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REPORT ON CYCLONED SAND CONSTRUCTION OF STAGE 3 AND ON-GOING STAGES OF THE TAILINGS STORAGE FACILITY
(REF. NO. 11162/12-2)

VOLUME I OF II

Knight Piésold
CONSULTING ENGINEERS

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REPORT ON CYCLONED SAND CONSTRUCTION OF STAGE 3 AND ON-GOING STAGES OF THE TAILINGS STORAGE FACILITY (REF. NO. 11162/12-2)

SECTION 1.0 - INTRODUCTION

1.1 PROJECT DESCRIPTION

The Mount Polley gold and copper mine is owned and operated by Mount Polley Mining Corporation (MPMC). It is located in central British Columbia, 56 kilometres north-east of Williams Lake, as shown on Figure 1.1. The Mount Polley mine has been in production since June 13, 1997. Ore is crushed and processed by selective flotation to produce a copper-gold concentrate. The current mill throughput rate is approximately 20,000 tonnes per day (7.3 million tonnes per year). An overall site plan of the Mount Polley Mine is shown on Drawing 11162-12-100.

Mill tailings are discharged as a slurry into the Tailings Storage Facility, which has been designed to provide environmentally secure storage of the solid waste. As the solids settle out of the slurry, process fluids are collected and recycled back to the mill for re-use in the milling process. There is no surface discharge of any process solution from the Tailings Storage Facility.

Knight Piésold Ltd. were originally engaged by Imperial Metals Corporation in 1989, to provide engineering services for the design of the Open Pit, Waste Dumps and Tailings Storage Facility. In the period since, Knight Piésold Ltd. has provided the following services:

- Detailed design of all stages of the Tailings Storage Facility and Ancillary Works completed to date.
- Preparation of contract documents and technical specifications for all stages of the Tailings Storage Facility construction to date.

- Construction supervision and quality assurance/quality control (QA/QC) for all stages of the Tailings Storage Facility completed to date.

- Geotechnical investigations for engineering design and construction materials suitability.

- Consulting services provided to the mine on all aspects of the operation and monitoring of the Tailings Storage Facility.

1.2 TAILINGS STORAGE FACILITY

The Tailings Storage Facility is currently comprised of the following components:

- A pipeline system which conveys the tailings slurry via gravity from the Mill Site to the Tailings Storage Facility. Up until 1999, the system had included a moveable discharge section, with spigot offtakes to distribute tailings from along the embankment crests. As of 1999, the system includes six - 20" discharge cyclones, which allow for the coarse tailings underflow fraction to be preferentially discharged along the upstream edge of the tailings embankments. The fines tailings fraction reports to the tailings deposit via cyclone overflow discharge pipes. In addition, a point discharge pipe allows for bulk tailings to be discharged directly into the tailings deposit, thus bypassing the cyclones.

- A make-up water supply system to provide extra water to the Tailings Storage Facility. The system comprises an intake and pump at Polley Lake and a pipeline to convey the water to the Tailings Storage Facility. The water is discharged into the Tailings Storage Facility near the northwest abutment of the Perimeter Embankment.

- The Mill Site Sump and Southeast Sediment Pond that provide additional make-up water to the system. Mill Site runoff is directed from the Mill Site Sump into the tailings line near the mill. Flows from the Southeast Sediment Pond enter the system at the reclaim booster pump station or at the T2 Tailings Dropbox.

- Earthfill embankments, which retain the tailings solids within the Tailings Storage Facility. The Main Embankment has a vertical chimney drain, with a collector (longitudinal) drain and three outlet drains.

- A low permeability basin liner (natural and constructed) provides containment of process fluids within the facility and minimises the potential for seepage through the tailings basin soils.

- A foundation drain and pressure relief well system located downstream of the Main Embankment to prevent the build-up of pressure in foundation materials and to collect seepage from the base of the Tailings Storage Facility. An engineered rockfill haul road located downstream of the embankment covers the foundation drains and the trenches that connect the pressure relief wells to the foundation drains.

- Seepage collection ponds located downstream of the Main and Perimeter Embankments. The seepage collection ponds are excavated in low permeability soils and store water collected from embankment drains and local runoff. Water is pumped back into the Tailings Storage Facility.

- Instrumentation in the tailings and embankment foundations, fill and drains (including vibrating wire piezometers, survey monuments and the measurement of drain flows) used to monitor the performance of the Tailings Storage Facility.

- A reclaim water system comprising a barge-mounted pump station in an excavated channel, a booster pump station and a pipeline that provides process water to the mill.

