration	451	428	1715	2014	2412	1984	3109	2860	6330	5271	9065	6352	41993
15	(-) Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
16	Sub-total (Water Recovered as U/D)	52657	52634	53921	54220	54619	54191	55316	55066	58536	57478	61271	58559	668465
17	Water retained in tailings	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	2692024
18	Evaporation From tailings	1216	0	0	0	0	0	0	35200	59520	74880	72240	46200	289256
19	Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
20	Sub-total (Unrecoverable Water)	231445	230229	230229	230229	230229	230229	230229	265429	289749	305109	302469	276429	3052008
21	>>>> Total Water Accounted For	762861	762633	775500	778495	782478	778198	820128	1068833	864697	843183	898731	853386	9989121
22	Total water added to tails surface	531415	532403	545270	548265	552248	547968	589899	803403	574947	538074	596261	576957	6937112
23	Water recycled to mill from tails	531415	532403	545270	548265	552248	547968	589899	667350	667350	581724	596261	576957	6937112
24	Monthly water surplus/deficit (-)	-135935	-134947	-122080	-119085	-115102	-119382	-77452	136053	-92403	-129276	-71089	-90394	-1071092
25	Cumulative surplus	0	0	0	0	0	0	0	136053	43650	0	0	0	0
26	Makeup water required at mill**	226937	225949	213082	210087	206104	210384	168454	91002	91002	176629	162091	181396	2163120

\# Snowfall is given in equivalent depth of rainfall and is assumed to accumulate on outside catchment until May when it melts with 24% recovery
* Maximum allowable recycle from tailings area is equiv to 88 % of water associated with incoming tail slurry at assumed solids content.
** Makeup water at mill is total nonrecycled water (including that in ore) required to produce a tailings slurry at assumed solids content.

DATE 15-Feb-90
FILE NAME F:\job\data\1621\POLWATER

TABLE 6.3
IMPERIAL METALS CORPORATION
Mt POLLEY PROJECT

TAILINGS STORAGE FACILITY

MONTH BY MONTH WATER BALANCE FOR
TAILINGS MASS AND WATER DISTRIBUTION
YEAR - 1 : DRY YEAR

Assumptions :-

Dry Solids to Tails	= 13425 t/day		Initial Dry Density	=	0.90 t/cu.m
Tailings % Solids	= 35%		Final Dry Density	=	1.10 t/cu.m
Tailings S.G.	= 2.78		Operating Days/Year	=	365
Beach Runoff Coeff.	= 90%	*	Maximum Recycle	=	667350 cu.m/month
Catchment Runoff coef.	= 24%		Initial Stored Vol	=	0 cu.m
Total Catchment	= 230 hectares		Evap Factor	=	0.80

	MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
A	Rainfall (mm/mon)	0.0	0.0	0.0	0.0	0.0	0.0	27.3	26.4	46.1	26.3	58.1	30.5	214.7
B	#Snowfall (mm/mon water equiv)	28.1	48.0	58.1	57.9	41.1	29.7	0.0	0.0	0.0	0.0	0.0	0.0	262.9
C	Pan evaporation (mm/mon)	38.0	0.0	0.0	0.0	0.0	0.0	0.0	88.0	124.0	144.0	129.0	77.0	600.0
D	Tailings beach area (ha)	4.0	5.0	13.0	18.0	25.0	35.0	45.0	50.0	60.0	65.0	70.0	75.0	
E	Outside catchment area (ha)	226.0	225.0	217.0	212.0	205.0	195.0	185.0	180.0	170.0	165.0	160.0	155.0	
	- <WATER IN> (cu.m)													
1	With slurry	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	9100232
2	Prec. runoff (beach)	1012	2160	6798	9380	9248	9356	11057	11880	24894	15386	36603	20588	158359
3	Prec. runoff (outside beach)	0	0	0	0	0	0	12121	124978	18809	10415	22310	11346	199979
4	Infiltration from precipitation	112	240	755	1042	1027	1039	1228	1320	2766	1709	4067	2287	17595
5	Recovery from Pit	0	0	0	0	0	0	0	0	0	0	0	0	0
6	>>>> Total Water Input	759477	760753	765906	768775	768628	768748	782759	896530	804821	785862	821333	792574	9476165
	- <WATER OUT> (cu.m)													
	Supernatant Recovery													
7	(+) Ini. recovery from tailings	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	5418284
8	(-) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
9	(-) Evap. from entire beach	1216	0	0	0	0	0	0	35200	59520	74880	72240	46200	289256
10	(+) Total precipitation runoff	1012	2160	6798	9380	9248	9356	23178	136858	43703	25800	58913	31934	358337
11	(+) Consolid. to final density	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	82494	989924
12	Sub-total (Water Recovered as S/N)	475713	478077	482715	485297	485165	485273	499095	577575	460100	426838	462591	461651	5780089
	Underdrainage Recovery													
13	(+) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
14	(+) Rainfall infiltration	112	240	755	1042	1027	1039	1228	1320	2766	1709	4067	2287	17595
15	(-) Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
16	Sub-total (Water Recovered as U/D)	52318	52446	52961	53248	53234	53246	53435	53526	54972	53916	56273	54494	644067
17	Water retained in tailings	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	224335	2692024
18	Evaporation From tailings	1216	0	0	0	0	0	0	35200	59520	74880	72240	46200	289256
19	Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
20	Sub-total (Unrecoverable Water)	231445	230229	230229	230229	230229	230229	230229	265429	289749	305109	302469	276429	3052008
21	>>>> Total Water Accounted For	759477	760753	765906	768775	768628	768748	782759	896530	804821	785862	821333	792574	9476165
22	Total water added to tails surface	528031	530523	535676	538545	538398	538518	552530	631101	515072	480753	518864	516144	6424157
23	Water recycled to mill from tails	528031	530523	535676	538545	538398	538518	552530	631101	515072	480753	518864	516144	6424157
24	Monthly water surplus/deficit (-)	-139319	-136827	-131674	-128805	-128952	-128832	-114821	-36249	-152278	-186597	-148487	-151206	-1584048
25	Cumulative surplus	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Makeup water required at mill**	230321	227829	222676	219807	219954	219834	205823	127252	243281	277600	239489	242208	2676075

\# Snowfall is given in equivalent depth of rainfall and is assumed to accumulate on outside catchment until May when it melts with 24% recovery
* Maximum allowable recycle from tailings area is equiv to 88 % of water associated with incoming tail slurry at assumed solids content.
** Makeup water at mill is total nonrecycled water (including that in ore) required to produce a tailings slurry at assumed solids content.

DATE 15-Feb-90
FILE NAME F:\job\data\1621\POLWATER

TABLE 6.4
IMPERIAL METALS CORPORATION
Mt POLLEY PROJECT

TAILINGS STORAGE FACILITY

MONTH BY MONTH WATER BALANCE FOR
TAILINGS MASS AND WATER DISTRIBUTION
YEAR - 10: AVERAGE YEAR

Assumptions :-

Dry Solids to Tails	= 13425 t/day		Initial Dry Density	= 0.90 t/cu.m
Tailings % Solids	= 35%		Final Dry Density	= 1.30 t/cu.m
Tailings S.G.	= 2.78		Operating Days/Year	= 365
Beach Runoff Coeff.	= 90%	*	Maximum Recycle	= 667350 cu.m/month
Catchment Runoff coef.	= 24%		Initial Stored Vol	= 0 cu.m
Total Catchment	= 230 hectares		Evap Factor	= 0.80

	MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
A	Rainfall (mm/mon)	0.0	0.0	0.0	0.0	0.0	0.0	48.2	41.8	75.8	53.7	93.8	57.6	370.9
B	#Snowfall (mm/mon water equiv)	70.4	66.8	95.0	84.9	68.8	43.2	0.0	0.0	0.0	0.0	0.0	0.0	429.1
C	Pan evaporation (mm/mon)	38.0	0.0	0.0	0.0	0.0	0.0	0.0	88.0	124.0	144.0	129.0	77.0	600.0
D	Tailings beach area (ha)	213.0	214.0	215.0	215.0	215.0	215.0	216.0	216.0	216.0	216.0	216.0	217.0	
E	Outside catchment area (ha)	17.0	16.0	15.0	15.0	15.0	15.0	14.0	14.0	14.0	14.0	14.0	13.0	
	- <WATER IN> (cu.m)													
1	With slurry	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	9100232
2	Prec. runoff (beach)	134957	128657	183825	164282	133128	83592	93701	81259	147355	104393	182347	112493	1549988
3	Prec. runoff (outside beach)	0	0	0	0	0	0	1620	15822	2547	1804	3152	1797	26742
4	Infiltration from precipitation	14995	14295	20425	18253	14792	9288	10411	9029	16373	11599	20261	12499	172221
5	Recovery from Pit	0	0	0	0	0	0	0	0	0	0	0	0	0
6	>>>> Total Water Input	908305	901305	962603	940888	906273	851233	864084	864463	924628	876149	964112	885142	10849183
	- <WATER OUT> (cu.m)													
	Supernatant Recovery													
7	(+) Ini. recovery from tailings	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	5418284
8	(-) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
9	(-) Evap. from entire beach	64752	0	0	0	0	0	0	152064	214272	248832	222912	133672	1036504
10	(+) Total precipitation runoff	134957	128657	183825	164282	133128	83592	95320	97081	149902	106197	185499	114290	1576730
11	(+) Consolid. to final density	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	1675256
12	Sub-total (Water Recovered as S/N)	603233	661685	716853	697310	666156	616620	628349	478046	468658	390393	495615	513646	6936566
	Underdrainage Recovery													
13	(+) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
14	(+) Rainfall infiltration	14995	14295	20425	18253	14792	9288	10411	9029	16373	11599	20261	12499	172221
15	(-) Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
16	Sub-total (Water Recovered as U/D)	67201	66501	72631	70460	66998	61494	62617	61235	68579	63805	72467	64705	798693
17	Water retained in tailings	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	2006692
18	Evaporation From tailings	64752	0	0	0	0	0	0	152064	214272	248832	222912	133672	1036504
19	Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
20	Sub-total (Unrecoverable Water)	237870	173118	173118	173118	173118	173118	173118	325182	387390	421950	396030	306790	3113924
21	>>>> Total Water Accounted For	908305	901305	962603	940888	906273	851233	864084	864463	924628	876149	964112	885142	10849183
22	Total water added to tails surface	670434	728186	789484	767769	733154	678114	690966	539281	537237	454199	568082	578351	7735259
23	Water recycled to mill from tails	667350	667350	667350	667350	667350	667350	667350	667350	667350	582672	568082	578351	7735259
24	Monthly water surplus/deficit (-)	3084	60836	122134	100419	65804	10764	23616	-128070	-130113	-213152	-99268	-88999	-272945
25	Cumulative surplus	3084	63920	186054	286473	352277	363041	386656	258587	128474	0	0	0	0
26	Makeup water required at mill**	91002	91002	91002	91002	91002	91002	91002	91002	91002	175681	190271	180001	1364973

\# Snowfall is given in equivalent depth of rainfall and is assumed to accumulate on outside catchment until May when it melts with 24% recovery
* Maximum allowable recycle from tailings area is equiv to 88 % of water associated with incoming tail slurry at assumed solids content.
** Makeup water at mill is total nonrecycled water (including that in ore) required to produce a tailings slurry at assumed solids content.

DATE 15-Feb-90
FILE NAME F:\job\data\1621\POLWATER

TABLE 6.5
IMPERIAL METALS CORPORATION
Mt POLLEY PROJECT

TAILINGS STORAGE FACILITY

MONTH BY MONTH WATER BALANCE FOR
TAILINGS MASS AND WATER DISTRIBUTION
YEAR - 10: WET YEAR

Assumptions :-

Dry Solids to Tails =	13425 t/day	Initial Dry Density =	0.90 t/cu.m
Tailings % Solids =	35%	Final Dry Density =	1.30 t/cu.m
Tailings S.G. =	2.78	Operating Days/Year =	365
Beach Runoff Coeff. =	90%	* Maximum Recycle =	667350 cu.m/month
Catchment Runoff coef. =	24%	Initial Stored Vol =	0 cu.m
Total Catchment =	230 hectares	Evap Factor =	0.80

	MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
A	Rainfall (mm/mon)	0.0	0.0	0.0	0.0	0.0	0.0	69.1	57.2	105.5	81.1	129.5	84.7	527.1
B	#Snowfall (mm/mon water equiv)	112.7	85.6	131.9	111.9	96.5	56.7	0.0	0.0	0.0	0.0	0.0	0.0	595.3
C	Pan evaporation (mm/mon)	38.0	0.0	0.0	0.0	0.0	0.0	0.0	88.0	124.0	144.0	129.0	77.0	600.0
D	Tailings beach area (ha)	213.0	214.0	215.0	215.0	215.0	215.0	216.0	216.0	216.0	216.0	216.0	217.0	
E	Outside catchment area (ha)	17.0	16.0	15.0	15.0	15.0	15.0	14.0	14.0	14.0	14.0	14.0	13.0	
	- <WATER IN> (cu.m)													
1	With slurry	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	9100232
2	Prec. runoff (beach)	216046	164866	255227	216527	186728	109715	134330	111197	205092	157658	251748	165419	2174551
3	Prec. runoff (outside beach)	0	0	0	0	0	0	2322	21924	3545	2725	4351	2643	37509
4	Infiltration from precipitation	24005	18318	28358	24058	20747	12190	14926	12355	22788	17518	27972	18380	241617
5	Recovery from Pit	0	0	0	0	0	0	0	0	0	0	0	0	0
6	>>>> Total Water Input	998404	941537	1041938	998938	965828	880258	909930	903829	989777	936254	1042424	944794	11553910
	- <WATER OUT> (cu.m)													
	Supernatant Recovery													
7	(+) Ini. recovery from tailings	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	5418284
8	(-) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
9	(-) Evap. from entire beach	64752	0	0	0	0	0	0	152064	214272	248832	222912	133672	1036504
10	(+) Total precipitation runoff	216046	164866	255227	216527	186728	109715	136652	133121	208637	160383	256099	168062	2212061
11	(+) Consolid. to final density	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	1675256
12	Sub-total (Water Recovered as S/N)	684322	697894	788255	749555	719756	642743	669681	514085	527393	444580	566216	567418	7571897
	Underdrainage Recovery													
13	(+) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
14	(+) Rainfall infiltration	24005	18318	28358	24058	20747	12190	14926	12355	22788	17518	27972	18380	241617
15	(-) Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
16	Sub-total (Water Recovered as U/D)	76211	70524	80565	76265	72954	64397	67132	64561	74994	69724	80178	70586	868089
17	Water retained in tailings	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	2006692
18	Evaporation From tailings	64752	0	0	0	0	0	0	152064	214272	248832	222912	133672	1036504
19	Seepage Losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
20	Sub-total (Unrecoverable Water)	237870	173118	173118	173118	173118	173118	173118	325182	387390	421950	396030	306790	3113924
21	>>>> Total Water Accounted For	998404	941537	1041938	998938	965828	880258	909930	903829	989777	936254	1042424	944794	11553910
22	Total water added to tails surface	760533	768418	868819	825819	792709	707139	736812	578646	602387	514303	646394	638004	8439985
23	Water recycled to mill from tails	667350	667350	667350	667350	667350	667350	667350	667350	667350	667350	667350	667350	8008204
24	Monthly water surplus/deficit (-)	93183	101068	201469	158469	125359	39789	69462	-88704	-64963	-153047	-20957	-29346	431781
25	Cumulative surplus	93183	194251	395720	554189	679548	719337	788799	700095	635131	482084	461128	431781	431781
26	Makeup water required at mill**	91002	91002	91002	91002	91002	91002	91002	91002	91002	91002	91002	91002	1092028

Snowfall is given in equivalent depth of rainfall and is assumed to accumulate on outside catchment until May when it melts with 24% recovery
* Maximum allowable recycle from tailings area is equiv to 88 % of water associated with incoming tail slurry at assumed solids content.
** Makeup water at mill is total nonrecycled water (including that in ore) required to produce a tailings slurry at assumed solids content.

DATE 15-Feb-90
FILE NAME F:\job\data\1621\POLWATER

TABLE 6.6
IMPERIAL METALS CORPORATION
Mt POLLEY PROJECT

TAILINGS STORAGE FACILITY

MONTH BY MONTH WATER BALANCE FOR
TAILINGS MASS AND WATER DISTRIBUTION
YEAR - 10: DRY YEAR

Assumptions :-

Dry Solids to Tails =	13425 t/day		Initial Dry Density =	0.90 t/cu.m
Tailings % Solids =	35%		Final Dry Density =	1.30 t/cu.m
Tailings S.G. =	2.78		Operating Days/Year =	365
Beach Runoff Coeff. =	90%	*	Maximum Recycle =	667350 cu.m/month
Catchment Runoff coef. =	24%		Initial Stored Vol =	0 cu.m
Total Catchment =	230 hectares		Evap Factor =	0.80

	MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
A	Rainfall (mm/mon)	0.0	0.0	0.0	0.0	0.0	0.0	27.3	26.4	46.1	26.3	58.1	30.5	214.7
B	#Snowfall (mm/mon water equiv)	28.1	48.0	58.1	57.9	41.1	29.7	0.0	0.0	0.0	0.0	0.0	0.0	262.9
C	Pan evaporation (mm/mon)	38.0	0.0	0.0	0.0	0.0	0.0	0.0	88.0	124.0	144.0	129.0	77.0	600.0
D	Tailings beach area (ha)	213.0	214.0	215.0	215.0	215.0	215.0	216.0	216.0	216.0	216.0	216.0	217.0	
E	Outside catchment area (ha)	17.0	16.0	15.0	15.0	15.0	15.0	14.0	14.0	14.0	14.0	14.0	13.0	
	- <WATER IN> (cu.m)													
1	With slurry	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	758353	9100232
2	Prec. runoff (beach)	53868	92448	112424	112037	79529	57470	53071	51322	89618	51127	112946	59567	925425
3	Prec. runoff (outside beach)	0	0	0	0	0	0	917	9720	1549	884	1952	952	15974
4	Infiltration from precipitation	5985	10272	12492	12449	8837	6386	5897	5702	9958	5681	12550	6619	102825
5	Recovery from Pit	0	0	0	0	0	0	0	0	0	0	0	0	0
6	>>>> Total Water Input	818206	861073	883268	882838	846718	822208	818238	825097	859478	816044	885801	825489	10144456
	- <WATER OUT> (cu.m)													
	Supernatant Recovery													
7	(+) Ini. recovery from tailings	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	451524	5418284
8	(-) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
9	(-) Evap. from entire beach	64752	0	0	0	0	0	0	152064	214272	248832	222912	133672	1036504
10	(+) Total precipitation runoff	53868	92448	112424	112037	79529	57470	53988	61042	91167	52011	114899	60518	941399
11	(+) Consolid. to final density	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	139605	1675256
12	Sub-total (Water Recovered as S/N)	522144	625476	645452	645065	612557	590498	587017	442006	409924	336207	425015	459874	6301235
	Underdrainage Recovery													
13	(+) Underdrainage	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	58100	697200
14	(+) Rainfall infiltration	5985	10272	12492	12449	8837	6386	5897	5702	9958	5681	12550	6619	102825
15	(-) Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
16	Sub-total (Water Recovered as U/D)	58191	62478	64698	64655	61043	58592	58103	57908	62164	57887	64756	58825	729297
17	Water retained in tailings	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	167224	2006692
18	Evaporation From tailings	64752	0	0	0	0	0	0	152064	214272	248832	222912	133672	1036504
19	Seepage losses	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	5894	70728
20	Sub-total (Unrecoverable Water)	237870	173118	173118	173118	173118	173118	173118	325182	387390	421950	396030	306790	3113924
21	>>>> Total Water Accounted For	818206	861073	883268	882838	846718	822208	818238	825097	859478	816044	885801	825489	10144456
22	Total water added to tails surface	580335	687954	710149	709719	673599	649089	645120	499915	472087	394094	489771	518699	7030532
23	Water recycled to mill from tails	580335	667350	667350	667350	667350	667350	667350	571444	472087	394094	489771	518699	7030532
24	Monthly water surplus/deficit (-)	-87015	20604	42799	42369	6249	-18261	-22231	-167436	-195263	-273256	-177580	-148651	-977672
25	Cumulative surplus	0	20604	63403	105772	112021	93760	71529	0	0	0	0	0	0
26	Makeup water required at mill**	178017	91002	91002	91002	91002	91002	91002	186909	286265	364259	268582	239654	2069700

\# Snowfall is given in equivalent depth of rainfall and is assumed to accumulate on outside catchment until May when it melts with 24% recovery
* Maximum allowable recycle from tailings area is equiv to 88 % of water associated with incoming tail slurry at assumed solids content.
** Makeup water at mill is total nonrecycled water (including that in ore) required to produce a tailings slurry at assumed solids content.

TABLE 6.7

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

GROUNDWATER QUALITY COMPARED TO TAILINGS WATER QUALITY

	Groundwater Quality(1)		Tailings Water Quality(2)		Objectives for Final Effluent Discharge (3)
Physical	Average	Range	Average	Range	Range
pH	7.72	7.28 to 8.24	8.2	8.1 to 8.3	6.5 to 10.0
Conductivity (umho/cm)	1197	289 to 4280	407	357 to 442	
Suspended Solids	NA		NA	NA	25 to 75
Dissolved Solids	NA		468	(one sample only)	2500 to 5000
Hardness ($CaCO_3$)	194	80 to 432	31	23 to 39	
TOC	NA		8	5 to 12	
Anions and Nutrients					
Alkalinity ($CaCO_3$)	NA		121	39 to 161	
Sulphate	NA		58	48 to 72	
Chloride	NA		6.2	5.2 to 7.4	
Ortho-Phosphate	NA		0.03	0.02 to 0.05	
Total Phosphate	NA		0.31	0.12 to 0.44	
Nitrate	NA		.08	0.05 to 0.11	
Nitrite	NA		0.01	<0.01 to 0.02	
Ammonia	NA		0.01	<0.01 to 0.02	

Revised: March 21, 1990

	Groundwater Quality(1)		Tailings Water Quality(2)		Objectives for Final Effluent Discharge (3)
Dissolved Metals	Average	Range	Average	Range	Range
Aluminum	0.043	0.014 to 0.13	0.67	<0.5 to 1.0	0.5 to 1.0
Arsenic	0.0122	0.0008 to 0.066	0.16	0.05 to 0.40	0.1 to 1.0
Cadmium	<0.0002	<0.0002	<0.01	<0.01	0.01 to 0.01
Calcium	52.8	16.1 to 128.0	NA		
Chromium	0.001	<0.001 to 0.002	<0.02	<0.02	0.05 to 0.3
Cobalt	<0.001	<0.001 to 0.002	<0.02	<0.02	0.5 to 1.0
Copper	0.004	<0.001 to 0.009	0.08	<0.01 to 0.24	0.5 to 1.0
Iron	0.43	<0.03 to 2.08	1.23	<0.20 to 4.60	0.3 to 1.0
Lead	0.001	<0.001 to 0.001	<0.05	<0.05	0.05 to 0.2
Magnesium	15.18	3.15 to 26.6	0.68	<0.05 to 1.55	
Manganese	0.28	0.066 to 0.78	<0.01	<0.01 to 0.06	0.1 to 1.0
Mercury	<0.00005	<0.00005 to 0.00005	<0.00005	<0.00005	NIL to 0.005
Molybdenum	0.005	0.002 to 0.009	0.76	0.08 to 2.05	0.5 to 5.0
Nickel	0.005	<0.001 to 0.013	<0.01	<0.01	0.2 to 1.0
Potassium	2.38	1.10 to 4.27	7.5	5.0 to 10.0	
Silver	<0.0001	<0.0001	<0.01	<0.01	0.05 to 0.5
Sodium	165.2	7.97 to 686.0	61.8	54.0 to 69.0	
Zinc	0.009	<0.005 to 0.025	<0.01	<0.01	0.2 to 1.0

Notes:

1. Results of analyses on 6 groundwater samples collected from piezometers in tailings area. Additional groundwater quality data are presented on Table 3.9.
2. Results of analyses on 6 samples from pilot metallurgical test program by Coastech Research Inc., February, 1990.
3. Pollution control objectives for the Mining, Smelting and Related Industries of British Columbia (1979).
4. All units in mg/l except where noted otherwise.

NA Not Available

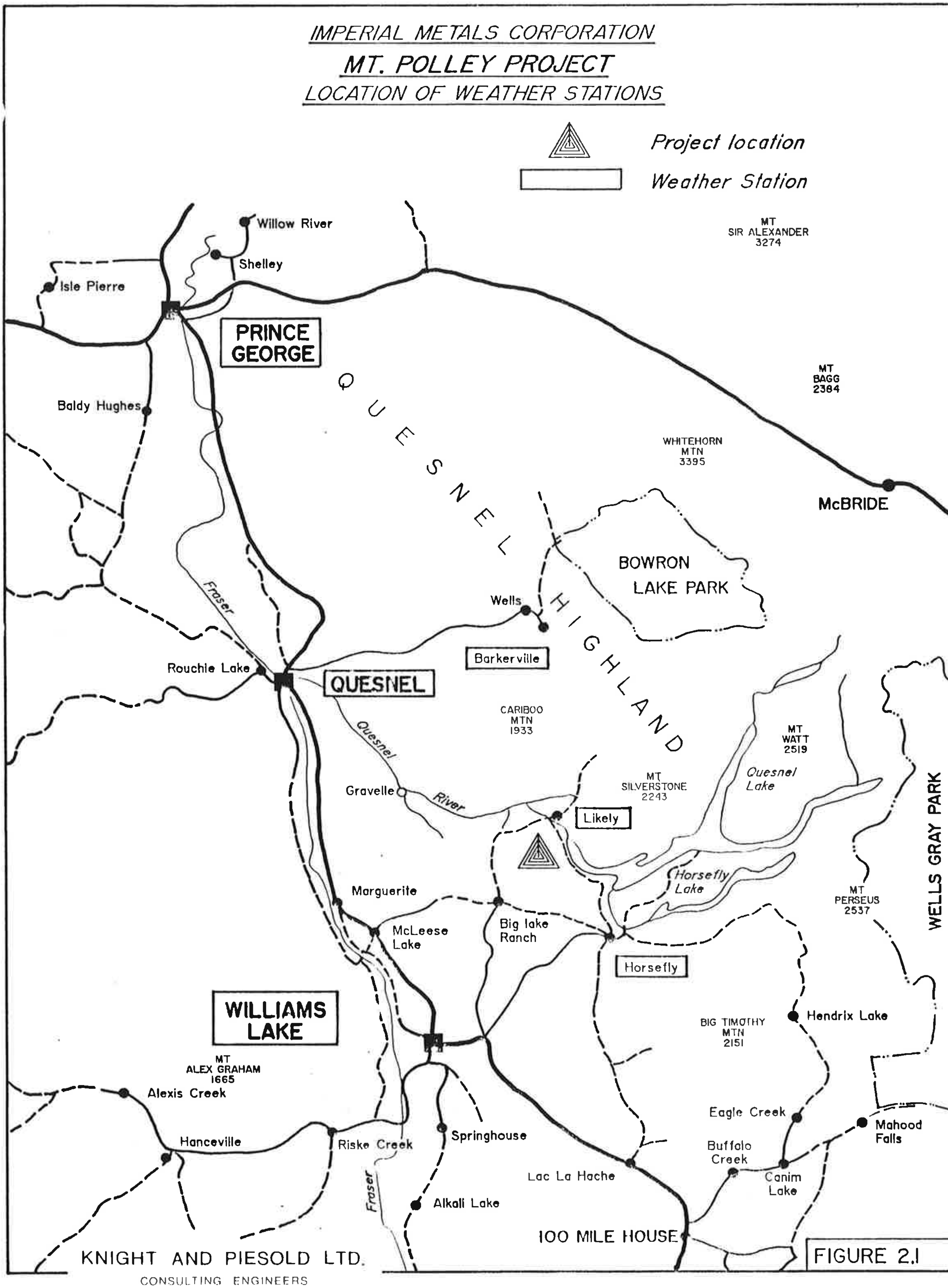
Revised: March 21, 1990

TABLE 7.2
IMPERIAL METALS CORPORATION
MT POLLEY PROJECT

TAILINGS STORAGE FACILITY
PRELIMINARY COST ESTIMATE ONGOING CONSTRUCTION

ITEM	DESCRIPTION	UNIT	QUANT	UNIT PRICE $	AMOUNT $	SUBTOTALS $
2.	**STAGE II (YEAR 2)					
2.1	EMBANKMENT TOE DRAINS	m	1000	60	60000	
2.2	WASTE ROCK HAUL ROAD	cu m	300000	1.25	375000	
2.3	EMBANKMENT FILL	cu m	550000	3.20	1760000	
2.4	TAILINGS PIPELINE RELOCATION	LS	1	50000	50000	
2.5	RECLAMATION	LS	1	20000	20000	
2.6	ENGINEERING & SITE SUPERVISION	LS	1	181200	181200	2446200
3.	**STAGE III (YEAR 4)					
3.1	EMBANKMENT FILL	cu m	250000	3.00	750000	
3.2	TAILINGS PIPELINE RELOCATION	LS	1	50000	50000	
3.3	INSTRUMENTATION	LS	1	15000	15000	
3.4	RECLAMATION	LS	1	5000	5000	
3.5	ENGINEERING & SITE SUPERVISION	LS	1	65600	65600	885600
4.	**STAGE IV (YEAR 6)					
4.1	EMBANKMENT FILL	cu m	280000	3.00	840000	
4.2	TAILINGS PIPELINE RELOCATION	LS	1	50000	50000	
4.3	RECLAMATION	LS	1	5000	5000	
4.4	ENGINEERING & SITE SUPERVISION	LS	1	71600	71600	966600
5.	**STAGE V (YEAR 8)					
5.1	EMBANKMENT FILL	cu m	320000	3.00	960000	
5.2	TAILINGS PIPELINE RELOCATION	LS	1	50000	50000	
5.3	RECLAMATION	LS	1	5000	5000	
5.4	ENGINEERING & SITE SUPERVISION	LS	1	81200	81200	1096200
6.	**FINAL RECLAMATION (YEAR 10+)					
6.1	TAILINGS SURFACE - HYDROSEED	ha	230	5000	1150000	
6.2	FINAL SPILLWAY	LS	1	50000	50000	
6.3	REMOVE PIPEWORK	LS	1	40000	40000	
6.4	EROSION PROTECTION & MISC	LS	1	400000	400000	1640000
	TOTAL ON-GOING CONSTRUCTION AND RECLAMATION COST					7034600

15-Feb-90
F:\JOB\DATA\1621\COST2



IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT
LOCATION OF WEATHER STATIONS
Project location
Weather Station
Willow River
Shelley
Isle Pierre
PRINCE GEORGE
MT SIR ALEXANDER 3274
MT BAGG 2384
WHITEHORN MTN 3395
McBRIDE
Baldy Hughes
QUESNEL HIGHLAND
BOWRON LAKE PARK
Wells
Fraser
Barkerville
Rouchie Lake
QUESNEL
CARIBOO MTN 1933
Quesnel River
MT WATT 2519
MT SILVERSTONE 2243
Quesnel Lake
Gravelle
Likely
WELLS GRAY PARK
Horsefly Lake
Marguerite
MT PERSEUS 2537
McLeese Lake
Big lake Ranch
Horsefly
WILLIAMS LAKE
BIG TIMOTHY MTN 2151
Hendrix Lake
MT ALEX GRAHAM 1665
Alexis Creek
Eagle Creek
Mahood Falls
Hanceville
Riske Creek
Springhouse
Buffalo Creek
Canim Lake
Lac La Hache
Fraser
Alkali Lake
100 MILE HOUSE
KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 2.1

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

SHORT DURATION RAINFALL INTENSITY - DURATION - FREQUENCY DATA FOR MINE SITE

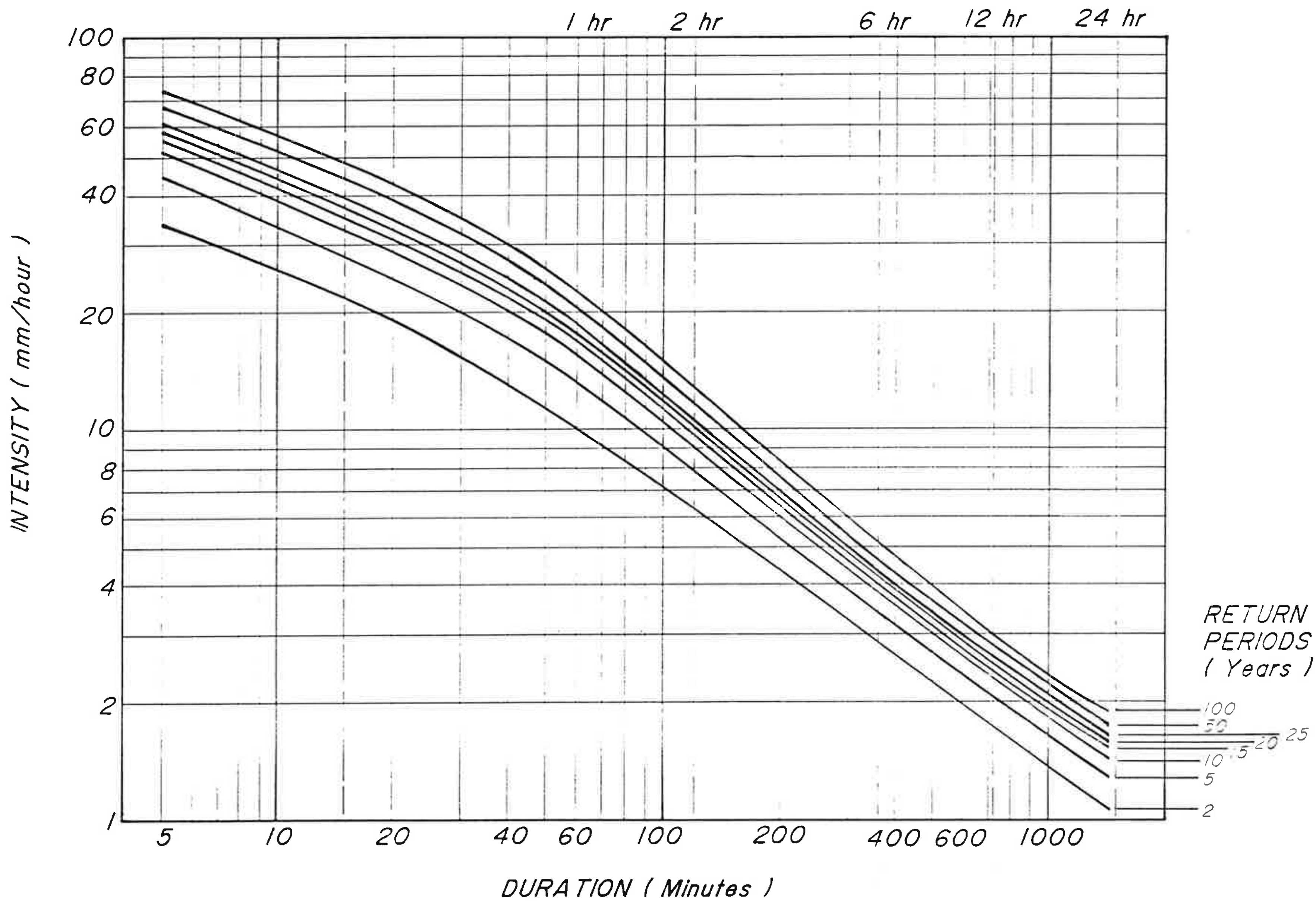


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FIGURE 2.2

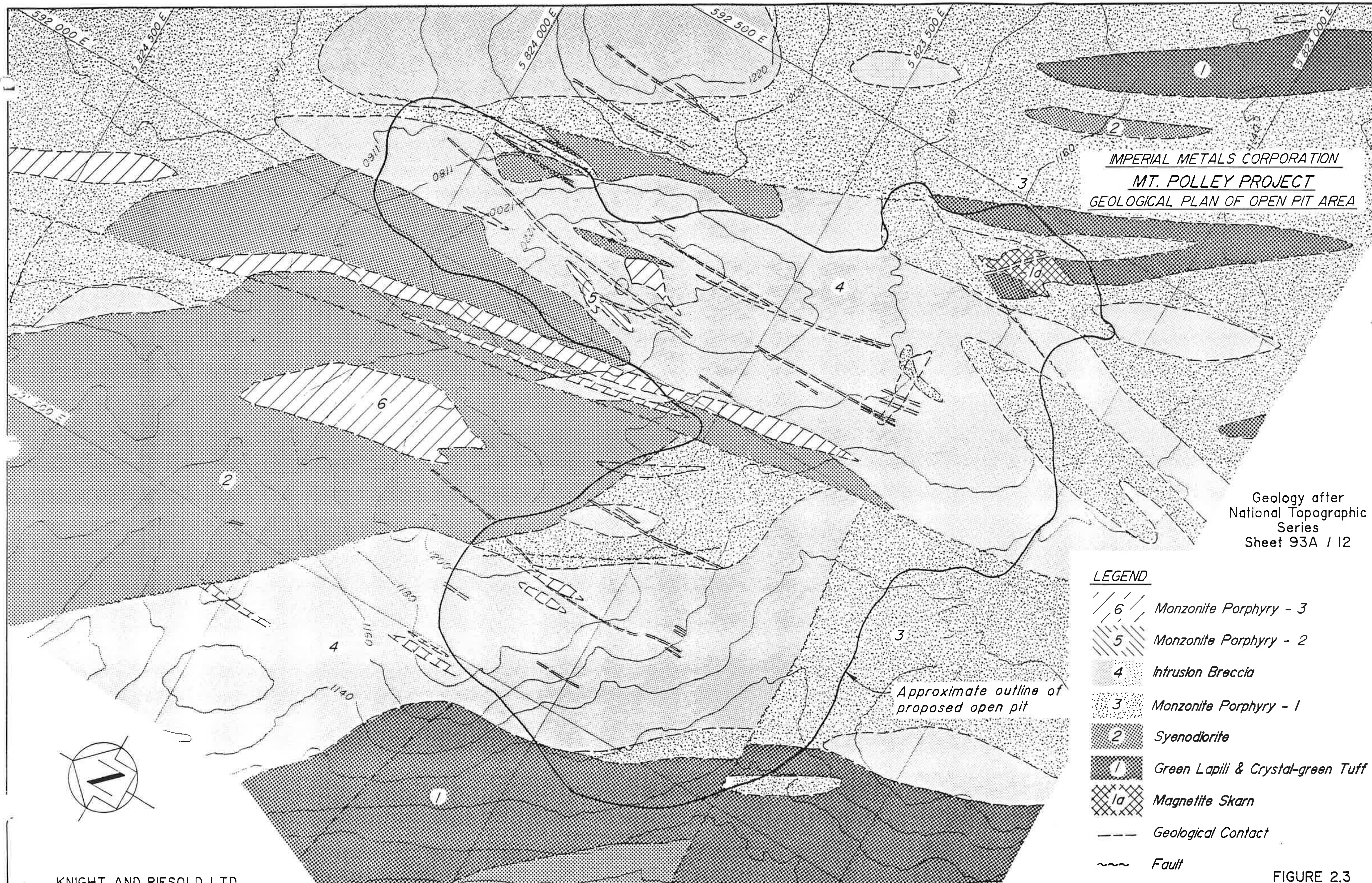


FIGURE 2.3

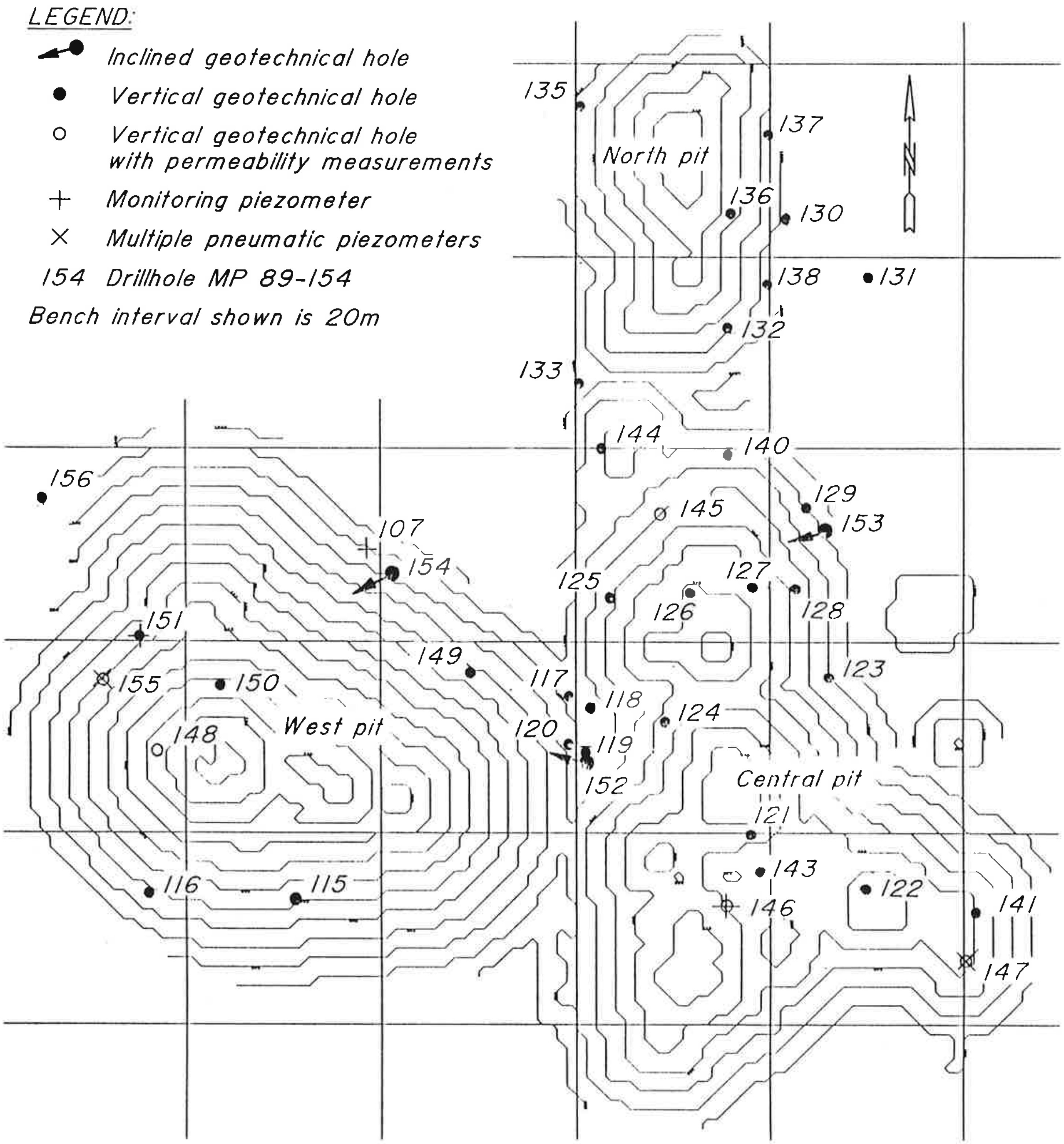
KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

NCI - 763

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

LOCATION PLAN OF GEOTECHNICAL DRILLHOLES



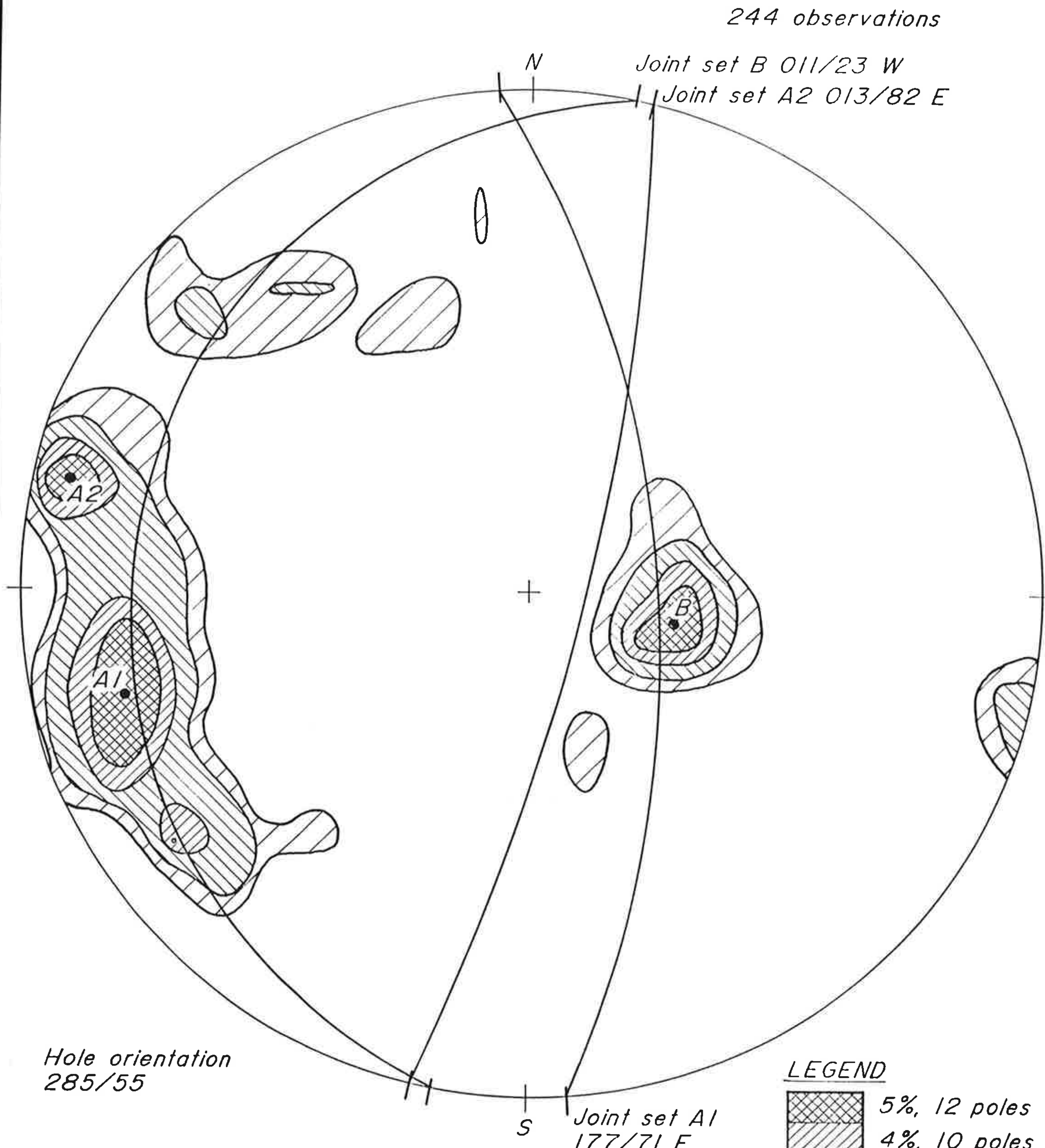
Oct. 19, 1989
KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 3.1

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

SUMMARY OF JOINT DATA FOR MP89-152



Oct. 6, 1989

KNIGHT AND PIESOLD LTD.

CONSULTING ENGINEERS

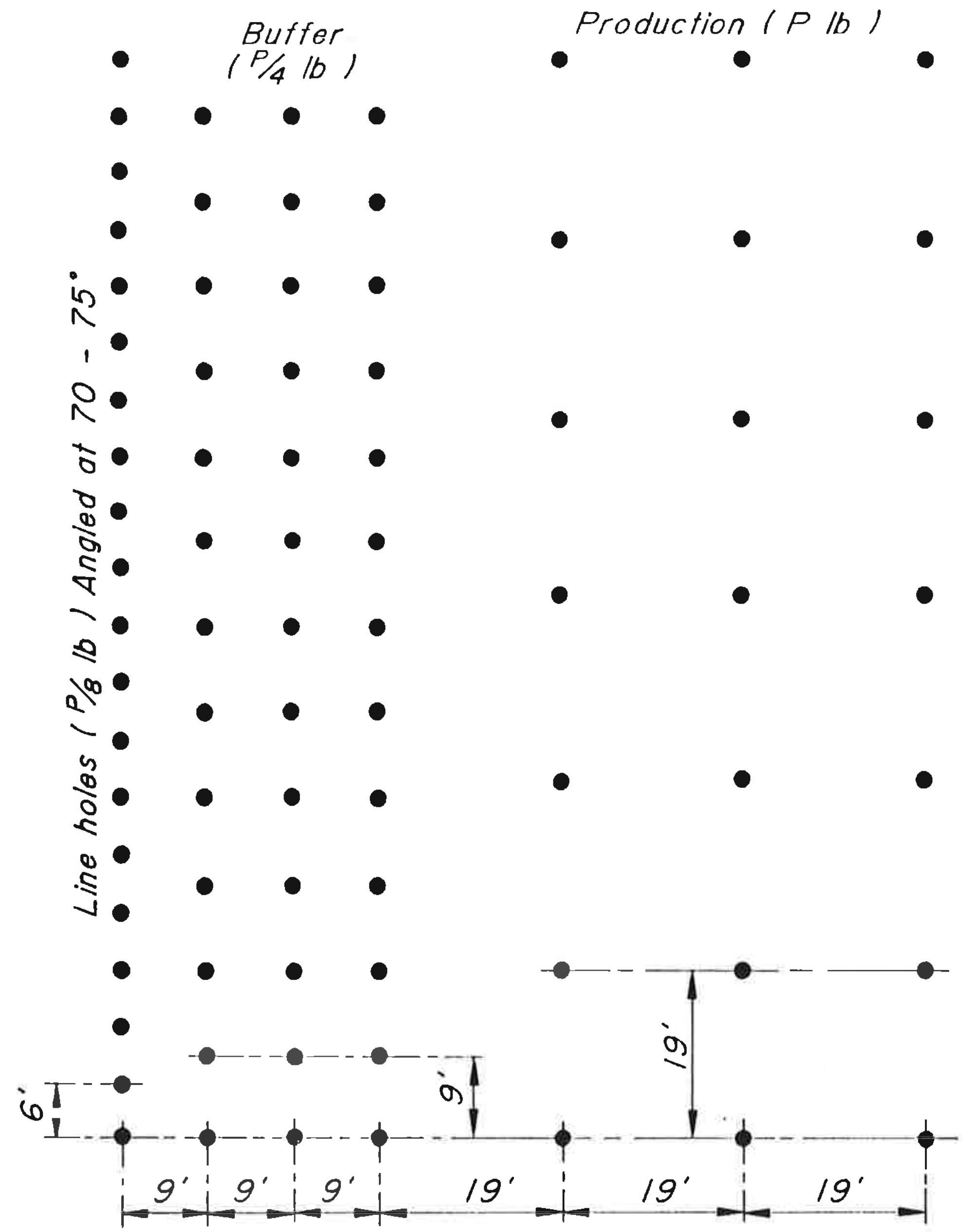
FIGURE 3.2

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

OPEN PIT

TRIAL BLAST PATTERN



NOTES:

- Trial 1, Blast line holes as preshear line (first) - 6 holes/delay.
- Trial 2, Blast line holes as cushion line (last) - 6 holes/delay.
- Adjust lbs. of explosives per hole in buffer and line holes based on results.
- Test and adjust blast pattern at working faces for use at final faces.

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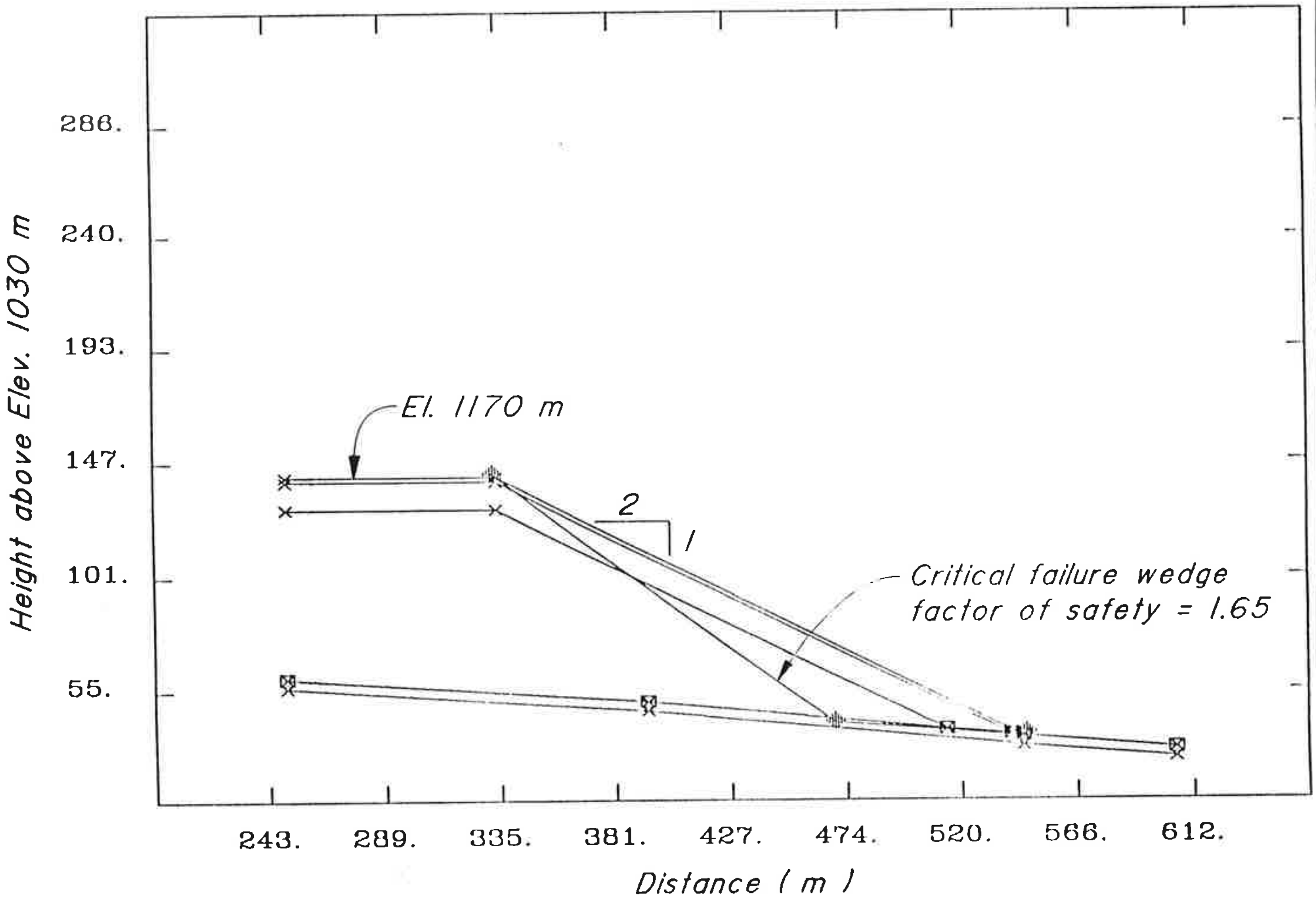
FIGURE 4.4

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

WASTE DUMP
STATIC WEDGE FAILURE ANALYSIS



UNIT WEIGHT	COHESION	PHI	DESCRIPTION
21.99 KN/m^3	.00	45.00	UPPER WASTE ROCK
21.99 KN/m^3	.00	42.00	MIDDLE WASTE ROCK
21.99 KN/m^3	.00	40.00	LOWER WASTE ROCK
21.57 KN/m^3	.00	30.00	TILL
−1.00 KN/m^3	.00	.00	BEDROCK

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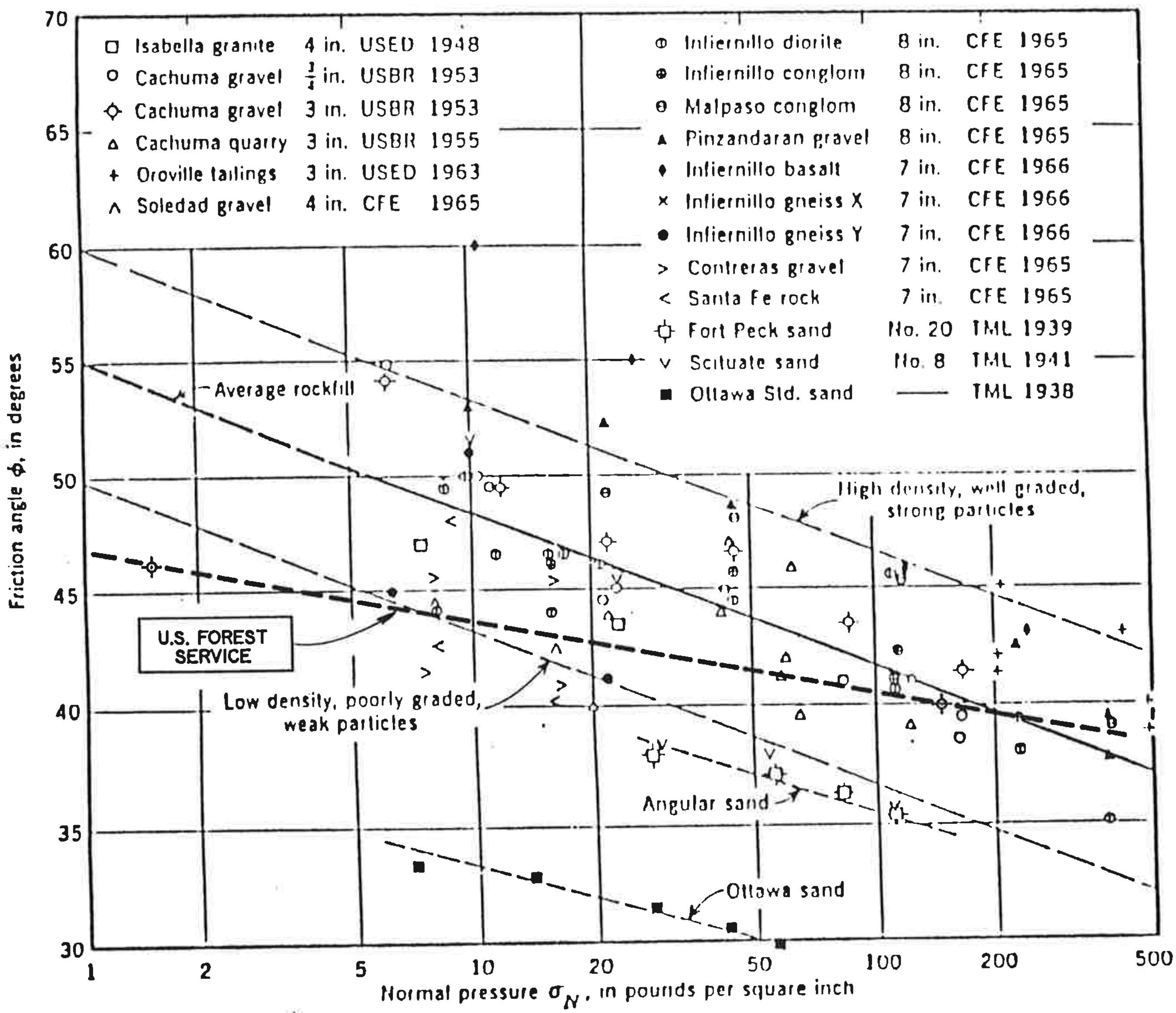
CONSULTING ENGINEERS

FIGURE 5.1

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

WASTE DUMPS
SHEAR STRENGTH OF ROCKFILL



Information taken from :

REVIEW OF SHEARING STRENGTH OF ROCKFILL
By Thomas M. Leps, F. ASCE
July , 1970

BCIL 7733 KP

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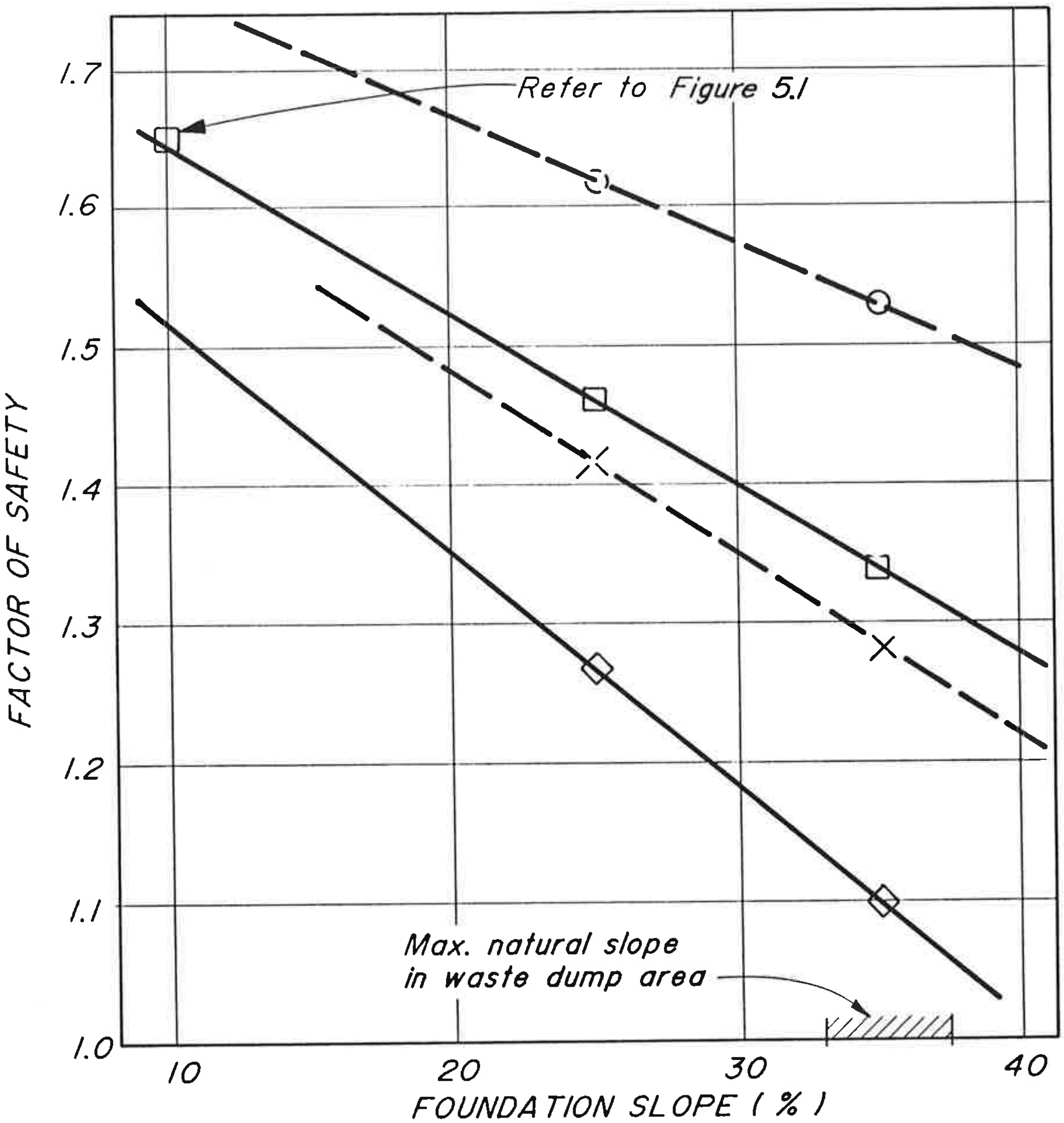
FIGURE 5.2

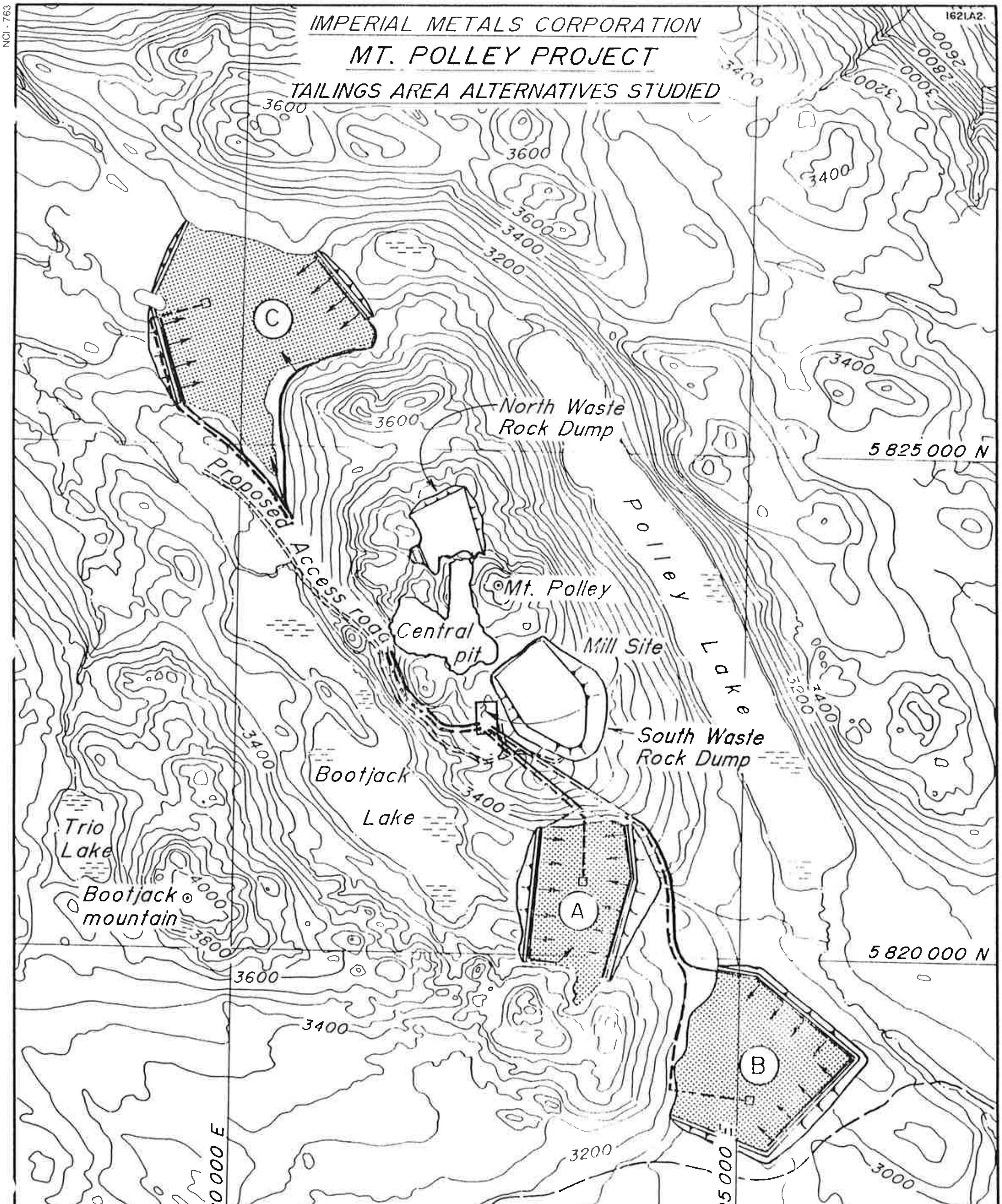
IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT
WASTE DUMPS
STABILITY CHART



Foundation	Waste Dump Slope	
	2:1	1.3:1
Stripped (φ' = 35°)	○	×
Not stripped (φ' = 30°)	□	◇

February 20, 1990
KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

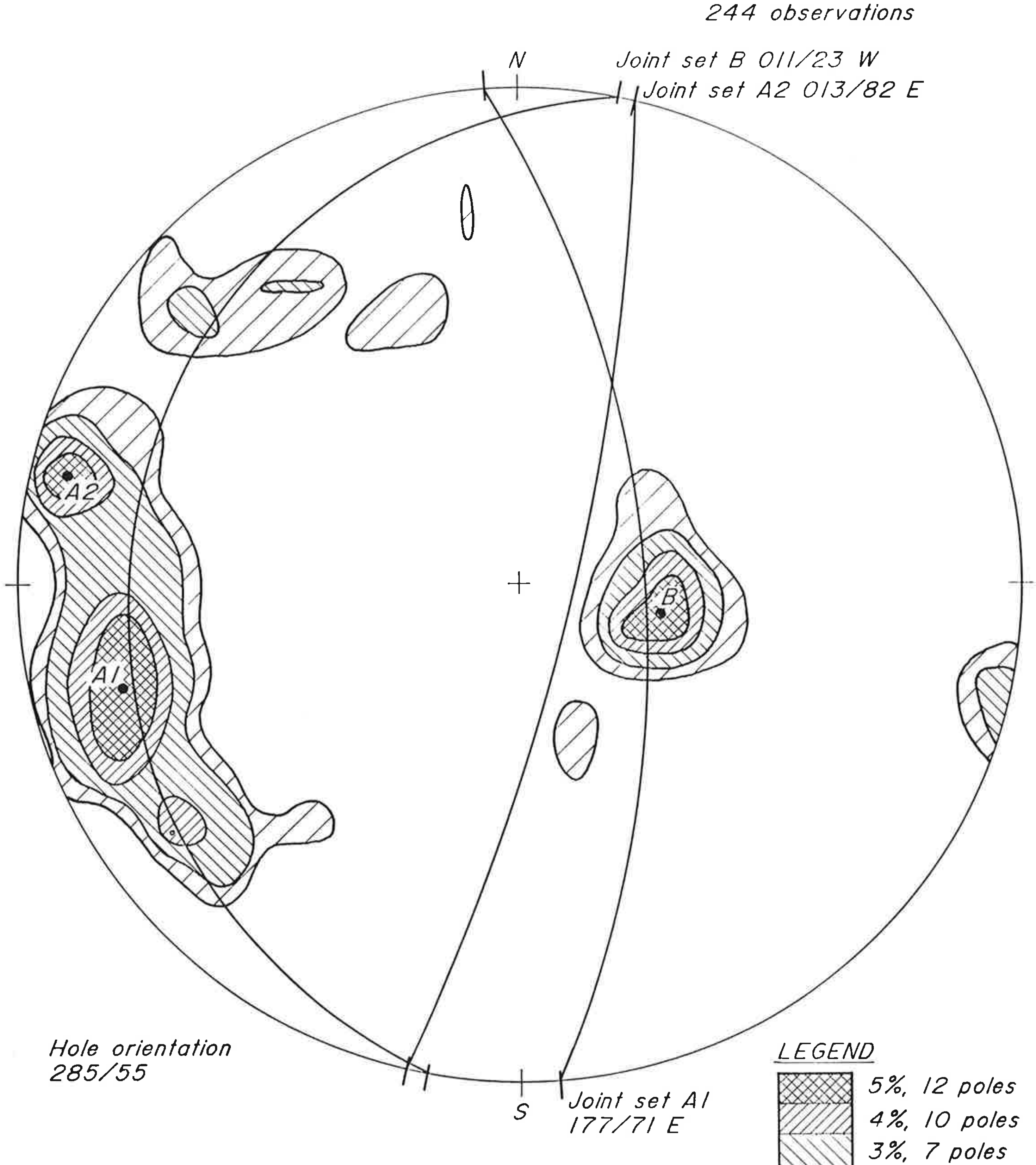
FIGURE 5.3


NCI-763
1621A2.
IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT
TAILINGS AREA ALTERNATIVES STUDIED
C
North Waste
Rock Dump
Proposed Access road
Mt. Polley
Central
pit
Mill Site
South Waste
Rock Dump
Polley Lake
Bootjack
Lake
Trio
Lake
Bootjack
mountain
A
B
5 825 000 N
5 820 000 N
590 000 E
595 000
1000 500 0 1000 2000 m
Dec. 13, 1989
KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS
FIGURE 6.1

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

SUMMARY OF JOINT DATA FOR MP89-152



Oct. 6, 1989

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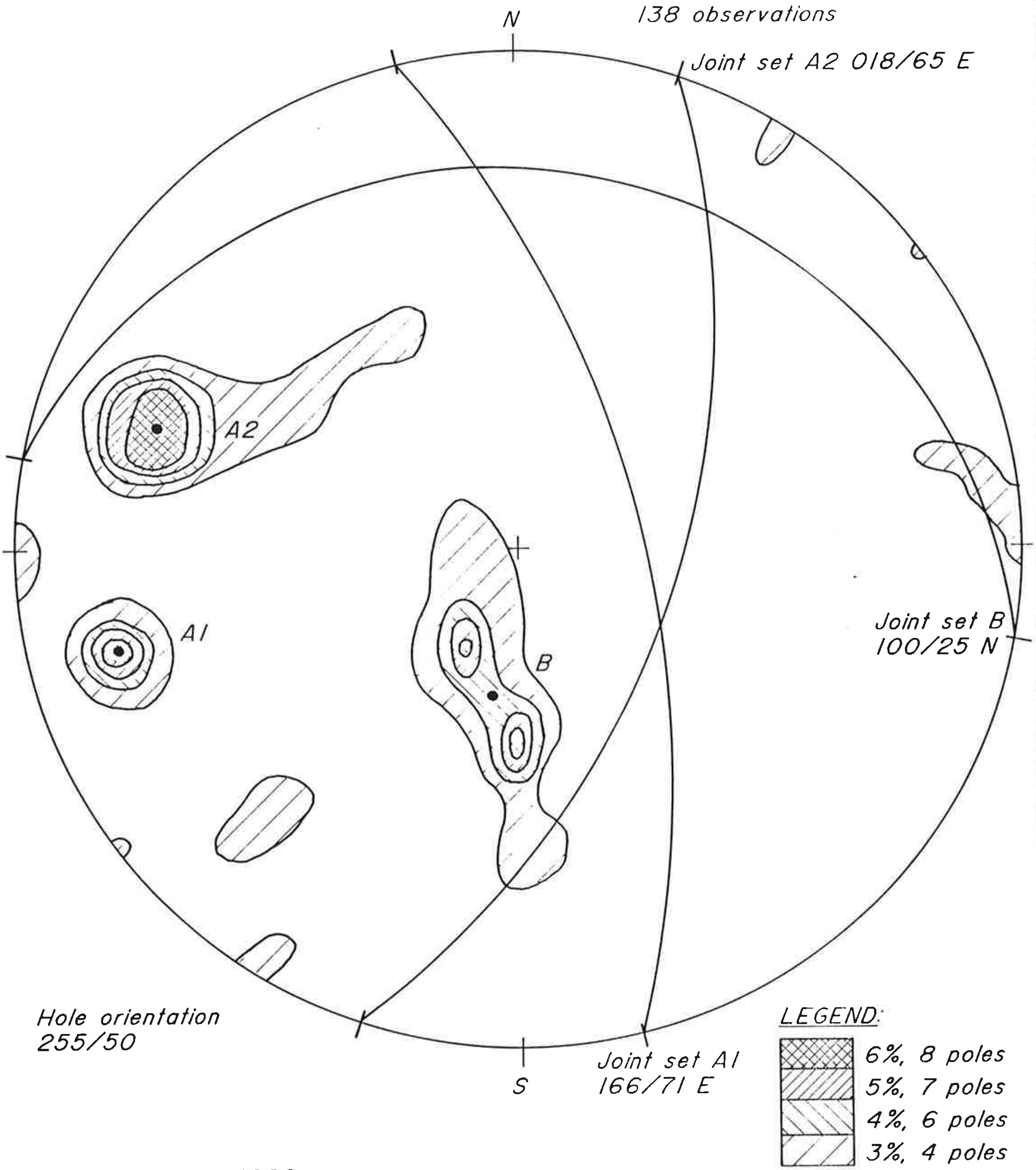
FIGURE 3.2

NCI-763

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

SUMMARY OF JOINT DATA FOR MP89-153



Oct. 6, 1989

KNIGHT AND PIESOLD LTD.

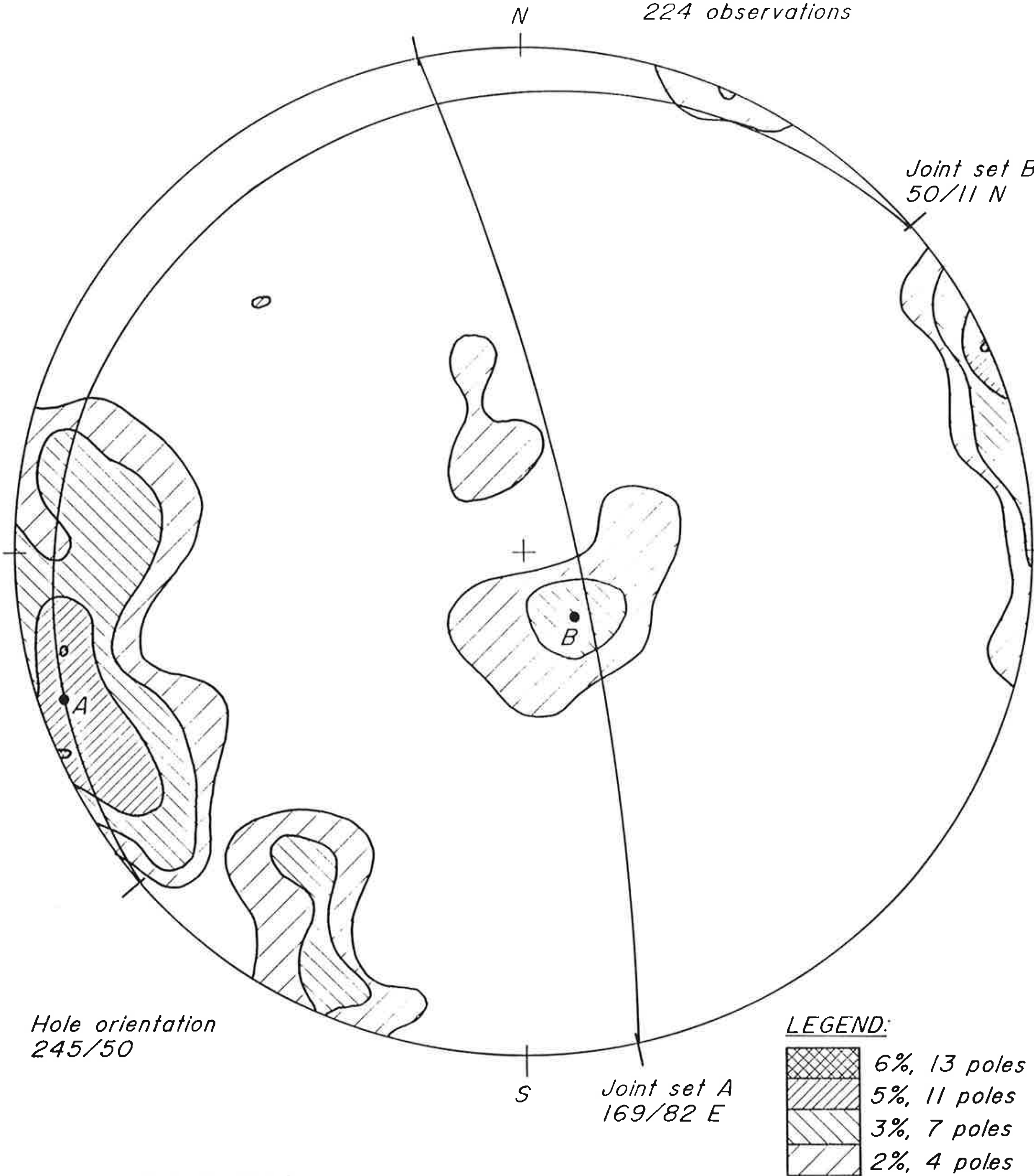
CONSULTING ENGINEERS

FIGURE 3.3

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

SUMMARY OF JOINT DATA FOR MP89-154



Oct. 6, 1989

KNIGHT AND PIESOLD LTD.

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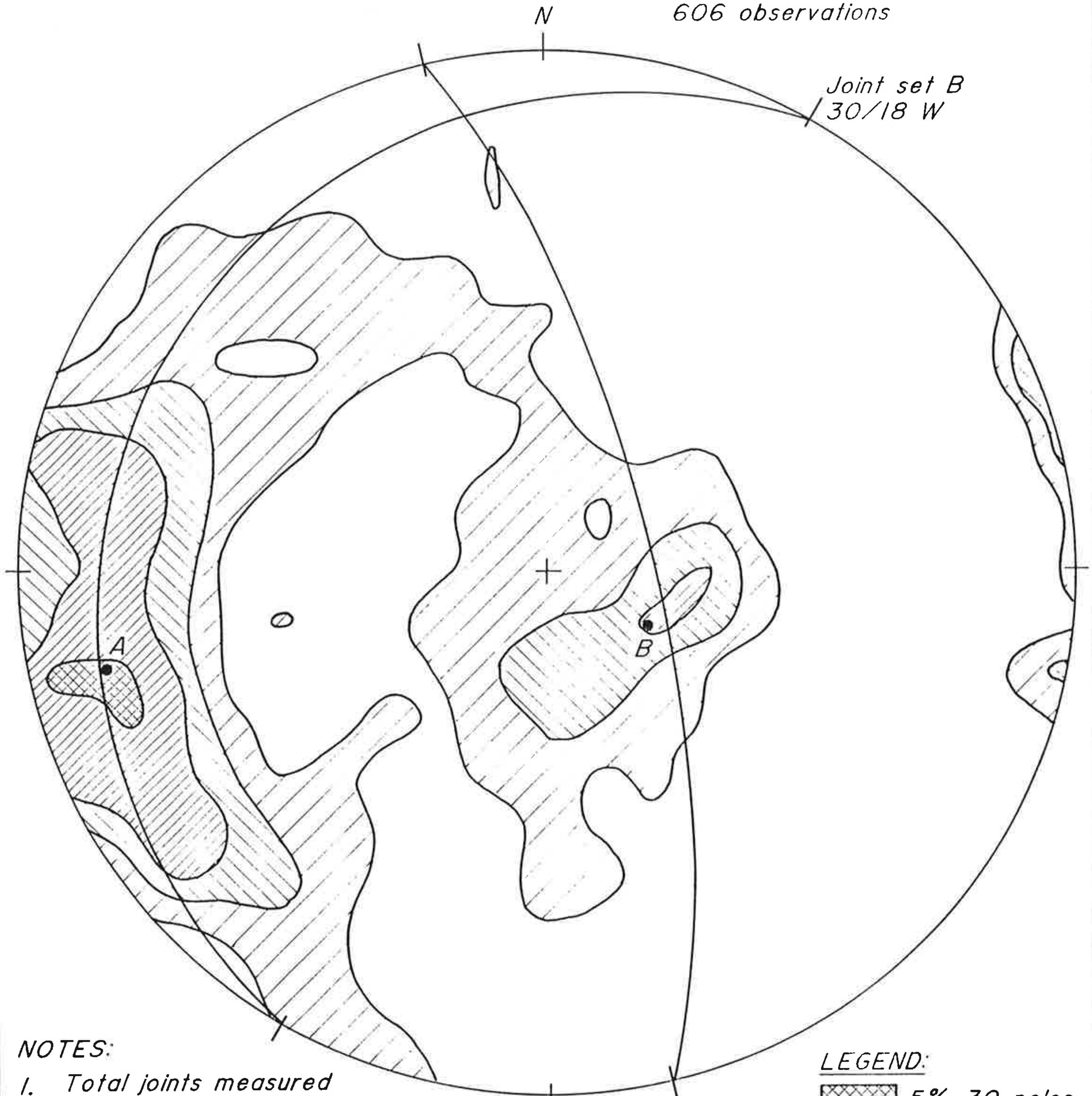
FIGURE 3.4

NCI - 763

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

SUMMARY OF JOINT DATA



NOTES:

1. Total joints measured in Drillholes MP89-152, MP89-153 and MP89-154.
2. Uncorrected for directional bias.

LEGEND:

- 5%, 30 poles
- 3%, 18 poles
- 2%, 12 poles
- 1%, 6 poles

Oct. 4, 1989

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FIGURE 3.5

NCI - 763

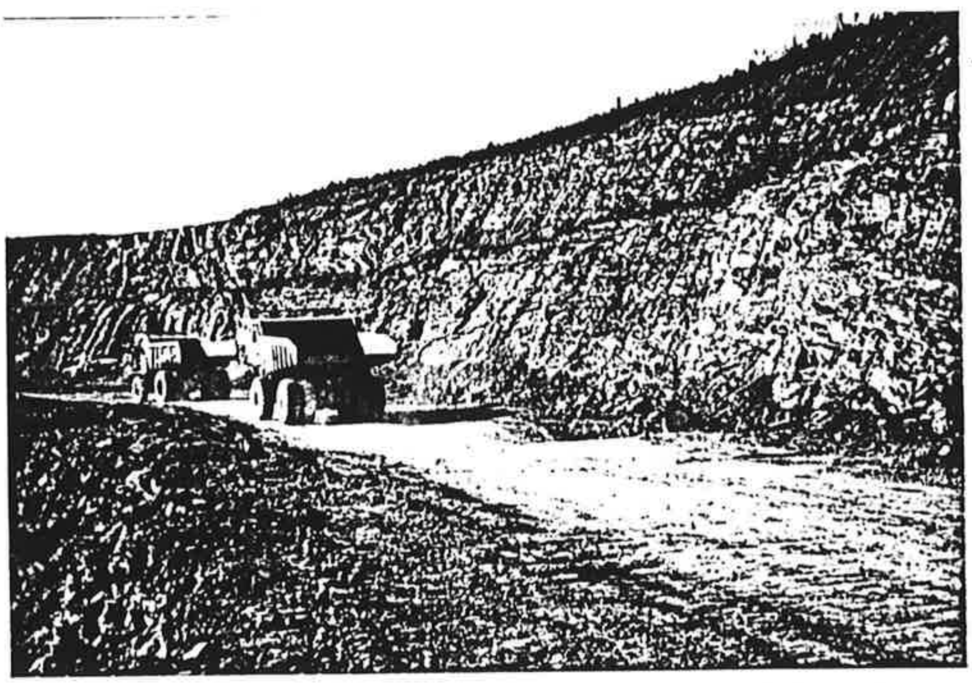
IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

OPEN PIT

PHOTOGRAPHS ILLUSTRATING INFLUENCE OF BLASTING CONTROL MEASURES

Damage behind the pitwall due to excessive blast charges per delay.



Controlled pre shear blasting at the final pit face has produced a clean stable face. Gortdrum Mines, Ireland.

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 4.2

NCI-763

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

OPEN PIT

VARIATION OF DAMAGE TO ROCK WITH WEIGHT OF CHARGE PER DELAY AND BLAST DISTANCE

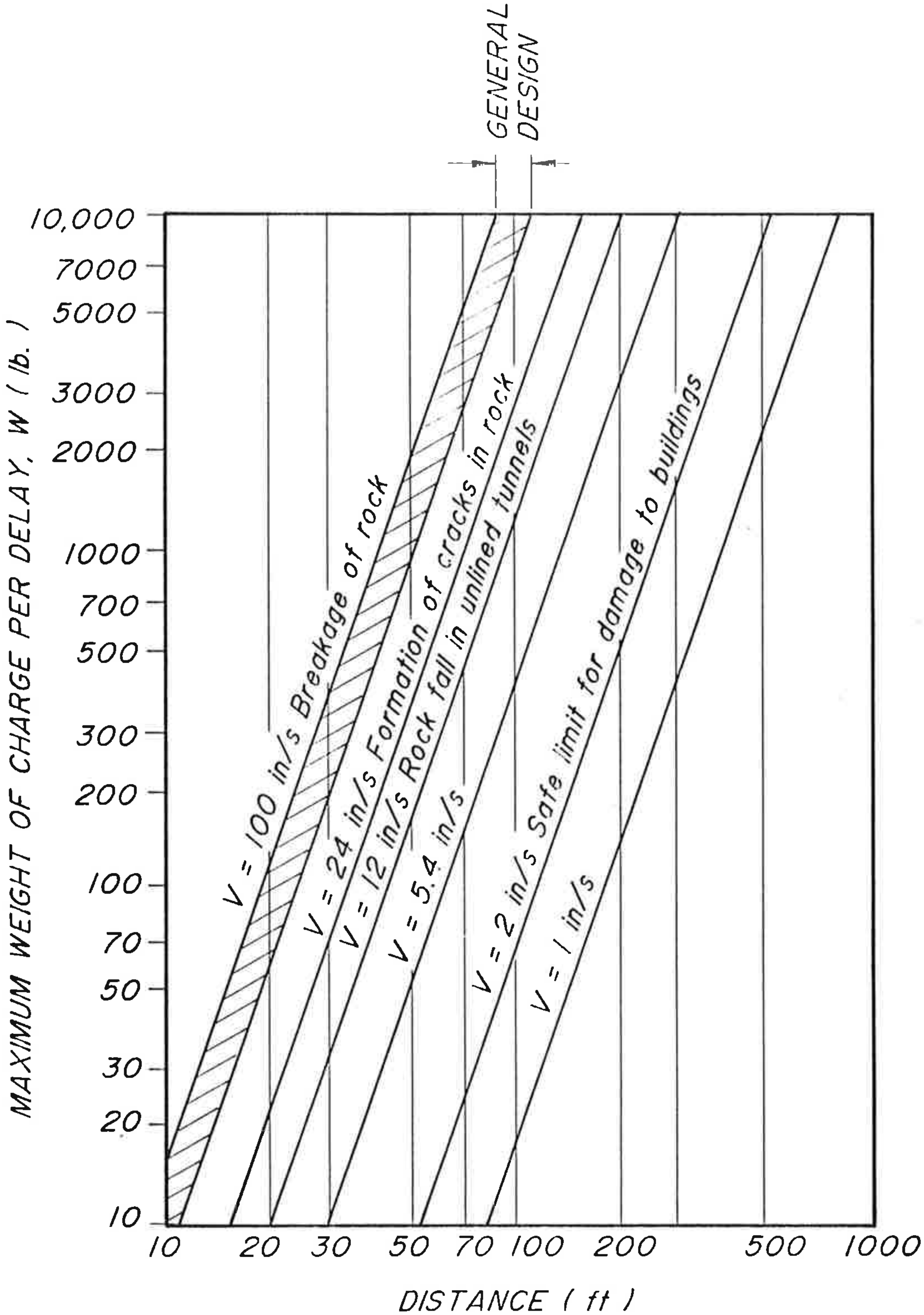


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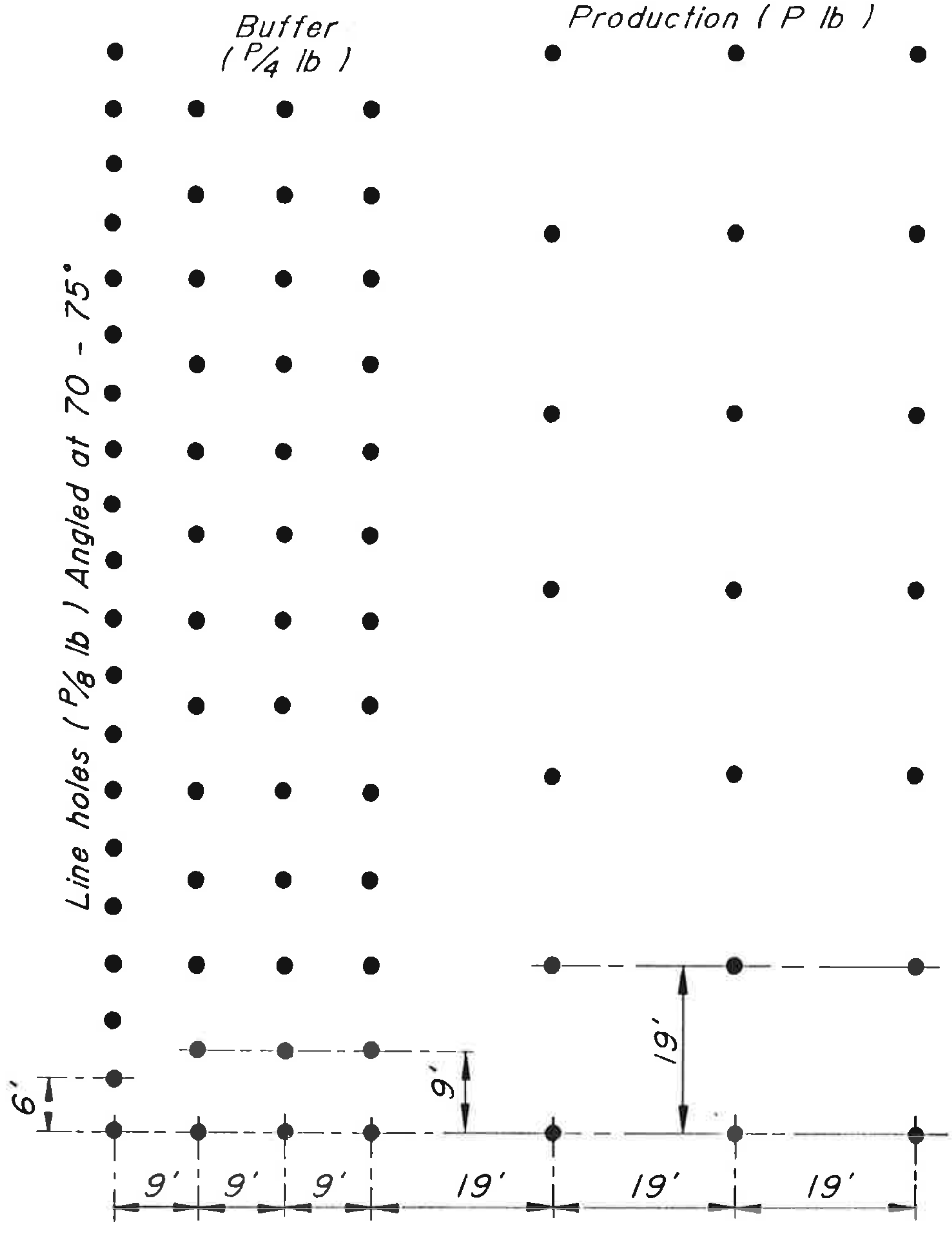
FIGURE 4.3

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

OPEN PIT

TRIAL BLAST PATTERN



NOTES:

- Trial 1, Blast line holes as preshear line (first) - 6 holes/delay.
- Trial 2, Blast line holes as cushion line (last) - 6 holes/delay.
- Adjust lbs. of explosives per hole in buffer and line holes based on results.
- Test and adjust blast pattern at working faces for use at final faces.

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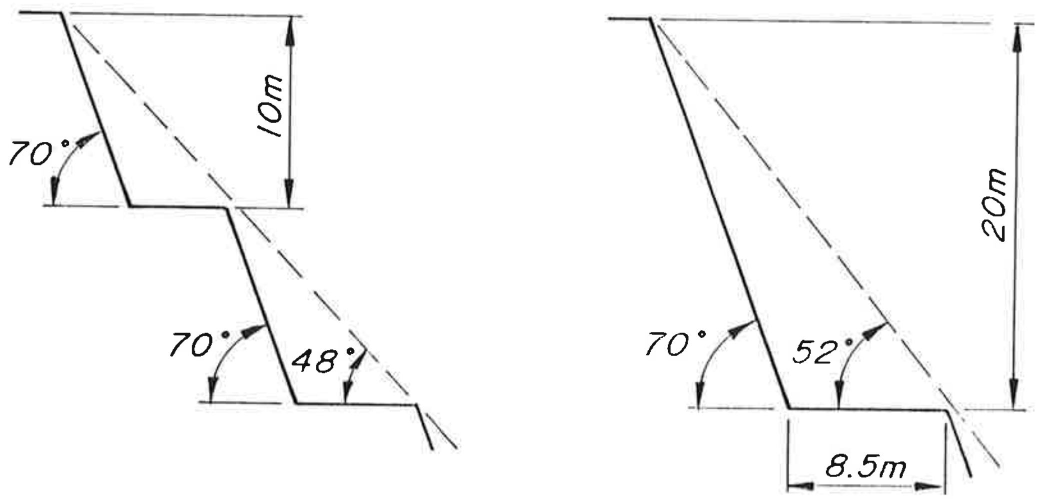
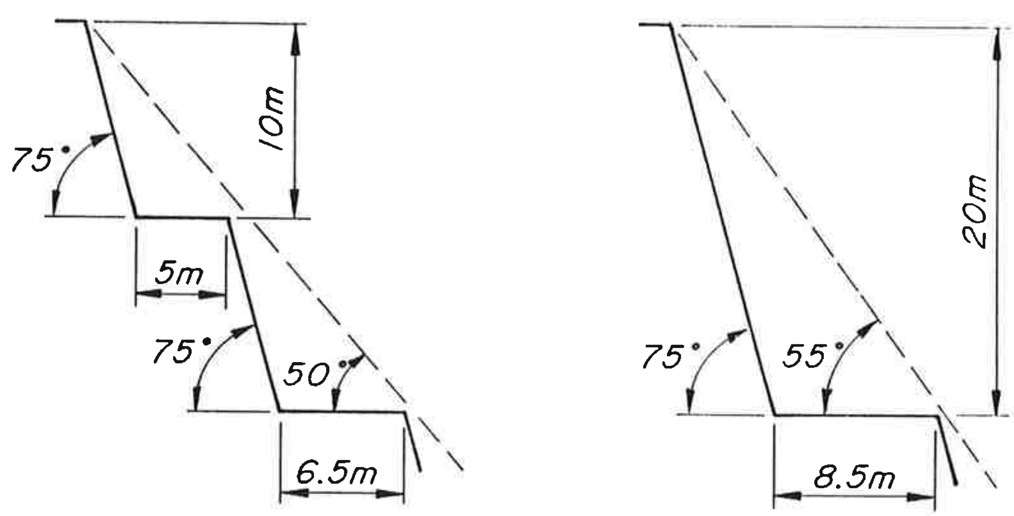
FIGURE 4.4

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT
OPEN PIT
SLOPE ANGLES AND BENCH DESIGN



DESIGN 'B' - EAST FACING WALLS
- NORTH FACING WALLS
- WEST FACING WALLS - STRUCTURAL DIP >60°E



DESIGN 'C' - SOUTH FACING WALLS
- WEST FACING WALLS - STRUCTURAL DIP <60°E

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FIGURE 4.5

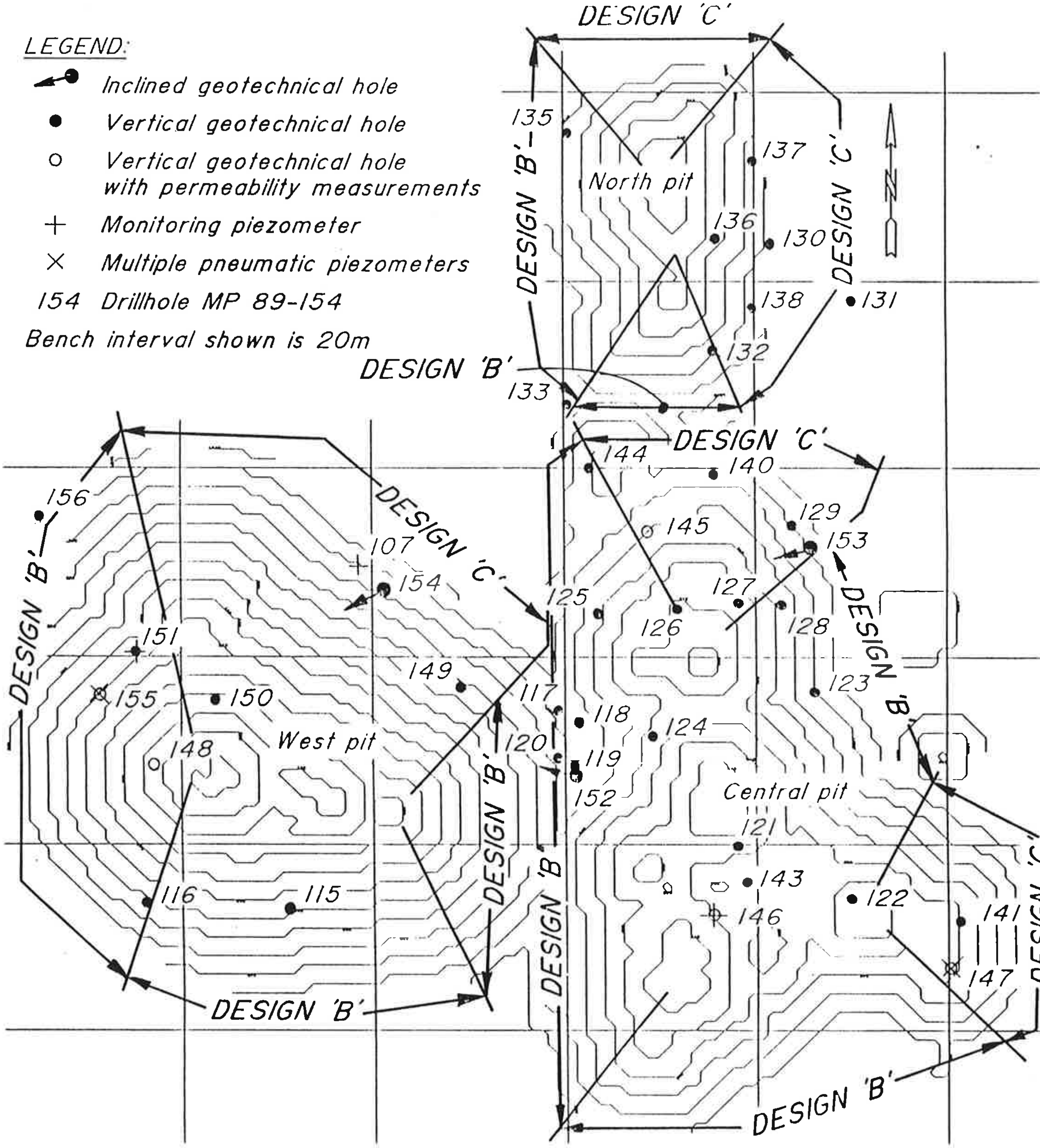
NCI - 763

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

OPEN PIT

DESIGN SECTORS



KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

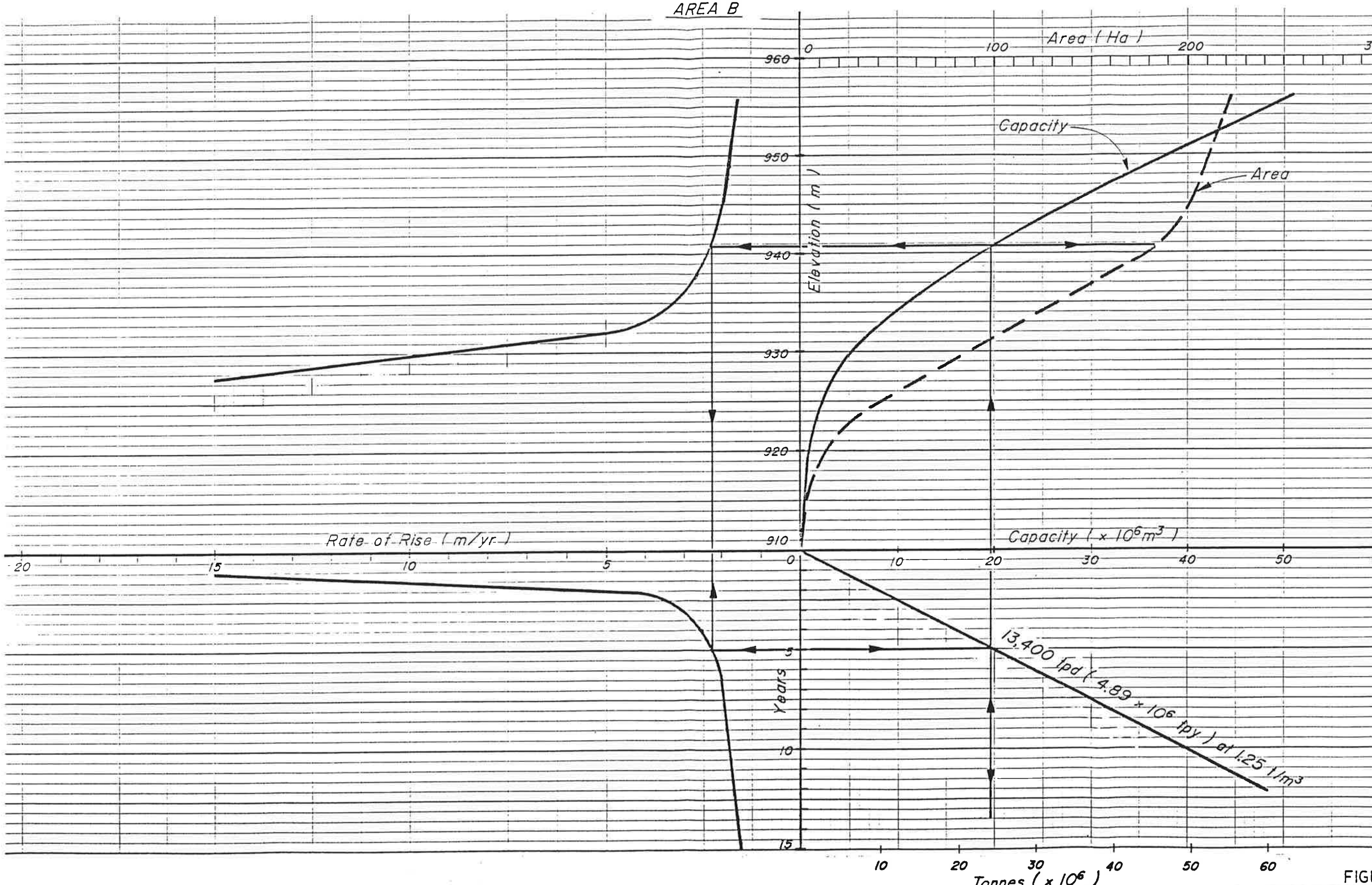
FIGURE 4.6

FEB. 13, 1990

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

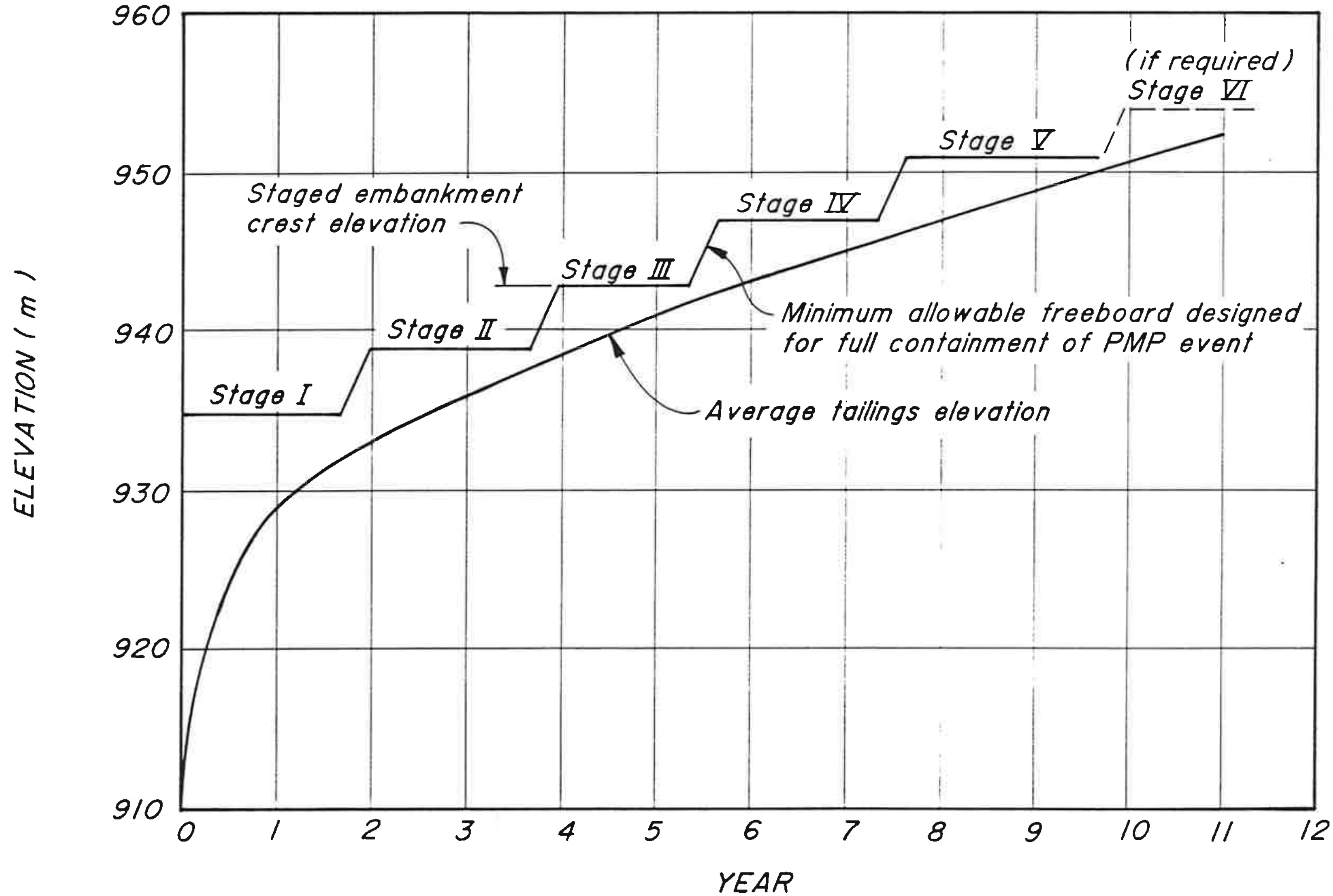
DEPTH / AREA / CAPACITY / FILLING RATE FOR TAILINGS STORAGE FACILITY AREA B



KNIGHT AND PIESOLD LTD.