- A system of monitoring wells installed around the Tailings Storage Facility for groundwater quality monitoring.

The Main, Perimeter and South Embankments form the boundaries of the tailings impoundment. In the final configuration, the tailings embankments will be connected and will form a three-sided impoundment. Specific design and operating information is presented in the various Knight Piésold reports referenced in Section 11 of this report.

The Tailings Storage Facility has been designed to incorporate staged construction during operations in order to minimize initial capital expenditures and to maintain an inherent flexibility to allow for variations in operation and production throughout the life of the mine. The construction stages incorporate a combination of centreline and modified centreline construction methods, with on-going raises providing incremental storage capacity for one or two years of production. This observational design approach requires that the proposed raises must be continually re-evaluated during operations to ensure that adequate storage capacity and embankment freeboard are maintained throughout the mine life. It also allows for design modifications to be incorporated in order to respond to specific opportunities or constraints and/or to defer or reduce on-going costs for tailings disposal and for water management.

1.3 SCOPE OF REPORT

MPMC have requested that Knight Piésold complete a geotechnical evaluation of a revised design concept for the tailings embankments. This revised design concept would require the coarse sand fraction to be extracted from the bulk tailings stream by cycloning for incorporation into the downstream shell zones of the embankments. The central core zone of low permeability glacial till would be retained as a seepage control measure in the embankments.

This report presents the concepts for the on-going construction and operation of the tailings impoundment using cycloned sand as a primary construction material. It is intended to provide supporting documentation for revisions to current operating permits. Based on the results of the design report, technical specifications and construction drawings will also be required for each embankment raise. Specific design items, which are addressed in this report, include:

- Characteristics of the cycloned sand that is produced with the 20-inch cyclones.

- Results of upstream and downstream cycloned sand trial programs, including in-situ and laboratory testing on the cycloned tailings sand.

- General design features including geotechnical considerations, annual water balances, operating requirements, on-going construction and final reclamation.

- A risk assessment of the Tailings Storage Facility and related systems.

MPMC have retained responsibility for the design of the cyclone operating system and Knight Piésold have been assigned responsibility for evaluating the geotechnical aspects of the proposed cycloned sand construction methodology. However, Knight Piésold have also evaluated the operating methods employed by MPMC during construction of the Upstream and Downstream Trial Berms during 1999, and have provided recommendations for improving the efficiency of the pipeworks systems and cyclone operations. This overview evaluation has also allowed Knight Piésold to complete the Risk Assessment for the proposed operating scenario.

Knight Piésold has also considered the cycloned sand materials balance in some detail in order to evaluate the construction sequencing required to facilitate direct hydraulic placement of cycloned sand materials in the embankment shell zones. This sequencing is important in order to minimize the volume of embankment fill that will need to be placed by mechanical methods. However, these material handling requirements and construction sequences require a detailed review by MPMC, since the methods and procedures for cycloned sand production and placement may require increased staff as well as additional equipment and mechanical support as compared to the trial programs implemented in 1999. The construction sequences and placement methods will also impact the geotechnical characteristics of the embankments and the design and operation of the water management systems.

SECTION 2.0 – PROPOSED MODIFICATIONS TO IMPOUNDMENT DESIGN

2.1 GENERAL

The proposed design revisions for the embankment are illustrated schematically on Figure 2.1. In summary, the following modifications can be identified from this figure:

- The use of a significant fraction of the tailings stream as a construction material results in a reduction in the required storage capacity for the impoundment. The ultimate height of the impoundment and confining embankments is reduced by approximately 3 meters.

- The downstream slope of the embankment is flattened from 2H:1V to 3H:1V, which is better for closure.

- The core zone alignment has been modified to be consistent with a centreline construction methodology rather than the slightly upgradient inclination that was incorporated in the previously envisaged modified centreline construction methodology.

- The internal drainage measures have been modified to take advantage of the relatively free draining nature of the cycloned sand. These revisions include the removal of vertical extensions to the chimney drain and addition of underdrainage features such as spine drains.

- Additional vibrating wire piezometers will be installed to monitor drainage in the cycloned sand shell zone.

- The drainage sump and associated pipeworks will be relocated to facilitate placement of the flatter embankment slope.

- The Seepage Recycle Ponds and runoff collection ditches will be modified to allow construction of the flatter embankment slopes and to support the updated water management plan.

These design modifications have been incorporated into the updated Stage 3 design Drawings 11162-12-100 to 159. An updated Final Arrangement for the impoundment is also included on Drawing 11162-12-200.