FIGURE 6.2

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT
TAILINGS AREA FILLING SCHEDULE AND STAGED CONSTRUCTION



Revised Feb. 20, 1990

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 6.3

NCI - 763

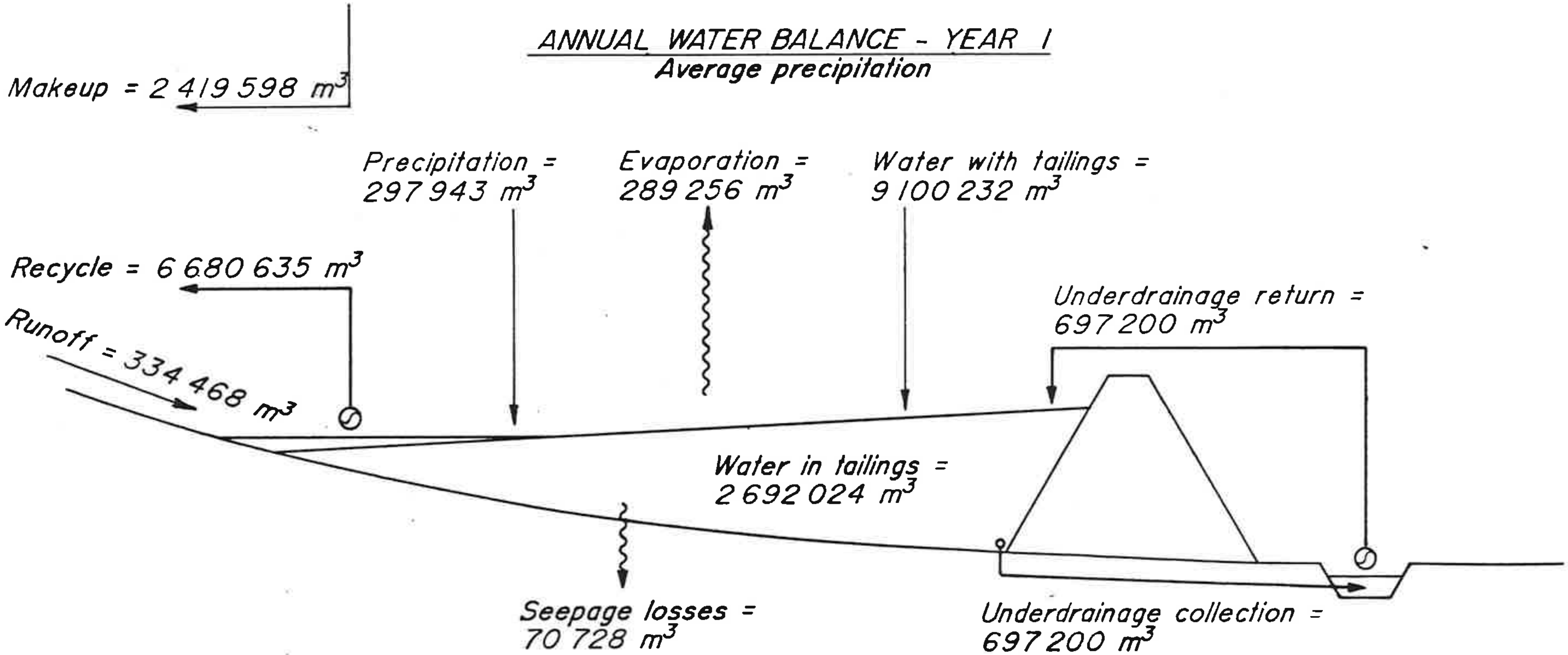
IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

TAILINGS STORAGE FACILITY

ANNUAL WATER BALANCE - YEAR I

Average precipitation



Revised Feb. 15, 1990

KNIGHT AND PIESOLD LTD.
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FIGURE 6.4

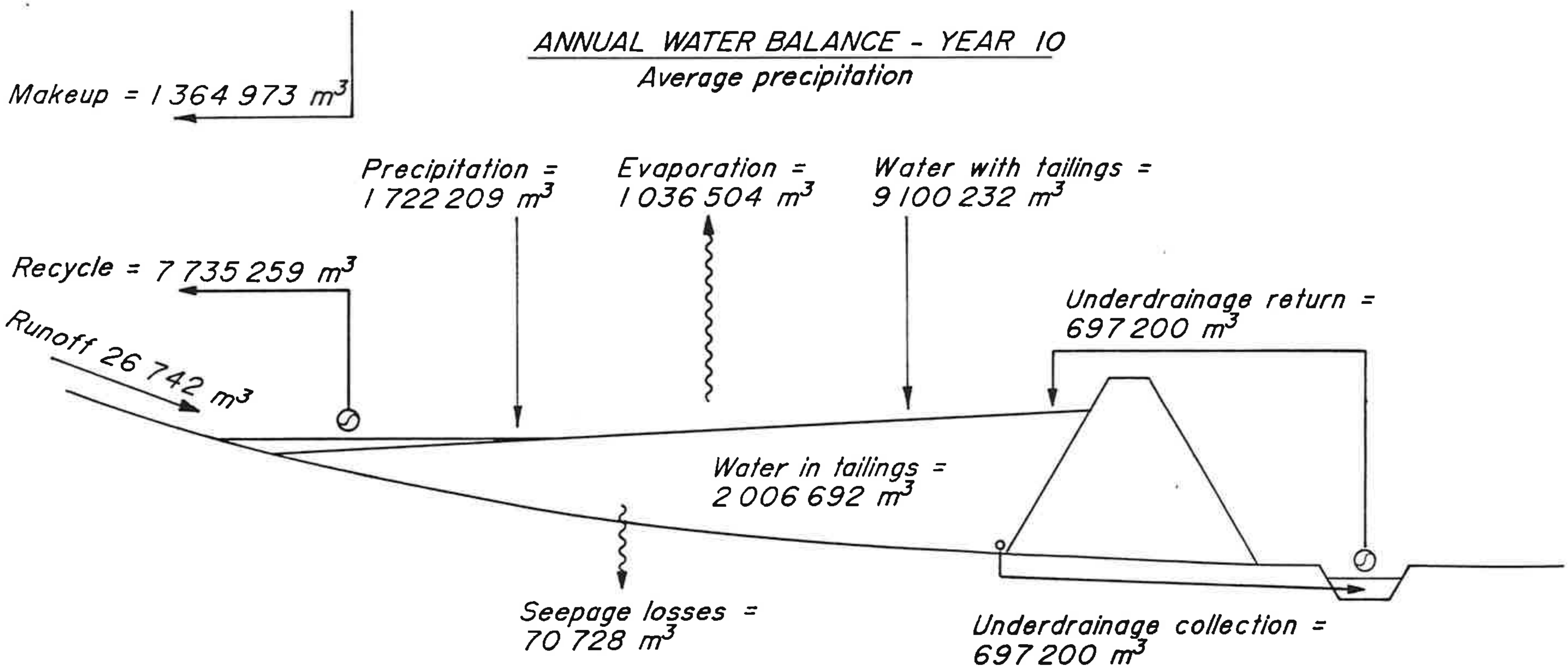
IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

TAILINGS STORAGE FACILITY

ANNUAL WATER BALANCE - YEAR 10

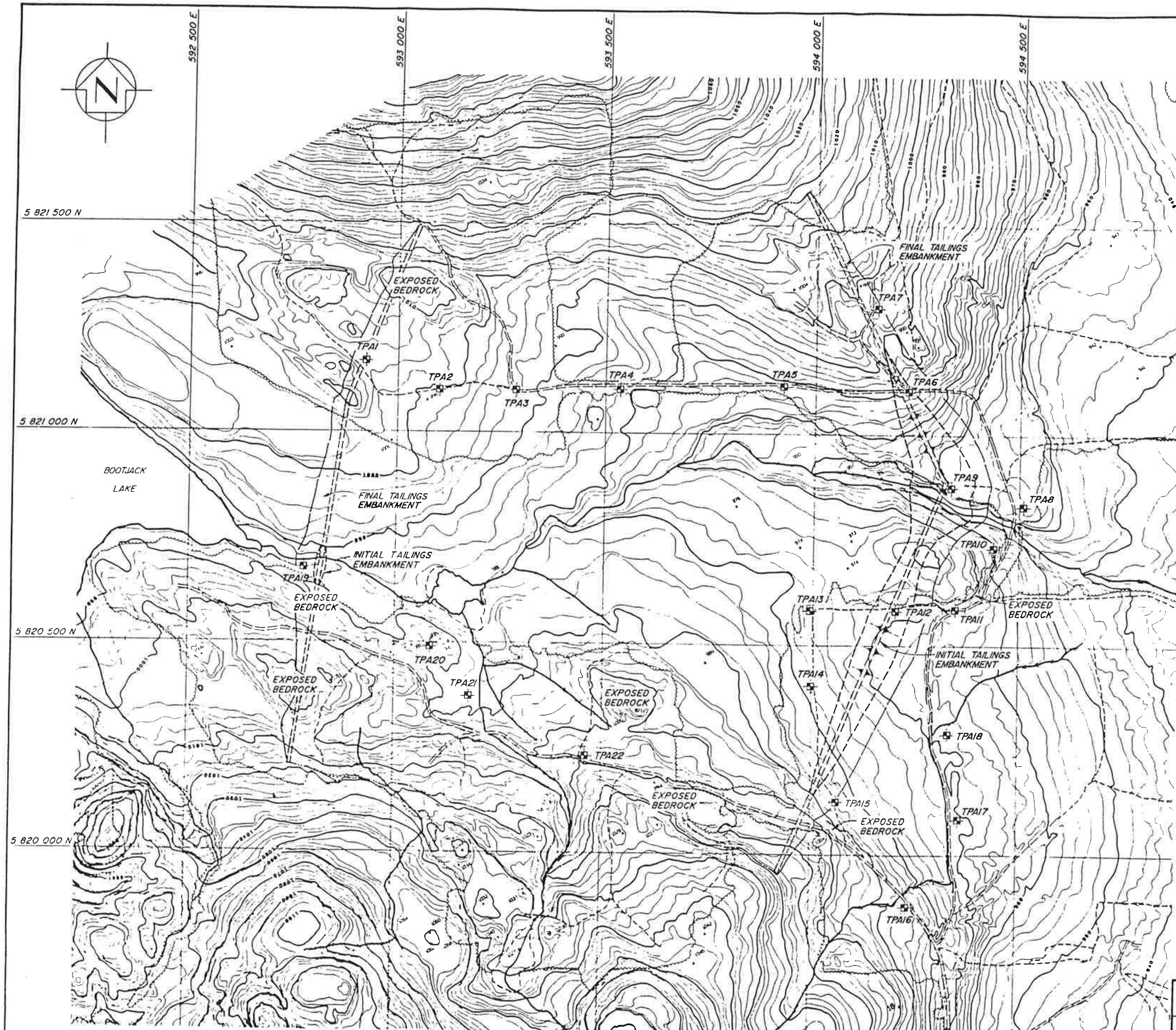
Average precipitation



Revised Feb. 15, 1990

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 6.5



TEST PIT	DEPTH INTERVAL (m)	MATERIAL DESCRIPTION
TPA1	0 - .15 0.15 - 0.6 0.6	TOPSOIL, organics and forest litter SAND, some silt, some gravel, glacial till BEDROCK
TPA2	0 - .15 0.15 - 1.7 1.7	TOPSOIL, brown SILTY SAND, some gravel, trace clay, glacial till BEDROCK
TPA3	0 - 2.4 2.4 - 3.4	SILTY SAND, some gravel, trace clay, glacial till. SANDY SILT, some gravel, trace to some till
TPA4	0 - 4.3	SILTY SAND, some gravel, trace clay, glacial till.
TPA5	0 - 2.6 2.6 - 2.7	SILTY SAND, some gravel, trace clay, glacial till BEDROCK, fractured, weathered, wet.
TPA6	0 - 1.8 1.8 - 3 3 - 4 4 - 5.2	SILTY SAND, some gravel, trace clay, glacial till. GRAVELLY SAND, trace to some silt, poorly sorted. SAND, some silt, some gravel, sandy glacial till. GRAVELLY SAND, some silt, glacial till.
TPA7	0 - 0.5 0.5	TOPSOIL, forest litter BEDROCK
TPA8	0 - 2.9	SAND, some gravel, some silt, glacial till
TPA9	0 - 0.5 0.5 - 1.2 1.2 - 4.3	TOPSOIL, organics and forest litter, brown GRAVELLY SAND, coarse, blue-grey SILTY SAND, some gravel, some clay, glacial till
TPA10	0 - 0.3 0.3	TOPSOIL, organics and forest litter BEDROCK
TPA11	0 - 0.5 0.5	SANDY SILT, some gravel, glacial till. BEDROCK
TPA12	0 - 0.3 0.3 - 3 3 - 5.2	TOPSOIL, organics and forest litter SILTY SAND, some gravel, trace clay, glacial till CLAYEY SILT, some sand, trace gravel, firm
TPA13	0 - 0.15 0.15 - 5.2	TOPSOIL, organics and forest litter SILTY SAND, some gravel, trace clay, glacial till
TPA14	0 - .15 0.15 - 5.2	TOPSOIL, organics and forest litter SILTY SAND, some gravel, trace clay, glacial till
TPA15	0 - 2.4 2.4 - 2.7 2.7	SILTY SAND, some gravel, trace clay, glacial till GRAVELLY SAND, some silt, well graded, wet BEDROCK
TPA16	0 - 0.3 0.3 - 5.2	TOPSOIL, organics and forest litter SILTY SAND, some gravel, trace to some clay, till
TPA17	0 - 0.3 0.3 - 3 3	TOPSOIL, organics and forest litter SILTY SAND, some gravel, trace clay, glacial till BEDROCK, fractured, weathered, pale brown
TPA18	0 - 2.4 2.4	SAND and GRAVEL, medium to coarse, BEDROCK, highly altered with iron staining
TPA19	0 - 0.3 0.3 - 0.6 0.6 - 1.4 1.4	SWAMP WATER MUSKEG, fibrous, black soil CLAYEY SILT, some sand, some gravel, till BEDROCK
TPA20	0.15 - 0.8 0.8	TOPSOIL, forest litter BEDROCK
TPA21	0 - 2.4 2.4 - 5.2	CLAYEY SILT, some sand, some gravel, till SILTY SAND, some gravel, trace clay, glacial till
TPA22	0 - 5.2	SILTY SAND, some gravel, trace clay, glacial till

LEGEND

Test Pit

SCALE 100 0 100 200 300 400 500 m

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

DESIGNED KJB
DRAWN NR
CHECKED
APPROVED

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

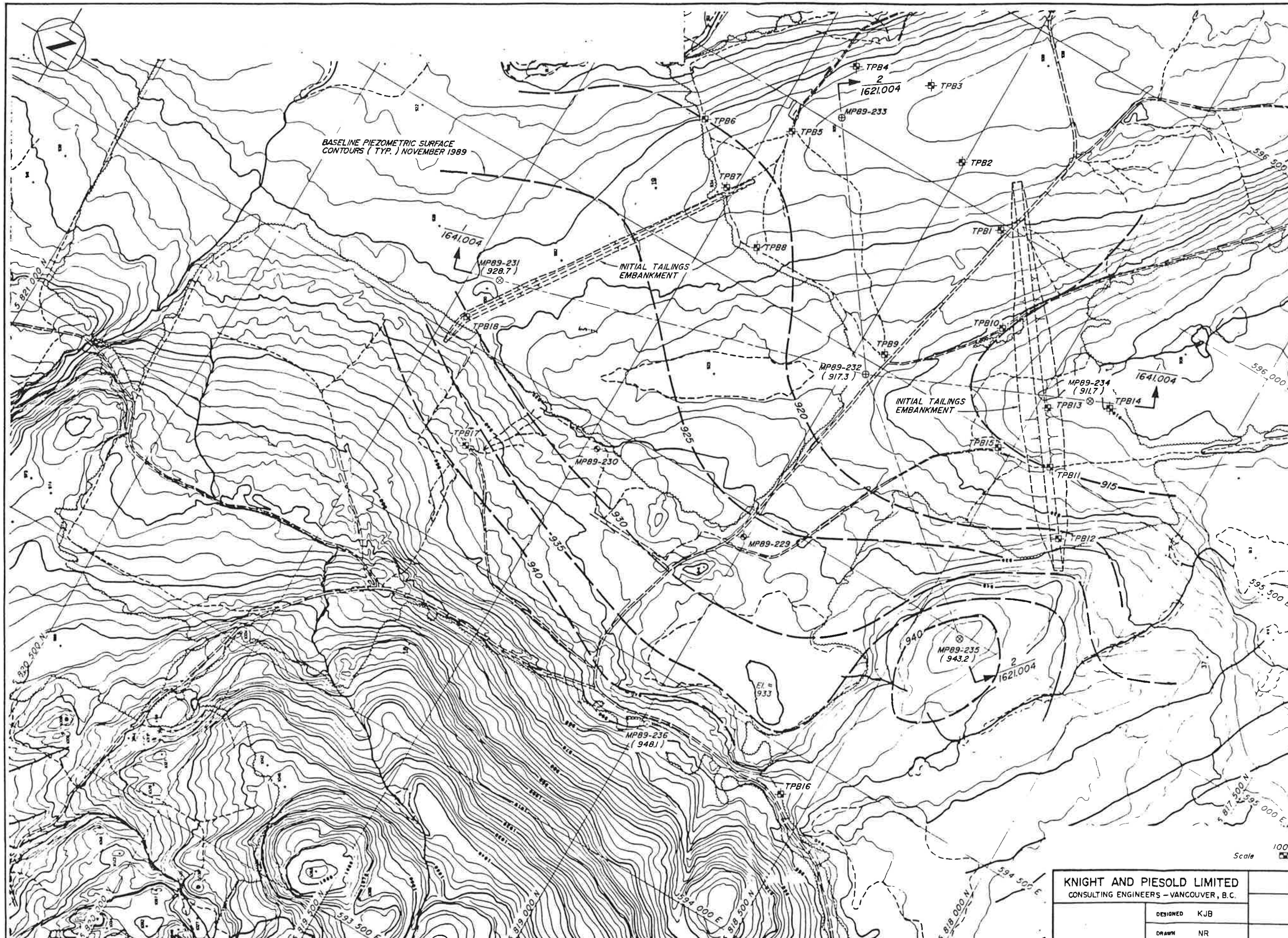
TAILINGS AREA INVESTIGATIONS

AREA A TEST PIT PLAN

DRG NO	DESCRIPTION	REV	DATE	DESCRIPTION	APPROVED	REV	DATE	DESCRIPTION	APPROVED

REFERENCE DRAWINGS

REVISIONS



NOTE: Test pits and boreholes shown are field located only.

LEGEND

TPB1	Test Pit Location
MP89-229	Condemnation Drillhole
O MP89-231	Vertical Geotechnical Hole with Permeability Measurements
+	Monitoring Standpipe Piezometer
×	Pneumatic and Standpipe Piezometers
(917.3)	Baseline elev. of piezometer surface (m)

Scale 100 50 0 100 200 300 400 500 m

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MT. POLLEY PROJECT

TAILINGS AREA INVESTIGATIONS

AREA B TEST PIT AND BOREHOLE PLAN

DATE DEC. 20, 1989 | SCALE AS SHOWN | DRG NO. 1621.002 | REV. 0

DRG NO	DESCRIPTION
1641.004	TAILINGS AREA B - GEOLOGICAL SECTIONS

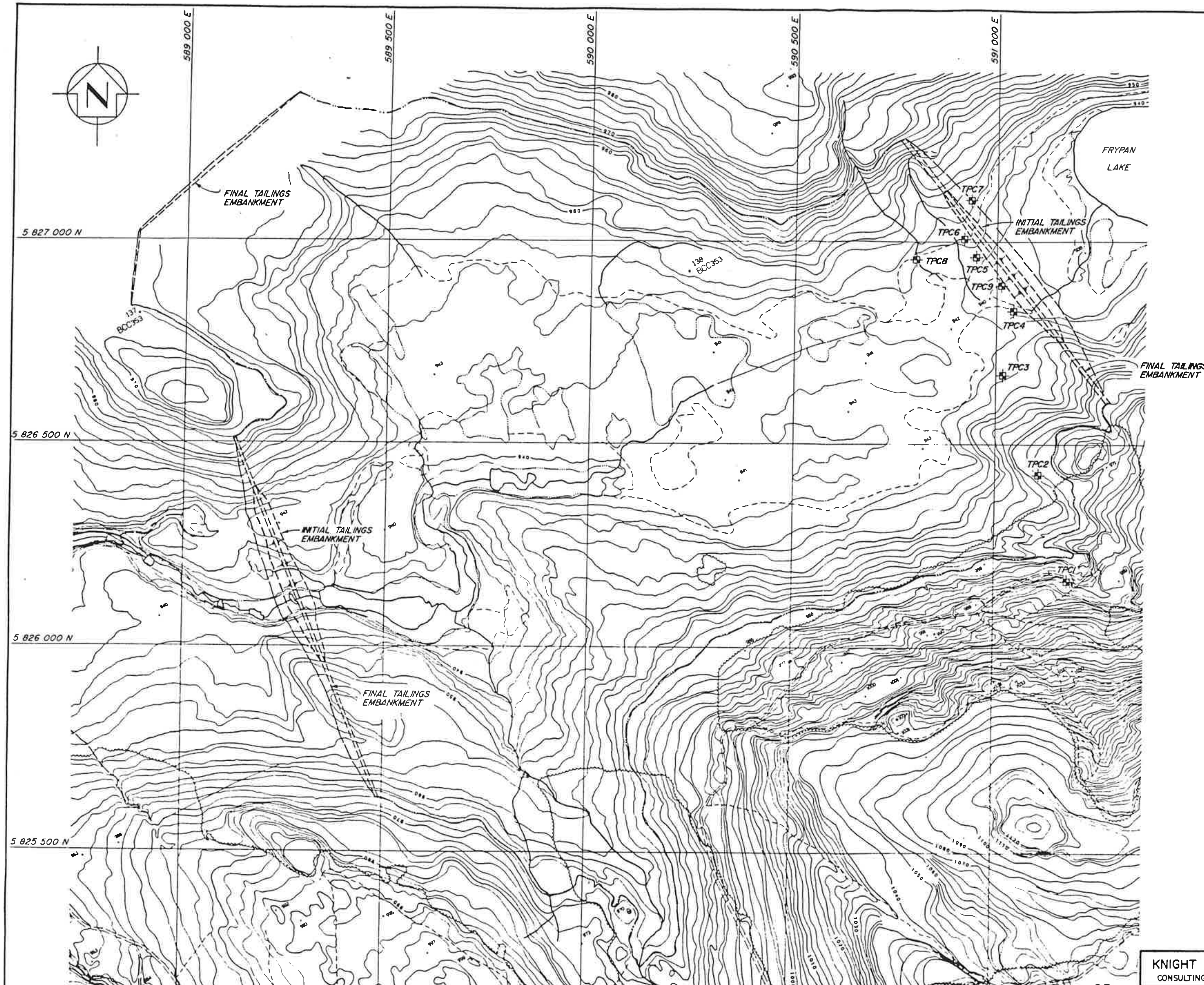
REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	APPROVED

REVISIONS



TEST PIT	DEPTH INTERVAL (m)	MATERIAL DESCRIPTION
TPC1	0 - 3	SILTY SAND, some gravel, trace clay, glacial till
TPC2	0 - 2.2 2.2 - 2.4 2.4 - 4.6 4.6 - 5.5	SILTY SAND, some gravel, trace clay, glacial till SILTY SAND, some gravel, dense, glacial till SILTY SAND, some gravel, trace clay, glacial till SANDY GRAVEL, poorly sorted, saturated
TPC3	0 - 0.3 0.3 - 5.2	SILTY SAND, some organics, saturated SILTY SAND, some gravel, glacial till
TPC4	0 - 1.2 1.2 - 2.1	PEAT and MUSKEG, dark, saturated SILTY SAND, some gravel, trace cobbles, glacial till
TPC5	0 - 5.2 m	GRAVELLY SAND, trace cobbles, alluvial
TPC6	0 - 2.4	SILTY SAND, some gravel, trace cobbles, glacial till
TPC7	0 - 0.15 0.156 - 2.4	ORGANICS and forest litter SILTY SAND, some gravel, trace cobbles, glacial till
TPC8	0 - 2 2	SAND and GRAVEL, trace silt, saturated BEDROCK
TPC9	0 - 2.4	PEAT, dark black, saturated

LEGEND

Test Pit

SCALE 100 0 100 200 300 400 500 m

DRG NO	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	APPROVED	REV	DATE	DESCRIPTION	APPROVED
REVISIONS				REVISIONS			

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DRAWN NR
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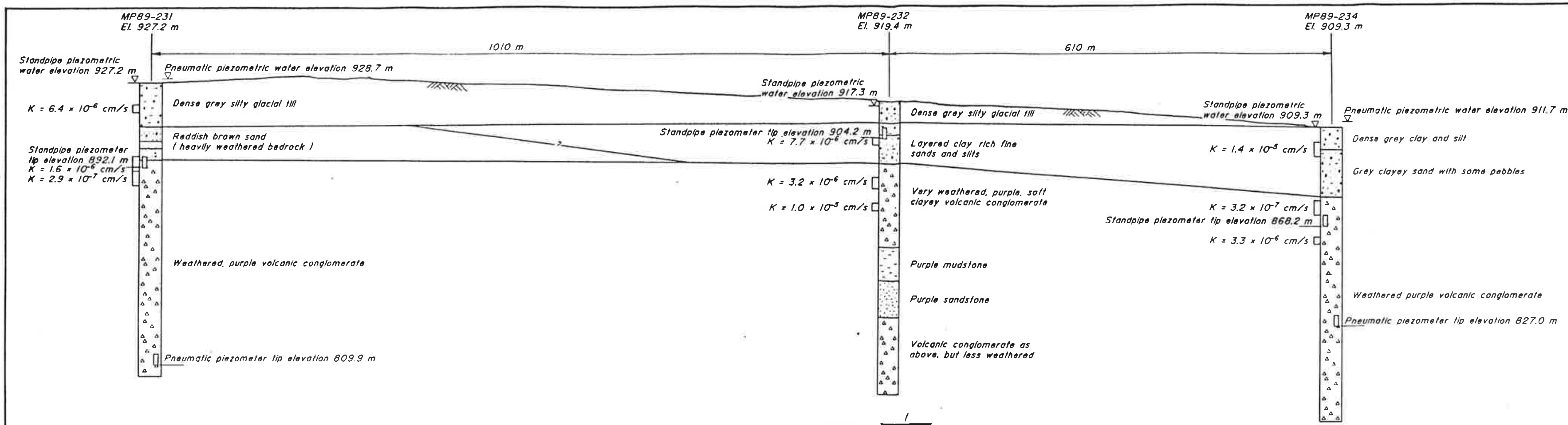
MT. POLLEY PROJECT

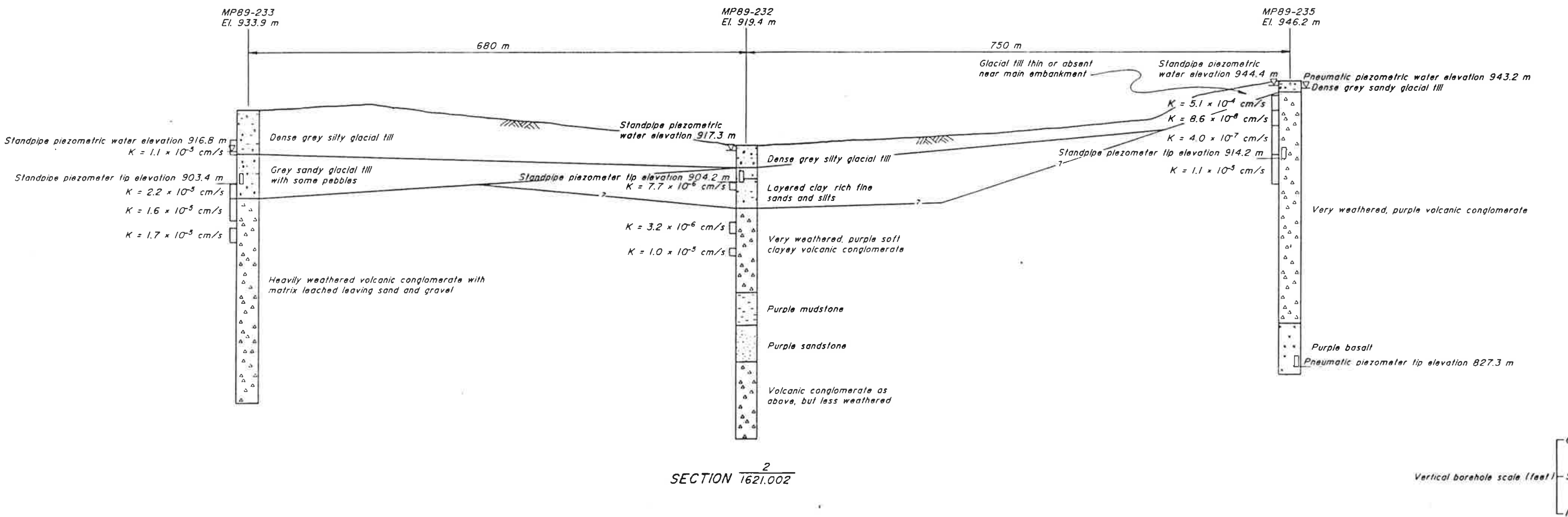
TAILINGS AREA INVESTIGATIONS

AREA C TEST PIT PLAN

DATE DEC. 20, 1989 | SCALE AS SHOWN | DRG. NO. 1621.003 | REV. 0



SECTION 1/1621.002



SECTION 2/1621.002

KNIGHT AND PIESOLD LIMITED CONSULTING ENGINEERS – VANCOUVER, B.C.	DESIGNED RNK DRAWN CHECKED APPROVED	IMPERIAL METALS CORPORATION MT. POLLEY PROJECT TAILINGS AREA B GEOLOGICAL SECTIONS	
DATE DEC. 20, 1989	SCALE AS SHOWN	DRG NO. 1621.004	REV. 0

DRG NO	DESCRIPTION
1621.002	TAILINGS AREA INVESTIGATIONS

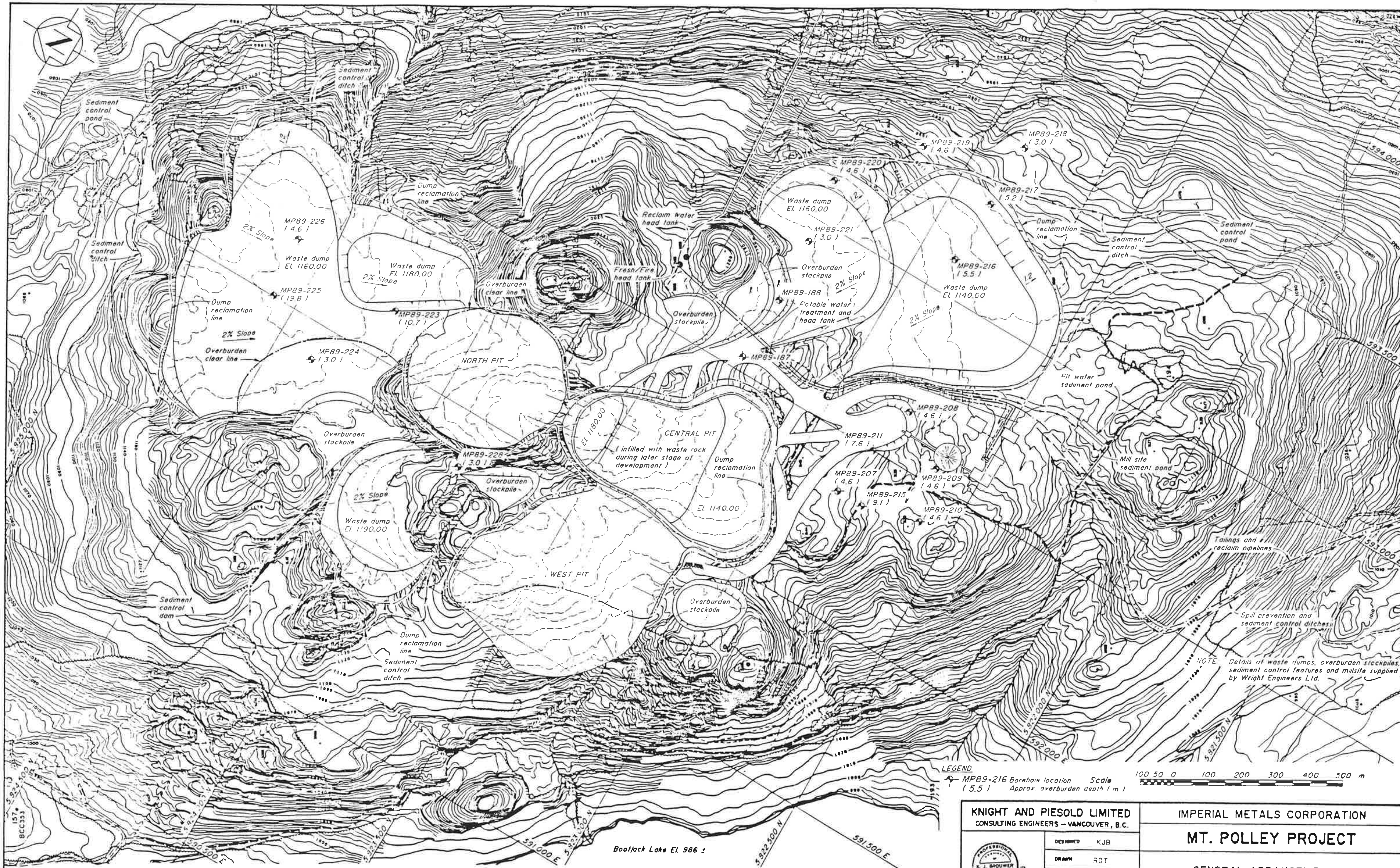
REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	APPROVED

REVISIONS



KNIGHT AND PIESOLD LIMITED CONSULTING ENGINEERS – VANCOUVER, B.C.	IMPERIAL METALS CORPORATION
DESIGNED KJB	MT. POLLEY PROJECT
DRAWN RDT	GENERAL ARRANGEMENT OF
CHECKED KJB	OPEN PIT AND WASTE DUMPS
APPROVED	
DATE DEC. 20, 1989	SCALE AS SHOWN · DRG. NO. 1621.100 · REV. 1

PROFESSIONAL ENGINEER K. J. BROUWER — Feb 20, 1990

DRG NO	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV	DATE	DESCRIPTION	APPROVED
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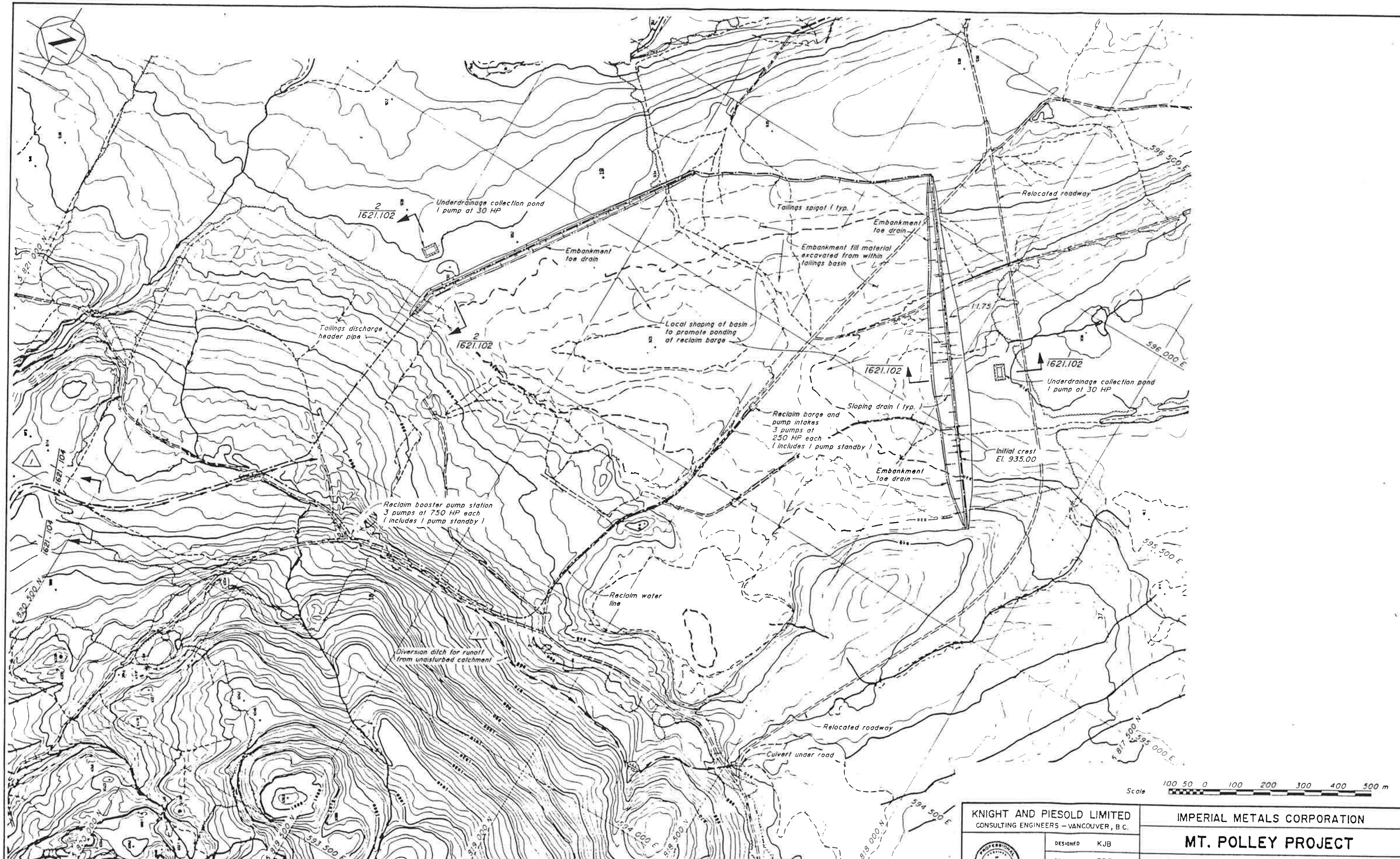
REVISIONS			

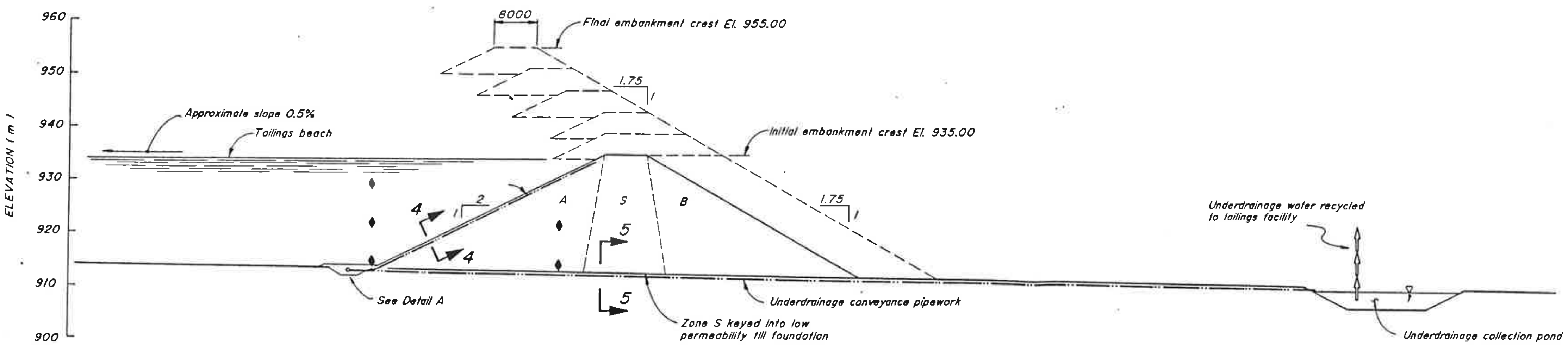


KNIGHT AND PIESOLD LIMITED CONSULTING ENGINEERS – VANCOUVER, B.C.		IMPERIAL METALS CORPORATION
PROFESSIONAL ENGINEER K. J. BROUWER Feb 20, 1990	DESIGNED KJB	MT. POLLEY PROJECT
	DRAWN RDT	TAILINGS STORAGE FACILITY
	CHECKED KJB	GENERAL ARRANGEMENT OF
	APPROVED	INITIAL STAGE
DATE DEC. 20, 1989	SCALE AS SHOWN	DRG NO. 1621.101 REV. 1

DRG NO	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV	DATE	DESCRIPTION	APPROVED
1	FEB. 16, 1990	DIVERSION DITCHES ADDED	
REVISIONS			

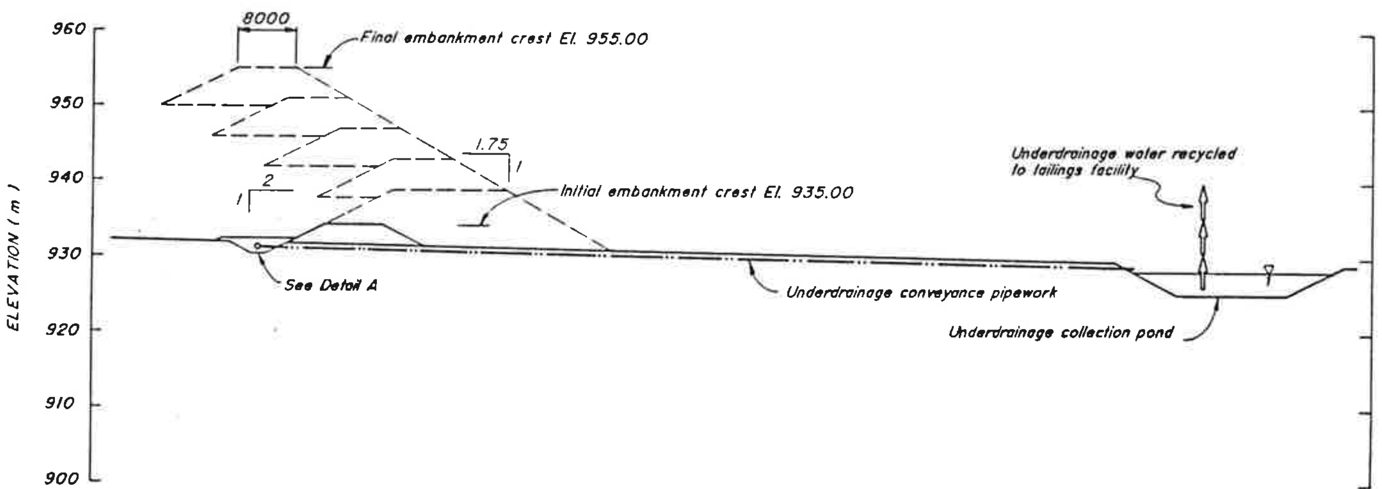


SECTION $\frac{1}{1621.101}$
MAIN EMBANKMENT
Scale A

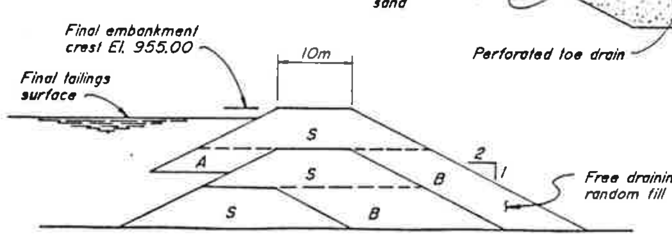
SUMMARY OF EMBANKMENT ZONE REQUIREMENTS			
ZONE	MATERIAL	PLACEMENT	COMPACTION
S	Low permeability glacial till	300 mm layers with moisture conditioning	6 passes, 10 T vibratory padfoot roller
A	Random fill	600 mm layers	6 passes, 10 T vibratory padfoot roller
B	Random fill or waste rock	600 mm layers	6 passes, 10 T vibratory smooth drum roller

Compaction objectives:

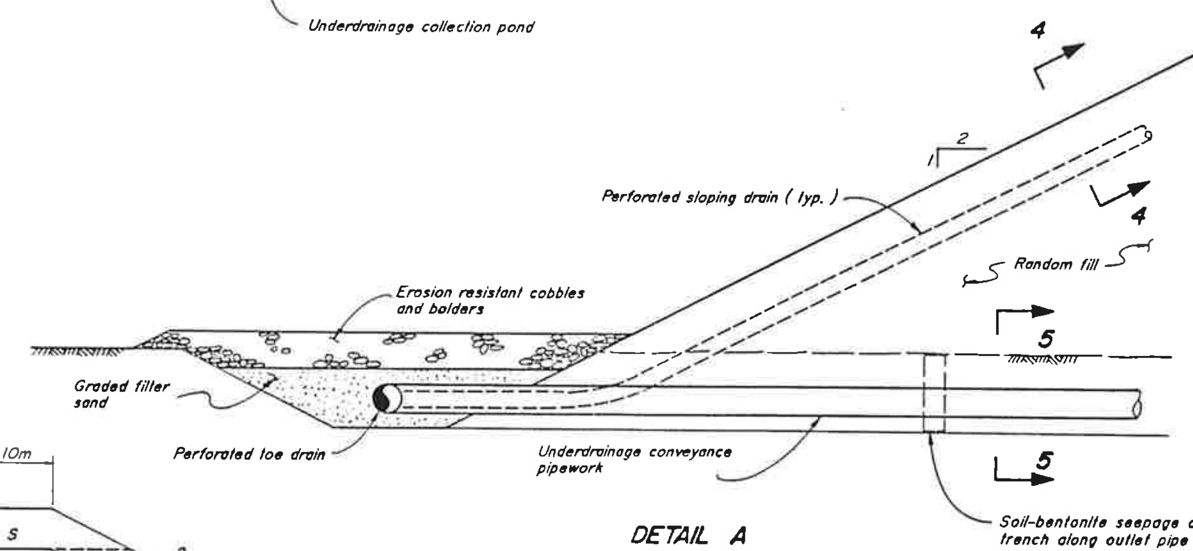
1. Till and Random Fill: 95% of modified proctor maximum density
2. Waste Rock: 90% of maximum density as determined by roller compaction curve.



SECTION $\frac{2}{1621.101}$
PERIMETER EMBANKMENT
Scale A



SECTION $\frac{1}{1621.103}$
SOUTH EMBANKMENT
Scale A



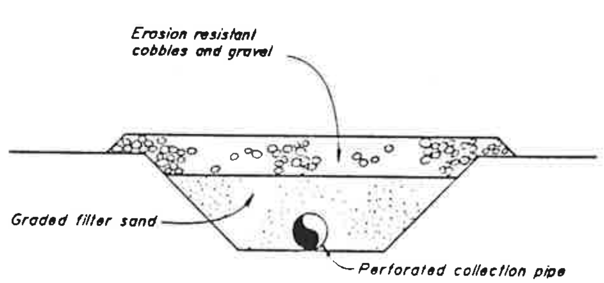
DETAIL A
EMBANKMENT TOE DRAIN
NTS

LEGEND

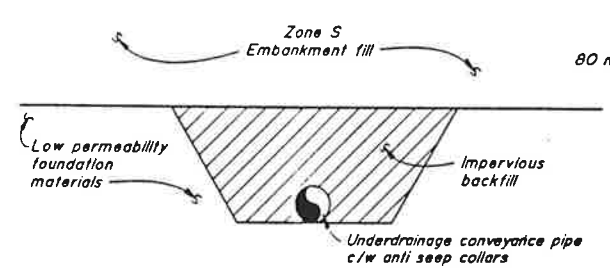
♦ Piezometer Installations

NOTE:

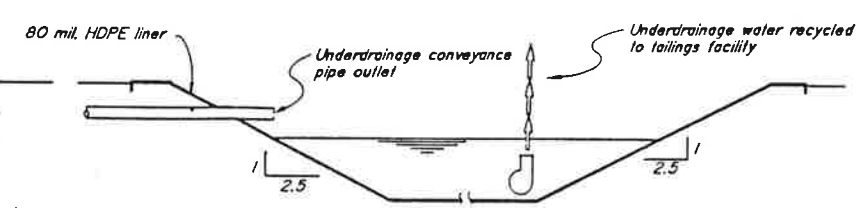
1. Embankment slopes to be designed on the basis of material strength parameters during final design.



SECTION 4
SLOPING DRAIN DETAIL
NTS



SECTION 5
UNDERDRAINAGE CONVEYANCE PIPE DETAIL
NTS



SCHEMATIC SECTION THROUGH
UNDERDRAINAGE COLLECTION PONDS (TYP.)
NTS

Scale A 10 5 0 10 20 30 40 50 m

DWG NO	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV	DATE	DESCRIPTION	APPROVED
1	FEB. 19, 1990	COLLECTION POND SIDE SLOPES CHANGED	[signature]
REVISIONS			

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

PROFESSIONAL ENGINEER K. J. BROUWER
Feb 20, 1990

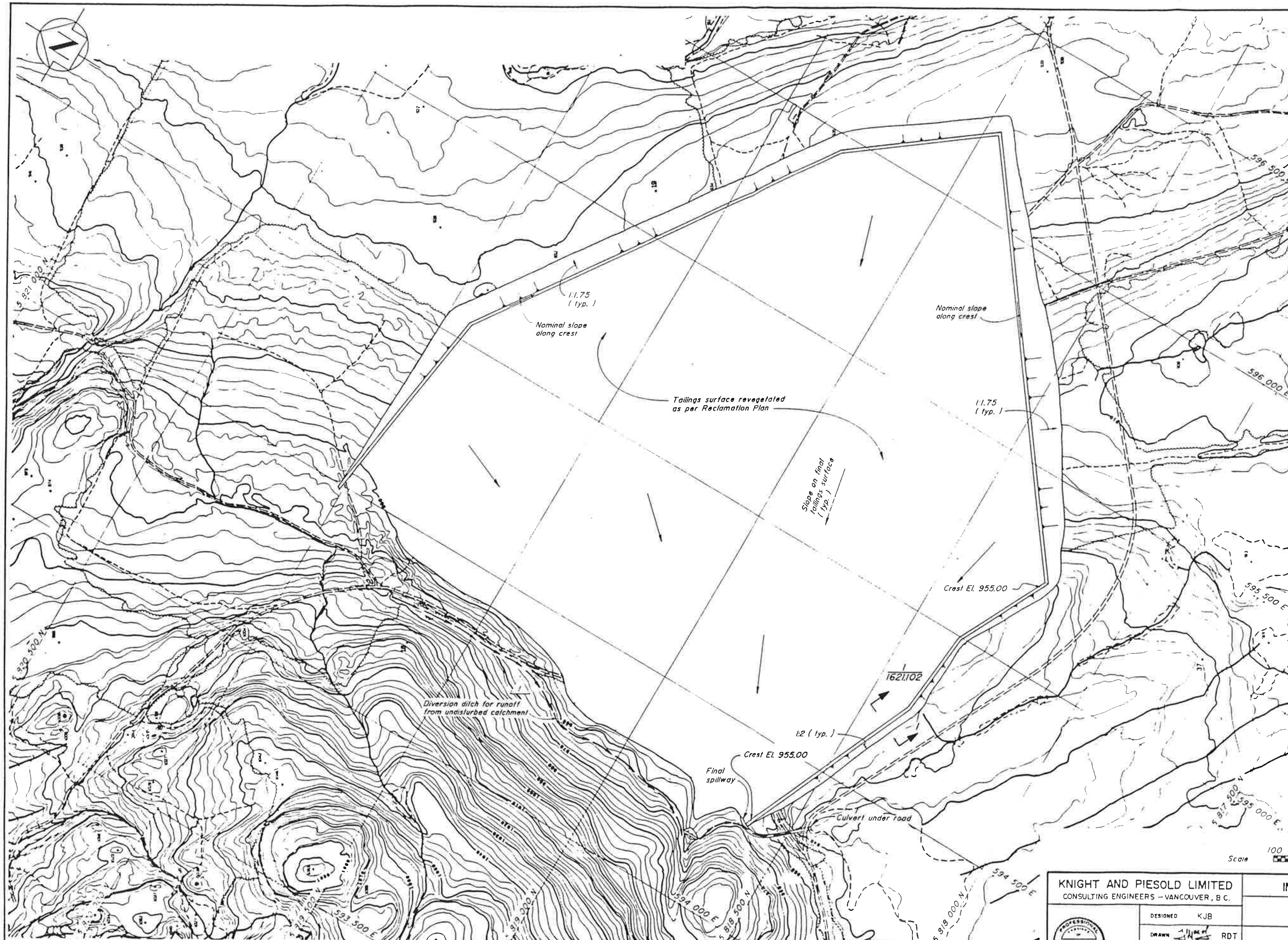
DESIGNED KJB
DRAWN RDT
CHECKED KJB
APPROVED [signature]

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

TAILINGS STORAGE FACILITY
EMBANKMENT SECTIONS AND DETAILS

DATE DEC. 20, 1989 | SCALE AS SHOWN | DRG. NO. 1621.102 | REV. 1



Scale 100 50 0 100 200 300 400 500 m

DRG NO	DESCRIPTION
	REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	APPROVED
		REVISIONS	

REV	DATE	DESCRIPTION	APPROVED
1	FEB. 16, 1990	DIVERSION DITCH ADDED	
		REVISIONS	

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

PROFESSIONAL ENGINEER K. J. BROUWER
Feb 20, 1990

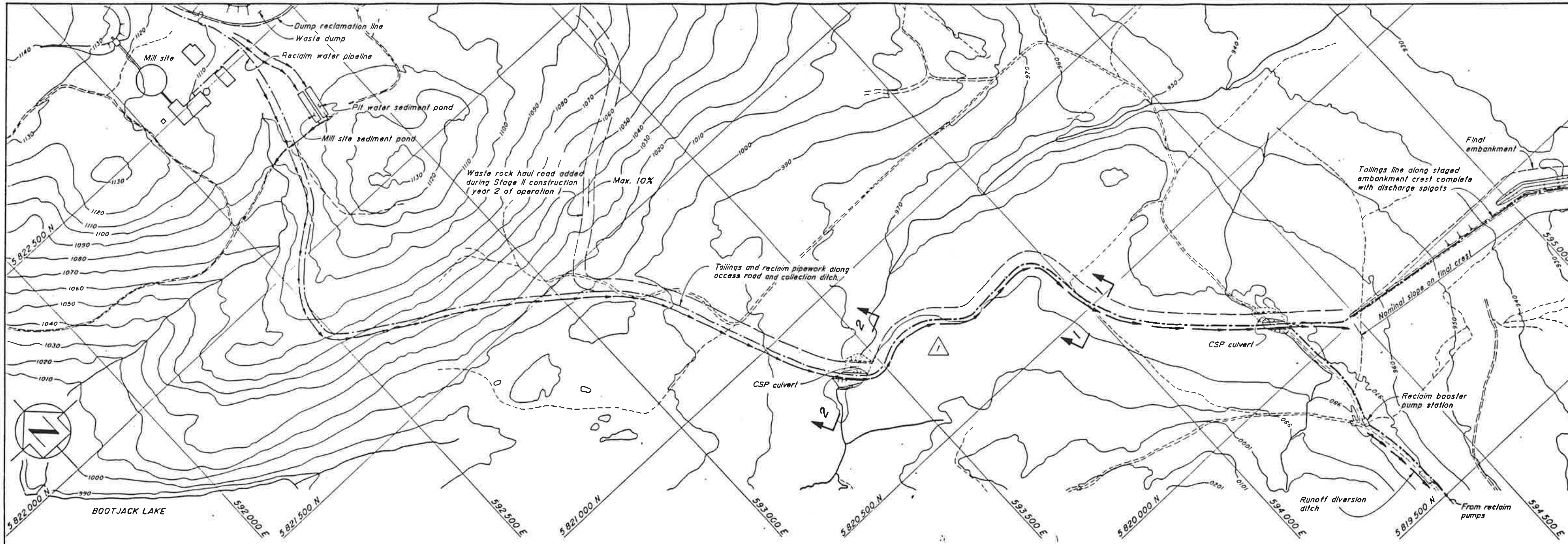
DESIGNED KJB
DRAWN RDT
CHECKED KJB
APPROVED

IMPERIAL METALS CORPORATION

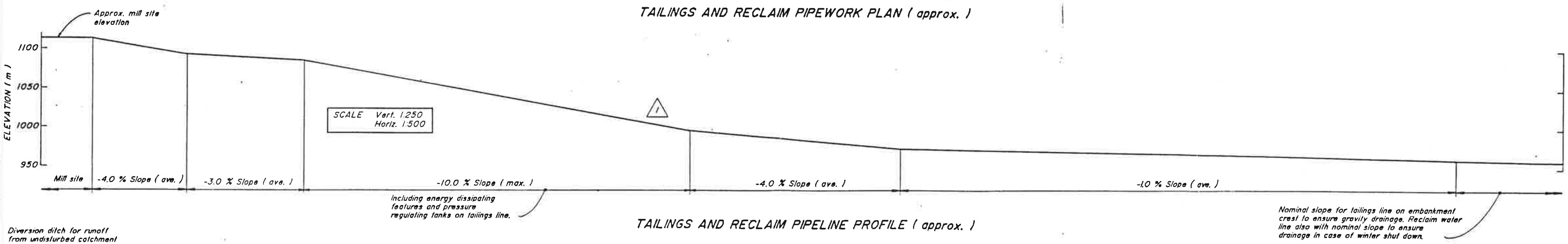
MT. POLLEY PROJECT

TAILINGS STORAGE FACILITY
FINAL ARRANGEMENT

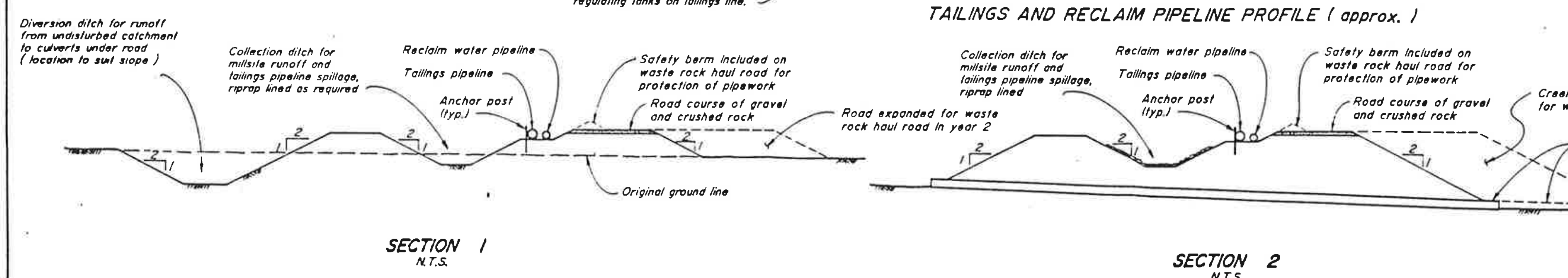
DATE DEC. 20, 1989 | SCALE AS SHOWN | DRG NO 1621.103 | REV 1



TAILINGS AND RECLAIM PIPEWORK PLAN (approx.)



TAILINGS AND RECLAIM PIPELINE PROFILE (approx.)



DRG NO	DESCRIPTION	REV	DATE	DESCRIPTION	APPROVED	REV	DATE	DESCRIPTION	APPROVED
						1	FEB. 16, 1990	PIPELINE ROUTE MODIFIED	
REFERENCE DRAWINGS		REVISIONS				REVISIONS			

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

PROFESSIONAL ENGINEER — K. J. BROUWER — Feb 20, 1990

DESIGNED KJB
DRAWN
CHECKED KJB
APPROVED

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

TAILINGS AND RECLAIM WATER PIPELINES
PLAN AND DETAILS

DATE DEC. 20, 1989 | SCALE AS SHOWN | DRG. NO. 1621.104 | REV. 1

APPENDIX A

CLIMATOLOGICAL SUMMARIES

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

BARKERVILLE
53° 4'N 121° 31'W 1265 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-5.6	-0.5	1.5	6.4	12.0	16.0	19.0	18.1	13.9	7.8	0.4	-3.6	7.1	2	Température Maximale Quotidienne
Daily Minimum Temperature	-15.6	-11.3	-10.2	-5.3	-0.6	3.1	5.2	5.0	1.6	-2.3	-8.7	-12.6	-4.3	2	Température Minimale Quotidienne
Daily Temperature	**-10.7**	**-5.9**	**-4.3**	**0.5**	**5.7**	**9.6**	**12.1**	**11.5**	**7.7**	**2.8**	**-4.1**	**-8.2**	**1.4**	**2**	**Température Quotidienne**
Standard Deviation, Daily Temperature	3.6	2.9	1.9	1.9	1.6	1.7	1.3	1.6	1.9	1.6	2.7	3.3	0.8	2	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	9.4	15.0	17.2	27.8	31.1	32.2	35.6	33.9	30.6	26.7	18.9	14.4	35.6		Température Maximale Extrême
Years of Record	87	86	86	89	89	88	89	90	89	89	90	88			Années de Relèves
Extreme Minimum Temperature	-46.7	-43.3	-37.2	-26.1	-15.0	-6.7	-3.9	-7.8	-13.3	-22.2	-33.3	-41.7	-46.7		Température Minimale Extrême
Years of Record	88	87	88	89	88	88	89	90	89	89	90	88			Années de Relèves
Rainfall	3.1	4.3	3.4	11.3	50.7	88.5	81.6	102.2	81.4	57.7	13.7	7.8	505.7	2	Chutes de Pluie
Snowfall	99.9	81.3	81.9	50.5	15.2	0.8	0.1	0.1	4.0	30.7	73.0	100.9	538.4	2	Chutes de Neige
Total Precipitation	**103.0**	**85.6**	**85.3**	**61.8**	**65.9**	**89.2**	**81.7**	**102.3**	**85.4**	**88.4**	**86.6**	**108.7**	**1043.9**	**2**	**Précipitations Totales**
Standard Deviation, Total Precipitation	44.4	42.5	29.1	24.5	28.9	28.8	31.0	53.0	39.9	37.4	28.2	42.5	112.7	2	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	38.1	38.1	21.3	21.8	25.4	58.4	36.1	52.8	69.9	51.8	50.8	27.0	69.9		Chute de Pluie Record en 24 heures
Years of Record	88	88	89	91	89	89	90	90	90	90	90	88			Années de Relèves
Greatest Snowfall in 24 hours	49.8	58.4	48.3	39.6	21.8	21.6	2.5	5.1	24.4	37.6	50.8	48.3	58.4		Chute de Neige Record en 24 heures
Years of Record	88	88	89	91	89	90	90	91	90	90	89	88			Années de Relèves
Greatest Precipitation in 24 hours	49.8	58.4	48.3	39.6	27.4	58.4	36.1	52.8	71.1	51.8	50.8	48.3	71.1		Précipitation Record en 24 heures
Years of Record	88	88	89	91	89	89	90	90	90	90	90	88			Années de Relèves
Days with Rain	1	1	1	3	11	16	14	15	14	10	3	1	90	2	Jours de Pluie
Days with Snow	16	14	15	9	3	*	*	*	1	6	13	17	94	2	Jours de Neige
Days with Precipitation	17	14	16	11	13	16	14	15	14	15	15	17	177	2	Jours de Précipitation

BARRIERE
51° 11'N 120° 7'W 375 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-4.0	2.6	8.4	15.7	21.0	24.9	27.9	27.3	21.4	12.5	3.8	-1.7	13.3	3	Température Maximale Quotidienne
Daily Minimum Temperature	-12.3	-7.8	-4.5	-0.1	4.2	8.1	9.7	9.1	5.1	0.8	-3.3	-8.5	0.0	3	Température Minimale Quotidienne
Daily Temperature	**-8.2**	**-2.6**	**2.0**	**7.8**	**12.6**	**16.6**	**18.8**	**18.2**	**13.3**	**6.7**	**0.3**	**-5.1**	**6.7**	**3**	**Température Quotidienne**
Standard Deviation, Daily Temperature	4.5	3.3	1.8	1.3	1.5	1.5	1.3	1.5	1.6	1.1	1.8	3.4	0.6	3	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	11.7	15.0	20.6	32.2	37.8	39.4	40.0	38.9	32.8	27.5	21.7	12.2	40.0		Température Maximale Extrême
Years of Record	21	22	22	22	21	21	21	22	22	21	21	22			Années de Relèves
Extreme Minimum Temperature	-42.8	-34.4	-29.5	-11.7	-4.4	-1.1	2.5	-2.2	-6.7	-12.8	-24.5	-39.4	-42.8		Température Minimale Extrême
Years of Record	21	22	22	22	21	21	21	22	22	21	21	22			Années de Relèves
Rainfall	7.3	9.2	16.5	21.0	33.7	40.8	43.3	39.8	31.9	31.4	24.1	9.7	308.7	3	Chutes de Pluie
Snowfall	45.6	22.5	4.6	0.6	0.0	0.0	0.0	0.0	0.0	1.0	17.2	42.2	133.7	3	Chutes de Neige
Total Precipitation	**53.0**	**31.7**	**21.1**	**21.6**	**33.7**	**40.8**	**43.3**	**39.8**	**31.9**	**32.4**	**41.3**	**51.9**	**442.5**	**3**	**Précipitations Totales**
Standard Deviation, Total Precipitation	22.3	18.9	8.1	14.6	11.3	26.2	23.2	28.6	19.5	21.2	19.1	24.0	91.4	3	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	20.3	30.2	13.5	15.2	23.9	27.7	43.7	42.2	22.9	23.6	15.5	12.4	43.7		Chute de Pluie Record en 24 heures
Years of Record	22	21	22	22	21	21	22	23	23	21	22	23			Années de Relèves
Greatest Snowfall in 24 hours	24.1	18.8	7.9	6.6	T	0.0	0.0	0.0	0.0	9.7	30.2	22.1	30.2		Chute de Neige Record en 24 heures
Years of Record	22	21	21	22	21	21	22	23	23	21	21	23			Années de Relèves
Greatest Precipitation in 24 hours	24.1	30.2	13.5	15.2	23.9	27.7	43.7	42.2	22.9	23.6	30.2	22.1	43.7		Précipitation Record en 24 heures
Years of Record	22	21	22	22	21	21	22	23	23	21	22	23			Années de Relèves
Days with Rain	2	4	7	7	11	10	9	9	9	9	8	4	89	3	Jours de Pluie
Days with Snow	11	7	3	*	0	0	0	0	0	*	5	10	36	3	Jours de Neige
Days with Precipitation	13	10	9	7	11	10	9	9	9	10	12	14	123	3	Jours de Précipitation

HORSEFLY LAKE
52° 23′N 121° 17′W 788 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-4.0	1.3	5.5	11.2	16.4	19.7	22.9	22.3	17.3	11.5	3.0	-1.3	10.5	8	Température Maximale Quotidienne
Daily Minimum Temperature	-14.6	-10.1	-7.7	-2.5	1.9	5.5	7.0	6.9	4.1	0.1	-5.4	-10.6	-2.1	8	Température Minimale Quotidienne
Daily Temperature	**-9.3**	**-4.4**	**-1.1**	**4.3**	**9.2**	**12.6**	**15.0**	**14.6**	**10.7**	**5.8**	**-1.2**	**-6.0**	**4.2**	8	**Température Quotidienne**
Standard Deviation, Daily Temperature	4.8	3.2	2.8	1.6	1.8	1.5	1.3	1.2	1.0	1.4	4.1	4.2	1.3	5	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	12.2	12.2	18.3	23.3	29.4	33.3	33.3	33.3	28.9	23.3	16.1	15.6	33.3		Température Maximale Extrême
Years of Record	10	11	11	11	10	10	9	10	8	10	10	11			Années de Relèves
Extreme Minimum Temperature	-42.2	-44.4	-40.6	-18.3	-7.2	-1.7	0.0	-1.1	-6.1	-12.8	-32.2	-41.1	-44.4		Température Minimale Extrême
Years of Record	10	11	11	11	10	9	8	9	8	10	10	11			Années de Relèves
Rainfall	1.8	14.1	13.1	34.7	61.5	105.9	88.5	77.3	65.1	63.7	18.0	8.5	552.2	8	Chutes de Pluie
Snowfall	58.7	26.5	33.7	5.0	3.3	0.0	0.0	0.0	0.2	3.5	32.9	50.2	214.0	8	Chutes de Neige
Total Precipitation	**52.9**	**30.7**	**47.5**	**40.0**	**64.0**	**105.9**	**88.5**	**77.3**	**65.3**	**66.3**	**48.5**	**52.5**	**739.4**	8	**Précipitations Totales**
Standard Deviation, Total Precipitation	15.2	18.5	37.4	27.3	35.2	49.8	32.3	59.4	45.4	38.5	28.8	39.0	149.4	6	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	6.4	13.2	18.8	40.1	38.6	51.8	41.4	35.6	30.5	24.6	18.8	19.3	51.8		Chute de Pluie Record en 24 heures
Years of Record	10	10	11	11	10	10	10	9	9	10	10	11			Années de Relèves
Greatest Snowfall in 24 hours	21.6	26.7	34.3	10.2	16.5	0.0	0.0	0.0	0.0	10.2	22.9	29.2	34.3		Chute de Neige Record en 24 heures
Years of Record	10	11	10	11	10	10	10	9	9	10	10	11			Années de Relèves
Greatest Precipitation in 24 hours	21.6	26.7	34.3	40.1	38.6	51.8	41.4	35.6	30.5	24.6	22.9	29.2	51.8		Précipitation Record en 24 heures
Years of Record	10	11	11	11	10	10	10	9	9	10	10	11			Années de Relèves
Days with Rain	0	1	2	6	9	14	11	12	10	10	4	1	80	8	Jours de Pluie
Days with Snow	12	8	6	2	0	0	0	0	0	1	6	9	44	8	Jours de Neige
Days with Precipitation	12	9	9	7	9	14	11	11	11	10	10	10	123	8	Jours de Précipitation

HUDSON HOPE BCHPA DAM
56° 1′N 122° 12′W 678 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-10.8	-4.6	0.0	8.7	15.4	19.4	21.3	20.6	15.4	9.4	-0.1	-6.3	7.4	8	Température Maximale Quotidienne
Daily Minimum Temperature	-19.7	-14.9	-11.0	-3.8	2.2	6.9	9.3	8.3	4.0	-0.7	-8.0	-14.4	-3.5	8	Température Minimale Quotidienne
Daily Temperature	**-15.3**	**-9.8**	**-5.5**	**2.5**	**8.8**	**13.2**	**15.3**	**14.4**	**9.7**	**4.4**	**-4.1**	**-10.4**	**1.9**	8	**Température Quotidienne**
Standard Deviation, Daily Temperature	4.4	6.1	2.8	1.8	0.9	1.0	1.2	1.4	1.8	1.6	4.5	4.4	0.9	4	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	11.1	14.4	17.2	26.7	30.0	32.8	33.3	32.2	29.4	25.0	15.6	14.0	33.3		Température Maximale Extrême
Years of Record	16	17	17	16	15	15	16	18	18	18	18	18			Années de Relèves
Extreme Minimum Temperature	-46.1	-39.4	-40.6	-22.2	-9.0	-2.2	2.5	-2.2	-11.1	-11.1	-33.9	-41.1	-46.1		Température Minimale Extrême
Years of Record	16	17	16	17	16	15	16	18	18	17	17	18			Années de Relèves
Rainfall	0.4	0.5	1.6	6.4	44.0	80.7	88.3	70.2	41.7	9.8	2.9	0.2	346.7	8	Chutes de Pluie
Snowfall	33.6	27.1	32.8	14.8	3.5	0.0	0.0	0.0	2.3	16.0	28.7	35.5	194.3	8	Chutes de Neige
Total Precipitation	**35.8**	**30.3**	**38.8**	**21.0**	**49.4**	**80.4**	**88.3**	**69.7**	**39.5**	**26.5**	**32.7**	**38.7**	**551.1**	8	**Précipitations Totales**
Standard Deviation, Total Precipitation	20.8	21.4	15.6	18.0	39.5	40.6	60.2	45.4	38.9	17.2	24.2	23.3	127.4	4	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	10.2	7.6	11.4	17.0	37.1	67.3	78.7	71.1	41.1	27.7	14.2	T	78.7		Chute de Pluie Record en 24 heures
Years of Record	16	17	17	14	16	16	16	18	18	16	18	16			Années de Relèves
Greatest Snowfall in 24 hours	25.4	25.4	16.3	20.8	16.3	0.0	0.0	0.0	12.7	33.8	26.4	30.0	33.8		Chute de Neige Record en 24 heures
Years of Record	16	17	16	16	17	17	17	18	18	17	17	16			Années de Relèves
Greatest Precipitation in 24 hours	25.4	25.4	16.3	20.8	37.1	67.3	78.7	71.1	41.1	33.8	26.4	30.0	78.7		Précipitation Record en 24 heures
Years of Record	16	17	16	14	16	16	16	18	18	16	17	16			Années de Relèves
Days with Rain	0	0	1	2	8	10	12	9	10	3	0	0	55	8	Jours de Pluie
Days with Snow	9	8	9	4	1	0	0	0	1	2	7	9	50	8	Jours de Neige
Days with Precipitation	10	8	10	6	8	10	12	9	10	6	7	9	105	8	Jours de Précipitation

QUESNEL
52° 59'N 122° 29'W 488 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	'G ÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-6.0	1.5	6.3	12.7	18.5	21.5	24.1	22.9	17.9	11.3	2.7	-2.7	10.9	8	Température Maximale Quotidienne
Daily Minimum Temperature	-14.6	-9.6	-6.1	-1.3	3.4	7.4	9.7	9.1	5.3	0.6	-5.1	-10.5	-1.0	8	Température Minimale Quotidienne
Daily Temperature	**-10.3**	**-4.1**	**0.1**	**5.7**	**11.0**	**14.5**	**16.9**	**16.0**	**11.6**	**6.0**	**-1.2**	**-6.6**	**5.0**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	5.2	3.5	2.5	1.6	1.3	1.5	1.2	1.5	1.3	1.5	3.6	4.1	1.1	4	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	16.1	18.9	23.3	31.1	35.6	36.7	40.6	38.3	34.4	28.3	24.4	18.3	40.6		Température Maximale Extrême
Years of Record	71	72	72	72	72	73	72	72	73	72	73	72			Annees de Relèves
Extreme Minimum Temperature	-46.1	-45.6	-34.4	-21.7	-11.1	-7.8	-1.1	-1.7	-11.1	-20.0	-35.0	-46.7	-46.7		Temperature Minimale Extrême
Years of Record	72	71	72	71	72	69	70	72	73	71	76	72			Annees de Relèves
Rainfall	3.5	5.3	9.3	20.2	38.9	60.5	54.7	61.3	44.3	41.3	16.8	8.9	365.0	8	Chutes de Pluie
Snowfall	55.5	23.2	12.7	3.5	0.9	0.0	0.0	0.0	0.1	4.3	21.9	44.3	166.4	8	Chutes de Neige
Total Precipitation	**59.0**	**27.2**	**22.0**	**23.7**	**39.7**	**60.5**	**54.7**	**61.3**	**44.5**	**46.0**	**39.0**	**50.1**	**527.7**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	29.8	15.5	13.0	14.6	17.0	38.3	28.2	36.4	27.9	25.4	19.9	27.2	75.4	4	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	12.7	20.3	22.4	26.4	37.1	72.1	38.1	39.1	34.3	36.6	25.9	20.3	72.1		Chute de Pluie Record en 24 heures
Years of Record	76	71	69	70	74	72	73	71	73	71	75	73			Années de Relèves
Greatest Snowfall in 24 hours	43.2	35.6	20.3	10.2	11.4	T	0.0	0.0	2.0	20.3	33.0	27.9	43.2		Chute de Neige Record en 24 heures
Years of Record	76	71	69	70	75	75	74	75	74	74	75	69			Années de Relèves
Greatest Precipitation in 24 hours	43.2	35.6	22.4	26.4	37.1	72.1	38.1	39.1	34.3	36.6	33.0	27.9	72.1		Précipitation Record en 24 heures
Years of Record	76	71	69	70	75	74	73	71	74	72	76	71			Années de Relèves
Days with Rain	1	2	4	6	10	12	11	12	11	10	5	3	87	8	Jours de Pluie
Days with Snow	11	6	3	1	0	0	0	0	0	1	5	9	36	8	Jours de Neige
Days with Precipitation	12	8	7	7	10	12	11	12	11	11	9	11	121	8	Jours de Précipitation

QUESNEL A
53° 2'N 122° 31'W 545 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	'G ÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-6.4	0.6	5.6	12.4	18.0	21.2	24.0	22.9	17.9	11.1	2.2	-3.0	10.5	1	Température Maximale Quotidienne
Daily Minimum Temperature	-15.8	-10.4	-6.3	-1.6	2.8	6.7	8.8	8.2	4.6	0.3	-5.8	-11.1	-1.6	1	Température Minimale Quotidienne
Daily Temperature	**-11.1**	**-4.9**	**-0.4**	**5.4**	**10.5**	**14.0**	**16.4**	**15.6**	**11.3**	**5.7**	**-1.8**	**-7.1**	**4.5**	**1**	**Température Quotidienne**
Standard Deviation, Daily Temperature	4.7	3.5	2.4	1.5	1.2	1.4	1.3	1.3	1.4	1.3	3.4	4.1	0.9	1	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	13.9	15.0	19.4	31.0	32.8	35.6	36.7	35.6	30.3	25.6	17.2	12.2	36.7		Température Maximale Extrême
Years of Record	34	34	35	35	35	35	35	35	35	35	35	35			Années de Relèves
Extreme Minimum Temperature	-46.7	-42.2	-38.9	-20.0	-10.0	-3.3	0.6	-1.7	-8.9	-21.1	-37.8	-41.1	-46.7		Température Minimale Extrême
Years of Record	34	34	35	35	35	35	35	35	35	35	35	35			Années de Relèves
Rainfall	3.7	5.0	12.0	19.2	38.1	63.1	52.7	64.4	45.0	41.8	16.3	7.5	368.8	1	Chutes de Pluie
Snowfall	61.2	29.7	18.4	4.1	0.4	0.0	0.0	0.0	0.5	6.3	28.6	49.5	198.7	1	Chutes de Neige
Total Precipitation	**56.0**	**32.0**	**29.6**	**23.2**	**38.5**	**63.1**	**52.7**	**64.4**	**45.5**	**48.2**	**42.9**	**51.0**	**547.1**	**1**	**Précipitations Totales**
Standard Deviation, Total Precipitation	28.2	18.4	14.9	13.3	17.3	35.4	25.5	36.2	24.7	23.6	21.6	25.5	75.5	1	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	10.2	25.4	14.2	34.0	28.2	55.1	30.5	48.3	28.5	31.0	25.4	22.0	55.1		Chute de Pluie Record en 24 heures
Years of Record	34	34	35	35	35	35	35	35	35	34	35	35			Années de Relèves
Greatest Snowfall in 24 hours	40.1	36.8	24.4	21.6	5.1	0.0	0.0	0.0	4.6	18.8	27.9	36.6	40.1		Chute de Neige Record en 24 heures
Years of Record	34	34	35	35	35	35	35	35	35	34	35	35			Années de Relèves
Greatest Precipitation in 24 hours	40.1	36.8	24.4	34.0	28.2	55.1	30.5	48.3	28.5	38.1	26.7	26.2	55.1		Précipitation Record en 24 heures
Years of Record	34	34	35	35	35	35	35	35	35	34	35	35			Années de Relèves
Days with Rain	1	2	4	7	11	13	11	12	11	11	5	3	91	1	Jours de Pluie
Days with Snow	14	9	7	2	*	0	0	0	*	2	8	13	55	1	Jours de Neige
Days with Precipitation	15	11	10	8	11	13	11	12	12	12	12	14	141	1	Jours de Précipitation

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

WILLIAM HEAD
48° 21′N 123° 32′W 12 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	6.3	8.3	9.4	12.0	15.3	18.2	20.5	20.1	17.1	12.9	9.4	7.5	13.1	8	Température Maximale Quotidienne
Daily Minimum Temperature	1.6	2.9	3.1	4.9	7.2	9.4	11.0	10.9	9.2	6.7	4.4	2.8	6.2	8	Température Minimale Quotidienne
Daily Temperature	**4.0**	**5.6**	**6.3**	**8.5**	**11.3**	**13.8**	**15.8**	**15.6**	**13.2**	**9.8**	**6.9**	**5.2**	**9.7**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	1.5	1.2	1.0	1.0	0.8	1.0	0.8	0.9	0.8	0.6	0.8	1.4	0.4	3	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	14.4	16.7	16.1	21.0	28.9	29.4	28.9	31.1	25.6	20.6	17.2	16.0	31.1		Température Maximale Extrême
Years of Record	20	20	21	21	21	21	19	21	21	20	22	21			Annees de Relèves
Extreme Minimum Temperature	-8.3	-7.5	-3.3	-0.6	1.1	3.9	6.5	5.0	2.2	0.0	-2.8	-13.9	-13.9		Temperature Minimale Extrême
Years of Record	20	20	21	21	21	21	19	21	21	21	21	21			Annees de Relèves
Rainfall	151.9	100.5	71.8	43.9	31.4	19.4	14.8	23.9	44.1	80.2	126.8	157.1	865.8	8	Chutes de Pluie
Snowfall	8.6	1.1	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.2	17.2	8	Chutes de Neige
Total Precipitation	**160.6**	**101.6**	**73.1**	**43.9**	**31.4**	**19.4**	**14.8**	**23.9**	**44.1**	**80.2**	**127.9**	**162.5**	**883.4**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	65.3	49.9	36.2	23.3	24.2	12.4	13.4	19.8	26.1	55.0	59.5	60.8	166.8	3	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	82.3	67.3	47.8	23.9	50.8	19.6	20.8	38.4	38.1	44.5	55.4	66.3	82.3		Chute de Pluie Record en 24 heures
Years of Record	19	20	20	21	21	19	19	21	20	21	22	22			Annees de Relèves
Greatest Snowfall in 24 hours	12.7	7.6	14.2	T	0.0	0.0	0.0	0.0	0.0	0.0	7.6	20.3	20.3		Chute de Neige Record en 24 heures
Years of Record	19	20	20	21	21	20	19	21	21	21	20	20			Annees de Relèves
Greatest Precipitation in 24 hours	82.3	67.3	47.8	23.9	50.8	19.6	20.8	38.4	38.1	44.5	55.4	66.3	82.3		Précipitation Record en 24 heures
Years of Record	19	20	20	21	21	19	19	21	20	21	22	22			Années de Relèves
Days with Rain	18	15	15	11	8	6	4	7	8	13	18	20	143	8	Jours de Pluie
Days with Snow	2	0	0	0	0	0	0	0	0	0	0	1	3	8	Jours de Neige
Days with Precipitation	19	15	15	11	8	6	4	7	8	13	18	20	144	8	Jours de Précipitation

WILLIAMS LAKE A
52° 11′N 122° 4′W 940 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-5.9	0.9	4.5	10.3	15.3	19.4	22.1	21.7	16.6	10.2	1.3	-3.7	9.4	3	Température Maximale Quotidienne
Daily Minimum Temperature	-14.8	-9.2	-6.4	-1.4	2.6	6.6	8.7	8.2	4.0	0.0	-6.4	-11.6	-1.6	3	Température Minimale Quotidienne
Daily Temperature	**-10.4**	**-4.2**	**-1.0**	**4.4**	**9.0**	**13.0**	**15.4**	**15.0**	**10.3**	**5.1**	**-2.6**	**-7.7**	**3.9**	**3**	**Température Quotidienne**
Standard Deviation, Daily Temperature	4.1	3.2	2.2	1.3	1.1	1.8	1.2	1.8	2.0	1.2	2.5	3.9	0.6	3	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	12.8	12.8	17.1	28.8	30.0	32.2	34.4	32.8	30.6	23.8	16.7	11.2	34.4		Température Maximale Extrême
Years of Record	20	20	20	20	20	20	20	20	20	20	20	20			Années de Relèves
Extreme Minimum Temperature	-42.2	-32.4	-31.7	-16.7	-5.6	-2.2	0.0	-1.7	-8.9	-16.7	-28.3	-42.8	-42.8		Température Minimale Extrême
Years of Record	20	20	20	20	20	20	20	20	20	20	20	20			Années de Relèves
Rainfall	3.8	3.2	3.3	12.2	28.3	44.9	48.3	42.6	29.1	23.2	5.1	2.5	246.5	3	Chutes de Pluie
Snowfall	49.6	25.4	21.9	9.7	3.0	0.1	0.0	0.0	1.2	7.5	31.0	49.5	198.9	3	Chutes de Neige
Total Precipitation	**43.9**	**24.0**	**22.5**	**21.5**	**31.6**	**45.1**	**48.3**	**42.6**	**30.2**	**30.3**	**31.5**	**41.3**	**412.8**	**3**	**Précipitations Totales**
Standard Deviation, Total Precipitation	29.9	11.8	13.8	14.2	19.5	29.6	24.8	30.3	18.9	20.1	14.7	15.8	90.6	3	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	15.7	14.2	5.6	20.3	19.0	26.2	34.3	29.7	24.9	37.3	9.9	8.6	37.3		Chute de Pluie Record en 24 heures
Years of Record	20	20	20	20	20	20	20	20	20	19	19	20			Années de Relèves
Greatest Snowfall in 24 hours	42.7	15.0	32.2	17.0	11.7	1.8	0.0	T	7.9	19.1	23.6	23.6	42.7		Chute de Neige Record en 24 heures
Years of Record	20	20	20	20	20	20	20	20	20	19	20	20			Annees de Relèves
Greatest Precipitation in 24 hours	42.7	14.2	32.8	24.9	22.4	26.2	34.3	29.7	27.9	37.3	17.5	17.8	42.7		Précipitation Record en 24 heures
Years of Record	20	20	20	20	20	20	20	20	20	19	20	20			Années de Relèves
Days with Rain	1	1	2	5	9	11	11	10	10	8	3	2	73	8	Jours de Pluie
Days with Snow	14	9	9	4	2	0	0	0	1	3	9	14	65	8	Jours de Neige
Days with Precipitation	14	10	10	8	10	11	11	10	10	10	12	15	131	8	Jours de Précipitation

Knight and Piésold Ltd.
CONSULTING ENGINEERS

APPENDIX B

DISCONTINUITY DATA AND POINT LOAD TEST RESULTS

Association of Consulting Engineers of Canada
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APPENDIX B

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

DISCONTINUITY DATA AND POINT LOAD TEST RESULTS

DRILLHOLE MP89-152 (285/55)

DEPTH from	DEPTH to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	COMP.STRENGTH (MPa)
10	20	DIORITE	60	2.0	3200	36188	250
20	30		82	2.0	3200	36188	250
30	40		83	1.0	3500	39581	273
					2900	32796	226
40	50		68	1.5	3500	39581	273
					2800	31665	218
50	60		95	1.2			
60	70		80	2.0	1000	11309	78
70	80		88	1.0	2000	22618	156
					4000	45235	312
80	90		93	1.5	2900	32796	226
90	100		68	3.0	2000	22618	156
100	110		93	1.0	1000	11309	78
110	120		100	1.2	2200	24879	172
120	130		65	2.7			
130	140		80	1.0	2800	31665	218
140	150		80	1.2	3000	33926	234
150	160		75	1.3	3000	33926	234
160	170		97	1.7	1900	21487	148
170	180		75	1.7	2600	29403	203
180	190		80	High	400	4524	31
190	200		20	High			
200	210		40	High	1800	20356	140
220	230		20	V.High			
220	230	SYENO	40	High	400	4524	31
230	240		60	2.5	1500	16963	117
240	250		35	3.0	1000	11309	78
250	260		18	High			
260	270		35	High	200	2262	16
270	280		25	High	200	2262	16
280	290		10	High	900	10178	70
290	300		7		100	1131	8
300	310		5	High			
310	320		3	High	700	7916	55

APPENDIX B (Continued)

DRILLHOLE MP89-152 (285/55)

from	DEPTH to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	(MPa)
320	330		0	High			
330	340		15	High	700	7916	55
340	350		-	1.5	600	6785	47
					800	9047	62
350	360		85	1.8	1700	19225	133
					2200	24879	172
360	370		99	0.7	1100	12440	86
370	380		95	1.5	2700	30534	211
380	390		95	1.2	2600	29403	203
390	400		80	4.0	1200	13571	94
					2000	22618	156
400	410		80	1.0	2100	23748	164
410	420		80	3.3	1800	20356	140
					2600	29403	203
420	430		65	3.3	1200	13571	94
430	440		70	3.0	700	7916	55
440	450		15	High	1200	13571	94
450	460		83	1.7	1200	13571	94
					1000	11309	78
460	470		94	1.4	1600	18094	125
470	480		90	1.0			
480	490		85	1.1	2800	31665	218
					400	4524	31
490	500		80	2.0			
500	510		65	1.0	700	7916	55
510	520		40	3.0	900	10178	70
520	530		70	1.6	1800	20356	140
530	540		75	0.8			
540	550		85	0.8	700	7916	55
					1200	13571	94
550	560		45	High	900	10178	70
560	570		45	High	600	6785	47
570	580		35	High	400	4524	31
			35	High	600	6785	47
580	590		30	High	2800	31665	218
590	600		15	High	700	7916	55
					1500	16963	117
600	610		92	0.4	2100	23748	164
610	620		98	0.5	1900	21487	148
620	630		73	1.6			

APPENDIX B (Continued)

DRILLHOLE MP89-152 (285/55)

DEPTH from	DEPTH to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	COMP.STRENGTH (MPa)
630	640		92	1.0	2000	22618	156
640	650		92	0.8	800	904	762
650	660		35	1.2	300	3393	23
660	670		98	0.5	200	2262	16
					900	10178	70
670	680	IB	95	0.8	1700	19225	133
					1600	18094	125
680	690		95	0.7	400	4524	31
					1000	11309	78
690	700		87	1.3	3000	33926	234
					2000	22618	156
					1700	1922	133
700	710	DYKE	95	1.2	1200	13571	94
		IB			1000	11309	78
710	720		100	0.6	2800	31665	218
720	730		85	1.1	600	6785	47
730	740		90	1.0	1900	21487	148
740	750		50	1.0	300	3393	23
					100	1131	8
750	760		100	0.4	1300	14701	101
					1200	13571	94
760	770		90	0.6	300	3393	23
					700	7916	55
770	780		40	High	50	565	4
780	790		35	1.5	1900	21487	148
790	800		25	High	1500	16963	117
800	810		-	0.9	3200	36188	250
810	820		92	0.9	1100	12440	86
					3200	36188	250
820	830		87	1.1	2500	28272	195
830	840		80	1.1	900	10178	70
					2100	23748	164
840	850		50	High	600	6785	47
					1600	18094	125
850	860		90	1.1	2300	26010	179
					1500	16963	117
860	870		95	1.1	1100	12440	86
870	880		25	1.2	800	9047	62
880	890		96	0.5	200	2262	16
					500	5654	39

APPENDIX B (Continued)

DRILLHOLE MP89-152 (285/55)

DEPTH from	to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	(MPa)
890	900		94	0.7	300	3393	23
900	910		90	1.7	800	9047	62
910	920		55	3.0	300	3393	23
920	930		45	2.0	200	2262	16
					400	4524	31
930	940		30	High	100	1131	8
940	950		87	1.4	3500	39581	273
950	960		70	2.0	1200	13571	94
960	970		90	1.5	1500	16963	117
970	980		93	1.4	2500	28272	195
					200	2262	16
980	990		85	1.3	1500	16963	117
990	1000			1.5	2300	26010	179

DRILLHOLE MP89-153 (253/50)

DEPTH from	to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	(MPa)
30	40		25	High	1000	11309	78
40	50		15	High			
50	60		35	High	500	5654	39
60	70		70	High	1000	11309	78
70	80	DYKE	35	High	2500	28272	195
		IB			600	6785	47
80	90		15	High	100	1131	8
90	100		35	High	100	1131	8
100	110		18	3.0	800	9047	62
110	120		50	2.2	2300	26010	179
120	130		15	3.0	1700	19225	133
130	140		12	4.0	1200	13571	94
140	150		95	1.1	400	4524	31
150	160		95	0.9	1300	14701	101
160	170		91	1.0	2000	22618	156
170	180		35	2.6	1200	13571	94
180	190		65	2.4	100	1131	8
					300	3393	23
190	200		87	1.3	2700	30534	211
200	210		99	0.8	3600	40712	281
210	220		94	1.2	1800	20356	140
					2500	28272	195
220	230		97	0.7	3800	42973	296
230	240		92	1.1	2900	32796	226

APPENDIX B (Continued)

DRILLHOLE MP89-153 (253/50)

DEPTH from	DEPTH to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	COMP.STRENGTH (MPa)
240	250		100	0.6	2500	28272	195
250	260		80	1.4	1100	12440	86
260	270		100	0.4	1000	11309	78
			100	0.4	1400	15832	109
270	280		100	0.4	3000	33926	234
			100	0.4	1500	16963	117
280	290		80	1.2	2600	29403	203
290	300		96	0.7	1700	19225	133
300	310		89	1.1	1400	15832	109
310	320		96	0.9	2400	27141	187
320	330		50	2.7	1300	14701	101
330	340	DYKE	80	1.2	600	6785	47
		IB			400	4524	31
340	355		83	1.0	2200	24879	172
350	360		98	0.6	1500	16963	117
360	370		100	0.6	1400	15832	109
370	380		80	1.6	1000	11309	78
380	390		100	0.4	1600	18094	125
390	400		98	0.9	2200	24879	172
400	410		100	0.3	2000	22618	156
410	420		100	0.5			
420	430		100	1.0	1300	14701	101
430	440		100	0.5	2000	22618	156
					1200	13571	94
440	450		91	0.4	1900	21487	148
450	460		96	0.6	1800	20356	140
460	470		100	0.5			
470	480		100	0.7	1200	13571	94
480	490		100	0.3	1200	13571	94
490	500		100	0.0	1200	13571	94
					1000	11309	78
					4000	45235	312
500	510		100	0.4	2500	28272	195
510	520		98	0.7	1500	16963	117
520	530		97	0.7	3000	33926	234
530	540		90	0.8	2200	24879	172
540	550		100	0.3	2200	24879	172
550	560		100	0.7	2300	26010	179
560	570		65	1.8	800	9047	62
570	580		50	2.6	300	3393	23

APPENDIX B (Continued)

DRILLHOLE MP89-153 (253/50)

DEPTH from	DEPTH to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	COMP.STRENGTH (MPa)
					700	7916	55
580	590		20	2.0	500	5654	39
					2800	31665	218
590	600		75	1.5	1100	12440	86
600	610		40	3.0	50	565	4
					100	1131	8
610	620		82	1.3	800	9047	62
620	630		97	0.6	1000	11309	78
630	640		95	0.3	2400	27141	187
640	650		80	1.2	2000	22618	156
650	660		100	0.3	2800	31665	218
660	670		100	0.1	500	5654	39
					1000	11309	78
670	680		98	0.4	2700	30534	211
					700	7916	55
680	690		95	1.1	100	1131	8
				1.1	700	7916	55
690	700		96	0.8	1000	11309	78
700	710		89	0.9	2200	24879	172
710	720		92	0.7	900	10178	70
720	730	DYKE	70	1.4	1000	11309	78
730	740		75	0.8	1500	16963	117

DRILLHOLE MP89-154 (245/50)

DEPTH from	DEPTH to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	COMP.STRENGTH (MPa)
10	20	IB	20	2.5	2000	22618	156
					2800	31665	218
20	30		30	2.5	1400	15832	109
30	40		50	1.8	400	4524	31
40	50		30	1.8			
50	60	DYKE	70	1.7	100	1131	8
		IB			300	3393	23
60	70		25	3.0	1100	12440	86
70	80		95	High	400	4524	31
80	90		45	High	400	4524	31
90	100		7	High	1100	12440	86
100	110		45	1.9	600	6785	47
110	120		55	1.9	2600	29403	203
120	130	DYKE	55	2.1	600	6785	47
130	140	IB	30	High	350	3958	27

APPENDIX B (Continued)

DRILLHOLE MP89-154 (245/50)

DEPTH from	DEPTH to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	COMP.STRENGTH (MPa)
140	150		25	3.0	350	3958	27
150	160		55	1.7	150	1696	12
160	170		55	1.0	300	3393	23
170	180		35	High			
180	190		30	High	300	3393	23
190	200		60	High			
200	210	DYKE	12	High	300	3393	23
210	220	IB	3	High	250	2827	19
220	230		3	High	50	565	4
230	240		15	High			
240	250		40	High	1100	12440	86
250	260		30	High			
260	270		45	High			
270	280		14	High			
280	290			High			
290	300	DYKE	18	High	500	5654	39
300	310	IB	5	High			
310	320		18	High	300	3393	23
320	330		45	7.5	700	7916	55
					900	10178	70
330	340		75	1.5	4100	46366	320
340	350		95	1.2	5000	56544	390
350	360		85	1.6			
360	370		94	0.9	3000	33926	234
370	380		91	1.1	2600	29403	203
380	390		40	2.2	3400	38450	265
390	400		97	1.2	4100	46366	320
					3600	40712	281
400	410		93	1.3	3000	33926	234
410	420		93	1.2	1400	15832	109
420	430		92	1.4	3500	39581	273
430	440		83	2.3			
440	450	SYENO	85	1.6	2900	32796	226
450	460		90	1.1	2800	31665	218
460	470		95	0.8			
470	480		87	1.0			
480	490		95	1.1			
490	500		94	1.2			
500	510		96	1.2			
510	520		91	1.0			

APPENDIX B (Continued)

DRILLHOLE MP89-154 (245/50)

DEPTH from	DEPTH to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	COMP.STRENGTH (MPa)
520	530		92	1.4			
530	540		100	0.4			
540	550		98	0.7			
550	560		92	0.9			
560	570	IB	87	1.3	2400	27141	187
570	580		95	1.1	2000	22618	156
580	590	DYKE	82	0.8	3400	38450	265
				25	High		
600	610	SYENO	100	0.1	3600	40712	281
610	620	IB	97	1.2	1400	15832	109
620	630	DYKE	95	0.7	1600	18094	125
630	640	SYENO	90	0.9	900	10178	70
640	650		92	1.3	3700	41843	289
650	660		85	1.4	1600	18094	125
660	670		90	1.3	1700	19225	133
670	680		96	0.7			
680	690		99	1.0	1400	15832	109
690	700		95	1.0	3500	39581	273
700	710	IB	87	1.0	500	5654	39
710	720		80	1.3	100	1131	8
					1500	16963	117
720	730		30	2.0	900	10178	70
730	740		40	2.0	500	5654	39
740	750		30	High	500	5654	39
750	760		20	High	0	0	0
760	770		25	V.High			
770	780		10	V.High	0	0	0
780	790		18	V.High	50	565	4
790	800		15	V.High			
800	810		34	High	50	565	4
810	820		23	High	300	3393	23
					0	0	0
820	830		6	V.High	150	1696	12
830	840		40	High			
840	850	IB	68	1.4	600	6785	47
850	860		53	1.4	1300	14701	101
860	870		50	1.2			
870	880		85	1.1	150	1696	12
880	890		70	1.3	800	9047	62
890	900		100	1.0	300	3393	23

APPENDIX B (Continued)

DRILLHOLE MP89-154 (245/50)

DEPTH from	to	ROCK TYPE	R.Q.D.	FRACTURE INDEX (jt/ft)	GAUGE (psi)	COMP.STRENGTH (psi)	(MPa)
900	910		100	0.4	800	9047	62
910	920		97	0.7	400	4524	31
920	930		65	1.0	1200	13571	94
930	940		100	0.6	800	9047	62
940	950		89	0.8	500	5654	39
950	960		98	0.7	1400	15832	109
960	970		90	1.4	200	2262	16
970	980		18	1.5	400	4524	31
980	990		70	1.2	2000	22618	156
990	1000		93	1.6	300	3393	23
1000	1010		15	High	100	1131	8
1010	1020		15	High			
1020	1030		85	1.5	1100	12440	86
1030	1040		85	1.5	1500	16963	117

Knight and Piésold Ltd.
CONSULTING ENGINEERS

APPENDIX C

WASTE ROCK ACID GENERATION POTENTIAL TESTWORK

(i) ENVIROCHEM SERVICES LIMITED

- acid base accounting (30 samples)

(ii) COASTECH RESEARCH INC.