The use of cycloned sand for construction of embankment shell zones is predicated on the assumption that the cycloned sand product will be geochemically inert. MPMC have completed a comprehensive evaluation of the geochemical characteristics of the tailings and have determined that it will be suitable for use in the embankment zones ("Tailings Cyclone Sands Geochemical Evaluation", Mount Polley Mining Corporation).

2.2 REVISED IMPOUNDMENT FILLING SCHEDULE

The filling schedule has been updated for the cycloned sand embankment concept as shown on Figure 2.2. The impoundment storage requirements have been reduced by the volume of sand that will be used to construct the embankment shell zones, but have been partially offset by an anticipated reduction in the stored density of the finer impounded tailings. Allowances for storage of process water, make-up water from Polley lake and emergency freeboard for containment of runoff from the PMP event along with an additional 1 meter for wave run-up have not changed from previous studies.

The filling schedule for the period from start-up in 1998 to the end of 2002 is also presented on Figure 2.3, to allow more detailed inspection when considering the specific requirements for Stage 3 construction. The revised quantities for Stage 3 construction are summarized in Table 2.1.

2.3 UPDATED DESIGN CRITERIA

The design criteria for the Tailings Storage Facility are summarized in Table 2.2. Items that have been changed or have been added since the last Knight Piésold Updated Design Report (Ref. No. 1627/2, June 1997) are as follows:

- Tailings throughput 20,000 tpd
- Final embankment height 962 m

•	Cycloned sand downstream shell slope	3H:1V
•	Cycloned sand angle of repose	5.5H: 1V
•	Pulp density of cycloned sand underflow	75%
•	Average cyclone availability	75%
•	Cyclone underflow/overflow split	35% / 65% ?
•	In-situ dry density of cycloned sand underflow	1.6 t/m^3 X ?
•	Annual cycloned sand production rate	3200 m^3/day
•	Annual cycloned sand operation period	7 months
•	Cycloned sand permeability	7 x 10^{-4} cm/s ?

The cycloned sand production rate of 3200 m^3/day is based on the mill throughput of 20,000 tpd at a 35% split and a 75% availability. The 75% availability is an assumed value that has not yet been confirmed during the 1999 cyclone trial programs. It is understood that MPMC will implement modifications to the pipeworks systems and operating procedures in order to achieve this higher level of availability.

SECTION 3.0 – CYCLONED SAND TRIAL PROGRAMS

3.1 GENERAL

The use of cycloned sand for tailings embankment construction was addressed in the Knight Piésold document "Evaluation of Cycloned Tailings for Embankment Construction" (Knight Piésold Ref. No. 11162/11-1). This report provided a preliminary evaluation of the use of cycloned tailings sand for construction of the Mount Polley Mine tailings embankments.

Cycloned sand tailings were first produced at the mine in a trial program in September and October, 1998. Two cyclones were used; one with a diameter of 50 inches (Krebs D50) and one with a diameter of 20 inches (Krebs D20). The cyclones were set up on skid mounted frames, near the left abutment of the Perimeter Embankment. Results of this program determined that the cycloned sand had suitable geotechnical properties and would be acceptable for use as embankment fill. This study recommended that trial studies be carried out in 1999 in order to evaluate the techniques to be employed in constructing the embankment using cycloned sand. These additional trial studies would also be carried out to confirm the suitability and availability of cycloned sand for use in future embankment construction programs.

Two separate trial programs were conducted during 1999. These included construction of an Upstream Trial Berm along the upstream crest of the Main and Perimeter Embankments and a Downstream Trial Berm constructed in a local cell immediately adjacent to the Perimeter Embankment Seepage Collection Pond. Extensive field and laboratory testwork have been carried out in conjunction with these trial programs.

A Cone Penetration Testing (CPT) program was conducted in November 1999 following cyclone operation. This testing was carried out in part to assess cycloned sand materials suitability. A total of twenty three (23) CPT tests were carried out along the upstream Main and Perimeter embankment Upstream Trial Berms and the Perimeter embankment Downstream Trial Berm, as discussed in Section 3.4.5.

3.2 RESULTS OF UPSTREAM TRIAL BERM

As a trial run to evaluate a full-scale cycloning program, cycloned sand tailings were utilized in the upstream shell zone of the 1999 Stage 2C embankment. This consisted of constructing a cycloned sand berm directly upstream of the Main and Perimeter Embankment crests. Upstream cycloned sand deposition took place along the Main and Perimeter embankments from May to October, 1999. Six 20-inch diameter cyclones were used. Typical cyclone operations consisted of four cyclones being operational, with the additional two cyclones used to maintain cycloned sand deposition during cyclone moves.