- acid base accounting (64 samples)

- humidity cell testwork (composite of 7 samples)

Revised: May 7, 1990

Association of Consulting Engineers of Canada
Association des Ingénieurs-Conseils du Canada

APPENDIX C

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

WASTE ROCK ACID GENERATION SAMPLES - NORTH-WEST GEOCHEM

Hole No.	Depth Interval (ft)	Description
MP88-31	6-100	Syenodiorite
MP88-39A	4-76, 93-103, 149-169	
	203-215, 241-275	Syenodiorite
MP88-39B	79-93, 123-149, 171-203	Intrusion Breccia
MP88-39C	103-123, 215-241	Monzonite Porphyry
MP88-42	14-300	Monzonite Porphyry
MP88-69	10-400	Syenodiorite
MP88-76	20-400	Syenodiorite/Plagioclase Porphyry (w/.dissem. Py)
MP88-80	30-400	Syenodiorite
MP89-100	20-30, 53-86, 110-185	
	205-235, 293-325, 419-469	Intrusion Breccia
MP89-107	10-583	Syenodiorite
MP89-110	10-300	Monzonite Porphyry
MP89-113	529-600	Breccia (Py)
MP89-115	38-300	Mix: Syeno/Int.Br/ Aug.Por/Monz.Por (Py)
MP89-116	44-260	Syenodiorite (Py)
MP89-117	10-400	Syenodiorite
MP89-118	10-398	Diorite
MP89-123	10-190	Syenodiorite
MP89-128A	10-170	Syenodiorite
MP89-128B	250-450	Monzonite Porphyry
MP89-128C	450-600	Intrusion Breccia
MP89-133	6-400	Alt. Diorite
MP89-134A	10-384	Intrusion Breccia (Py)
MP89-134B	384-500	Syenodiorite
MP89-135	10-505	Alt. Diorite
MP89-136	10-600	Monz. Por/Int. Breccia (Py)
MP89-139A	60-165	Syenodiorite
MP89-139B	165-280	Intrusion Breccia
MP89-141A	20-322	Monz. Porphyry
MP89-141B	322-364	Diorite (w/ 2-3% Py)
MP89-142	119-199, 262-488	Intrusion Breccia (minor py)

APPENDIX C

IMPERIAL METAL CORPORATION
MT. POLLEY PROJECT

ACID BASE ACCOUNTING ON WASTE ROCK - PART I

Sample ID	pH	Paste Sulphur (%)	Total Carbon (%)	Total Acid Pot.	NP 1	NP 2	NNP 1	NNP 2
MP89-31	8.63	0.01	0.04	0.3	20.1	3.3	19.8	3.0
MP89-39A	8.93	0.01	0.07	0.3	19.6	5.8	19.3	5.5
MP89-39B	9.09	0.01	0.04	0.3	11.5	3.3	11.2	3.0
MP89-39C	9.11	0.01	0.24	0.3	25.5	20.0	25.2	19.7
MP89-42	7.62	0.01	0.07	0.03	16.9	5.8	16.6	5.5
MP89-69	8.56	0.01	0.10	0.3	19.9	8.3	19.6	8.0
MP89-86	8.25	0.05	0.25	17.2	24.9	20.8	29.8	19.2
MP89-80	8.19	0.05	0.25	1.6	31.4	20.8	29.8	19.2
MP89-100	8.14	0.64	0.31	20.0	33.4	25.8	13.4	5.8
MP89-107	8.44	0.00	0.23	0.3	27.4	19.2	27.1	18.9
MP89-110	8.22	0.01	0.14	0.3	22.4	11.7	22.1	11.4
MP89-113	8.15	0.17	0.56	5.3	48.8	46.6	43.5	41.3
MP89-115	8.34	0.66	0.47	20.6	46.3	39.2	25.7	18.6
MP89-116	8.64	0.07	0.23	2.2	28.9	19.2	26.7	17.0
MP89-117	8.71	0.01	0.13	0.3	23.4	10.8	23.1	10.5
MP89-118	8.33	0.01	0.17	0.3	27.1	14.2	26.8	13.9
MP89-123	8.70	0.1	0.08	0.3	15.3	6.7	15.0	6.4
MP89-128A	8.30	0.7	0.17	2.2	23.6	14.2	21.4	12.0
MP89-128B	8.79	0.05	0.19	1.6	21.8	15.8	20.2	14.2
MP89-128C	9.02	0.11	0.26	3.4	30.6	21.7	27.2	18.3
MP89-133	8.61	0.01	0.13	0.3	22.0	10.8	21.7	10.5
MP89-134A	8.14	2.93	0.47	91.6	36.6	39.2	-55.0	-52.4
MP89-134B	8.05	1.53	0.39	47.8	34.6	32.5	-13.2	-15.3
MP89-135	8.35	0.02	0.28	0.6	34.1	23.3	33.5	22.7
MP89-136	8.19	1.00	0.42	31.3	38.6	35.0	7.3	3.7
MP89-139A	8.51	0.06	0.80	1.9	65.5	66.6	63.6	64.7
MP89-139B	8.59	0.13	0.64	4.1	50.3	53.3	46.2	49.2
MP89-141A	8.43	0.16	0.64	5.0	59.2	53.3	54.2	48.3
MP89-141B	7.75	0.32	0.27	10.0	34.2	22.5	24.2	12.5
MP89-142	8.22	0.23	0.24	7.2	33.7	20.0	26.5	12.8

NP 1: Neutralization potential based on laboratory titration
NP 2: Neutralization potential calculated from Total Carbon
NNP 1: Net neutralization potential using laboratory titration results (NP1)
NNP 2: Net neutralization potential using calculated neutralization potential (NP2)

Acid potential, neutralization potential and net neutralization potential reported as tonnes $CaCO_3$ equivalent/1000 tonnes.

APPENDIX C

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

ACID BASE ACCOUNTING ON WASTE ROCK - PART II

Sample 10	Paste pH	Total Sulphur (%)	Sulphide (%)	Acid Potential	NP1	NNP1
MP88-68A	8.7	0.20	0.15	4.7	38.7	34.0
MP88-68B	8.8	0.16	0.11	3.4	31.6	28.2
MP88-68C	9.1	0.14	0.09	2.9	20.0	17.1
MP88-68D	9.1	0.08	0.03	0.8	27.4	26.6
MP89-102A	8.8	0.04	0.00	0.0	10.1	10.1
MP89-102B	8.8	0.05	0.02	0.6	16.8	16.3
MP89-102C	8.8	0.05	0.01	0.3	25.1	24.7
MP89-102D	8.8	0.13	0.10	3.0	27.8	24.7
MP89-102E	9.0	0.21	0.16	4.9	25.2	20.3
MP89-102F	8.9	0.16	0.12	3.6	45.6	42.0
MP89-103A	8.9	0.01	0.00	0.0	17.2	17.2
MP89-103B	8.9	0.00	0.00	0.0	22.5	22.5
MP89-103C	8.9	0.00	0.00	0.0	24.8	24.8
MP89-103D	8.8	0.05	0.02	0.5	25.3	24.9
MP89-103E	9.0	0.04	0.00	0.1	15.0	14.9
MP89-103F	8.7	0.34	0.30	9.3	23.1	13.9
MP89-105A	9.2	0.08	0.05	1.6	19.4	17.8
MP89-105B	9.0	0.03	0.00	0.1	29.4	29.3
MP89-105C	9.1	0.06	0.00	0.0	22.3	22.3
MP89-105D	9.1	0.03	0.00	0.0	20.0	20.0
MP89-105E	9.2	0.08	0.05	1.5	29.2	27.7
MP89-105F	9.3	0.09	0.04	1.3	42.7	41.3

NP1: Neutralization potential based on laboratory titration
NNP1: Net neutralization potential using laboratory titration results (NP1)

Acid potential, neutralization potential and net neutralization potential reported as tonnes $CaCO_3$ equivalent/1000 tonnes.

APPENDIX C

ACID BASE ACCOUNTING ON WASTE ROCK - PART II

Sample ID	Depth Interval	Paste pH	Total Sulphur (%)	Sulphide (%)	Acid Potential	NP	NNP
MP88-68	10-100	8.7	0.20	0.15	4.7	38.7	34.0
MP88-68	100-200	8.8	0.16	0.11	3.4	31.6	28.2
MP88-68	200-300	9.1	0.14	0.09	2.9	20.0	17.1
MP88-68	300-390	9.1	0.08	0.03	0.8	27.4	26.6
MP89-102	10-100	8.8	0.04	0.00	0.0	10.1	10.1
MP89-102	100-200	8.8	0.05	0.02	0.6	16.8	16.3
MP89-102	200-300	8.8	0.05	0.01	0.3	25.1	24.7
MP89-102	300-400	8.8	0.13	0.10	3.0	27.8	24.7
MP89-102	400-500	9.0	0.21	0.16	4.9	25.2	20.3
MP89-102	500-600	8.9	0.16	0.12	3.6	45.6	42.0
MP89-103	10-100	8.9	0.01	0.00	0.0	17.2	17.2
MP89-103	100-200	8.9	0.00	0.00	0.0	22.5	22.5
MP89-103	200-300	8.9	0.00	0.00	0.0	24.8	24.8
MP89-103	300-400	8.8	0.05	0.02	0.5	25.3	24.9
MP89-103	400-500	9.0	0.04	0.00	0.1	15.0	14.9
MP89-103	500-596	8.7	0.34	0.30	9.3	23.1	13.9
MP89-105	10-100	9.2	0.08	0.05	1.6	19.4	17.8
MP89-105	100-200	9.0	0.03	0.00	0.1	29.4	29.3
MP89-105	200-300	9.1	0.06	0.00	0.0	22.3	22.3
MP89-105	300-400	9.1	0.03	0.00	0.0	20.0	20.0
MP89-105	400-500	9.2	0.08	0.05	1.5	29.2	27.7
MP89-105	500-600	9.3	0.09	0.04	1.3	42.7	41.3

Sample ID	Depth Interval	Paste pH	Total Sulphur (%)	Sulphide (%)	Acid Potential	NP	NNP
MP89-106	15-100	8.9	0.06	0.04	1.2	24.3	23.1
MP89-106	100-200	8.8	0.2	0.00	0.1	16.4	16.3
MP89-106	200-300	8.9	0.4	0.2	0.6	23.6	22.9
MP89-106	300-400	8.9	0.07	0.06	1.7	24.2	22.4
MP89-106	400-500	9.3	0.03	0.02	0.7	44.2	43.5
MP89-106	500-600	9.3	0.05	0.02	0.5	8.8	8.3
MP89-108	10-100	8.2	0.01	0.00	0.0	11.0	11.0
MP89-108	100-200	8.7	0.04	0.01	0.4	16.5	16.1
MP89-108	200-300	8.7	0.02	0.01	0.3	33.2	32.9
MP89-108	300-400	8.7	0.04	0.02	0.7	23.5	22.8
MP89-108	400-500	9.0	0.04	0.00	0.0	21.5	21.5
MP89-108	500-600	9.1	0.13	0.05	1.7	37.5	35.8
MP89-121	10-100	8.7	0.07	0.05	1.4	9.4	8.0
MP89-121	100-200	9.1	0.12	0.11	3.3	15.1	11.8
MP89-121	200-300	9.3	0.14	0.11	3.4	15.5	12.1
MP89-121	300-400	9.2	0.06	0.05	1.6	20.1	18.5
MP89-121	400-500	9.3	0.13	0.12	3.7	15.8	12.1
MP89-121	500-600	9.6	0.11	0.10	3.3	19.1	15.9
MP89-122	30-100	8.0	0.04	0.01	0.3	40.4	40.1
MP89-122	100-200	8.5	0.42	0.38	11.9	38.0	26.1
MP89-122	200-300	8.7	0.21	0.19	5.9	41.9	36.0
MP89-122	300-400	8.7	0.16	0.09	2.8	46.0	43.2
MP89-122	400-500	8.8	0.12	0.09	2.8	48.4	45.6
MP89-124	10-100	9.2	0.02	0.01	0.3	29.2	28.9
MP89-124	100-200	9.3	0.02	0.00	0.0	42.7	42.7
MP89-124	200-300	8.7	0.10	0.07	2.1	9.4	7.4
MP89-124	300-400	9.1	0.18	0.15	4.6	15.1	10.6
MP89-124	400-500	8.2	0.06	0.03	0.9	16.0	15.2

Sample ID	Depth Interval	Paste pH	Total Sulphur (%)	Sulphide (%)	Acid Potential	NP	NNP
MP89-126	10-100	8.5	0.30	0.25	7.8	25.5	17.7
MP89-126	100-200	8.6	0.31	0.27	8.6	22.5	13.9
MP89-126	200-300	8.2	0.26	0.21	6.7	52.4	45.7
MP89-126	300-400	8.4	0.17	0.14	4.4	28.0	23.6
MP89-126	400-500	8.6	0.14	0.10	3.1	15.8	12.7
MP89-126	500-600	8.2	0.05	0.03	0.9	74.5	73.6
MP89-140	10-100	8.9	0.06	0.04	1.3	26.9	25.6
MP89-140	100-200	8.8	0.14	0.11	3.3	41.3	38.0
MP89-150	10-100	8.8	0.06	0.02	0.6	19.6	19.0
MP89-150	100-200	8.7	0.06	0.04	1.4	29.4	28.0
MP89-150	200-300	8.8	0.84	0.82	25.5	84.2	58.6
MP89-150	300-400	8.8	0.67	0.64	19.9	29.1	9.2
MP89-150	400-500	8.9	0.34	0.33	10.4	26.3	15.9
MP89-150	500-600	8.8	0.47	0.46	14.3	25.9	11.5

Note:

A negative net neutralization potential indicates that a sample might become the source of acidic drainage upon weathering.

NP: Neutralization potential based on laboratory titration
NNP: Net neutralization potential using laboratory titration results

Acid potential, neutralization potential and net neutralization potential reported as tonnes $CaCO_3$ equivalent/1000 tonnes.

NORTHWEST
GEOCHEM

#204 - 26 Bastion Square, Victoria, B.C. V8W 1H9 • (604) 393-8375 Fax: (604) 383-9354

Acid-Base Accounting
Imperial Metals - Mt. Polley Project
August 29, 1989

Sample ID	Paste pH	Total Sulphur	Total Carbon	Acid Pot.	NP 1	NP 2	NNP 1	NNP 2
MP-89- 31	8.63	0.01%	0.04%	0.3	20.1	3.3	19.8	3.0
MP-89-39A	8.93	0.01%	0.07%	0.3	19.6	5.8	19.3	5.5
MP-89-39B	9.09	0.01%	0.04%	0.3	11.5	3.3	11.2	3.0
MP-89-39C	9.11	0.01%	0.24%	0.3	25.5	20.0	25.2	19.7
MP-89- 42	7.62	0.01%	0.07%	0.3	16.9	5.8	16.6	5.5
MP-89- 69	8.56	0.01%	0.10%	0.3	19.9	8.3	19.6	8.0
MP-89- 86	8.25	0.55%	0.25%	17.2	24.9	20.8	7.7	3.6
MP-89- 80	8.19	0.05%	0.25%	1.6	31.4	20.8	29.8	19.2
MP-89-100	8.14	0.64%	0.31%	20.0	33.4	25.8	13.4	5.8
MP-89-107	8.44	0.00%	0.23%	0.3	27.4	19.2	27.1	18.9
MP-89-110	8.22	0.01%	0.14%	0.3	22.4	11.7	22.1	11.4
MP-89-113	8.15	0.17%	0.56%	5.3	48.8	46.6	43.5	41.3
MP-89-115	8.34	0.66%	0.47%	20.6	46.3	39.2	25.7	18.6
MP-89-116	8.64	0.07%	0.23%	2.2	28.9	19.2	26.7	17.0
MP-89-117	8.71	0.01%	0.13%	0.3	23.4	10.8	23.1	10.5
MP-89-118	8.33	0.01%	0.17%	0.3	27.1	14.2	26.8	13.9
MP-89-123	8.70	0.01%	0.08%	0.3	15.3	6.7	15.0	6.4
MP-89-128A	8.39	0.07%	0.17%	2.2	23.6	14.2	21.4	12.0
MP-89-128B	8.79	0.05%	0.19%	1.6	21.8	15.8	20.2	14.2
MP-89-128C	9.02	0.11%	0.26%	3.4	30.6	21.7	27.2	18.3
MP-89-133	8.61	0.01%	0.13%	0.3	22.0	10.8	21.7	10.5
MP-89-134A	8.14	2.93%	0.47%	91.6	36.6	39.2	-55.0	-52.4
MP-89-134B	8.05	1.53%	0.39%	47.8	34.6	32.5	-13.2	-15.3
MP-89-135	8.35	0.02%	0.28%	0.6	34.1	23.3	33.5	22.7
MP-89-136	8.19	1.00%	0.42%	31.3	38.6	35.0	7.3	3.7
MP-89-139A	8.51	0.06%	0.80%	1.9	65.5	66.6	63.6	64.7
MP-89-139B	8.59	0.13%	0.64%	4.1	50.3	53.3	46.2	49.2
MP-89-141A	8.43	0.16%	0.64%	5.0	59.2	53.3	54.2	48.3
MP-89-141B	7.75	0.32%	0.27%	10.0	34.2	22.5	24.2	12.5
MP-89-142	8.22	0.23%	0.24%	7.2	33.7	20.0	26.5	12.8

NP 1 : Neutralization potential based on laboratory titration
NP 2 : Neutralization potential calculated from Total Carbon

NNP 1 : Net neutralization potential using laboratory titration results (NP1)

NNP 2 : Net neutralization potential using calculated neutralization potential (NP2)

Acid potential, neutralization potential and net neutralization potential reported as tonnes $CaCO_3$ equivalent /1000 tonnes.

Dennis Kramer

NORTHWEST
GEOCHEM

#204 - 26 Bastion Square, Victoria, B.C. V8W 1H9 • (604) 393-8375 Fax: (604) 383-9354

Procedures used for acid-base accounting:

- Rock samples were ground to -100 mesh (%98).
- Total sulfur and carbon determined by use of Leco furnace
- Neutralization potential based on adding excess hydrochloric acid, boiling, and titrating excess acid with sodium hydroxide to an endpoint of pH 7.

Data interpretation

It has been suggested by Sobek et al (1978) that acid generation is indicated only if the net neutralization potential (NNP) is < -5 kg $CaCO_3$/t.

Only two samples from the Mt. Polley project are within this range for acid generation: MP-89-134A and MP-89-134B.

Paste pH determinations do not indicate presence of current oxidation.

Dennis Kramer

IMPERIAL METALS CORPORATION
EXPLORATORY METALLURGICAL TESTING

REPORT NO. 5

Project No. 92105

Prepared for

IMPERIAL METALS CORPORATION
800 - 601 West Hastings Street
Vancouver, BC V6B 5A6

Attention: Mr. Rad Pesalj

Distribution: Imperial Metals (2)
Wright Engineers Ltd.(M. Allan)

30 November, 1989

IMPERIAL METALS CORPORATION
EXPLORATORY METALLURGICAL TESTING

REPORT NO. 5

Project No. 92105

Prepared by

Coastech Research Inc.
80 Niobe Street
North Vancouver, BC V7J 2C9

Prepared by:

Tony Chong, B.Sc. (Eng.) ARSM
Project Engineer

Reviewed and Approved by:

P. Bradley Marchant, M.A.Sc.
President

Richard W. Lawrence, Ph.D.
Vice-President, Technical

APPENDIX 4
Acid base account test results

C O A S T E C H   R E S E A R C H
A C I D   B A S E   A C C O U N T   R E P O R T

To: R. Pesalj, Imperial Metals — Date: October 30, 1989
Project: Mt. Polley
Project No. 2105

SAMPLE	SULPHUR (%)	SULPHIDE (%)	PASTE pH	ACID POTENTIAL (kg CaCO3/t)	NEUT. POTENTIAL (kg CaCO3/t)	NET NEUT. POTENTIAL (kg CaCO3/t)
68-10-100	0.20	0.15	8.7	4.7	38.7	34.0
68-100-200	0.16	0.11	8.8	3.4	31.6	28.2
68-200-300	0.14	0.09	9.1	2.9	20.0	17.1
68-300-400	0.08	0.03	9.1	0.8	27.4	26.6
102-10-100	0.04	0.00	8.8	0.0	10.1	10.1
102-100-200	0.05	0.02	8.8	0.6	16.8	16.3
102-200-300	0.05	0.01	8.8	0.3	25.1	24.7
102-300-400	0.13	0.10	8.8	3.0	27.8	24.7
102-400-500	0.21	0.16	9.0	4.9	25.2	20.3
102-500-600	0.16	0.12	8.9	3.6	45.6	42.0
103-10-100	0.01	0.00	8.9	0.0	17.2	17.2
103-100-200	0.00	0.00	8.9	0.0	22.5	22.5
103-200-300	0.00	0.00	8.9	0.0	24.8	24.8
103-300-400	0.05	0.02	8.8	0.5	25.3	24.9
103-400-500	0.04	0.00	9.0	0.1	15.0	14.9
103-500-596	0.34	0.30	8.7	9.3	23.1	13.9
105-10-100	0.08	0.05	9.2	1.6	19.4	17.8
105-100-200	0.03	0.00	9.0	0.1	29.4	29.3
105-200-300	0.06	0.00	9.1	0.0	22.3	22.3
105-300-400	0.03	0.00	9.1	0.0	20.0	20.0
105-400-500	0.08	0.05	9.2	1.5	29.2	27.7
105-500-600	0.09	0.04	9.3	1.3	42.7	41.3

Note: A negative Net Neutralization Potential indicates that a sample might become the source of acidic drainage upon weathering.

COASTECH RESEARCH INC.

COASTECH RESEARCH
ACID BASE ACCOUNT REPORT

To: R. Pesalj, Imperial Metals
Project: Mt. Polley
Project No. 2105

Date: October 30, 1989

SAMPLE	SULPHUR (%)	SULPHIDE (%)	PASTE pH	ACID POTENTIAL (kg CaCO3/t)	NEUT. POTENTIAL (kg CaCO3/t)	NET NEUT. POTENTIAL (kg CaCO3/t)
124-10-100	0.02	0.01	9.2	0.3	29.2	28.9
124-100-200	0.02	0.00	9.3	0.0	42.7	42.7
124-200-300	0.10	0.07	8.7	2.1	9.4	7.4
124-300-400	0.18	0.15	9.1	4.6	15.1	10.6
124-400-500	0.06	0.03	8.2	0.9	16.0	15.2
126-10-100	0.30	0.25	8.5	7.8	25.5	17.7
126-100-200	0.31	0.27	8.6	8.6	22.5	13.9
126-200-300	0.26	0.21	8.2	6.7	52.4	45.7
126-300-400	0.17	0.14	8.4	4.4	28.0	23.6
126-400-500	0.14	0.10	8.6	3.1	15.8	12.7
126-500-600	0.05	0.03	8.2	0.9	74.5	73.6
140-10-100	0.06	0.04	8.9	1.3	26.9	25.6
140-100-200	0.14	0.11	8.8	3.3	41.3	38.0
150-10-100	0.06	0.02	8.8	0.6	19.6	19.0
150-100-200	0.06	0.04	8.7	1.4	29.4	28.0
150-200-300	0.84	0.82	8.8	25.5	84.2	58.6
150-300-400	0.67	0.64	8.8	19.9	29.1	9.2
150-400-500	0.34	0.33	8.9	10.4	26.3	15.9
150-500-600	0.47	0.46	8.8	14.3	25.9	11.5

Note: A negative Net Neutralization Potential indicates that a sample might become the source of acidic drainage upon weathering.

COASTECH RESEARCH INC.

HUMIDITY CELL TEST

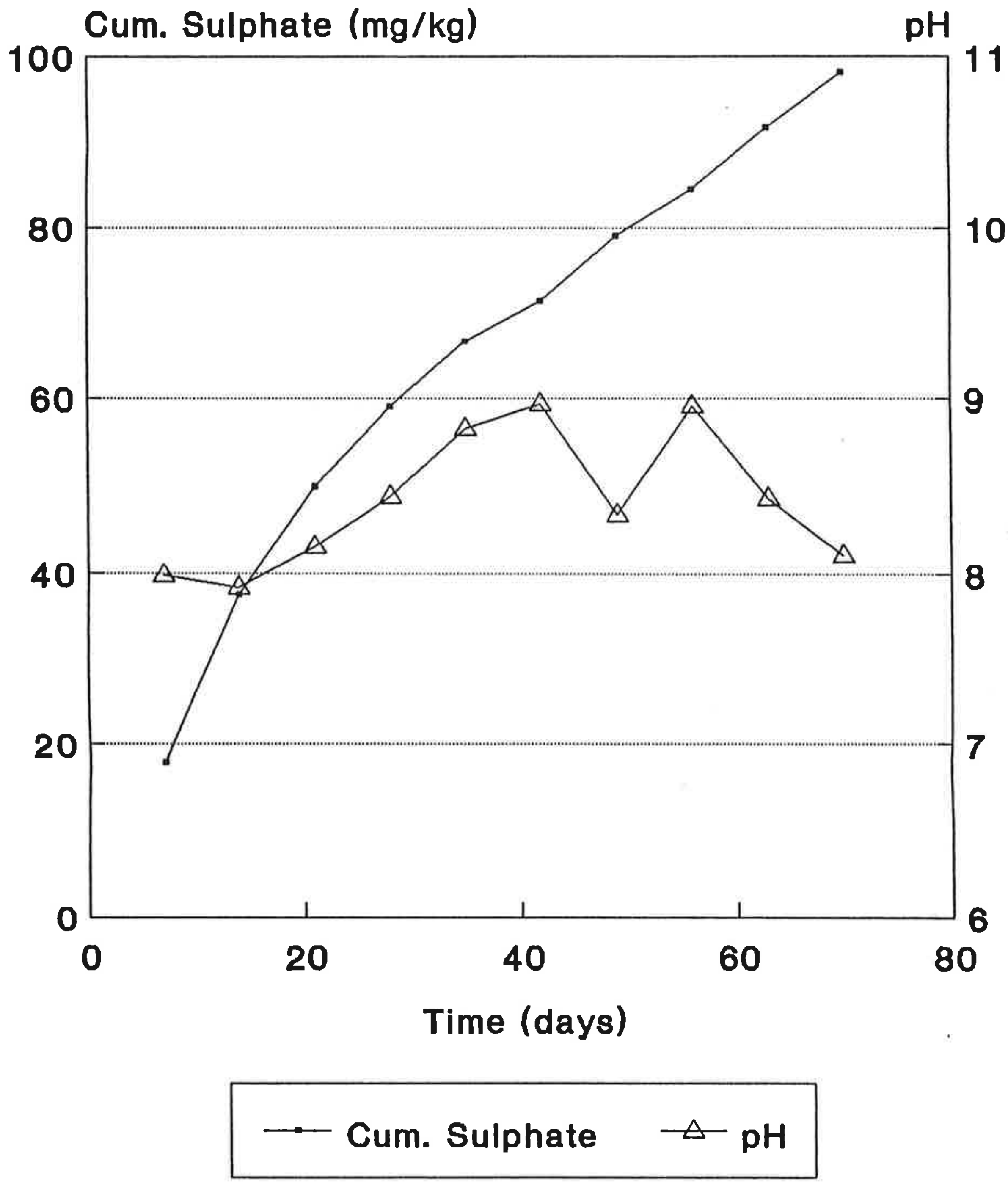
IMPERIAL METALS - Mt. Polley Sample 2105-CMP89

CYCLE	DAYS	pH	CONDUCTIVITY (mS/cm3)	ALKALINITY (mg/L CaCO3)	ACIDITY (pH 4.5) --(mg/L CaCO3)--	ACIDITY (pH 8.3) --(mg/L CaCO3)--	CUM. ACIDITY (pH 8.3) (mg CaCO3/kg)	SULPHATE (mg/L)	CUMULATIVE SULPHATE (mg/kg)
1	7	7.99	181	20.7	0.0	0.9	0.4	40	17.8
2	14	7.92	192	20.2	0.0	0.7	0.7	45	37.6
3	21	8.16	135	23.9	0.0	0.4	0.9	25	49.9
4	28	8.44	132	48.8	0.0	0.0	0.9	20	59.1
5	35	8.83	110	23.5	0.0	0.0	0.9	15	66.6
6	42	8.97	103	22.5	0.0	0.0	0.9	10	71.3
7	49	8.34	102	24.6	0.0	0.0	0.9	15	79.1
8	56	8.96	98	26.5	0.0	0.0	0.9	10	84.5
9	63	8.43	104	27.5	0.0	0.0	0.9	13	91.9
10	70	8.11	102	26.0	0.0	0.5	1.2	11	98.2

HUMIDITY CELL TEST
LEACHATE ANALYSIS
Sample 2105 - CMP 89

CYCLE	WATER EXTRACT ICP ANALYSIS (mg/L)																			
	Ag 0.01	Al 0.5	As 0.05	Ba 0.1	Bi 0.05	Ca 0.5	Cd 0.01	Co 0.02	Cr 0.02	Cu 0.01	Fe 0.2	K 5	Mg 0.05	Mn 0.01	Mo 0.01	Na 1	Ni 0.01	Pb 0.05	Sb 0.05	Zn 0.01
1	< 0.01	< 0.5	0.05	0.1	< 0.05	18.5	< 0.01	< 0.02	< 0.02	< 0.01	< 0.2	< 5	3.20	0.01	0.01	6	< 0.01	< 0.05	< 0.05	< 0.01
2	< 0.01	< 0.5	< 0.05	0.1	< 0.05	20.0	< 0.01	0.02	< 0.02	< 0.01	< 0.2	< 5	3.65	0.01	0.01	6	< 0.01	< 0.05	< 0.05	< 0.01
3	< 0.01	< 0.5	< 0.05	< 0.1	< 0.05	14.5	< 0.01	< 0.02	< 0.02	< 0.01	< 0.2	< 5	2.80	< 0.01	< 0.01	5	< 0.01	< 0.05	< 0.05	< 0.01
4	< 0.01	< 0.5	0.05	0.1	< 0.05	15.0	< 0.01	< 0.02	< 0.02	0.01	< 0.2	< 5	2.60	0.01	0.04	4	< 0.01	< 0.05	< 0.05	0.02
5	< 0.01	0.5	< 0.05	< 0.1	0.05	13.0	< 0.01	< 0.02	< 0.02	< 0.01	< 0.2	< 5	2.20	< 0.01	0.02	4	< 0.01	< 0.05	< 0.05	< 0.01
6	< 0.01	< 0.5	< 0.05	< 0.1	< 0.05	10.0	< 0.01	< 0.02	< 0.02	< 0.01	< 0.2	< 5	1.80	< 0.01	< 0.01	3	< 0.01	< 0.05	< 0.05	< 0.01
7	< 0.01	< 0.5	< 0.05	< 0.1	< 0.05	9.5	< 0.01	< 0.02	< 0.02	< 0.01	< 0.2	< 5	1.70	< 0.01	< 0.01	2	< 0.01	< 0.05	< 0.05	< 0.01
8	< 0.01	< 0.5	< 0.05	< 0.1	< 0.05	9.0	< 0.01	< 0.02	< 0.02	< 0.01	< 0.2	< 5	1.35	< 0.01	0.01	2	< 0.01	< 0.05	< 0.05	< 0.01
9	< 0.01	< 0.5	< 0.05	< 0.1	< 0.05	11.5	< 0.01	< 0.02	< 0.02	< 0.01	< 0.2	< 5	1.85	0.02	< 0.01	2	< 0.01	< 0.05	< 0.05	< 0.01
10	< 0.01	< 0.5	< 0.05	< 0.1	< 0.05	10.4	< 0.01	< 0.02	< 0.02	< 0.01	< 0.2	< 5	2.00	0.01	0.04	2	< 0.01	< 0.05	< 0.05	0.03

HUMIDITY CELL TEST
SAMPLE CMP89



THE PREDICTION OF
THE ACID GENERATING POTENTIAL
OF MINE WASTE MATERIALS

CURRENT TEST PROCEDURES

COASTECH RESEARCH INC

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1989

THE PREDICTION OF THE ACID GENERATING POTENTIAL OF MINE WASTE MATERIALS

INTRODUCTION

The disposal of mining and mineral processing wastes can have a significant environmental impact. Acidity and associated heavy metal contamination in run-off and seepage water from waste rock and tailings containing the sulphide minerals pyrite and/or pyrrhotite is a common and costly problem to mining operations throughout the world, often requiring costly remediation measures.

For new mines and new developments in existing operations, it is necessary to characterize tailings and waste rock materials prior to production to predict if AMD will be generated. Accurate prediction would reduce environmental damage and costs to the industry by allowing the implementation of sound waste management practices to both prevent acid generation and to maximize containment and effective treatment if AMD cannot be avoided. Regulatory agencies are now requiring verification that waste materials have been characterized and that AMD control measures will be implemented before permits are issued. Since AMD predictive procedures and their interpretation are by no means definitive, Coastech is involved with the development of procedures and special equipment for more reliable prediction. In this endeavour, discussions and consultation with AMD specialists from research, environmental consultants, industry, and the regulatory authorities is ongoing. The results of recent Coastech work and a discussion on prediction methods can be found in the proceedings of the Symposium on Tailings and Effluent Management held in Halifax, Nova Scotia, August 1989[1].

Predictive techniques include static tests which examine the balance between the acid producing and acid consuming components in a waste material, and kinetic tests which attempt to predict drainage quality over time. The data obtained is useful in characterizing waste materials for waste management planning, and can be used to support permitting applications. At the present time, we use a modified version of the widely used EPA acid-base account method as our standard static test, although we are familiar with and experienced in other methods if these are requested.

---

[1]Lawrence, R.W. et al (1989). Assessment of predictive methods for the determination of AMD potential in mine tailings and waste rock. Proc. Intl. Symp. on Tailings and Effluent Management, Halifax, August, Pergamon Press, New York, 317-31.

Kinetic tests are usually only carried out if static testing indicates that a sample is potentially a source of AMD. However, we recommend that kinetic tests are also performed for samples which are marginal net acid consumers. Currently we are recommending that kinetic tests such as humidity cells are used as they provide a reasonable simulation of the weathering process and appear to provide an accurate prediction of the field behaviour of tailing and waste rock. On a larger scale, column leach or lysimeter tests can be carried out. We can also perform biological shake flask oxidation tests to confirm the AMD potential predicted by static procedures. This type of procedure has been widely accepted in Canada for a number of years. However, the method does not address the weathering and oxidation characteristics in the approximate pH range of 7 down to 2, nor does it provide kinetic and leachate quality data.

TEST PROCEDURES

Determination of Neutralization Potential (Acid-Base Account)

Acid-base accounting procedures based on those recommended by the U.S. Environmental Protection Agency are currently the methods of choice at Coastech[2]. The method examines the balance between acid producing components (primarily pyrite, FeS_2) and acid consuming components (carbonates and other rock types capable of neutralizing strong acids). One week is required to obtain all test and assay data

The first part of the procedure involves the determination of the paste pH of the sample and an preliminary indication of the quantity of acid consuming constituents of the sample. Excess hydrochloric acid is then added to a known weight of the sample. Once the reaction between the acid and acid consuming constituents of the sample are complete, the amount of acid consumed is determined by titrating the residual acid with alkali. This allows calculation of the neutralization capacity of the sample which can be balanced against the theoretical acid producing potential derived from sulphur assays, to give the net neutralization potential.

---

[2] Sobek, A.A. et al (1978). Field and laboratory methods applicable to overburdens and minesoils. EPA 600/2-78-054, 203pp.

The EPA methods have been modified to reduce a perceived bias towards the alkaline side by carrying out the acid digestion at ambient temperature for 24 hours. Titration of the residual acid is carried out to pH 8.3 and also to pH 3.5 and pH 2.0 to allow better interpretation of kinetic oxidation tests. In addition, sulphide-sulphur analyses are used to calculate the acid potential to avoid error in assessment by neglecting the presence of sulphates such as gypsum.

Humidity Cell Tests

The humidity cell test is a kinetic test which aims to model the processes of geochemical weathering of a mining waste material. A special apparatus is used to provide simple control over air, temperature and moisture, while allowing for the removal of oxidation products which are collected and monitored. Humidity cells have been developed at Coastech to promote more rapid oxidation of sulphides contained in the waste sample. The cells allow the good aeration up through or across the sample bed of tailing or waste rock during sequential dry and moist aeration cycles, and thorough solution contact during the leach cycle.

The test procedure comprises subjecting a bed of the sample in a humidity cell to alternating cycles of dry air (3 days), moist air (3 days), and leaching (1 day). The leachates can then analyzed for a number of parameters typically including pH, redox (mV), acidity, alkalinity, sulphate, conductivity, and dissolved metals by ICP. The test generally is generally specified to run for 10 weeks although it is our experience that a longer time period is required to establish the weathering characteristics of many samples.

Lysimeter and Column Leach Tests

Lysimeters and leach columns are used to provide weathering data for waste rock and tailings on a larger scale and are often used to confirm leaching characteristics or to evaluate AMD control methods (blending, covers) on a larger scale following initial characterization in humidity cells or other kinetic test procedure. Column leach tests are usually conducted in PVC columns of 10 cm diameter x 150 cm high or larger and involves the addition of water at a specified rate to the top of the sample contained in the column. Effluent emerging from the bottom of the column is collected for the analysis of parameters such as listed for humidity cell testing. Lysimeters are columns or rectangular boxes, generally of larger surface area and shallower depth than leach columns, and are sometimes more suitable for the testing of larger quantities of material while evaluating the effect of covers, simulated water tables and other variables during weathering cycles. For larger lysimeters, the evaluation of changes in mineralogy of the sample with depth and the determination of effluent quality profiles is possible.

Shake Flask Biological Oxidation Test

The shake flask biological oxidation test determines if acid produced due to biological oxidation is sufficient to overcome the acid consuming components of the sample. The test utilizes naturally occurring sulphide-oxidizing bacteria which have the capability of breaking down minerals such as pyrite. These bacteria are maintained as stock cultures in conditions of high activity in the Coastech laboratory and facilitate the rapid assessment of the acid generating potential of a waste material. Usually four weeks is required to complete this test.

The oxidation tests are carried out using procedures based on many years of extensive experience in biological mineral oxidation systems. This ensures optimum test performance through proper selection of test conditions, availability of a selection of bacterial cultures for different waste types, and experienced interpretation of results.

The oxidation test involves the addition of sulphide-oxidizing bacteria to a slurry of the waste material at an acidic pH chosen to promote the rapid development of sulphide oxidation. The progress of oxidation is monitored by measuring pH changes which occur as pyrite is oxidized. The test is continued until oxidative activity is complete. At this time more waste sample, equal to the original weight, is added. If the pH remains within the range suitable for biological oxidation, the acid produced from the pyritic component was more than the alkaline components could consume and the sample is classified as a potential source of AMD. If, however, the acid produced is consumed so that the final pH rises to be outside the range considered to be the limit for biochemical oxidation, the sample is classified as a non-acid producer.

The test is similar to the B.C. Research Confirmation Test but has several procedural differences which have been introduced to overcome some perceived shortcomings in technique and to aid in the interpretation of the results and in the predictive assessment.

Other Weathering Tests

Other AMD prediction tests which provide a simulation of the long term weathering characteristics of mine waste materials have been shown to be effective and, for certain types of waste and modes of deposition, might be more useful than the humidity cell test. Such methods include soxhlet extraction tests and shake flask tests (non-biological). These and other tests can be carried out at Coastech to meet specific requirements.

DISCUSSION

Static and kinetic procedures can provide a good prediction of the field behaviour of many of the tailing and waste rock samples. However, static test procedures alone are not likely to provide a definitive assessment of whether a particular sample is going to produce AMD. It is more likely that a combination of static and kinetic tests will provide a more confident assessment but even then, for some samples, prediction might be uncertain. The prediction of long term weathering characteristics of a tailing or waste rock will always have some uncertainty factor if the prediction test is carried out on a convenient time scale in the laboratory. Longer term testwork can be carried out for larger waste rock sizes using column leach tests or other larger scale apparatus. Such tests can include the evaluation of various waste management scenarios such as waste rock blending and the use of till covers to minimize AMD formation and impact.

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COPY

YOUR REFERENCE
OUR REFERENCE 1621.03
NUMBER 0/0013

January 5, 1990

Mr. Tony Chong
Coastech Research Inc.
80 Niobe Street
North Vancouver, B.C.
V7J 2C9

Dear Tony,

Re: Imperial Metals Corporation
Mount Polley Project
Humidity Cell Testwork

Please conduct a humidity cell test on a composite sample of the enclosed drill core. The enclosed samples are representative of waste rock from the proposed North Pit area and are labelled as follows:

MP89-133
MP89-134A
MP89-134B
MP89-135
MP89-136
MP89-139A
MP89-139B

The test methods should be as per your standard procedures.

Please bill Imperial Metals Corp. directly for this work. Send the test results to Mr. Rad Pesalj along with a copy to us. Please feel free to contact us if you have any questions.

Yours very truly,

KNIGHT AND PIESOLD LTD.

J.P. Haile, P. Eng.
Director

KJB/wj
Encl.

copy: Mr. Rad Pesalj
Mr. Tom Griffing

APPENDIX D

LABORATORY TESTWORK ON TAILINGS

IMPERIAL METALS CORPORATION
MT. POLLEY PROJECT

APPENDIX D
LABORATORY TESTWORK ON TAILINGS

SECTION 1.0 - GENERAL

A series of laboratory tests were carried out on tailings samples obtained from Coastech Research Inc. The performance of the tailings slurry was evaluated at different solids contents and using different deposition techniques.

The following tests were carried out:

- Particle size distribution by sieve and hydrometer
- Solids specific gravity
- Particle diameter versus settling velocity
- Undrained settling tests
- Drained settling tests
- Permeability tests on drained and settled tailings
- Air drying of tailings to determine the densities achievable and the reduction in saturation levels.

SECTION 2.0 - TAILINGS SOLIDS CHARACTERISTICS

The specific gravity of the tailings solids was measured to be 2.78. The particle size distribution was determined using sieve and hydrometer analyses. The tailings gradation is shown on Figure D1. The tailings material is a non plastic, yellow-grey, fine grained material with 6 percent clay, 64 percent silt and 30 percent fine sand.

SECTION 3.0 - TAILINGS DEPOSITION AND WATER RECOVERY CHARACTERISTICS

Drained and undrained settling tests were carried out on three slurries at 25 percent solids, 35 percent solids and 45 percent solids.

The undrained settling tests indicate the water recovery and settled densities of tailings deposited underwater while the drained settling tests indicate the increase in density and water recovery resulting from drainage. The results of the tests are given on Figures D2 and D3 and in Tables D1 and D2.

The tailings solids settled rapidly and a pronounced segregation was observed. The sandy materials settled first and were overlain by progressively finer fractions of silt. The supernatant water remained quite cloudy as the fine colloidal clay fraction remained in suspension.

Additional slurry samples were allowed to settle and surface water was decanted. When settling was complete the water losses and sample volume changes due to evaporation were recorded. This was continued until the tailings reached the maximum density achievable by air drying.

The dry densities achieved by undrained settling, drained settling and by air drying of the tailings are shown on Figure D4 and summarized as follows:

Initial Solids Content	25%	35%	45%
Dry Density			
Undrained Settling	0.84 t/m^3	0.89 t/m^3	0.96 t/m^3
Drained Settling	1.12 t/m^3	1.10 t/m^3	1.19 t/m^3
Air Drying	1.44 t/m^3	1.49 t/m^3	1.33 t/m^3

On the basis of the above tests and for an initial solids content of 35 percent, it is predicted that the tailings will settle on deposition to a dry density of 0.9 t/m^3 yielding 1.18 m^3 of supernatant per tonne of deposited tailings. The tailings could then be expected to drain and consolidate to 1.1 t/m^3. Continued consolidation, air drying and freeze-thaw consolidation will further increase the tailings density thereby reducing the tailings storage requirements. On-going monitoring will determine the actual densities achieved by the tailings. This will allow accurate planning of the construction of future stages of the tailings facility.

SECTION 4.0 - TAILINGS PERMEABILITY

Falling head permeability tests were carried out on the settled and drained tailings slurry after completion of the settling tests. The results are summarized as follows:

Initial solids content (%)	25	35	45
Drained density (t/m^3)	1.12	1.10	1.19
Permeability (cm/s)	1.4×10^{-5}	2.0×10^{-5}	2.4×10^{-5}

SECTION 5.0 - PARTICLE SETTLING VELOCITY ANALYSIS

Particle settling velocities are used in conjunction with particle specific gravity, solids content, flow data, etc. to determine friction losses in slurry pipelines. Settling velocity as a function of particle diameter is plotted on Figure D5.

TABLE D1

MT. POLLEY
TAILINGS STORAGE FACILITY

RESULTS OF UNDRAINED SETTLING TESTS ON TAILINGS

Solids content of initial slurry (%)	25	35	45
Pulp density of initial slurry (t/m^3)	1.19	1.26	1.37
Water to supernatant (% of total water)	72.9	63.6	49.8
Void ratio of settled slurry	2.33	2.12	1.90
Bulk density of settled slurry	1.54	1.57	1.62
Dry density of settled slurry (t/m^3)	0.84	0.89	0.96

TABLE D2

MT. POLLEY
TAILINGS STORAGE FACILITY

RESULTS OF DRAINED SETTLING TESTS ON TAILINGS

Solids content of initial slurry (%)	25	35	45
Pulp density of initial slurry (t/m^3)	1.19	1.26	1.37
Water to supernatant (% of total water)	72.9	63.6	49.8
Additional water recovered with underdrainage (% of total water)	9.1	8.4	12.2
Total water recovered (% of total water)	82	72	62
Void ratio of drained slurry	1.48	1.53	1.34
Bulk density of settled slurry (t/m^3)	1.46	1.70	1.76
Dry density of settled slurry (t/m^3)	1.12	1.10	1.19

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UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT No. 1621
SAMPLE No.
DATE

PROJECT : MT. POLLEY TAILINGS GRADATION

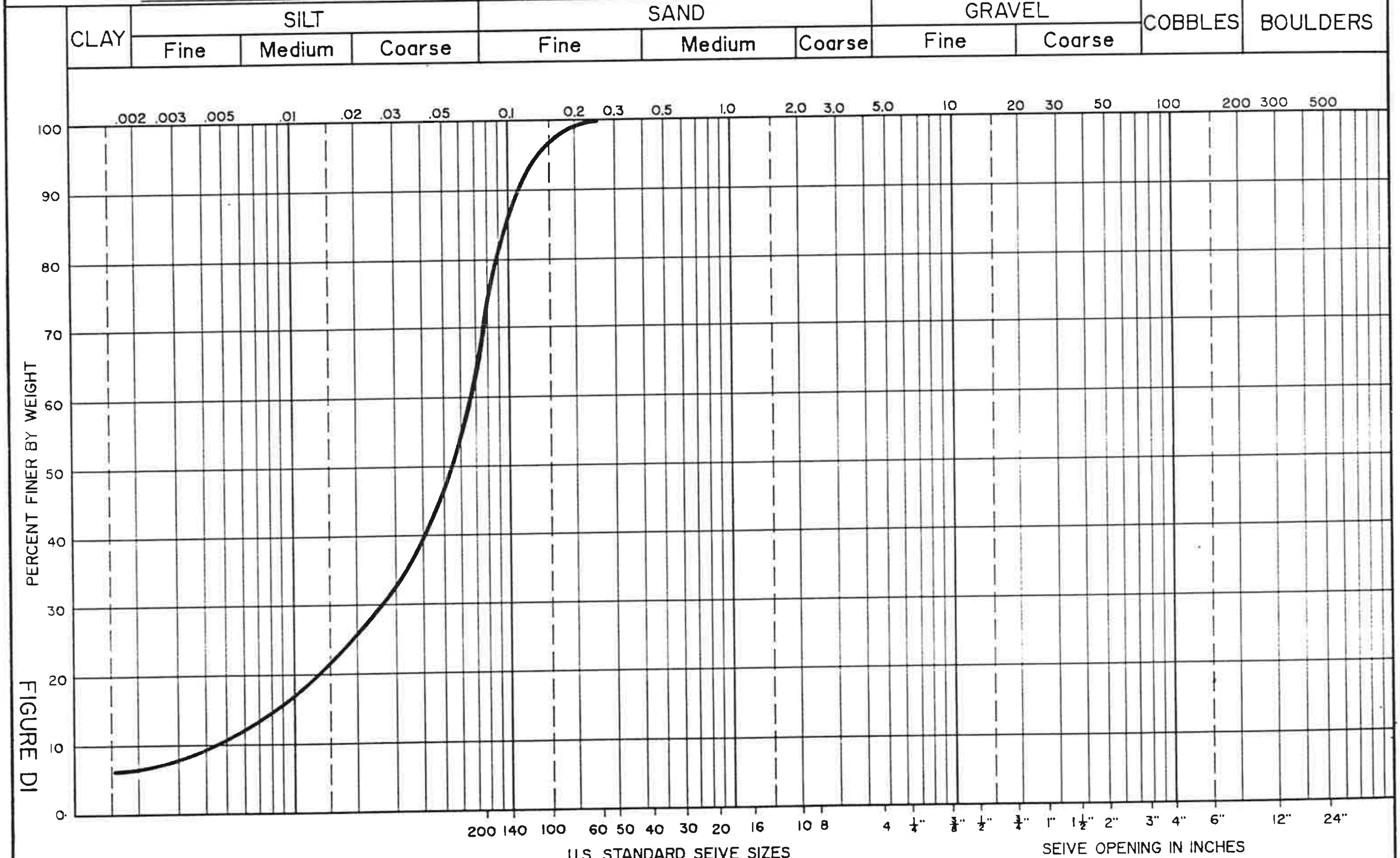

FIGURE DI

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

TESTWORK ON TAILINGS

UNDRAINED SETTLING TESTS ON TAILINGS

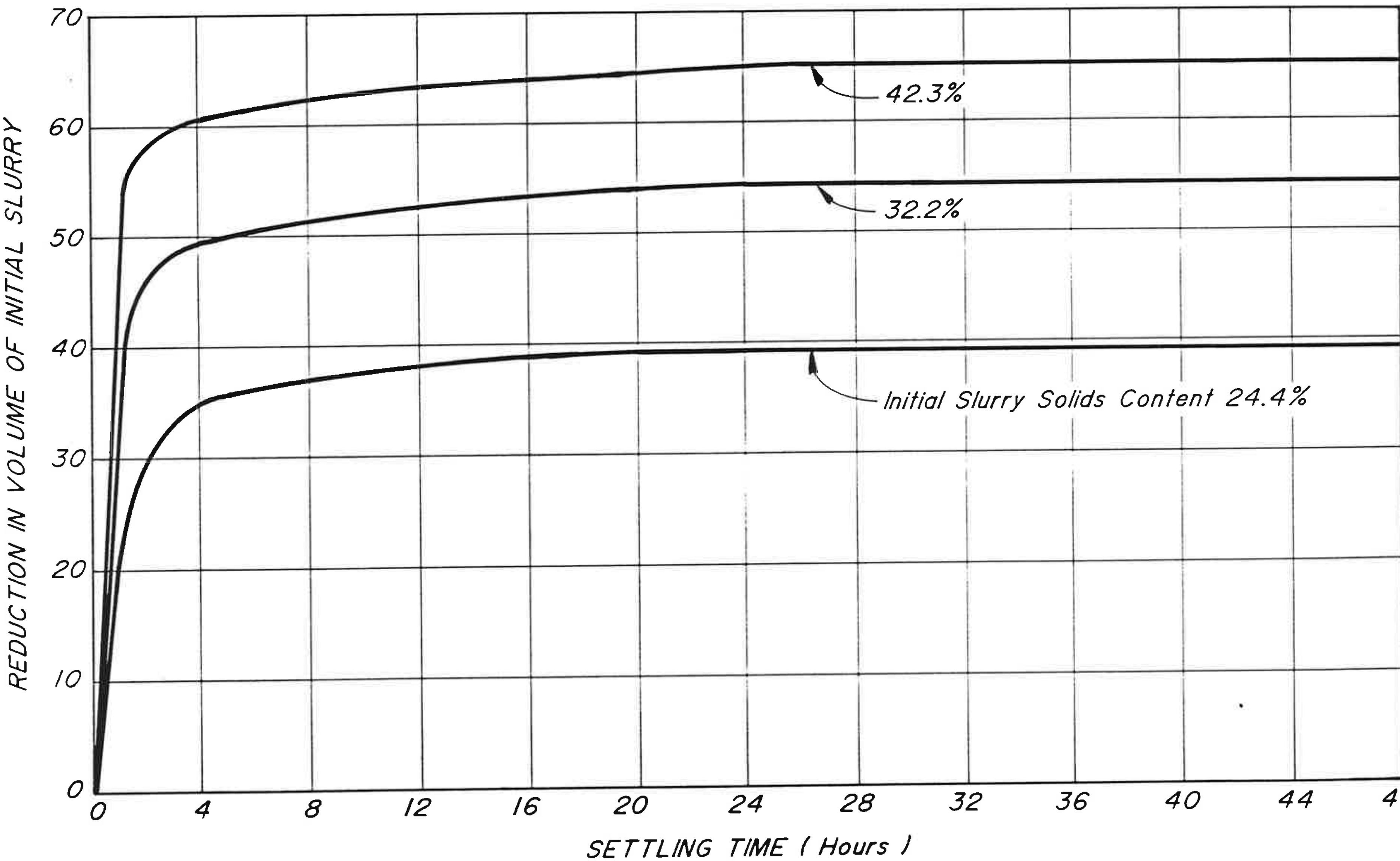

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FIGURE D2

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

TESTWORK ON TAILINGS

DRAINED SETTLING TESTS ON TAILINGS

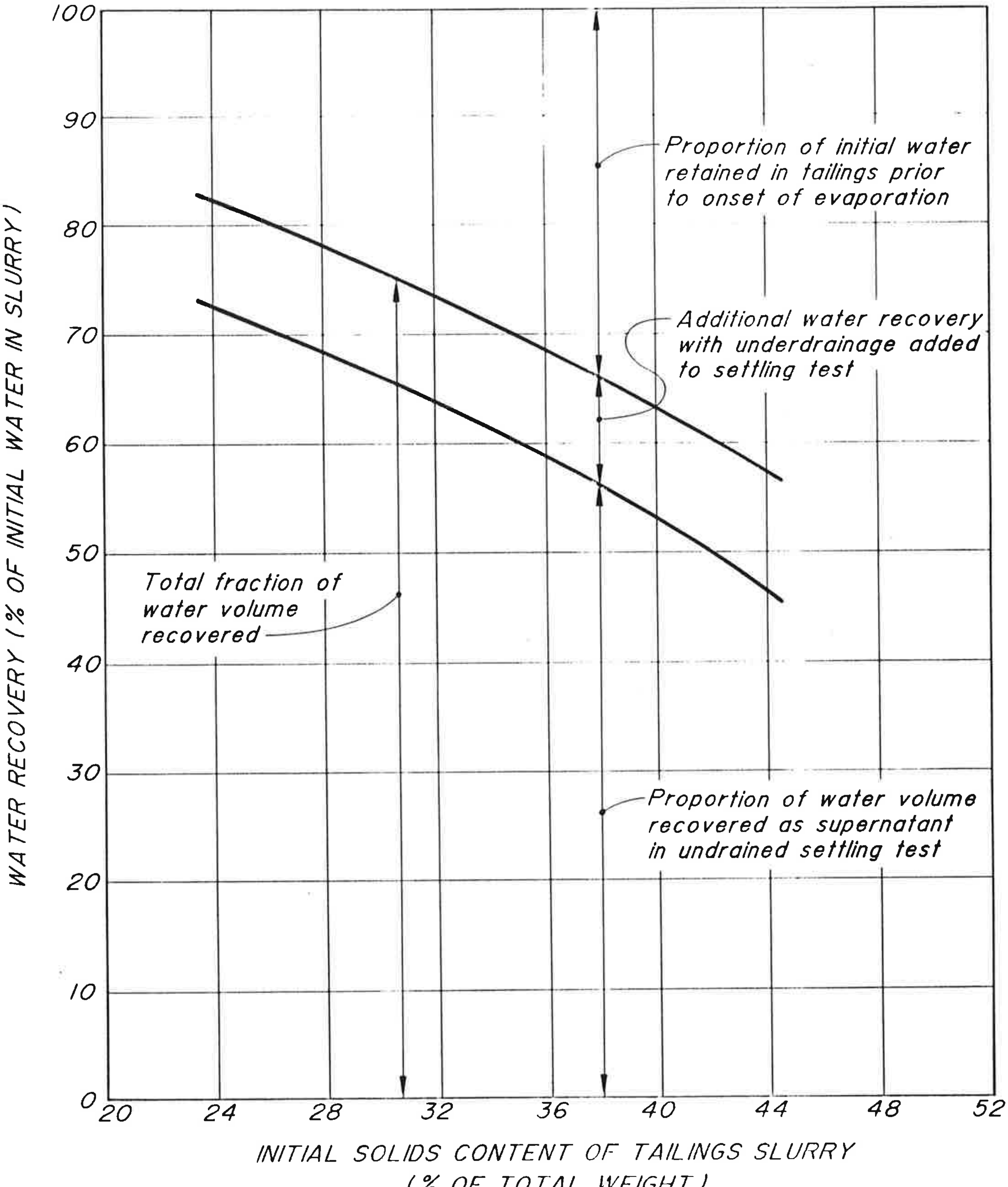

FIGURE D3

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IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

RELATIONSHIP BETWEEN DENSITIES ACHIEVED AND SOLIDS CONTENT OF INITIAL TAILINGS SLURRY

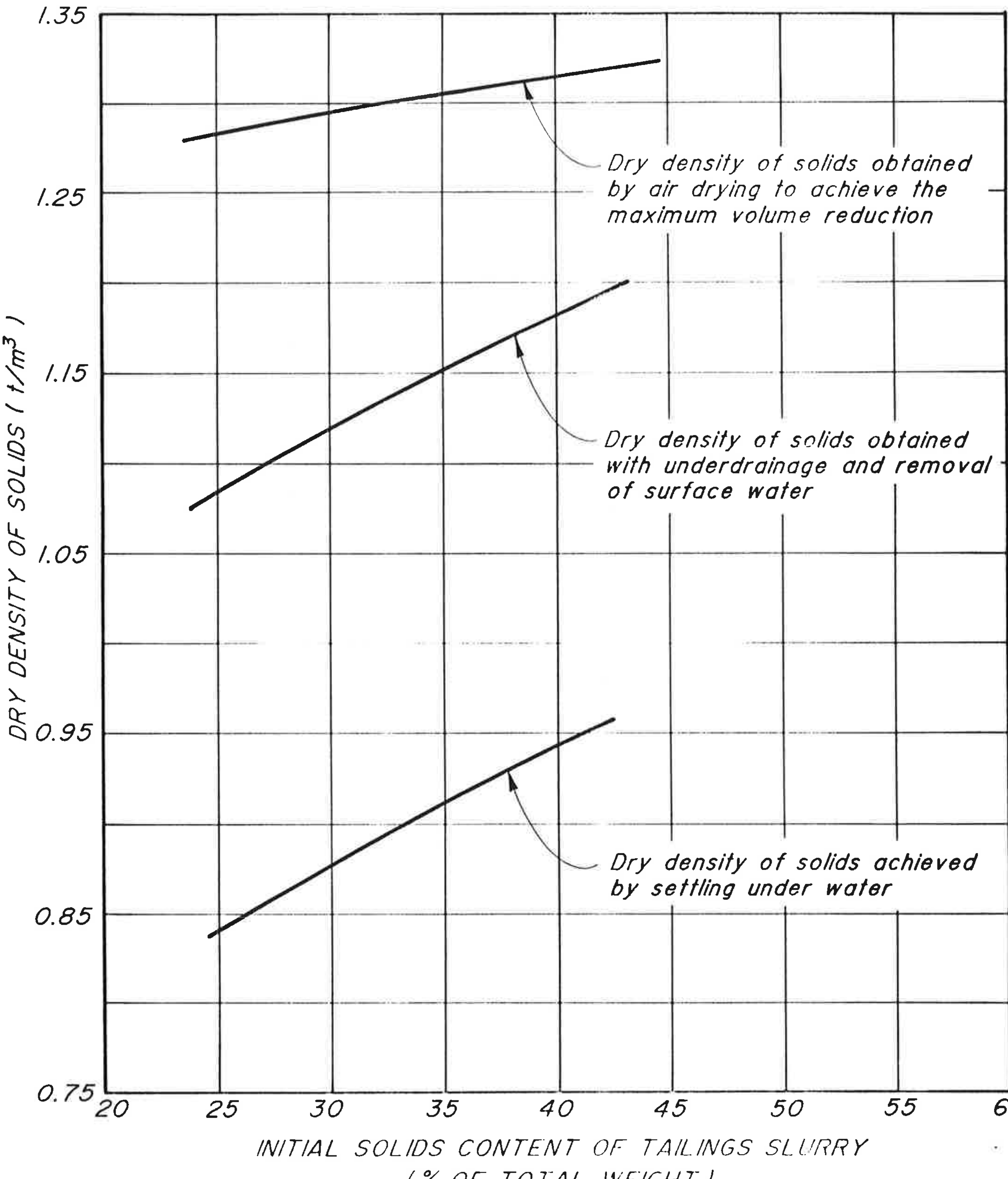

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FIGURE D4

IMPERIAL METALS CORPORATION

MT. POLLEY PROJECT

TESTWORK ON TAILINGS

SETTLING VELOCITY ANALYSIS

% PASSING	PARTICLE DIAMETER (mm)	WATER TEMP (C)	Gs WATER	Gs SOIL	ABSOLUTE VISCOSITY (Poise)	KINEMATIC VISCOSITY (Stoke)	SETTLING VELOCITY (cm/sec)
59.3	0.0685	22.0	0.9978	2.78	0.00955	0.00957	0.4758
47.9	0.0513	22.0	0.9978	2.78	0.00955	0.00957	0.2668
39.0	0.0378	22.0	0.9978	2.78	0.00955	0.00957	0.1449
30.9	0.0276	22.0	0.9978	2.78	0.00955	0.00957	0.0772
25.2	0.0200	22.0	0.9978	2.78	0.00955	0.00957	0.0406
21.9	0.0148	22.0	0.9978	2.78	0.00955	0.00957	0.0222
17.4	0.0106	22.0	0.9978	2.78	0.00955	0.00957	0.0114
13.8	0.0076	22.0	0.9978	2.78	0.00955	0.00957	0.0059
11.0	0.0054	22.5	0.9977	2.78	0.00944	0.00946	0.0030
9.2	0.0039	23.0	0.9976	2.78	0.00933	0.00935	0.0016
8.2	0.0032	24.0	0.9973	2.78	0.00911	0.00914	0.0011
6.2	0.0016	24.0	0.9973	2.78	0.00911	0.00914	0.0003

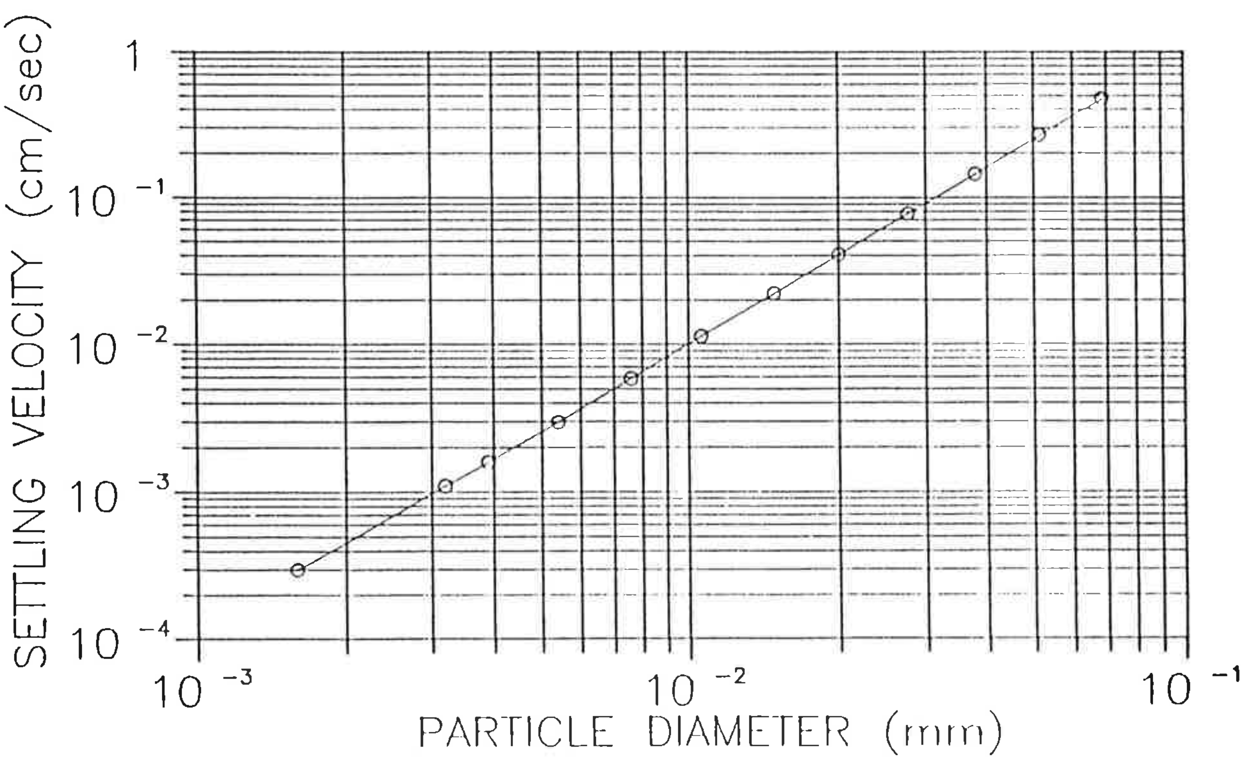

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FIGURE D5.

APPENDIX E

GEOCHEMICAL TESTS ON TAILINGS

IMPERIAL METALS CORPORATION
EXPLORATORY METALLURGICAL TESTING

ADDENDUM TO
REPORT NO. 4

Project No. 92105

Prepared for

IMPERIAL METALS CORPORATION
800 - 601 W Hastings Street
Vancouver, BC V6B 5A6

Attention: Mr. Rad Pesalj

Distribution: Imperial Metals (2)
Kilborn (B. Fukahara) (1)

21 November, 1989

SUMMARY

Acid base accounting, humidity cell weathering tests and special waste tests have been conducted on the tailings from the Phase V locked cycle tests. In addition, a 10 foot column settling test at natural pH was performed. The principal findings and conclusions are as follows:

(a) acid base account test shows the tailings to be net acid consumer with a NET NP value of 24.7 kg $CaCO_3$ (equiv) per tonne of tailings.

(b) the results from both the acetic and carbonic acid tests indicate that the tailings from the locked cycle tests did not exceed the B.C. Waste Management Branch regulations for special wastes.

(c) humidity cell testing demonstrated that the tailings exhibit very low reactivity, with very low sulphate, acidity and conductivity values, and the pH remained stable at above 7.0. The ICP data showed no significant leachability of any metals.

(d) the ultimate solids density was reached after a period of 14 days at natural pH and was calculated at 69.7% (w/w). The decant solution remained turbid at the end of the test. Previous testing indicated that pH adjustment (6.0) with acid is required to clarify the tailings decant solution.

1.0 TERMS OF REFERENCE

This is an addendum to Coastech Report No.4, Project No. 92105, September 6, 1989. This report presents the results and conclusions of the acid base account, humidity cell test, special waste tests and a 10 foot column settling test. These tests were performed on the tailings from the locked cycle tests in the Phase V testwork.

2.0 METHODS AND PROCEDURES

2.1 Acid Base Account Test

A description of the test procedure is provided in Appendix 1. In summary, excess hydrochloric acid was added to a 2.0g sample and the pulp was agitated for 24 hours at ambient temperature. Titration of the residual acid with 0.1N NaOH was then carried out to pH 8.3 to determine the neutralization potential of the tailings. The head sample was submitted for sulphide-sulphur analysis to determine the acid potential.

2.2 Humidity Cell Test

A bed of tailings from the locked cycle tests (approximately 1.0 kg) was subjected to alternating cycles of dry air (3 days), moist air (3 days), and leaching (1 day). The leachates were then analyzed for a number of parameters typically including pH, redox (mV), acidity, alkalinity, sulphate, conductivity, and dissolved metals by ICP. The test was run for 10 weeks. A description of the test procedure is presented in Appendix 1.

2.3 Special Waste Test

2.3.1 Acetic Acid

The test was conducted in according to the procedure published by the B.C. Ministry of the Environment, entitled "B.C. Special Waste List".

The tailings from the locked cycle test (approximately 35% solids) was dewatered by vacuum filtration. The filtrate, referred to as "pore water", was retained for subsequent analysis. 100 g of the filtered cake was then mixed with 1600 mL of distilled water and the pH was maintained at 5.0 for a period of 24 hours with dilute acetic acid. The pulp was agitated throughout the test.

TABLES

IMPERIAL METALS CORPORATION
MOUNT POLLEY PROJECT
PHASE V TESTWORK

TABLE 1
ACID-BASE ACCOUNT

SAMPLE	SULPHUR (%)	PASTE pH	ACID POTENTIAL (kg $CaCO_3$/t)	NEUT. POTENTIAL (kg $CaCO_3$/t)	NET NEUT. POTENTIAL (kg $CaCO_3$/t)
Locked Cycle Tailings	0.02	8.22	0.6	24.6	24.0

NOTE: A negative Net Neutralization Potential (Net NP) indicates that the sample is a potential source of acid mine drainage.

IMPERIAL METALS CORPORATION
MOUNT POLLEY PROJECT
PHASE V TESTWORK

Table 2

Special Waste Test (acetic acid)

Sample : Locked Cycle Tailings

Element	Concentration as ug/Litre in Pore Water	Concentration as ug/Litre in Extract	Concentration as ug/gram in dewatered sample	B.C. Waste Management Branch Regulations (as ug/g of dewatered sample)
Antimony	3.0	36.0	0.73	10
Arsenic	10.6	190.0	3.82	10
Bismuth	< 4.0	< 4.0	< 0.09	-
Cadmium	< 1.0	2.0	< 0.04	1
Chromium	< 2.0	< 2.0	< 0.04	10
Cobalt	< 2.0	8.0	< 0.16	-
Copper	6.0	1360.0	27.21	30
Lead	8.0	16.0	0.34	10
Mercury	< 2.0	1.0	< 0.02	1
Nickel	< 2.0	46.0	< 0.92	10
Zinc	10.0	56.0	1.14	500

< = less than

Test conditions:

Paste pH =9.3

Volume of 0.5N acetic acid required to maintain @pH 5.0 = 58.0 ml.

Volume of water + acetic acid added : 2.0 Litre

Weight of solids : 100.0 g

IMPERIAL METALS CORPORATION
MOUNT POLLEY PROJECT
PHASE V TESTWORK

Table 3

"MODIFIED TEST FOR SHAKE EXTRACTION OF SOLID WASTE WITH WATER" ASTM d3987

Sample : Locked Cycle Tailings

Element	Concentration as ug/Litre in Pore Water	Concentration as ug/Litre in Extract	Concentration as ug/gram in dewatered sample	B.C. Waste Management Branch Regulations (as ug/g of dewatered sample)
Antimony	36	16	0.13	10
Arsenic	363	97.3	1.06	10
Bismuth	< 1	< 1	< 0.01	-
Cadmium	< 1	< 1	< 0.01	1
Chromium	< 10	< 10	< 0.06	10
Cobalt	< 2	< 2	< 0.01	-
Copper	2	6	0.03	30
Lead	2	< 2	< 0.01	10
Mercury	<0.1	< 0.1	< 0.00	1
Nickel	< 2	< 2	< 0.01	10
Zinc	4	8	0.04	500

< less than

Test data:

Paste pH : 9.2

Weight of solid : 117.0 g

Volume of dilution water added: 0.45 L

Volume of extract : 0.43 L

IMPERIAL METALS - MT. POLLEY

Table 4 : HUMIDITY CELL TEST - LOCKED CYCLE TAILINGS

CYCLE	DAYS	pH	REDOX (mV SCE)	CONDUCTIVITY (mS/cm3	ALKALINITY (mg/L CaCO3)	ACIDITY (pH 4.5) --(mg/L CaCO3)--	ACIDITY (pH 8.3)	CUM. ACIDITY (pH 8.3) (mg CaCO3/100g)	SULPHATE (mg/L)	CUMULATIVE SULPHATE (mg/100g)
1	7	7.64	211	641	40.4	0.0	2.9	0.1	248	6.1
2	14	7.57	288	438	88.9	0.0	9.6	0.5	124	12.2
3	21	7.65	110	597	157.6	0.0	3.8	0.7	43	14.3
4	28	7.81	232	197	46.5	0.0	4.3	0.9	47	15.7
5	35	8.31	228	185	53.4	0.0	0.0	0.9	50	17.3
6	42	8.33	226	265	57.8	0.0	0.0	0.9	24	18.0
7	49	8.27	201	165	62.7	0.0	0.0	0.9	12	18.4
8	56	8.00	220	87	56.2	0.0	0.0	0.9	12	19.0
9	63	7.85	261	96	33.1	0.0	1.2	0.9	13	19.6
10	70	7.52	215	96	76.0	0.0	0.0	0.9	14	20.2

IMPERIAL METAL - MT. POLLEY

Table 5 : HUMIDITY CELL TESTING - LOCKED CYCLE TAILINGS

LEACHATE ANALYSIS

CYCLE	WATER EXTRACT ICP ANALYSIS (mg/L)															
	Al 0.20 *	Sb 0.20	As 0.20	Ba 0.01	Cd 0.010	Ca 0.05	Cr 0.015	Co 0.015	Cu 0.010	Fe 0.015	Pb 0.050	Mg 0.01	Mn 0.005	Mo 0.030	Ni 0.025	Zn 0.005
1	< 0.20	< 0.20	<0.20	0.180	<0.010	63.1	<0.015	<0.015	0.014	<0.015	<0.050	7.08	0.07	0.110	<0.025	0.008
2	< 0.20	< 0.20	<0.20	0.180	<0.010	63.1	<0.015	<0.015	0.014	<0.015	<0.050	7.08	0.07	<0.030	<0.025	0.008
3	< 0.20	< 0.20	<0.20	0.102	<0.010	50.0	<0.015	<0.015	0.011	<0.015	<0.001	7.08	0.07	<0.030	<0.025	0.008
4	< 0.20	< 0.20	<0.20	0.102	<0.010	49.0	<0.015	<0.015	0.010	<0.015	<0.050	2.31	0.07	<0.030	<0.025	0.006
5	< 0.20	< 0.20	<0.20	0.102	<0.010	9.9	<0.015	<0.015	0.035	<0.015	<0.050	2.31	0.07	<0.030	<0.025	0.011
6	< 0.20	< 0.20	<0.20	0.110	<0.010	22.0	<0.015	<0.015	0.021	<0.030	<0.050	2.06	0.03	<0.030	<0.025	0.025
7	< 0.20	< 0.20	<0.20	0.086	<0.010	14.3	<0.015	<0.015	<0.010	<0.015	<0.050	1.79	0.03	<0.030	<0.025	<0.005
8	< 0.20	< 0.20	<0.20	0.042	<0.010	6.9	<0.015	<0.015	<0.010	<0.015	<0.050	1.17	0.02	<0.030	<0.025	<0.005
9	< 0.20	< 0.20	<0.20	0.024	<0.010	4.8	<0.015	<0.015	<0.010	<0.015	<0.050	1.37	0.02	<0.030	<0.025	<0.005
10	< 0.20	< 0.20	<0.20	0.024	<0.010	4.8	<0.015	<0.015	<0.010	<0.015	<0.050	1.37	0.02	<0.030	<0.025	<0.005

* Detection Limit in ppm

IMPERIAL METALS - MT.POLLEY

Table 6 : HUMIDITY CELL TESTING - LOCKED CYCLE TAILINGS

METAL EXTRACTION

CYCL	CUMULATIVE WATER EXTRACT ICP ANALYSIS (mg/100 g sample)															
	Al	Sb	As	Ba	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Mo	Ni	Zn
	9100	< 5.00	189	225	1.4	1080	527	31	626	5290	43	6400	306	51	280	75
1	0.00	0.00	0.00	0.00	0.00	1.55	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
2	0.01	0.01	0.01	0.01	0.00	4.63	0.00	0.00	0.00	0.00	0.00	0.52	0.01	0.00	0.00	0.00
3	0.02	0.02	0.02	0.02	0.00	7.08	0.00	0.00	0.00	0.00	0.00	0.87	0.01	0.01	0.00	0.00
4	0.03	0.03	0.03	0.02	0.00	8.54	0.00	0.00	0.00	0.00	0.01	0.94	0.01	0.01	0.00	0.00
5	0.04	0.04	0.04	0.02	0.00	8.86	0.00	0.00	0.00	0.00	0.01	1.01	0.01	0.01	0.00	0.00
6	0.05	0.05	0.05	0.03	0.00	9.51	0.00	0.00	0.00	0.00	0.01	1.07	0.01	0.01	0.01	0.00
7	0.06	0.06	0.06	0.03	0.00	10.01	0.00	0.00	0.00	0.00	0.01	1.13	0.02	0.01	0.01	0.00
8	0.07	0.07	0.07	0.03	0.00	10.37	0.00	0.00	0.00	0.00	0.01	1.19	0.02	0.01	0.01	0.00
9	0.08	0.08	0.08	0.03	0.00	10.57	0.01	0.00	0.00	0.01	0.01	1.25	0.02	0.01	0.01	0.00
10	0.08	0.08	0.08	0.03	0.00	10.77	0.01	0.00	0.01	0.01	0.02	1.31	0.02	0.01	0.01	0.00

* assay in mg/100g unless otherwise indicated

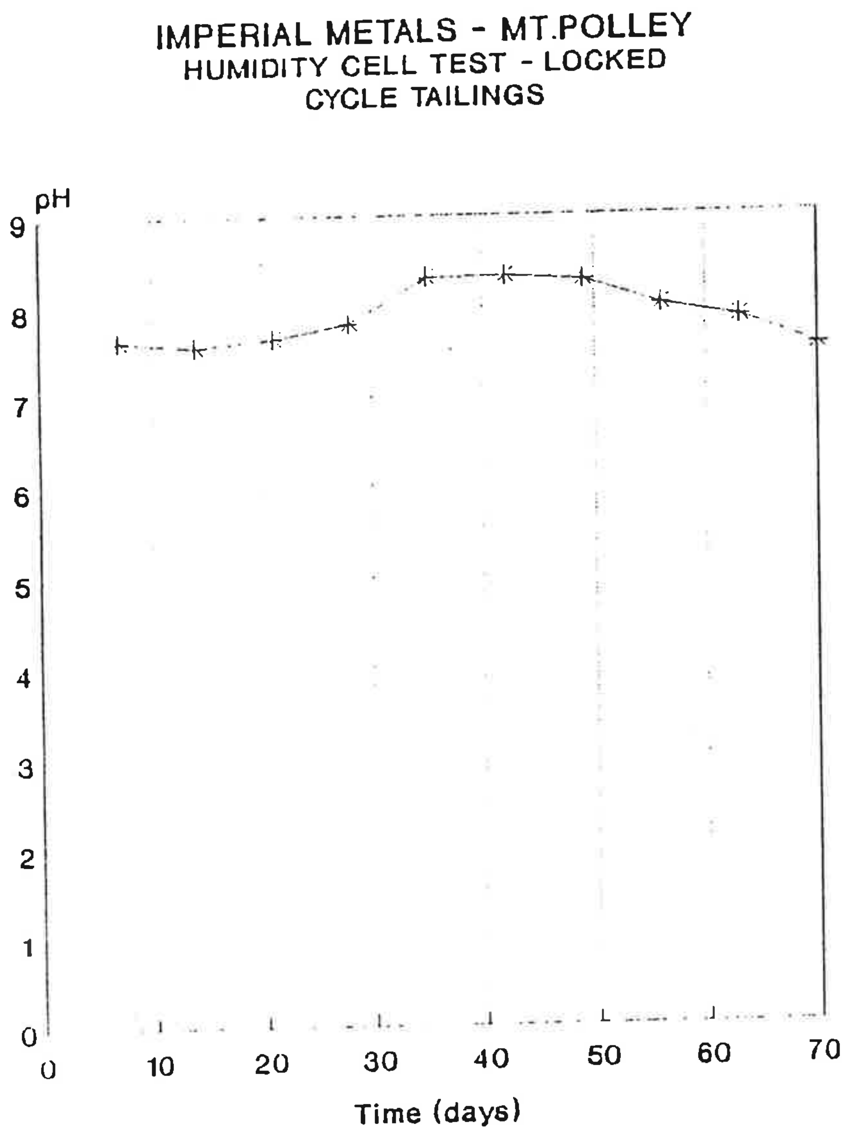

Figure 1

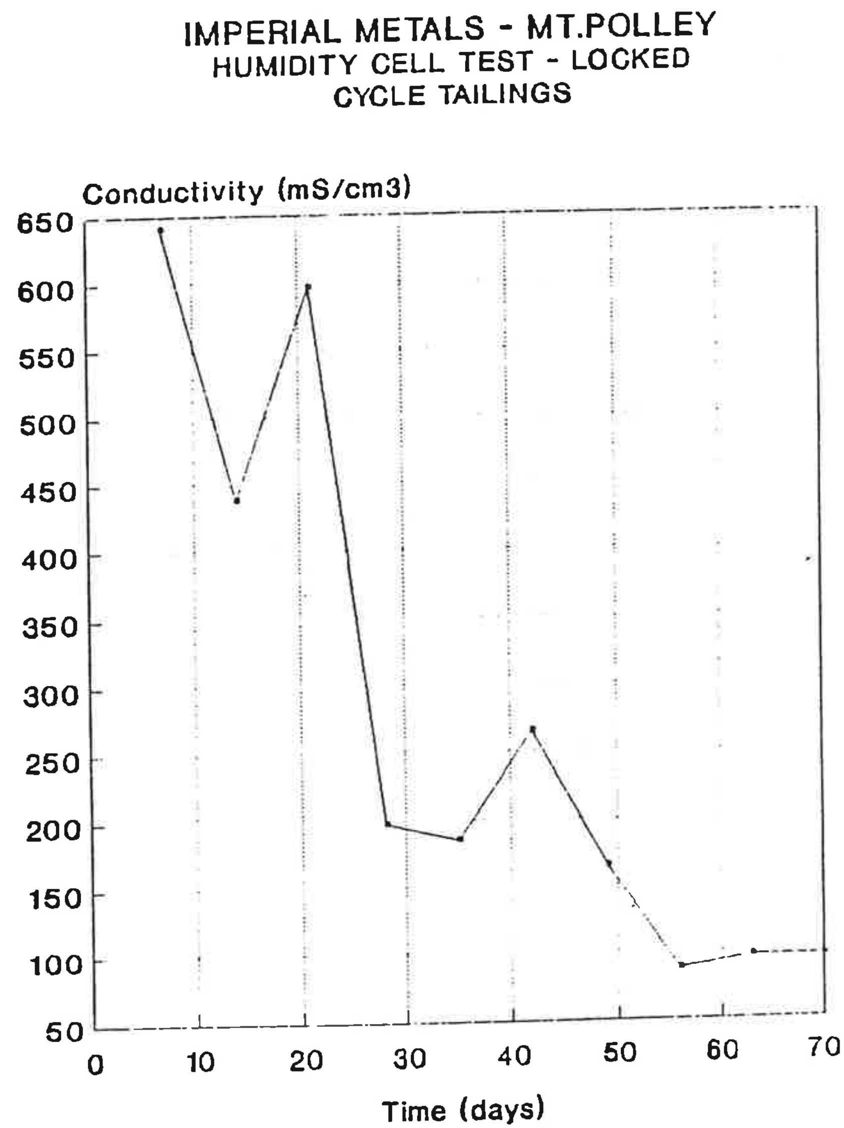

Figure 2

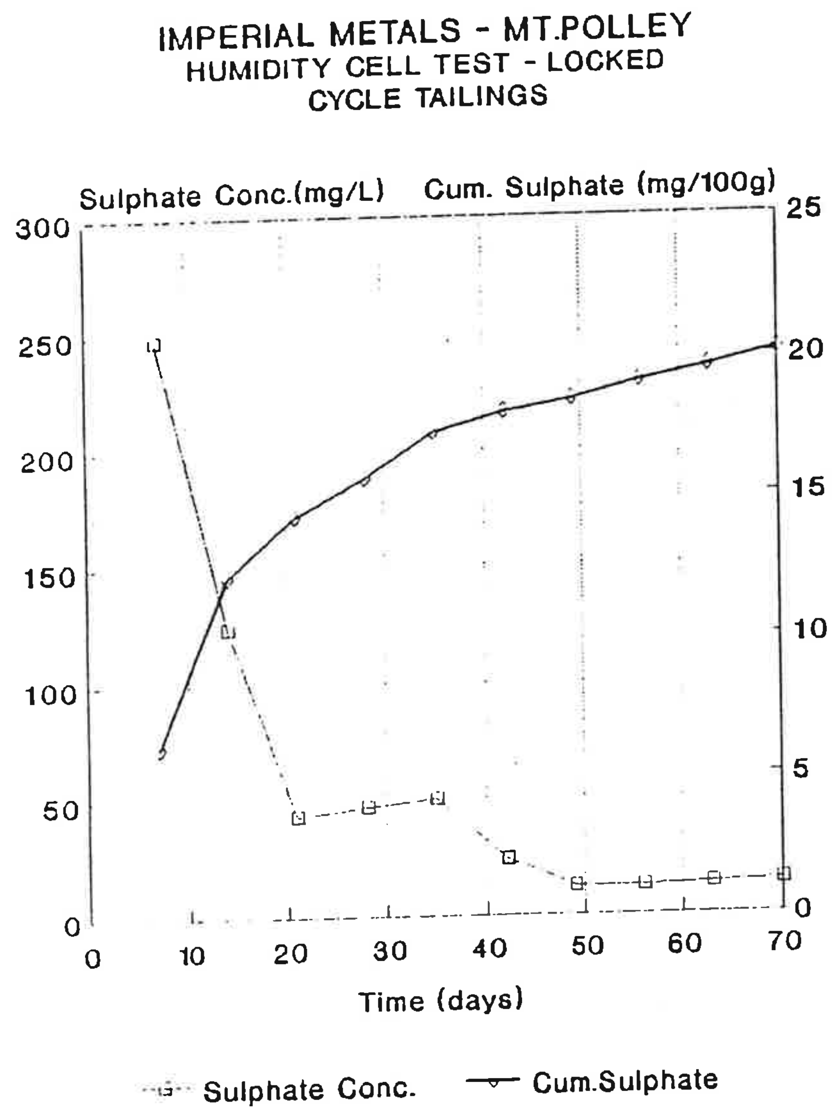

Figure 3

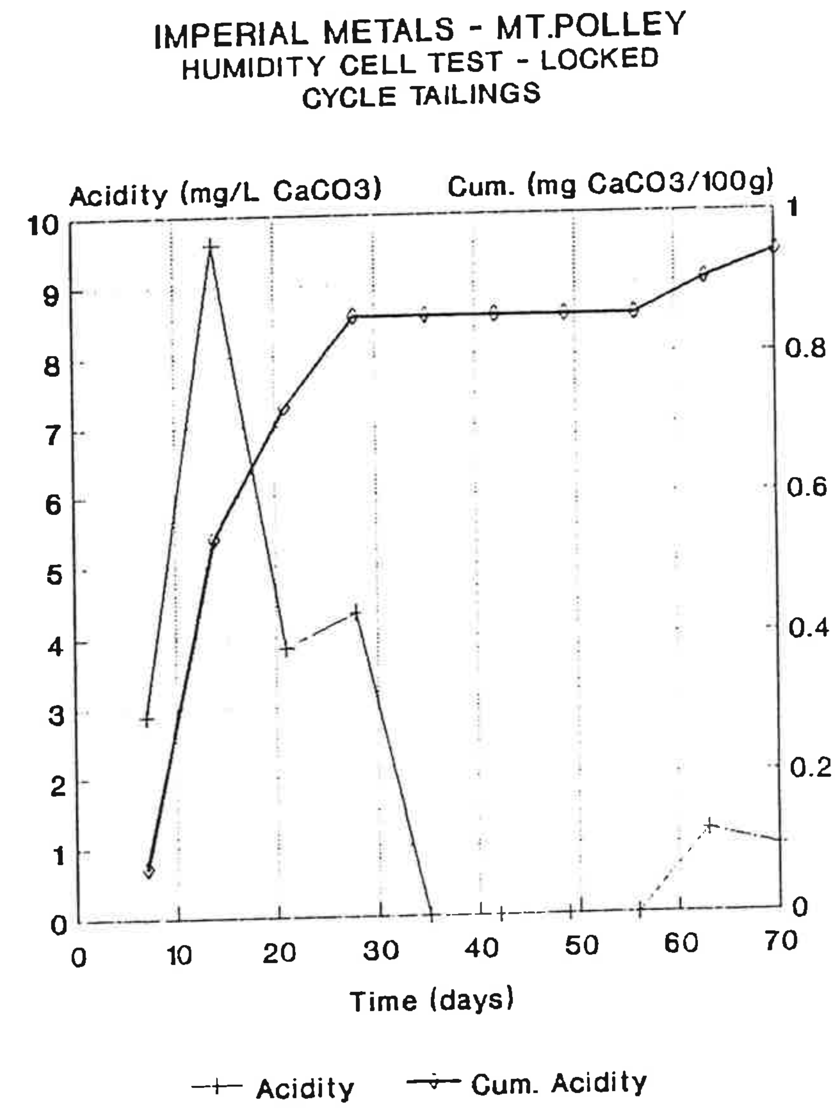

Figure 4

APPENDIX 1
COASTECH AMD PROCEDURES

THE PREDICTION OF THE ACID GENERATING POTENTIAL OF MINE WASTE MATERIALS

CURRENT TEST PROCEDURES

COASTECH RESEARCH INC

80 Niobe Street
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B.C. V7J 2C9

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1989

THE PREDICTION OF
THE ACID GENERATING POTENTIAL
OF MINE WASTE MATERIALS

INTRODUCTION

The disposal of mining and mineral processing wastes can have a significant environmental impact. Acidity and associated heavy metal contamination in run-off and seepage water from waste rock and tailings containing the sulphide minerals pyrite and/or pyrrhotite is a common and costly problem to mining operations throughout the world, often requiring costly remediation measures.

For new mines and new developments in existing operations, it is necessary to characterize tailings and waste rock materials prior to production to predict if AMD will be generated. Accurate prediction would reduce environmental damage and costs to the industry by allowing the implementation of sound waste management practices to both prevent acid generation and to maximize containment and effective treatment if AMD cannot be avoided. Regulatory agencies are now requiring verification that waste materials have been characterized and that AMD control measures will be implemented before permits are issued. Since AMD predictive procedures and their interpretation are by no means definitive, Coastech is involved with the development of procedures and special equipment for more reliable prediction. In this endeavour, discussions and consultation with AMD specialists from research, environmental consultants, industry, and the regulatory authorities is ongoing. The results of recent Coastech work and a discussion on prediction methods can be found in the proceedings of the Symposium on Tailings and Effluent Management held in Halifax, Nova Scotia, August 1989[1].

Predictive techniques include static tests which examine the balance between the acid producing and acid consuming components in a waste material, and kinetic tests which attempt to predict drainage quality over time. The data obtained is useful in characterizing waste materials for waste management planning, and can be used to support permitting applications. At the present time, we use a modified version of the widely used EPA acid-base account method as our standard static test,

---

[1]Lawrence, R.W. et al (1989). Assessment of predictive methods for the determination of AMD potential in mine tailings and waste rock. Proc. Intl. Symp. on Tailings and Effluent Management, Halifax, August, Pergamon Press, New York, 317-31.

although we are familiar with and experienced in other methods if these are requested.

Kinetic tests are usually only carried out if static testing indicates that a sample is potentially a source of AMD. However, we recommend that kinetic tests are also performed for samples which are marginal net acid consumers. Currently we are recommending that kinetic tests such as humidity cells are used as they provide a reasonable simulation of the weathering process and appear to provide an accurate prediction of the field behaviour of tailing and waste rock. On a larger scale, column leach or lysimeter tests can be carried out. We can also perform biological shake flask oxidation tests to confirm the AMD potential predicted by static procedures. This type of procedure has been widely accepted in Canada for a number of years. However, the method does not address the weathering and oxidation characteristics in the approximate pH range of 7 down to 2, nor does it provide kinetic and leachate quality data.

TEST PROCEDURES

Determination of Neutralization Potential (Acid-Base Account)

Acid-base accounting procedures based on those recommended by the U.S. Environmental Protection Agency are currently the methods of choice at Coastech[2]. The method examines the balance between acid producing components (primarily pyrite, FeS_2) and acid consuming components (carbonates and other rock types capable of neutralizing strong acids). One week is required to obtain all test and assay data

The first part of the procedure involves the determination of the paste pH of the sample and an preliminary indication of the quantity of acid consuming constituents of the sample. Excess hydrochloric acid is then added to a known weight of the sample. Once the reaction between the acid and acid consuming constituents of the sample are complete, the amount of acid consumed is determined by titrating the residual acid with alkali. This allows calculation of the neutralization capacity of the sample which can be balanced against the theoretical acid producing potential derived from sulphur assays, to give the net neutralization potential.

The EPA methods have been modified to reduce a perceived bias towards the alkaline side by carrying out the acid

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2 Sobek, A.A. et al (1978). Field and laboratory methods applicable to overburdens and minesoils. EPA 600/2-78-054, 203pp.

digestion at ambient temperature for 24 hours. Titration of the residual acid is carried out to pH 8.3 and also to pH 3.5 and pH 2.0 to allow better interpretation of kinetic oxidation tests. In addition, sulphide-sulphur analyses are used to calculate the acid potential to avoid error in assessment by neglecting the presence of sulphates such as gypsum.

Humidity Cell Tests

The humidity cell test is a kinetic test which aims to model the processes of geochemical weathering of a mining waste material. A special apparatus is used to provide simple control over air, temperature and moisture, while allowing for the removal of oxidation products which are collected and monitored. Humidity cells have been developed at Coastech to promote more rapid oxidation of sulphides contained in the waste sample. The cells allow the good aeration up through or across the sample bed of tailing or waste rock during sequential dry and moist aeration cycles, and thorough solution contact during the leach cycle.

The test procedure comprises subjecting a bed of the sample in a humidity cell to alternating cycles of dry air (3 days), moist air (3 days), and leaching (1 day). The leachates can then analyzed for a number of parameters typically including pH, redox (mV), acidity, alkalinity, sulphate, conductivity, and dissolved metals by ICP. The test generally is generally specified to run for 10 weeks although it is our experience that a longer time period is required to establish the weathering characteristics of many samples.

Lysimeter and Column Leach Tests

Lysimeters and leach columns are used to provide weathering data for waste rock and tailings on a larger scale and are often used to confirm leaching characteristics or to evaluate AMD control methods (blending, covers) on a larger scale following initial characterization in humidity cells or other kinetic test procedure. Column leach tests are usually conducted in PVC columns of 10 cm diameter x 150 cm high or larger and involves the addition of water at a specified rate to the top of the sample contained in the column. Effluent emerging from the bottom of the column is collected for the analysis of parameters such as listed for humidity cell testing. Lysimeters are columns or rectangular boxes, generally of larger surface area and shallower depth than leach columns, and are sometimes more suitable for the testing of larger quantities of material while evaluating the effect of covers, simulated water tables and other variables during weathering cycles. For larger lysimeters, the evaluation of changes in mineralogy of the sample with depth and the determination of effluent quality profiles is possible.

Shake Flask Biological Oxidation Test

The shake flask biological oxidation test determines if acid produced due to biological oxidation is sufficient to overcome the acid consuming components of the sample. The test utilizes naturally occurring sulphide-oxidizing bacteria which have the capability of breaking down minerals such as pyrite. These bacteria are maintained as stock cultures in conditions of high activity in the Coastech laboratory and facilitate the rapid assessment of the acid generating potential of a waste material. Usually four weeks is required to complete this test.

The oxidation tests are carried out using procedures based on many years of extensive experience in biological mineral oxidation systems. This ensures optimum test performance through proper selection of test conditions, availability of a selection of bacterial cultures for different waste types, and experienced interpretation of results.

The oxidation test involves the addition of sulphide-oxidizing bacteria to a slurry of the waste material at an acidic pH chosen to promote the rapid development of sulphide oxidation. The progress of oxidation is monitored by measuring pH changes which occur as pyrite is oxidized. The test is continued until oxidative activity is complete. At this time more waste sample, equal to the original weight, is added. If the pH remains within the range suitable for biological oxidation, the acid produced from the pyritic component was more than the alkaline components could consume and the sample is classified as a potential source of AMD. If, however, the acid produced is consumed so that the final pH rises to be outside the range considered to be the limit for biochemical oxidation, the sample is classified as a non-acid producer.

The test is similar to the B.C. Research Confirmation Test but has several procedural differences which have been introduced to overcome some perceived shortcomings in technique and to aid in the interpretation of the results and in the predictive assessment.

Other Weathering Tests

Other AMD prediction tests which provide a simulation of the long term weathering characteristics of mine waste materials have been shown to be effective and, for certain types of waste and modes of deposition, might be more useful than the humidity cell test. Such methods include soxhlet extraction tests and shake flask tests (non-biological). These and other tests can be carried out at Coastech to meet specific requirements.

DISCUSSION

Static and kinetic procedures can provide a good prediction of the field behaviour of many of the tailing and waste rock samples. However, static test procedures alone are not likely to provide a definitive assessment of whether a particular sample is going to produce AMD. It is more likely that a combination of static and kinetic tests will provide a more confident assessment but even then, for some samples, prediction might be uncertain. The prediction of long term weathering characteristics of a tailing or waste rock will always have some uncertainty factor if the prediction test is carried out on a convenient time scale in the laboratory. Longer term testwork can be carried out for larger waste rock sizes using column leach tests or other larger scale apparatus. Such tests can include the evaluation of various waste management scenarios such as waste rock blending and the use of till covers to minimize AMD formation and impact.

APPENDIX 2
PORE WATER AND EXTRACT: TOTAL METALS ANALYSIS

Sample #	Acid used	Sample
H5002	Acetic	Pore Water
H5003	Acetic	Extract
J2193	Carbonic	Pore Water
J2194	Carbonic	Extract

Chemex Labs Ltd.
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212 BROOKSBANK AVE., NORTH VANCOUVER
BRITISH COLUMBIA, CANADA V7J-2C1
PHONE (604) 984-0221

To: OASTECH RESEARCH INC.

80 NIOBE ST.
NORTH VANCOUVER, B.C.
V7J 2C9

Project :
Comments: ALSO ON CERT A8923877

Page No. : 1-A
Tot. Pages: 1
Date : 24-AUG-89
Invoice # : I-8923876
P.O. # : NONE

CERTIFICATE OF ANALYSIS A8923876

SAMPLE DESCRIPTION	PREP CODE		Mo ug/L	W ug/L	Zn ug/L	P ug/L	Pb ug/L	Bi ug/L	Cd ug/L	Co ug/L	Ni ug/L	Ba ug/L	Fe mg/L	Mn ug/L	Cr ug/L	Mg mg/L
H 5002 PORE	--	--	100	< 20	10	120	8	< 4	< 1	< 2	< 2	20	0.2	18	< 2	1.2
H 5003 EXTRACT	--	--	< 2	< 20	56	40	16	< 4	2	8	46	920	0.8	1020	< 2	3.0

CERTIFICATION : B. Cargill

Chemex Labs Ltd.
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BRITISH COLUMBIA, CANADA V7J-2C1
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Comments: ALSO ON CERT A8921877

Page : 1
Tot. Pages: 1
Date : 24-AUG-89
Invoice # : I-8923876
P.O. # : NONE

CERTIFICATE OF ANALYSIS A8923876

SAMPLE DESCRIPTION	PREP CODE	V ug/L	Al mg/L	Be ug/L	Ca mg/L	Cu ug/L	Ag ug/L	Ti mg/L	Sr ug/L	Na mg/L	K mg/L
H 5002 PORE	-- --	< 2	< 0.2	< 1	10.0	6	< 1	< 0.2	54	26	6.6
H 5003 EXTRACT	-- --	< 2	0.2	< 1	145	1360	< 1	< 0.2	490	3.4	5.8

CERTIFICATION : B. Cargill

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British Columbia, Canada V7J 2C1
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Comments: ALSO ON CERT. A8923876

CERTIFICATE A8923877

COASTECH RESEARCH INC.

Project:
P.O. # : NONE

Samples submitted to our lab in Vancouver, BC.
This report was printed on 30-OCT-89.

SAMPLE PREPARATION

CHEMEX CODE	NUMBER SAMPLES	DESCRIPTION

ANALYTICAL PROCEDURES

CHEMEX CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
605	2	Hg ppb: Total, H2SO4 digestion	AAS-FLAMELESS	0.1	10000
621	2	As ppb: Total, hydride gen	AAS	0.1	10000
633	2	Sb ppb: Total, organic extract	AAS	4	10000

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Project :
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Invoice No. : I-8923877
P.O. Number : NONE

** CORRECTED COPY

CERTIFICATE OF ANALYSIS A8923877

PARAMETER DESCRIPTIONS	SAMPLE H 5002	SAMPLE H 5003								
Sample preparation code	---	---	---	---	---	---	---	---	---	---
Sample preparation code	---	---	---	---	---	---	---	---	---	---
Hg ppb (total)	< 0.2	1.0								
As ppb (total)	10.6	190.0								
Sb ppb (total)	3	36								

CERTIFICATION : [signature]

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Comments: ATTN: TONY CHONG

CERTIFICATE A8928325

COASTECH RESEARCH INC.

Project: 2105
P.O. # : 894155

Samples submitted to our lab in Vancouver, BC.
This report was printed on 25-OCT-89.

SAMPLE PREPARATION

CHEMEX CODE	NUMBER SAMPLES	DESCRIPTION
221	2	Water sample

ANALYTICAL PROCEDURES

CHEMEX CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
622	2	As ppb: Dissolved, hydride gen	AAS	0.1	10000
634	2	Sb ppb: Dissolved, organic ext	AAS	4	10000
606	2	Hg ppb: Dissolved, H2SO4 digest	AAS-FLAMELESS	0.1	10000
624	2	Cd ppb: Dissolved, HNO3, org ext	AAS	1	10000
628	2	Cr ppb: Dissolved, HNO3, org ext	AAS	4	10000
626	2	Co ppb: Dissolved, HNO3, org ext	AAS	1	10000
602	2	Cu ppb: Dissolved, HNO3 digest	AAS	1	10000
618	2	Pb ppb: Dissolved, HNO3, org ext	AAS	2	10000
728	2	Ni ppb: Dissolved, HNO3, org ext	AAS	1	10000
620	2	Zn ppb: Dissolved, HNO3, org ext	AAS	1	10000

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Invoice Date: 25-OCT-89
Invoice No. : I-8928325
P.O. Number : 894155

CERTIFICATE OF ANALYSIS A8928325

PARAMETER DESCRIPTIONS	SAMPLE J2193	SAMPLE J2194								
Sample preparation code	221	221	---	---	---	---	---	---	---	---
Sample preparation code	---	---	---	---	---	---	---	---	---	---
As ppb (dissolved)	363	97.3								
Sb ppb (dissolved)	36	16								
Hg ppb (dissolved)	< 0.1	< 0.1								
Cd ppb (dissolved)	< 1	< 1								
Cr ppb (dissolved)	< 10	< 10								
Co ppb (dissolved)	< 2	< 2								
Cu ppb (dissolved)	2	6								
Pb ppb (dissolved)	2	< 2								
Ni ppb (dissolved)	< 2	< 2								
Zn ppb (dissolved)	4	8								
Bi ppb (dissolved)	< 1	< 1								

CERTIFICATION : ____________

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P.O. Number : 894155

CERTIFICATE OF ANALYSIS A8928325

PARAMETER DESCRIPTIONS	SAMPLE J2193	SAMPLE J2194								
Sample preparation code	221	221	---	---	---	---	---	---	---	---
Sample preparation code	---	---	---	---	---	---	---	---	---	---
As ppb (dissolved)	363	97.3								
Sb ppb (dissolved)	36	16								
Hg ppb (dissolved)	< 0.1	< 0.1								
Cd ppb (dissolved)	< 1	< 1								
Cr ppb (dissolved)	< 10	< 10								
Co ppb (dissolved)	< 2	< 2								
Cu ppb (dissolved)	2	6								
Pb ppb (dissolved)	2	< 2								
Ni ppb (dissolved)	< 2	< 2								
Zn ppb (dissolved)	4	8								
Bi ppb (dissolved)	< 1	< 1								

CERTIFICATION : ____________

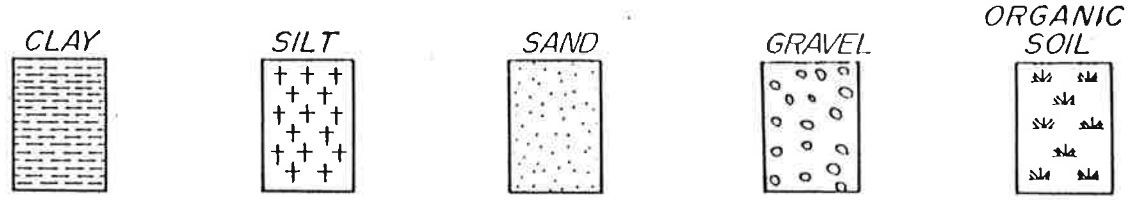
Knight and Piésold Ltd.
CONSULTING ENGINEERS

APPENDIX F

TAILINGS AREA B
TEST PIT LOGS,
BOREHOLE LOGS AND PERMEABILITY TEST RESULTS

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

SYMBOLS AND TERMS USED IN THE REPORTS



The symbols may be combined to denote various soil combinations, the predominant soil being heavier.

RELATIVE PROPORTIONS

TERM	RANGE
Trace	0 - 10%
Some	10 - 20%
"y" or "ey"	20 - 35%
and	35 - 50%

ie. CLAY - silty, trace sand

means : Clay soil with 20% to 35% silt and 0% to 10% sand

CLASSIFICATION BY PARTICLE SIZE

Boulder		Over 8"
Cobble		3" - 8"
Gravel -		
	Coarse	3/4" - 3"
	Fine	# 4 - 3/4"
Sand -		
	Coarse	# 4 - # 10
	Medium	# 10 - # 40
	Fine	# 40 - # 200
Silt		# 200 - # 0.002 mm
Clay		Finer than 0.002 mm

NOTE

Sieve sizes shown are U.S. standard

DENSITY OF SANDS AND GRAVELS

DESCRIPTIVE TERM	RELATIVE DENSITY	STANDARD PENETRATION TEST
Very loose	0 - 15%	0 - 4 Blows per foot
Loose	15 - 35%	4 - 10 Blows per foot
Medium dense	35 - 65%	10 - 30 Blows per foot
Dense	65 - 85%	30 - 50 Blows per foot
Very dense	85 - 100%	Over 50 Blows per foot

CONSISTENCY OF CLAYS AND SILTS

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH - TONS/SQ.FT.	N VALUE STANDARD PENETRATION TEST	REMARKS
Very soft	Less than 0.25	Less than 2	Can penetrate with fist
Soft	0.25 - 0.50	2 - 4	Can indent with fist
Firm	0.50 - 1.0	4 - 8	Can penetrate with thumb
Stiff	1.0 - 2.0	8 - 15	Can indent with thumb
Very stiff	2.0 - 4.0	15 - 30	Can indent with thumb - nail
Hard	4.0 and greater	Greater than 30	Cannot indent with thumb - nail

NOTES:
1. Relative density determined by standard laboratory tests
2. N Value - blows/ft. of a 140 lb. hammer falling 30 in. on a 2 in. O.D. split spoon

APPENDIX F

TEST PIT	DEPTH INTERVAL (m)	MATERIAL DESCRIPTION
TPB1	0 - 4.1	SANDY SILT, trace gravel, trace clay, trace cobbles, green-brown well graded, fissured dense, low permeability, glacial till - good construction material - ponded water on surface
TPB2	0 - 4.9 m	SILTY SAND, trace to some gravel, trace clay, trace cobbles and boulders to 60 cm, green-brown, well graded, fissured, dense, low permeability, glacial till
TPB3	0 - .15	TOPSOIL, forest litter, black to dark brown
	0.15 - 1.8	SILTY SAND, some gravel, trace cobbles and boulders to 45 cm, brown, very well graded, dense, glacial till (slightly coarser than previously)
	1.8 - 5.5	SAND, trace gravel, clean, medium to fine, moderately sorted, brown, grades to fine, uniform, clean SAND with depth
TPB4	0 - 5.2	SILTY SAND, some gravel, trace cobbles, occasional boulder, brown, firm to dense, moist, low permeability glacial till - good construction material

TEST PIT	DEPTH INTERVAL (m)	MATERIAL DESCRIPTION
TPB5	0 - 4 m	SILTY SAND, some gravel, trace cobbles and boulders, rounded, trace clay, dense, brown, very well graded, glacial till
TPB6	0 - 1.5	SILTY SAND, trace gravel, brown, well graded, low permeability, glacial till
	1.5 - 3	SAND, trace to some silt, moderately graded, fine brown, moist
	3 - 5.2	SAND, trace silt to clean, mor gravel and cobbles with depth, grades to GRAVELLY SAND at bottom, clean, coarse, moderately graded
TPB7	0 - .15	TOPSOIL, clayey, brown
	0.15 - 3.4	SAND, some silt, some gravel, trace cobbles, very dense, very well graded, glacial till
TPB8	0 - .15	ORGANICS and forest litter
	0.15 - 4.9	SILTY SAND, some gravel, trace cobbles, green-brown, very well graded, low permeability, dense, glacial till, slightly wet
TPB9	0 - 5.2	SILTY SAND, some gravel, trace cobbles, green-brown, very well graded, low permeability, dense, colour changes to pale brown below 2 m, glacial till

TEST PIT	DEPTH INTERVAL (m)	MATERIAL DESCRIPTION
TPB13	0 - 0.15	PEAT, organics, dark reddish brown to black
	0.15 - 1.1	CLAYEY SILT, fissured, moist, place green-brown, firm, moist
	1.1 - 4.9	SILT, trace to some sand, fine, dense, trace gravel, trace clay, pale brown, fissured with fine sand in fissures, moist, low permeability, appears to be reworked
TPB14	0 - .3	PEAT, and organics, dark reddish-brown to black
	0.3 - 1.1	CLAYEY SILT, pale green brown, firm, fissured, wet for top 60 cm
	1.1 - 4.9	SILT, some sand to sandy, fine dense, fissured, fine sand laminations, moist
TPB15	0 - 4.9	SILTY SAND, some gravel, trace clay, trace cobbles and boulders to 35 cm, very well graded, dense, brown, low permeability, glacial till
TPB16	0 - 1.2	GRAVELLY SAND, some cobbles, trace boulders, poorly sorted, reddish brown, colluvium and road fill

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TEST HOLE LOG

TEST HOLE No. MP 89-229
SHEET 1 of 1

PROJECT Mt. Polley
LOCATION OF TEST HOLE Tailings Area B
DATE BEGUN Oct. 29, 1989 DATE FINISHED Oct. 29, 1989
PROJECT No. 1621
GROUND ELEVATION 929.1
LOGGED BY RNK & K. McN

NOTES Water loss, type and size of hole, drilling method, groundwater level, etc.	CORE RECOVERY %	RQD	DEFECT SPACING (cm)	PERMEABILITY ($\times 10^{-6}$ cm/s)	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION OF MATERIAL
							- dense, grey, silty till
					50		
NO	40	0	5				
PIEZOMETER	95	20	↓				
	100	20	↓				
INSTALLATIONS	↓	30	↓		100		
	↓	40	10				
	↓	40	↓				- weathered reddish brown volcanic conglomerate with rough planar to wavy joints infilled with calcite
	↓	40	↓				
	↓	60	<3				
TRICONE BIT	↓	80	20		150		
USED TO	↓	30	20				
DRILL	↓	0	<3				-75% clay and gouge
	↓	40	<3				
OVERBURDEN.	↓	40	10				
	↓	60	50		200		
	↓	90	↓				
HOLE SIZE: NQ	↓	65	↓				
	↓	65	↓				
	↓	70	10		250		
	↓	60	10				
	↓	60	20				- purple basalt
	↓	80	↓				
	↓	85	↓				
	↓	60	↓		300		
	↓	90	↓				
	↓	70	↓				
	↓	70	↓				
	↓	85	50				
	↓	85	50		350		
	↓	80	50				
	↓	90	20				
	↓	[illegible]	↓				
	↓	[illegible]	↓				
	100	[illegible]	↓				EOH

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TEST HOLE LOG

TEST HOLE No. MP89-231
SHEET 1 of 1

PROJECT: Mt. Polley
PROJECT No. 1621
LOCATION OF TEST HOLE: [illegible]
GROUND ELEVATION: 927.?
DATE BEGUN: Oct 31, 1989 DATE FINISHED: Nov. 1, 1989
LOGGED BY: RNK + KMcN

NOTES Water loss, type and size of hole, drilling method, groundwater level, etc.	CORE RECOVERY %	RQD	DEFECT SPACING (cm)	PERMEABILITY ($\times 10^{-6}$cm/s)	DEPTH (feet)	DESCRIPTION AND CLASSIFICATION OF MATERIAL
pneumatic leads						∇ - water table at surface
						- dense, grey, silty till with abundant rounded pebbles
water table at surface	10			6.4		
1½" Ø PVC standpipe piezometer slotted to surface					50	
	20					- reddish brown coarse sand and gravel (weathered K-spar rich intrusive)
	50					- fine beach sand with minor clay binder
	0					- reddish brown coarse sand and gravel (weathered K-spar rich intrusive)
	85				100	
				1.6		
sand backfill	100	70	10			
	100	70				
bentonite seal	90	50		.29		- purple weathered volcanic conglomerate with rough planar joints infilled with clay, hematite, or calcite (decreasing weathering down hole)
	90	20	<3			
	100	30			150	
		50				
		65	10			
		50				
		50				
					200	
		40				
		40				
sand backfill		[illegible]				
		50				
		60				
		70	30		250	
		70	30			
		20	<3			
		70	20			
		20	<3			
		0	<3		300	- Conglomerate strained to sandy clay gouge
		20	<3			
bentonite seal		40	30			
		85				
sand backfill		65				
		70			350	
		40	10			
		40	10			
pneumatic piezometer, tip at 385'		75	30			
	80	50	10			EOH

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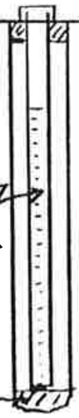
TEST HOLE LOG

TEST HOLE No. mP89-233
SHEET 1 of 1

PROJECT Mt. Polley
LOCATION OF TEST HOLE [illegible]
DATE BEGUN Nov. 5, 1989 DATE FINISHED Nov. 6, 1989
PROJECT No. 1621
GROUND ELEVATION 933.9
LOGGED BY RNK + K McN

NOTES: Water loss, type and size of hole, drilling method, groundwater level, etc.



1 1/2" Ø PVC standpipe piezometer

bentonite seal

hole sloughed in at 100'

Core Recovery %	RQD	Defect Spacing (cm)	Permeability (× 10⁻⁶ cm/s)	Depth (feet)
5				
15			11	50
0				
10			22	100
50	0	< 3		
15	↓	↓		
15			16	
25				
70				150
70	↓	↓	17	
75	40	↓		
75	40	10		
60	0	< 3		
95	50	10		200
55	10	< 3		
70	20	< 3		
100	35	10		
100	45	10		
90	30	10		250
90	0	< 3		
100	↓	↓		
100				
95				
80				300
70				
40				
40				
10				
40	↓	↓		350
70	25	10		
30	10	10		
20	0	< 3		
[illegible]	0	< 3		

DESCRIPTION AND CLASSIFICATION OF MATERIAL

- dense, grey silty glacial till with abundant pebbles (recovery mostly pebbles and silty clay)

∇ water table at 56'

- grey sandy glacial till with some pebbles (recovery mostly pebbles)

- heavily weathered volcanic conglomerate, with matrix leached to leave sand and gravel

EOH

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TEST HOLE LOG

TEST HOLE No. MP89-235
SHEET 1 of 1

PROJECT Mt. Polley
LOCATION OF TEST HOLE Tailings Area B
DATE BEGUN Nov. 9, 1989 DATE FINISHED Nov. 10, 1989

PROJECT No. 1621
GROUND ELEVATION 946.2
LOGGED BY RNK + K McN

NOTES (Water loss, type and size of hole, drilling method, groundwater level, etc.)	CORE RECOVERY %	RQD	DEFECT SPACING (cm)	PERMEABILITY ($\times 10^{-6}$ cm/s)	DEPTH (feet)	DESCRIPTION AND CLASSIFICATION OF MATERIAL
pneumatic leads	80	20	<3			~~water table at 6'~~ – dense grey sandy glacial till
	100	40	10	510		
		70	10			– very weathered purple volcanic conglomerate with rough, wavy, thin clay filled fractures
1½" ϕ PVC standpipe piezometer		90	30		50	
		70		.086		
		85				
		95				
		70	10	.40		
sand backfill		60				
		60			100	
bentonite seal		60				
		50		11		
		65				
		65			150	
		85				
		90	30			
		70				
		80				
		90			200	
		85				
		75				
sand backfill		70				
		85				
		60			250	← healed shear zone
		70	10			
		75	30			
		85				
		90				
		60			300	
	90	60	10			
	100	60				
	90	50				
	95	50				
	100	80	30		350	– purple basalt
bentonite seal		40	10			
		60	10			
sand backfill		100	30			
pneumatic piezometer,		70	30			
tip at 390'		60	10			EOH

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TEST HOLE LOG

TEST HOLE No. MP89-236
SHEET 1 of 1

PROJECT: Mt. Polley
PROJECT No.: 1621
LOCATION OF TEST HOLE: Tailings Area [?]
GROUND ELEVATION: 944.4
DATE BEGUN: Nov. 10, 1989 DATE FINISHED: Nov. 11, 1989
LOGGED BY: RNK + KMcN

NOTES (Water loss, type and size of hole, drilling method, groundwater level, etc.):
- pneumatic leads
- 1½" Ø PVC standpipe piezometer
- sand backfill
- bentonite seal
- sand backfill
- bentonite seal
- sand backfill
- Pneumatic piezometer tip at 380'

CORE RECOVERY %	RQD	DEFECT SPACING (cm)	PERMEABILITY (× 10⁻⁶ cm/s)	DEPTH (feet)
5				
10				
10	0	<3		
40	0	↓	27	
60	0			50
40	10			
40	10		2.7	
70	20			
70	10	10		
45	30	↓	2.0	100
80	25			
100	25	<3		
60	30	10		
90	15	↓	.77	
100	60			150
80	60			
100	50			
80	20	<3		
100	35	<3		
100	45	10		200
90	20	<3		
90	15	<3		
100	40	10		
45	10	<3		
80	25	10		250
60	5	10		
70	10	<3		
80	15	↓		
80	0			
50	0			300
30	0			
45	10			
40	0			
70	0			
90	30			350
95	45	10		
100		10		
100		<3		

DESCRIPTION AND CLASSIFICATION OF MATERIAL

▽ - water table at surface.
- dense grey silty till with some pebbles

- weathered golfball syenite with thin calcite and chlorite filled tight planar, smooth fractures. Defects at 20° and 70° to core axis

? EOH

PACKER TESTING CALCULATION SHEET

PROJECT: MOUNT POLLEY
LOCATION: TAILINGS AREA B
HOLE No: MP-89-231
TEST DATE: OCT. 31, 1989
COORDINATES(ft) N: S:

HOLE DIAMETER (inches): 2.98
GROUNDWATER DEPTH(ft): 0
BEDROCK DEPTH(ft): 90
TESTED BY: RNK
ANGLE FROM VERTICAL (deg): 0

TEST No.	INTERVAL (ft) from	to	METER RDG (liters) init	final	ELAPSED TIME (min)	FLOW RATE (lpm)	GAUGE PRESSURE (psi)	HEAD CORR'N (psi)	TEST HEAD (m)	PERMEABILITY (cm/sec)	COMMENTS
1	29	40	846.80	847.35	3	0.183	10.0	0.0	7.0	9.2E-06	
1	29	40	847.78	848.95	5	0.234	14.5	0.0	10.2	8.1E-06	
1	29	40	850.15	851.66	4	0.377	25.0	0.0	17.6	7.6E-06	TILL
1	29	40	851.67	852.35	4	0.170	17.0	0.0	12.0	5.0E-06	
1	29	40	852.16	852.46	4	0.075	10.0	0.0	7.0	3.8E-06	
						0.000			0.0		
2	100	120	1065.00	1066.14	4	0.285	24.0	0.0	16.9	3.7E-06	
2	100	120	1068.91	1070.57	5	0.332	52.0	0.0	36.6	2.0E-06	WEATHERED VOLCANIC
2	100	120	1073.40	1077.37	5	0.794	85.0	0.0	59.8	2.9E-06	CONGLOMERATE
2	100	120	1077.19	1078.00	5	0.162	52.0	0.0	36.6	9.8E-07	
2	100	120	1077.42	1077.60	5	0.036	23.0	0.0	16.2	4.9E-07	
						0.000			0.0		
3	120	140	1132.71	1132.86	3	0.050	25.0	0.0	17.6	6.3E-07	
3	120	140	1135.56	1135.85	5	0.058	52.0	0.0	36.6	3.5E-07	MORE COMPETENT
3	120	140	1137.03	1137.45	5	0.084	79.0	0.0	55.6	3.3E-07	VOLCANIC
3	120	140	1136.61	1136.72	5	0.022	47.0	0.0	33.1	1.5E-07	CONGLOMERATE
3	120	140	1135.17	1135.25	5	0.016	25.0	0.0	17.6	2.0E-07	
						0.000			0.0		

PACKER TESTING CALCULATION SHEET

PROJECT: MOUNT POLLEY
LOCATION: TAILINGS AREA B
HOLE No: MP-89-232
TEST DATE: NOV. 2, 1989
COORDINATES(ft) N: S:

HOLE DIAMETER (inches): 2.98
GROUNDWATER DEPTH(ft): 6.8
BEDROCK DEPTH(ft): 85
TESTED BY: RNK
ANGLE FROM VERTICAL (deg): 0

TEST No.	INTERVAL (ft) from	INTERVAL (ft) to	METER RDG (liters) init	METER RDG (liters) final	ELAPSED TIME (min)	FLOW RATE (lpm)	GAUGE PRESSURE (psi)	HEAD CORR'N (psi)	TEST HEAD (m)	PERMEABILITY (cm/sec)	COMMENTS
1	50	60	1407.20	1408.90	5	0.340	15.0	0.0	12.6	1.0E-05	
1	50	60	1409.30	1411.50	5	0.440	22.0	0.0	17.6	9.6E-06	
1	50	60	1412.10	1414.70	5	0.520	35.0	0.0	26.7	7.4E-06	LAYERED FINE
1	50	60	1415.10	1416.70	5	0.320	22.0	0.0	17.6	7.0E-06	SANDS AND SILTS
1	50	60	1416.90	1417.80	5	0.180	15.0	0.0	12.6	5.4E-06	
						0.000			0.0		
2	105	120	4039.56	4040.24	4	0.170	25.0	0.0	19.7	2.4E-06	
2	105	120	4046.61	4050.37	5	0.752	47.0	0.0	35.2	5.9E-06	WEATHERED VOLCANIC
2	105	120	4053.39	4059.34	5	1.190	78.0	0.0	57.0	5.8E-06	CONGLOMERATE, WITH
2	105	120	4059.51	4061.31	5	0.360	50.0	0.0	37.3	2.7E-06	FAULT GOUGE
2	105	120	4060.97	4061.49	5	0.104	25.0	0.0	19.7	1.5E-06	
						0.000			0.0		
3	140	150	4220.15	4224.46	5	0.862	30.0	0.0	23.2	1.4E-05	
3	140	150	4225.95	4232.45	5	1.300	63.0	0.0	46.4	1.1E-05	WEATHERED VOLCANIC
3	140	150	4234.98	4242.57	5	1.518	92.0	0.0	66.8	8.7E-06	ROCK, WITH SOME
3	140	150	4243.64	4248.62	5	0.996	62.0	0.0	45.7	8.3E-06	CALCITE INFILLED
3	140	150	4248.98	4251.72	5	0.548	29.0	0.0	22.5	9.3E-06	JOINTS
						0.000			0.0		

PACKER TESTING CALCULATION SHEET

PROJECT:	MOUNT POLLEY	HOLE DIAMETER (inches):	2.98
LOCATION:	TAILINGS AREA B	GROUNDWATER DEPTH(ft):	55.6
HOLE No:	MP-89-233	BEDROCK DEPTH(ft):	110
TEST DATE:	NOV. 5, 1989	TESTED BY:	RNK
COORDINATES(ft) N:	S:	ANGLE FROM VERTICAL (deg):	0

TEST No.	INTERVAL (ft) from	to	METER RDG (liters) init	final	ELAPSED TIME (min)	FLOW RATE (lpm)	GAUGE PRESSURE (psi)	HEAD CORR'N (psi)	TEST HEAD (m)	PERMEABILITY (cm/sec)	COMMENTS
2	40	60	5213.60	5219.00	5	1.080	12.0	0.0	25.4	9.4E-06	
2	40	60	5222.10	5232.10	5	2.000	26.0	1.0	34.5	1.3E-05	SILTY TILL
2	40	60	5234.00	5243.20	2	4.600	36.0	1.0	41.6	2.4E-05	Leak at this Press
2	40	60	5251.90	5264.50	3	4.200	26.0	1.5	34.2	2.7E-05	Leak at this Press
2	40	60	5265.70	5279.30	5	2.720	12.0	1.5	24.3	2.4E-05	
						0.000			0.0		
3	100	120	5323.50	5331.10	5	1.520	20.0	1.0	30.3	1.1E-05	
3	100	120	5338.00	5367.10	5	5.820	40.0	2.5	43.3	2.9E-05	HEAVILY WEATHERED
3	100	120	5379.40	5423.50	5	8.820	62.0	4.0	57.8	3.3E-05	VOLCANIC
3	100	120	5429.50	5458.60	5	5.820	40.0	2.5	43.3	2.9E-05	CONGLOMERATE
3	100	120	5460.00	5471.50	5	2.300	20.0	1.0	30.3	1.7E-05	
						0.000			0.0		
4	120	150	5524.00	5538.20	5	2.840	18.0	2.0	28.2	1.6E-05	
4	120	150	5552.50	5580.40	5	5.580	45.0	2.5	46.9	1.9E-05	HEAVILY WEATHERED
4	120	150	5603.40	5673.80	5	14.08	75.0	6.5	65.2	3.3E-05	VOLCANIC
4	120	150	5676.10	5701.90	5	5.160	47.0	2.5	48.3	1.7E-05	CONGLOMERATE
4	120	150	5698.32	5701.45	3	1.043	16.0	0.0	28.2	5.9E-06	
						0.000			0.0		
5	160	180	5928.56	5939.26	5	2.140	32.0	1.0	38.8	1.2E-05	
5	160	180	5948.91	5975.26	5	5.270	69.0	2.0	64.1	1.8E-05	HEAVILY WEATHERED
5	160	180	5997.30	6072.40	5	15.02	105.0	7.0	85.9	3.7E-05	VOLCANIC
5	160	180	6066.76	6089.40	5	4.528	62.0	2.0	59.2	1.7E-05	CONGLOMERATE
5	160	180	6084.09	6093.27	5	1.836	29.0	1.0	36.7	1.1E-05	
						0.000			0.0		

PACKER TESTING CALCULATION SHEET

PROJECT:	MOUNT POLLEY	HOLE DIAMETER (inches):	2.98
LOCATION:	TAILINGS AREA B	GROUNDWATER DEPTH(ft):	0
HOLE No:	MP-89-234	BEDROCK DEPTH(ft):	95
TEST DATE:	NOV. 7, 1989	TESTED BY:	RNK
COORDINATES(ft) N:	S:	ANGLE FROM VERTICAL (deg):	0

TEST No.	INTERVAL (ft) from	to	METER RDG (liters) init	final	ELAPSED TIME (min)	FLOW RATE (lpm)	GAUGE PRESSURE (psi)	HEAD CORR'N (psi)	TEST HEAD (m)	PERMEABILITY (cm/sec)	COMMENTS
1	20	40	6121.74	6124.22	5	0.496	10.0	0.0	7.0	1.6E-05	
1	20	40	6126.49	6134.40	5	1.582	18.0	1.0	12.0	2.8E-05	DENSE, LAYERED
1	20	40	6141.13	6156.01	5	2.976	24.0	1.5	15.8	4.0E-05	CLAY AND SILT
1	20	40	6153.38	6155.57	5	0.438	16.0	0.0	11.3	8.6E-06	WITH RARE SAND
1	20	40	6154.31	6154.78	5	0.094	10.0	0.0	7.0	3.0E-06	STRINGERS
						0.000			0.0		
2	100	120	6305.90	6305.90	5	0.000	20.0	0.0	14.1	0.0E+00	<--OMIT THIS RESULT
2	100	120	6306.14	6306.36	5	0.044	40.0	0.0	28.2	3.5E-07	
2	100	120	6306.50	6307.01	5	0.102	64.0	0.0	45.0	5.0E-07	WEATHERED
2	100	120	6307.01	6307.15	4	0.035	40.0	0.0	28.2	2.7E-07	VOLCANIC
2	100	120	6307.01	6307.05	3	0.013	20.0	0.0	14.1	2.1E-07	CONGLOMERATE
						0.000			0.0		
3	150	160	6690.45	6691.50	5	0.210	28.0	0.0	19.7	4.1E-06	
3	150	160	6692.30	6694.90	5	0.520	60.0	0.0	42.2	4.7E-06	WEATHERED
3	150	160	6695.60	6698.35	5	0.550	85.0	0.0	59.8	3.5E-06	VOLCANIC
3	150	160	6698.40	6699.35	5	0.190	58.0	0.0	40.8	1.8E-06	CONGLOMERATE
3	150	160	6699.10	6698.67	5	-0.09	28.0	0.0	19.7	-1.7E-06	PRESS REBOUND (OMIT)
						0.000			0.0		

PACKER TESTING CALCULATION SHEET

PROJECT: MOUNT POLLEY
LOCATION: TAILINGS AREA B
HOLE No: MP-89-235
TEST DATE: NOV. 9, 1989
COORDINATES(ft) N: S:

HOLE DIAMETER (inches): 2.98
GROUNDWATER DEPTH(ft): 6
BEDROCK DEPTH(ft): 15
TESTED BY: RNK
ANGLE FROM VERTICAL (deg): 0

TEST No.	INTERVAL (ft) from	to	METER RDG (liters) init	final	ELAPSED TIME (min)	FLOW RATE (lpm)	GAUGE PRESSURE (psi)	HEAD CORR'N (psi)	TEST HEAD (m)	PERMEABILITY (cm/sec)	COMMENTS
1	20	40	6795.40	6879.70	5	16.86	10.0	7.5	3.6	5.7E-04	TEST COMPLETED IN
1	20	40	6919.20	7026.20	5	21.40	15.0	11.0	4.6	5.2E-04	CONTACT BETWEEN
1	20	40	7049.90	7176.20	5	25.26	19.0	13.0	6.1	5.0E-04	TILL AND BEDROCK
1	20	40	7198.20	7301.90	5	20.74	15.0	9.5	5.7	4.8E-04	(FRACTURED BEDROCK)
1	20	40	7325.70	7397.10	5	14.28	10.0	7.0	3.9	4.7E-04	
						0.00			0.0		
2	40	60	7409.86	7409.87	4	0.003	11.0	0.0	9.6	5.8E-08	
2	40	60	7409.97	7410.03	4	0.015	24.0	0.0	18.7	1.8E-07	VERY WEATHERED
2	40	60	7410.35	7410.42	5	0.014	38.0	0.0	28.6	1.1E-07	VOLCANIC
2	40	60	7410.41	7410.43	5	0.004	24.0	0.0	18.7	4.7E-08	COMGLOMERATE
2	40	60	7410.41	7410.41	5	0.000	12.0	0.0	10.3	0.0E+00	PRESS REBOUND (OMIT)
						0.000			0.0		
3	60	100	7593.12	7593.49	5	0.074	18.0	0.0	14.5	6.4E-07	
3	60	100	7593.73	7594.36	5	0.126	38.0	0.0	28.6	5.5E-07	VERY WEATHERED
3	60	100	7594.60	7595.36	5	0.152	52.0	0.0	38.4	5.0E-07	VOLCANIC
3	60	100	7595.46	7595.83	5	0.074	37.0	0.0	27.9	3.3E-07	COMGLOMERATE
3	60	100	7595.85	7595.95	5	0.020	18.0	0.0	14.5	1.7E-07	
						0.000			0.0		
4	100	140	7611.48	7617.52	5	1.208	20.0	0.5	15.6	9.6E-06	
4	100	140	7618.47	7631.33	5	2.572	40.0	1.5	28.9	1.1E-05	VERY WEATHERED
4	100	140	7633.11	7652.48	5	3.874	61.0	2.0	43.4	1.1E-05	VOLCANIC
4	100	140	7655.31	7667.80	5	2.498	38.0	1.5	27.5	1.1E-05	COMGLOMERATE
4	100	140	7669.41	7676.71	5	1.460	19.0	0.5	14.9	1.2E-05	
						0.000			0.0		

PACKER TESTING CALCULATION SHEET

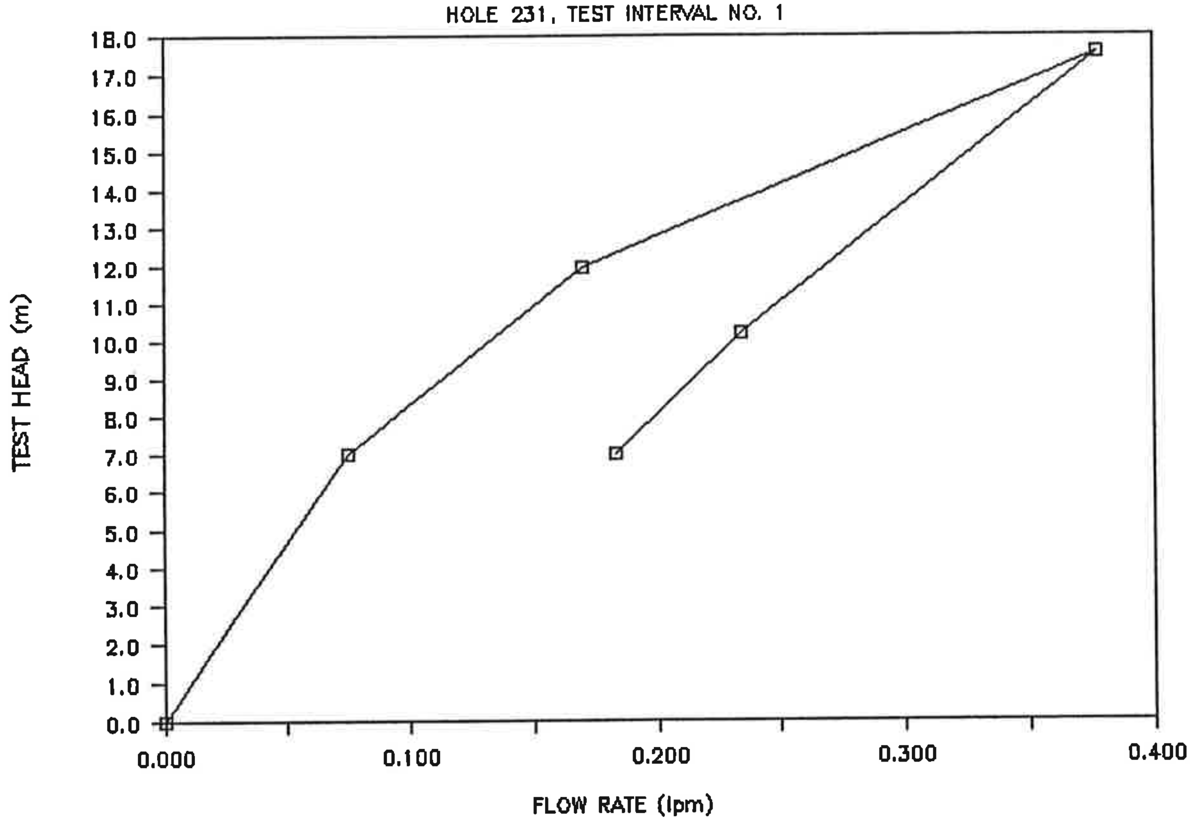
PROJECT: MOUNT POLLEY
LOCATION: TAILINGS AREA B
HOLE No: MP-89-236
TEST DATE: NOV. 11, 1989
COORDINATES(ft) N: S:

HOLE DIAMETER (inches): 2.98
GROUNDWATER DEPTH(ft): 0
BEDROCK DEPTH(ft): 25
TESTED BY: RNK
ANGLE FROM VERTICAL (deg): 0

TEST No.	INTERVAL (ft) from	to	METER RDG (liters) init	final	ELAPSED TIME (min)	FLOW RATE (lpm)	GAUGE PRESSURE (psi)	HEAD CORR'N (psi)	TEST HEAD (m)	PERMEABILITY (cm/sec)	COMMENTS
1	27	40	7712.45	7716.35	5	0.780	12.0	0.0	8.4	2.9E-05	
1	27	40	7717.01	7723.41	5	1.280	15.0	0.5	10.2	3.8E-05	WEATHERED
1	27	40	7724.50	7733.45	5	1.790	20.0	1.0	13.4	4.0E-05	GOLFBALL
1	27	40	7733.90	7737.63	5	0.746	15.0	0.0	10.6	2.2E-05	SYENITE
1	27	40	7737.81	7739.76	5	0.390	12.0	0.0	8.4	1.4E-05	
						0.000			0.0		
2	45	80	7747.68	7749.49	5	0.362	16.0	0.0	11.3	4.5E-06	
2	45	80	7750.01	7754.02	5	0.802	28.0	0.0	19.7	5.7E-06	WEATHERED
2	45	80	7755.50	7758.73	5	0.646	48.0	0.0	33.8	2.7E-06	GOLFBALL
2	45	80	7758.81	7760.01	5	0.240	28.0	0.0	19.7	1.7E-06	SYENITE
2	45	80	7760.11	7760.50	5	0.078	14.0	0.0	9.9	1.1E-06	
						0.000			0.0		
3	80	120	7769.18	7770.34	5	0.232	20.0	0.0	14.1	2.1E-06	
3	80	120	7771.41	7773.53	4	0.530	42.0	0.0	29.6	2.3E-06	WEATHERED
3	80	120	7774.05	7778.11	5	0.812	62.0	0.0	43.6	2.3E-06	GOLFBALL
3	80	120	7778.30	7780.30	5	0.400	38.0	0.0	26.7	1.9E-06	SYENITE
3	80	120	7780.31	7781.09	5	0.156	19.0	0.0	13.4	1.5E-06	
						0.000			0.0		
4	115	150	7789.57	7790.21	3	0.213	28.0	0.0	19.7	1.5E-06	
4	115	150	7791.84	7792.78	3	0.313	50.0	0.0	35.2	1.2E-06	WEATHERED
4	115	150	7794.05	7795.42	5	0.274	74.0	0.0	52.1	7.4E-07	GOLFBALL
4	115	150	7795.47	7796.12	5	0.130	48.0	0.0	33.8	5.4E-07	SYENITE
4	115	150	7796.16	7796.40	5	0.048	25.0	0.0	17.6	3.8E-07	
						0.000			0.0		

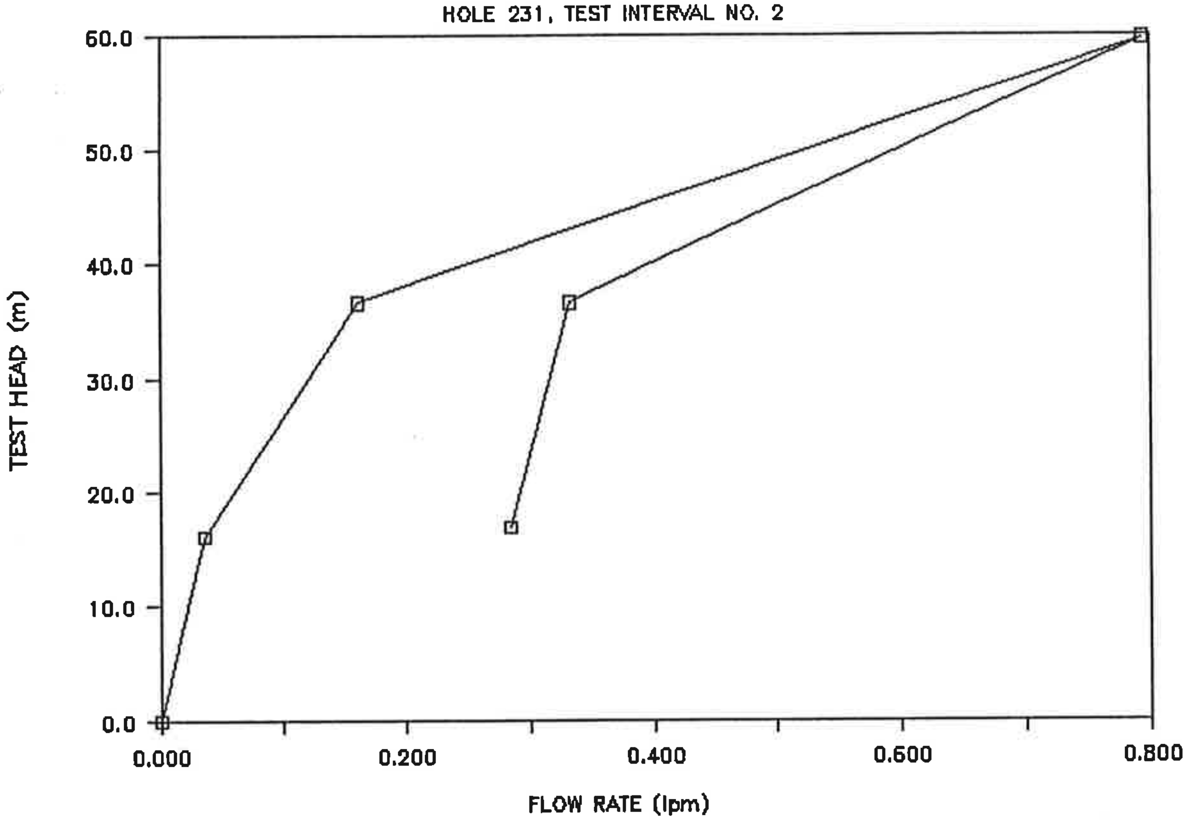
MT POLLEY PACKER TEST RESULTS

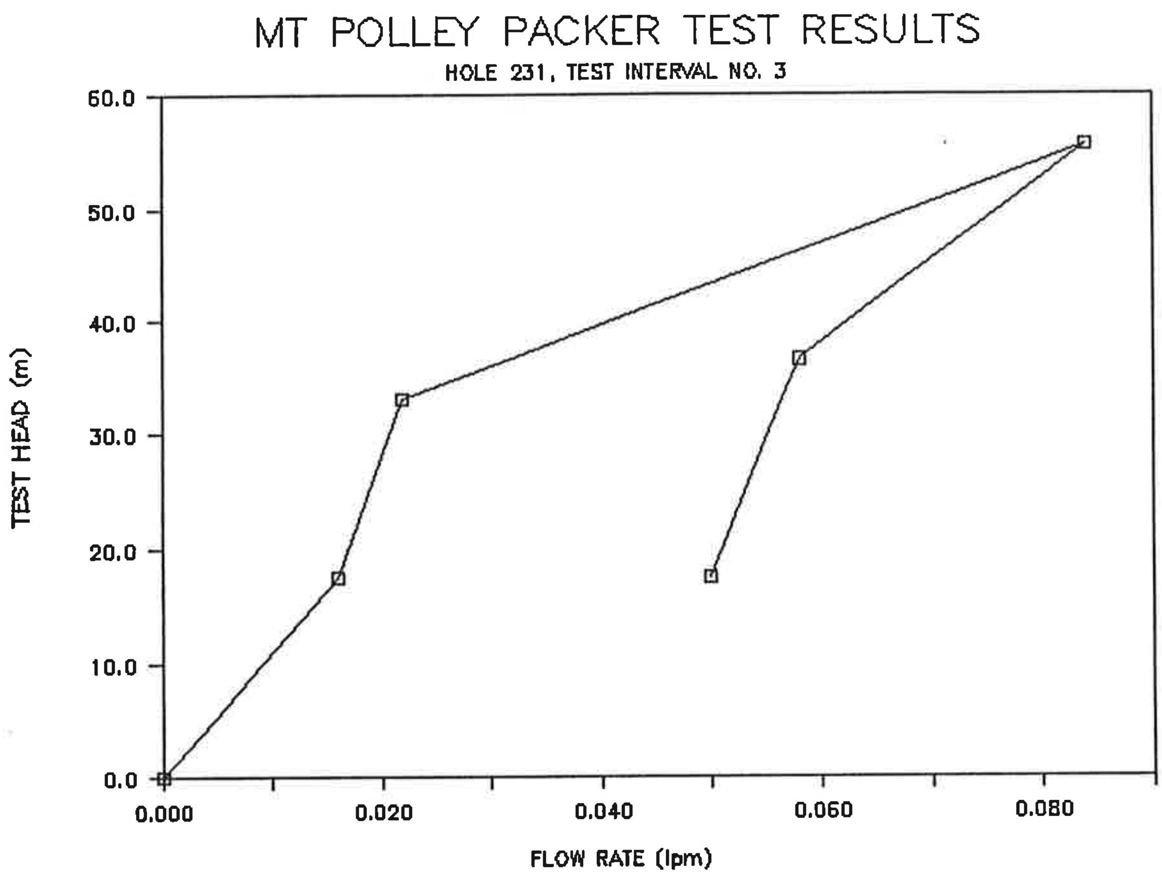
HOLE 231, TEST INTERVAL NO. 1



MT POLLEY PACKER TEST RESULTS

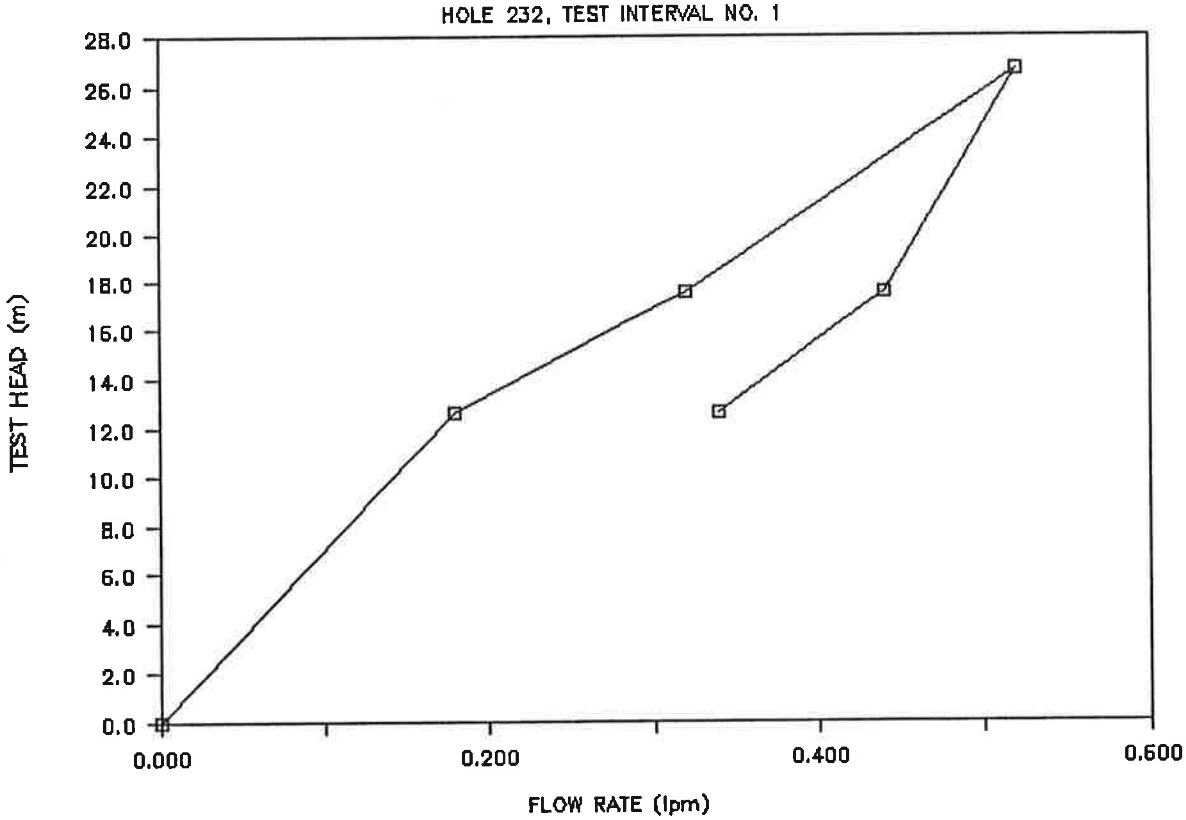
HOLE 231, TEST INTERVAL NO. 2

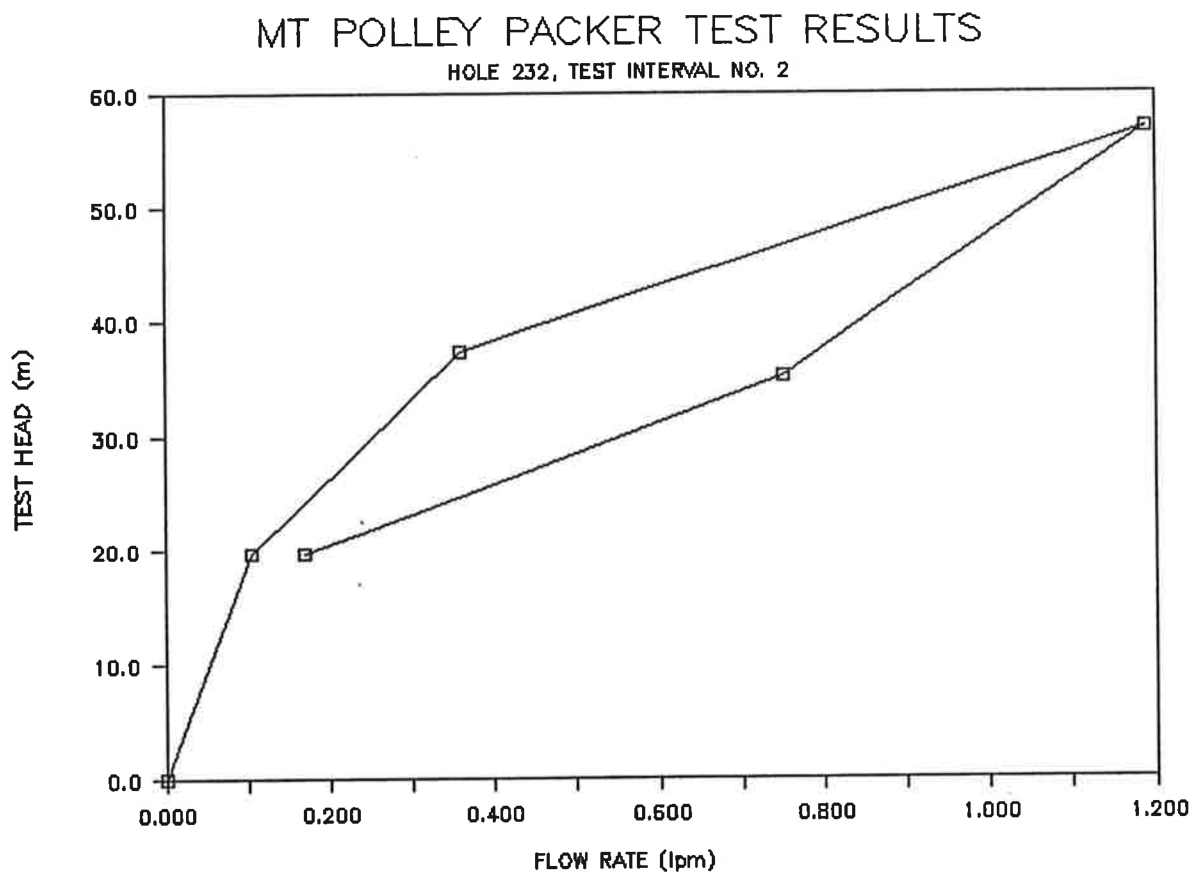



MT POLLEY PACKER TEST RESULTS
HOLE 231, TEST INTERVAL NO. 3
TEST HEAD (m)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.000
0.020
0.040
0.060
0.080
FLOW RATE (lpm)

MT POLLEY PACKER TEST RESULTS

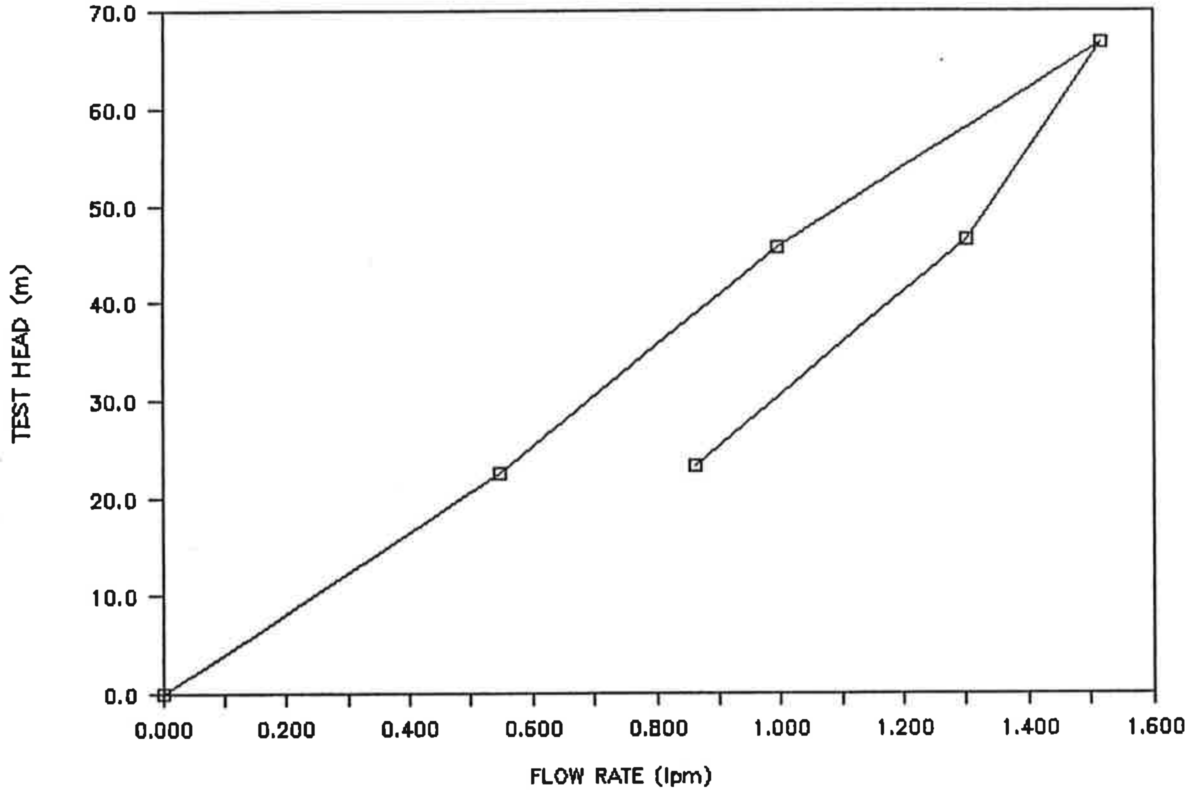
HOLE 232, TEST INTERVAL NO. 1




MT POLLEY PACKER TEST RESULTS
HOLE 232, TEST INTERVAL NO. 2
60.0
50.0
40.0
30.0
20.0
10.0
0.0
TEST HEAD (m)
0.000
0.200
0.400
0.600
0.800
1.000
1.200
FLOW RATE (lpm)

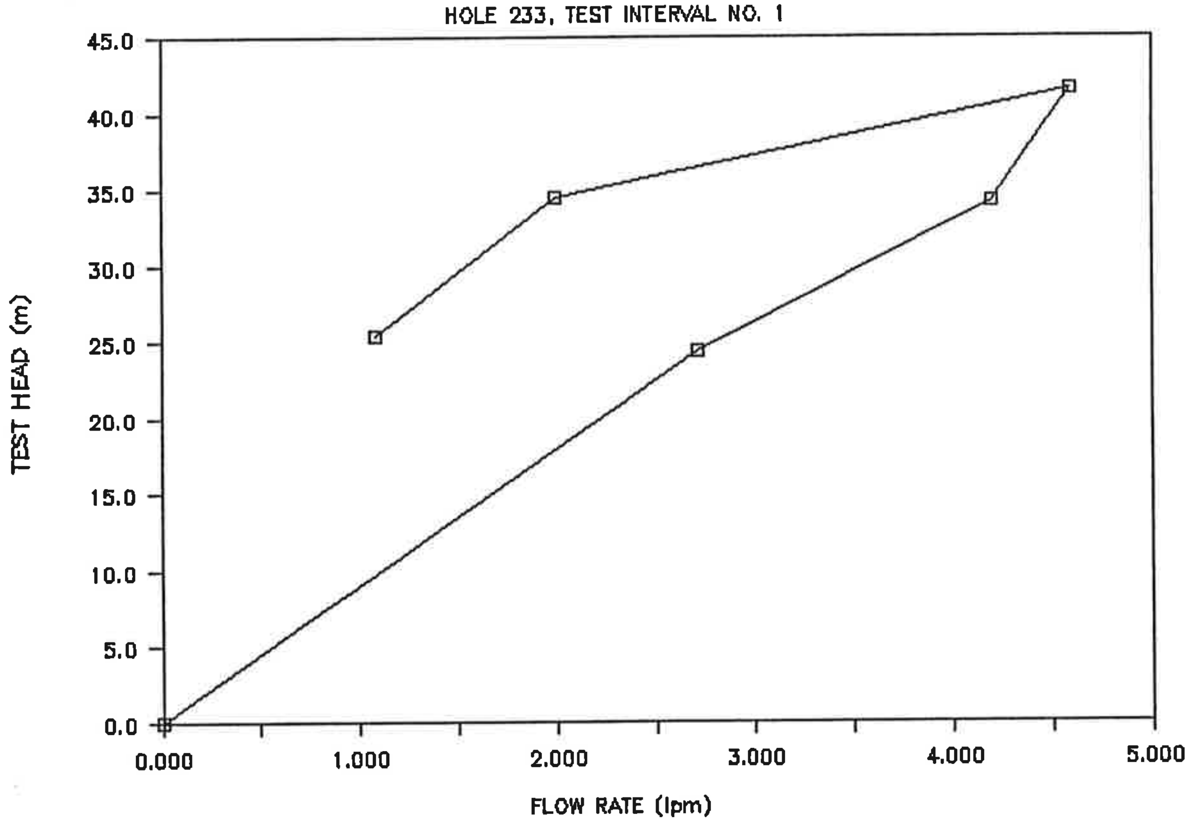
MT POLLEY PACKER TEST RESULTS

HOLE 232, TEST INTERVAL NO. 3



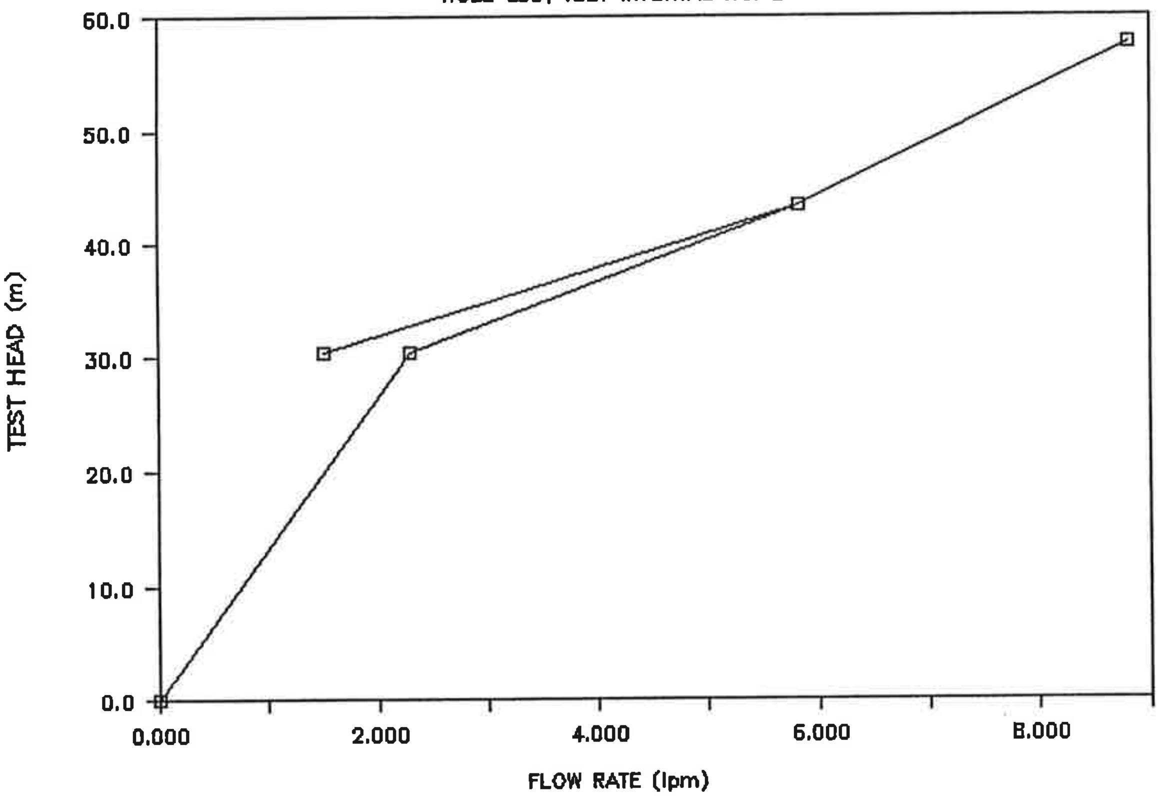
MT POLLEY PACKER TEST RESULTS

HOLE 233, TEST INTERVAL NO. 1



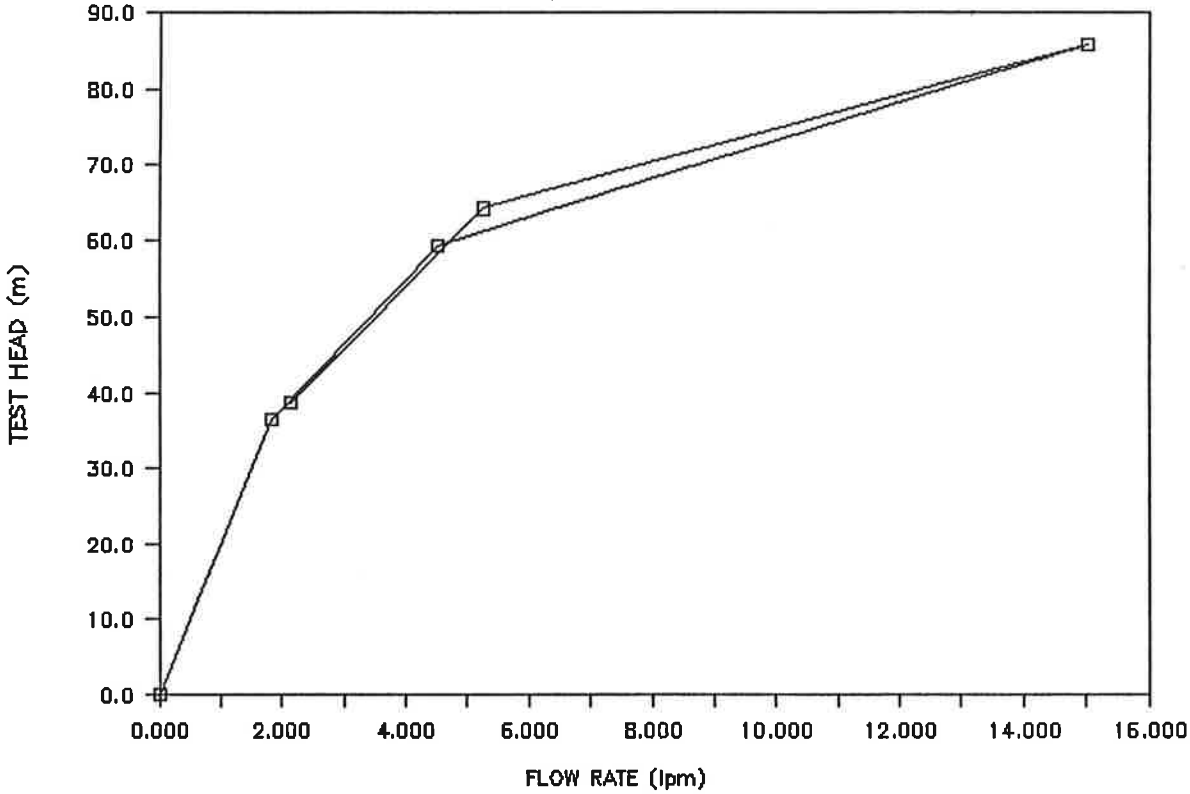
MT POLLEY PACKER TEST RESULTS

HOLE 233, TEST INTERVAL NO. 2



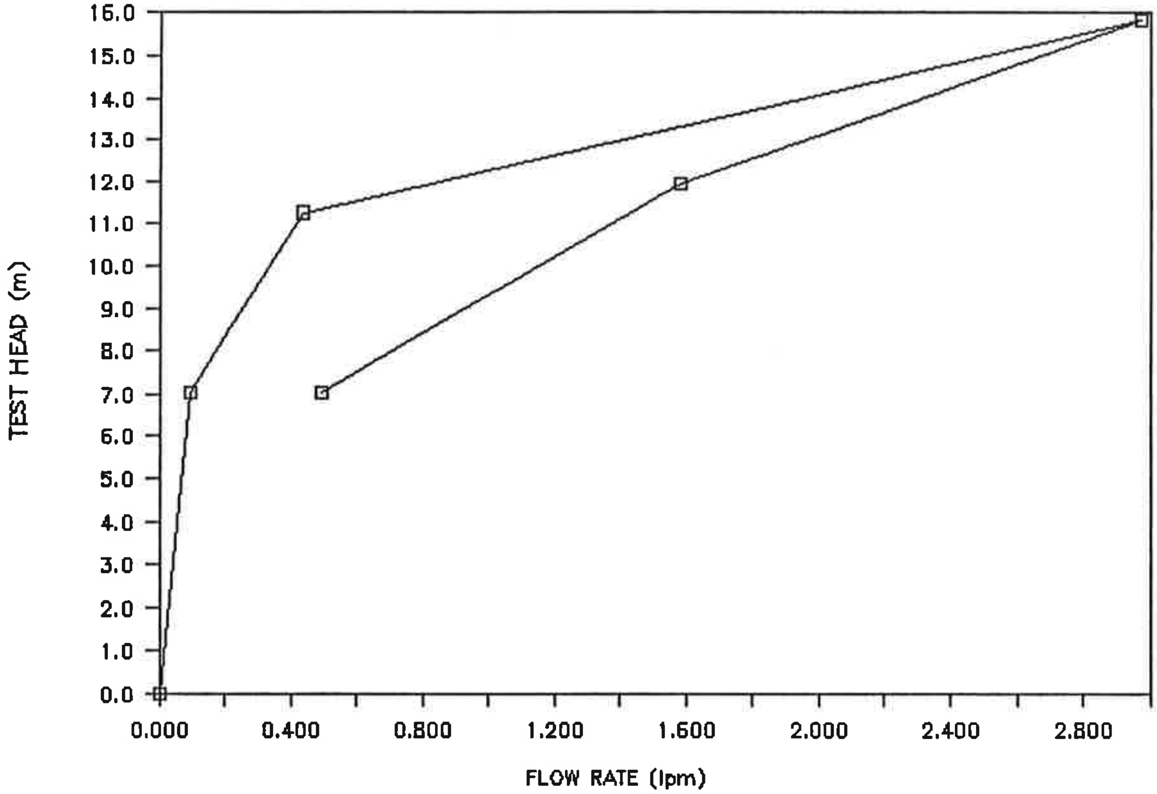
MT POLLEY PACKER TEST RESULTS

HOLE 233, TEST INTERVAL NO. 4

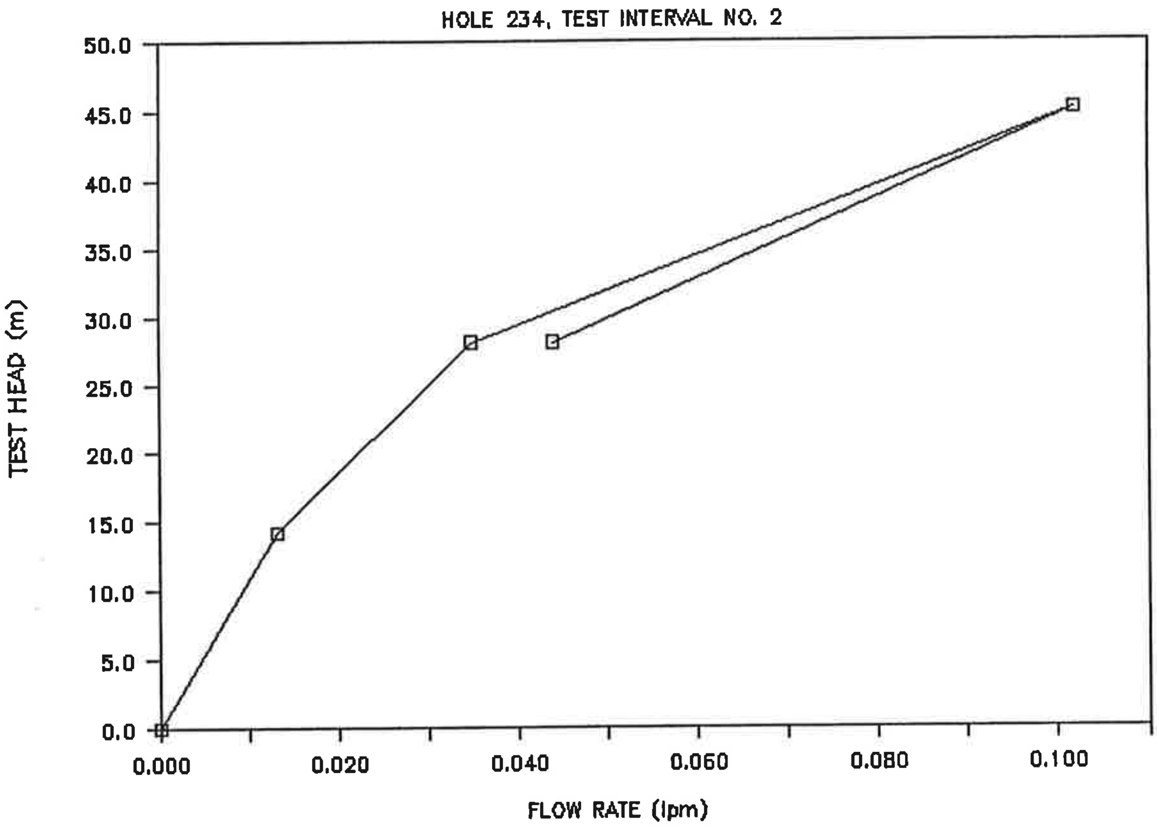


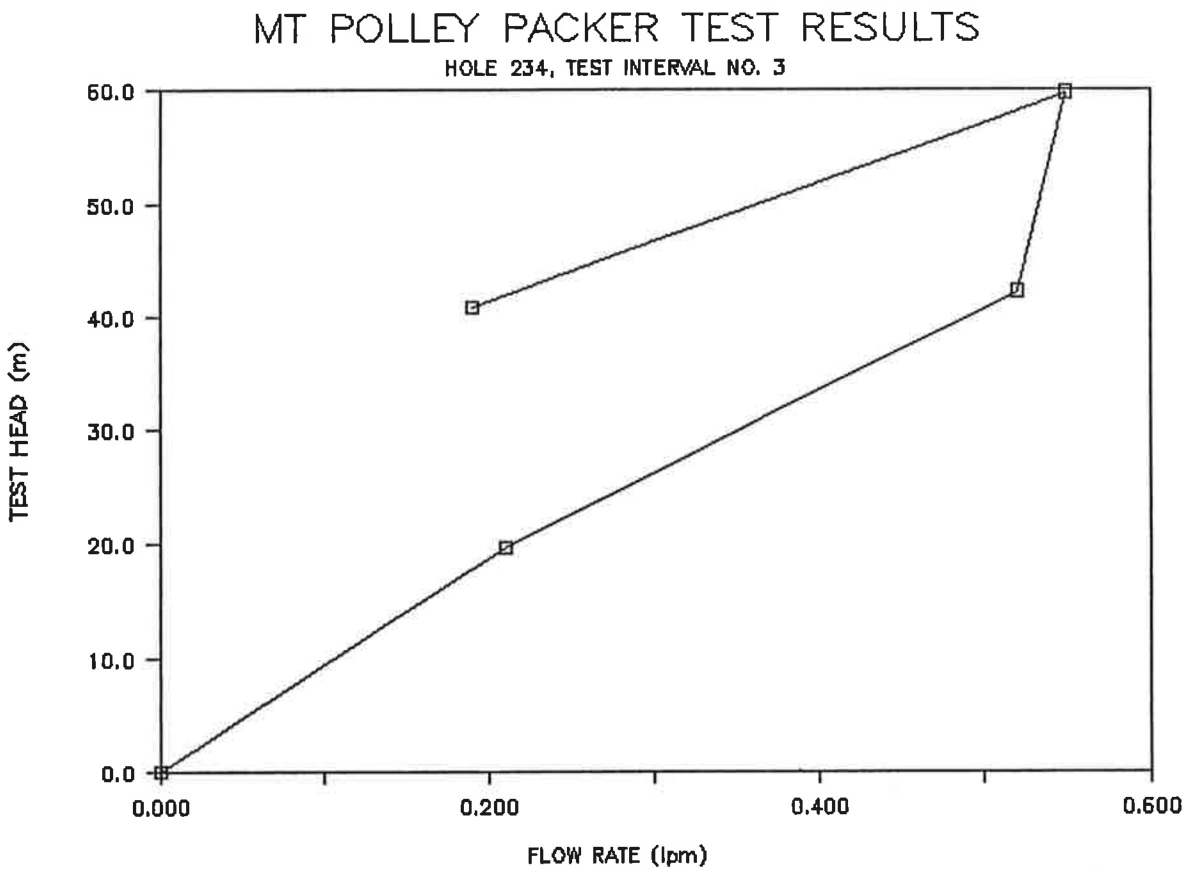
MT POLLEY PACKER TEST RESULTS

HOLE 234, TEST INTERVAL NO. 1



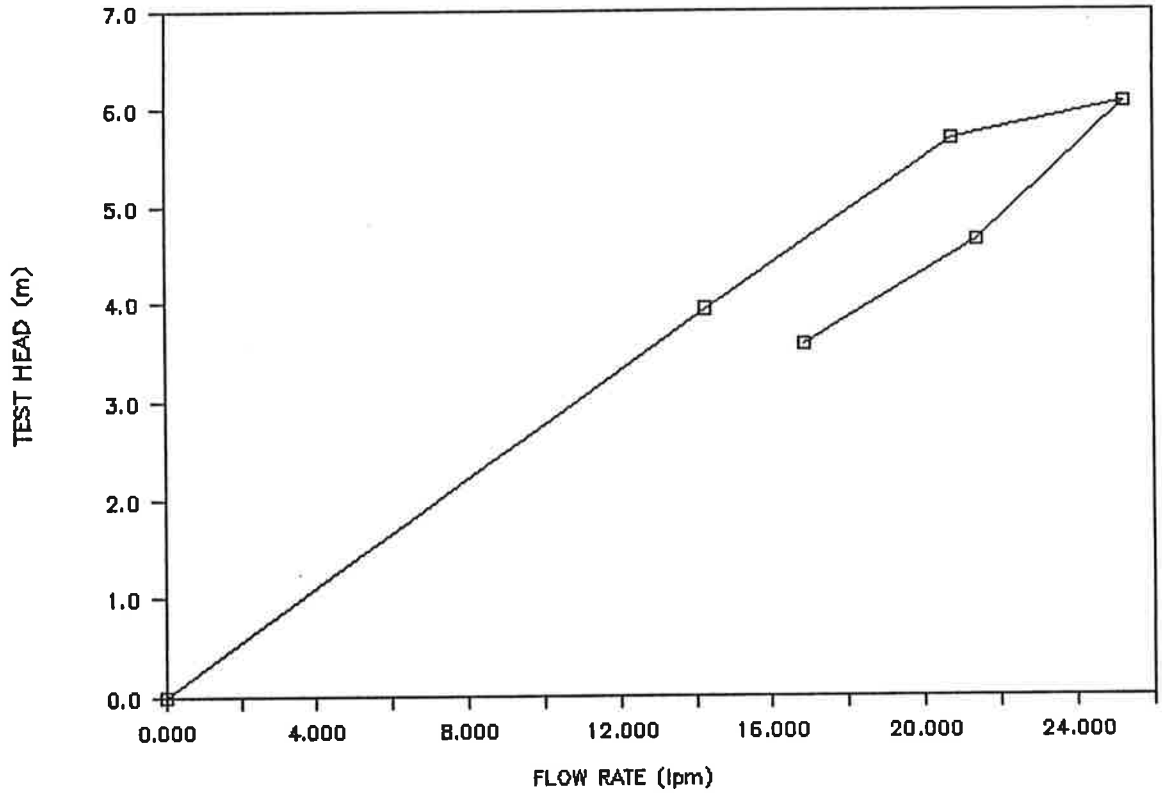
MT POLLEY PACKER TEST RESULTS




MT POLLEY PACKER TEST RESULTS
HOLE 234, TEST INTERVAL NO. 3
TEST HEAD (m)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.000
0.200
0.400
0.600
FLOW RATE (lpm)

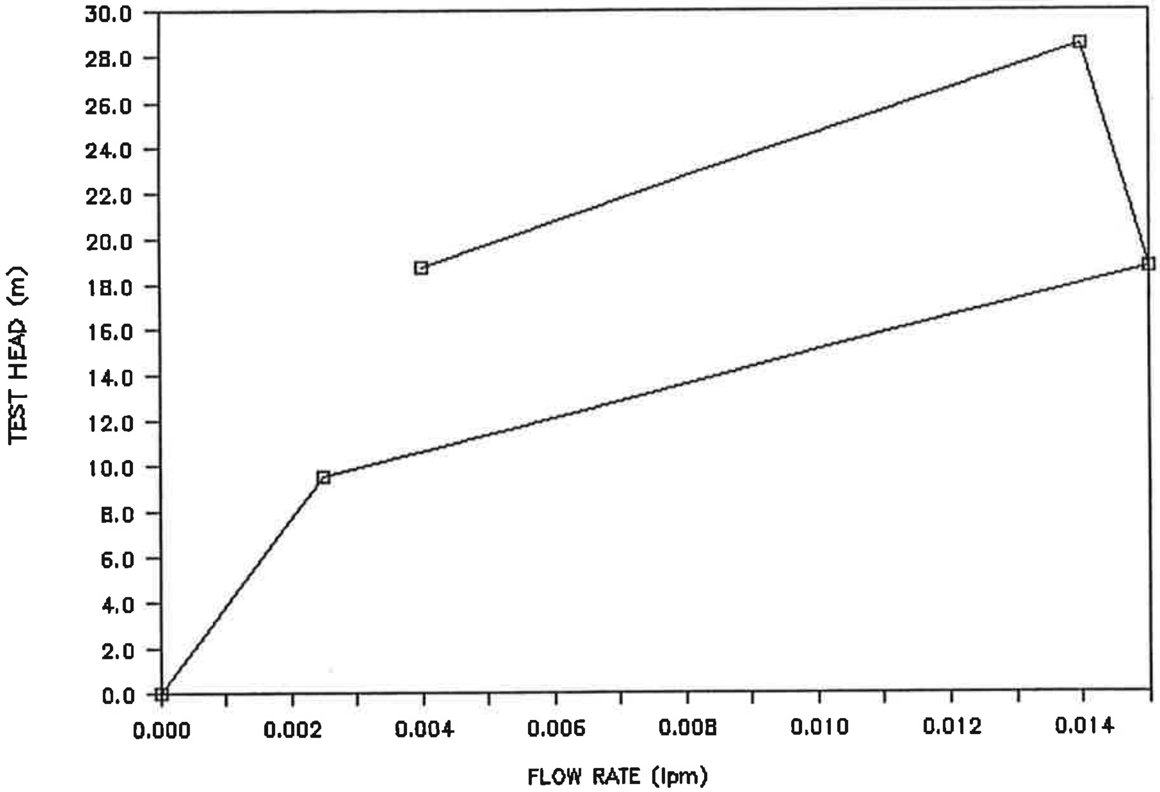
MT POLLEY PACKER TEST RESULTS

HOLE 235, TEST INTERVAL NO. 1



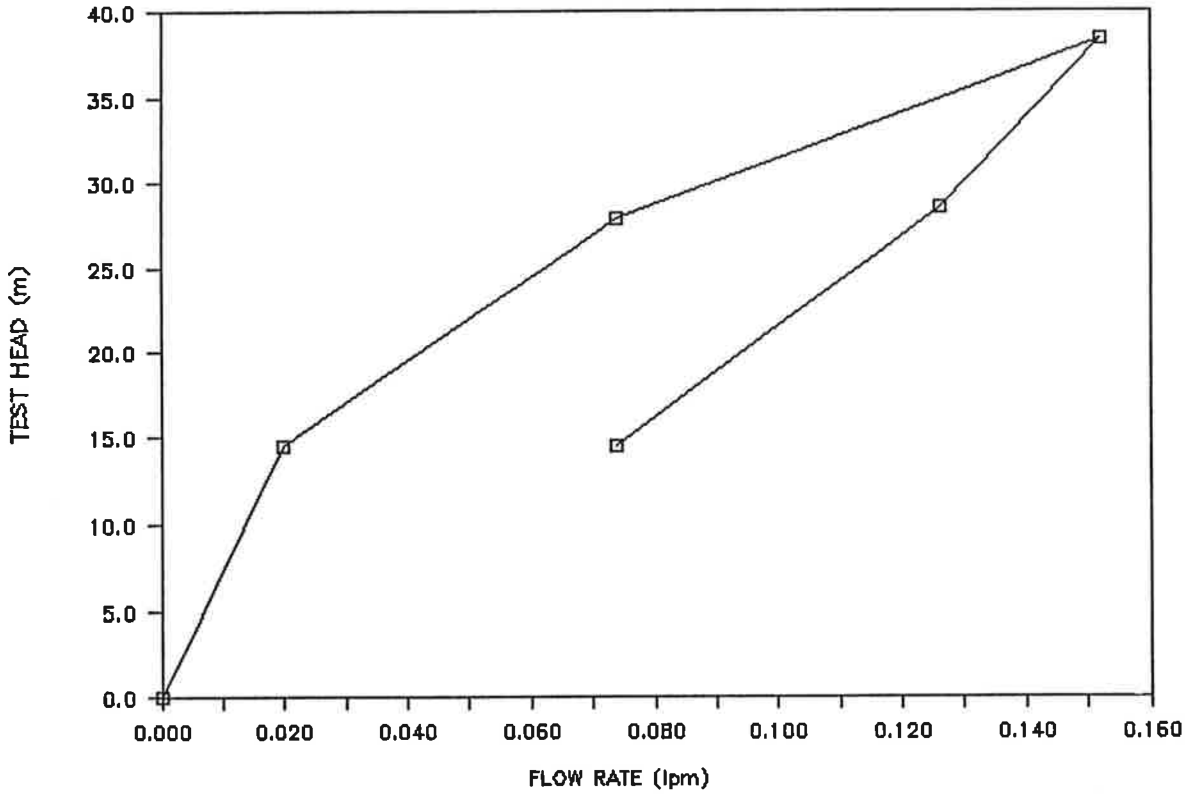
MT POLLEY PACKER TEST RESULTS

HOLE 235, TEST INTERVAL NO. 2

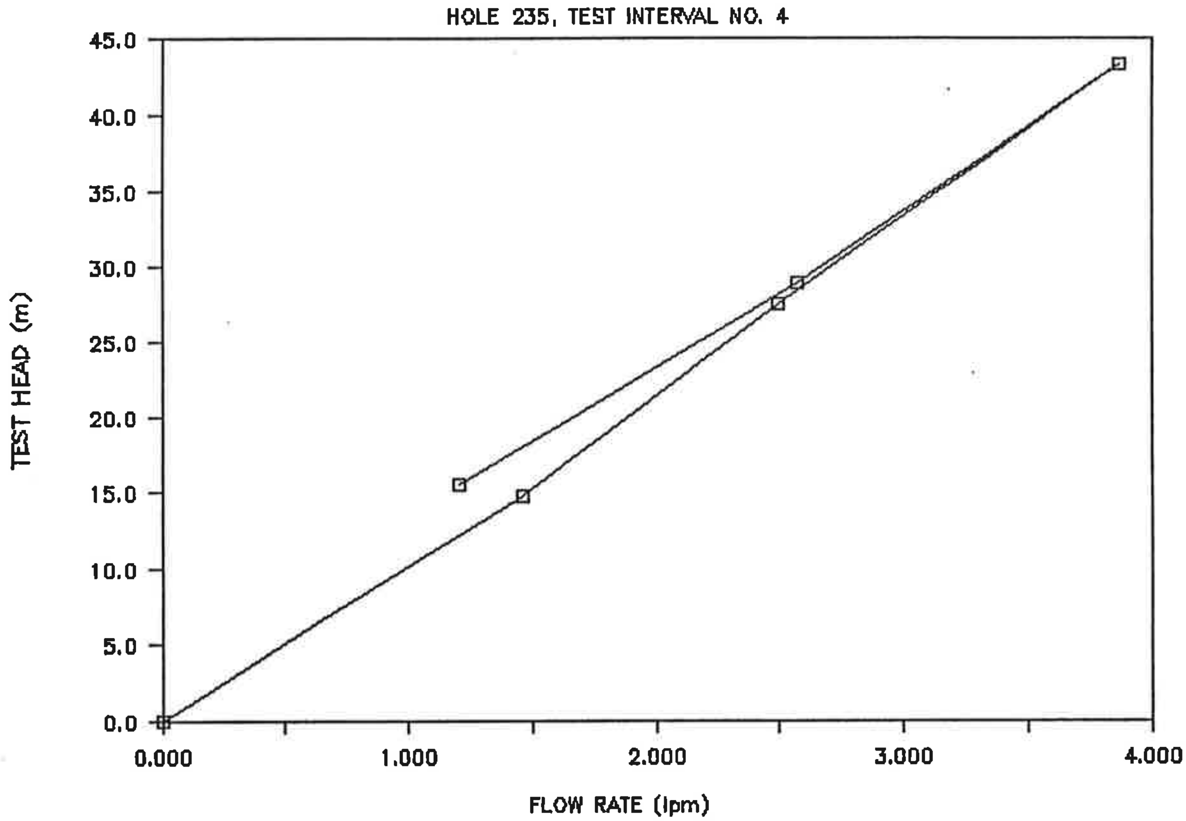


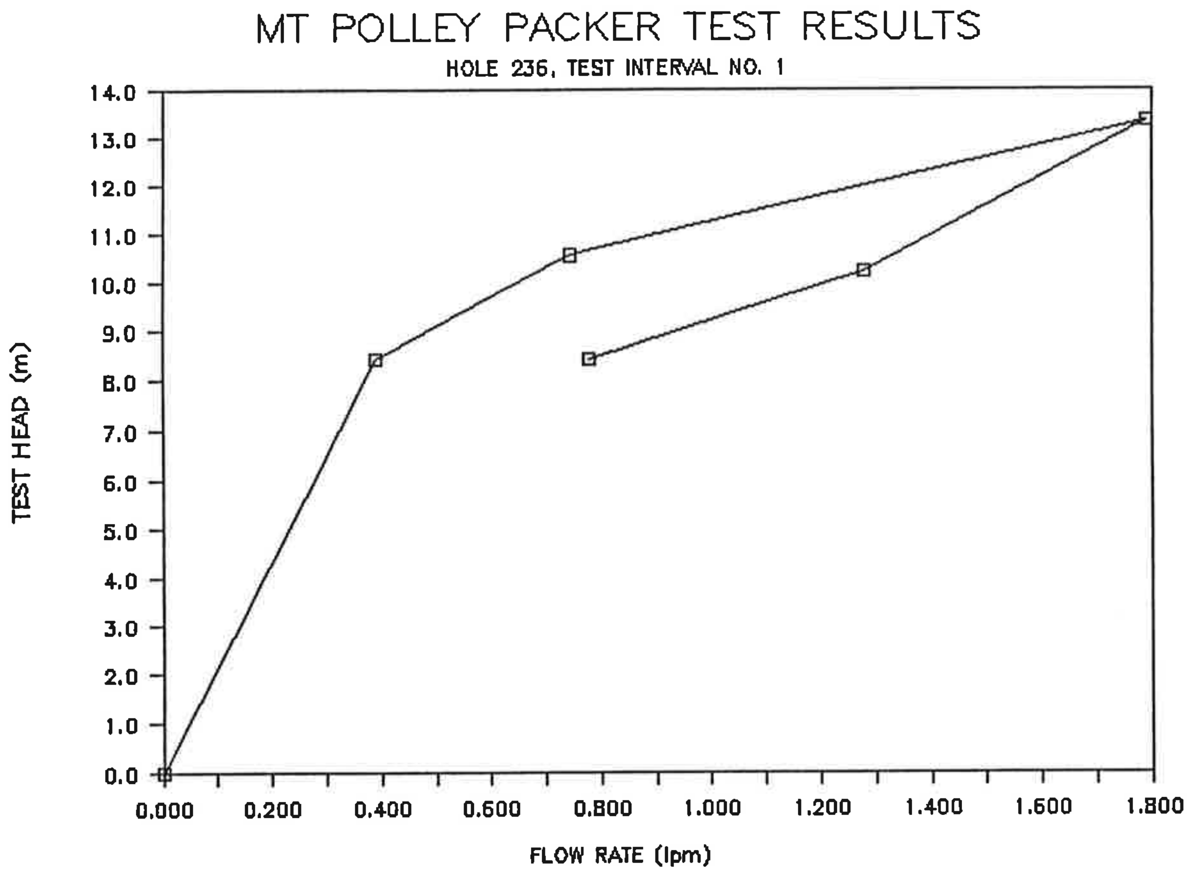
MT POLLEY PACKER TEST RESULTS

HOLE 235, TEST INTERVAL NO. 3



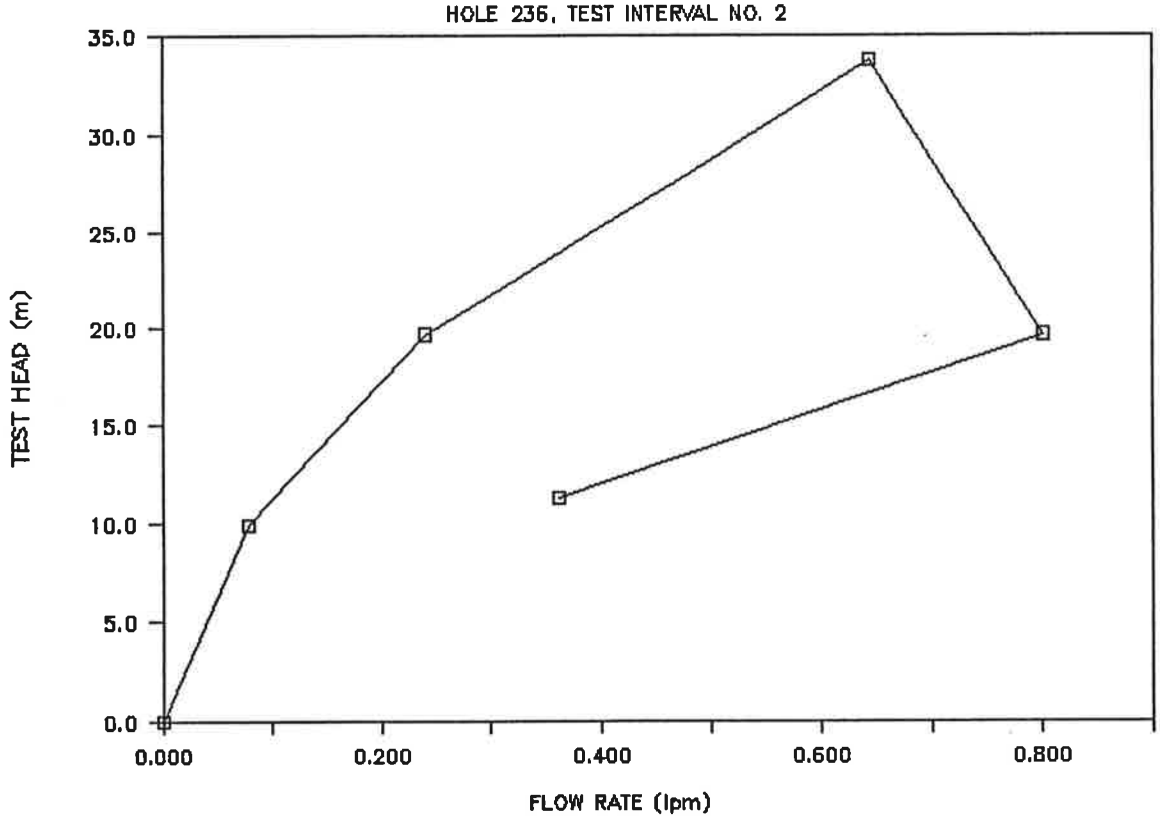
MT POLLEY PACKER TEST RESULTS




MT POLLEY PACKER TEST RESULTS
HOLE 236, TEST INTERVAL NO. 1
TEST HEAD (m)
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.000
0.200
0.400
0.600
0.800
1.000
1.200
1.400
1.600
1.800
FLOW RATE (lpm)

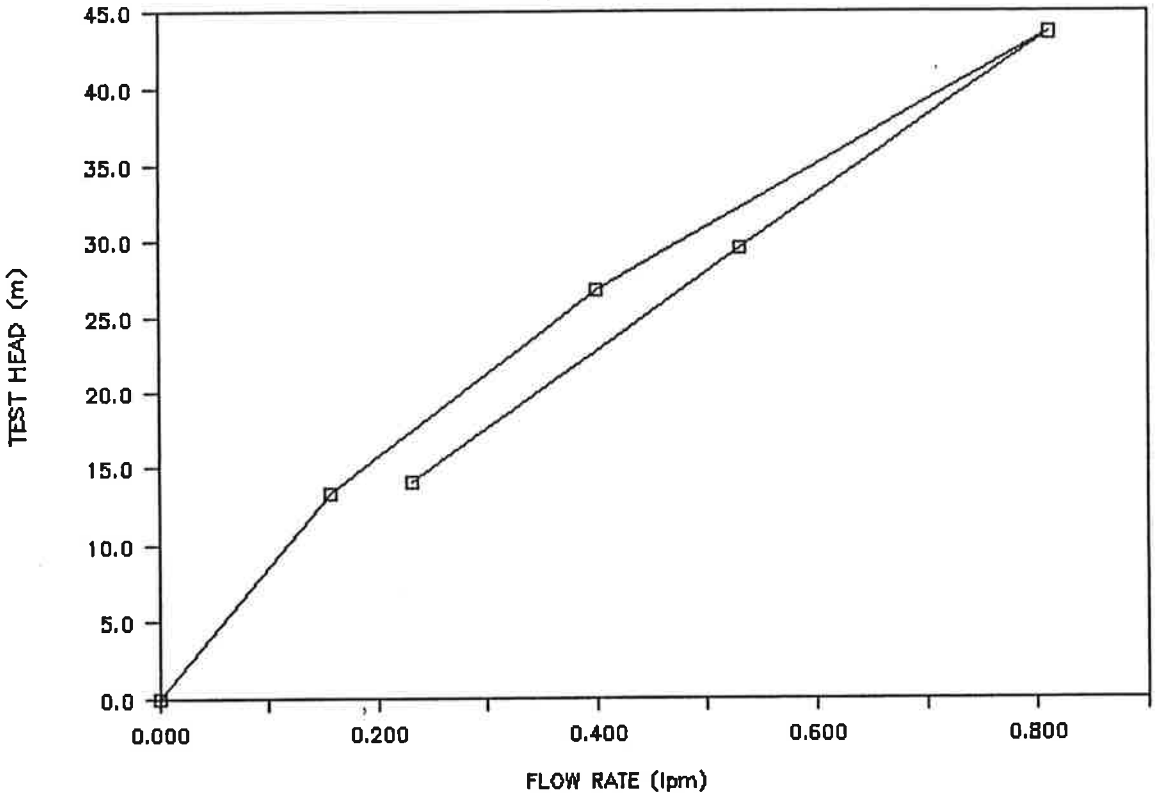
MT POLLEY PACKER TEST RESULTS

HOLE 236, TEST INTERVAL NO. 2



MT POLLEY PACKER TEST RESULTS

HOLE 236, TEST INTERVAL NO. 3



MT POLLEY PACKER TEST RESULTS

HOLE 236, TEST INTERVAL NO. 4