From May to August 1999, approximately 200,000 m^3 of cycloned sand was deposited along the Main Embankment upstream berm. Material from the cycloned sand berm was mechanically placed along the upstream till core interface, to provide an upstream embankment shell zone. The original plan for upstream deposition included for two cyclone passes to be made along the Upstream Trial Berm areas, to reach the final cyclone berm geometries. Actual deposition along the upstream Main Embankment was completed in one pass, in order to minimize cyclone moves. The Upstream Trial Berm was constructed to an elevation of 940 meters, with a height of about 4 meters along the extent of the Main Embankment. The cycloned sand piles typically set up at an angle of repose of about 5.5H:1V, although flatter sections were also encountered at some cyclone locations.

The cyclones were positioned upstream of the Perimeter Embankment during September and October 1999. During some of this time, two of the cyclones were used for deposition within a Downstream Trial Berm, as discussed in Section 3.3. Due to accelerated construction requirements, upstream cyclone operations along the Perimeter Embankment were suspended in October 1999, prior to the completion of a continuous upstream cycloned sand berm. Stage 2C construction along the Perimeter embankment allowed for upstream cycloned sand to be used in conjunction with a rockfill coarse bearing layer, over which a till upstream shell zone would be constructed.

Results of the 1999 upstream cyclone operations confirmed that the geotechnical characteristics of the cycloned sand underflow are suitable and suggest that these materials can be used to construct the shell zones of the embankments. The drainage characteristics of cycloned sand were found to be sufficient to support medium-weight machinery within several days following deposition. Drainage of the sand was found to be accelerated by equipment trafficking within the cycloned sand areas. Drainage was also enhanced by excavation of a drainage ditch between the upstream embankment till core and the cycloned sand berms.

The 1999 cyclone operations also allowed for an evaluation of techniques to be employed in constructing the embankment using cycloned sand, as well as to confirm the suitability and availability of cycloned sand for embankment construction. These aspects are discussed further in subsequent sections of this report.

3.3 RESULTS OF DOWNSTREAM TRIAL BERM

The Downstream Trial Berm was constructed in two phases during September and October 1999. The trial berm was built along the downstream side of the Perimeter Embankment to assess the performance in two phases of cycloned sand tailings placement in the downstream shell zones where better underdrainage conditions could be achieved. For Phase 1 cyclone deposition, a small rockfill confining berm was constructed along the downstream toe of the trial area as shown on Figure 3.1.

Two planes of vibrating wire piezometers were installed within the trial berm area, to assess the piezometric conditions along both a "drained" and "undrained" section of the trial discharge area. As shown on Figure 3.1, the "drained" section was positioned along existing piezometer plane "D", at the location of the Perimeter embankment outlet drain OD-4. An "undrained" piezometer plane "F" constitutes a new section of piezometers, and was positioned 20 metres south-east of plane "D". It should be noted that the entire base of the trial area is underlain by pervious free draining Zone T materials, and the "drained" and "undrained" designations have been adopted to distinguish between areas of the trial that may or may not be influenced by the existing gravel outlet drain (OD-4) which extends up the 2H:1V slope of the Stage 2 embankment in this area. Pore pressure results from the monitoring of Planes "D" and "F" piezometers are included in Appendix B.

Two backhoe trenches were excavated within the cycloned sand deposit following Phase 1 deposition. Nuclear densometer field density and moisture content testing were carried out with depth within each trench, and samples were collected for further laboratory testing. Additional surface tailings samples were also collected from various locations within the downstream trial area. The Phase 1 trenches and sampling locations are shown on Figure 3.1, with results of laboratory and field testing summarised in Table 3.1, as well as Appendices A and B.

Results of the trenching program indicate that cycloned sand achieved about 95% compaction from hydraulic placement alone, with moisture content values ranging from approximately 8% near the surface to over 25% within saturated zones at depth. The trenching program also provided direct evidence of the drainage in the sand pile. In Trench No 1, the phreatic surface was encountered at a depth of about 2 meters, whereas in Trench No 2 the water level was identified at a depth of about 3.5 meters. This variation in phreatic depth is attributed to the fact that active cycloning over Trench No 1 stopped two weeks earlier than that of Trench No 2. Other factors may include a slight difference in the duration of cycloning as well as slight variations in sand gradations from the two cyclones. These observations suggest that the rate of percolation ranged from 0.2 to 0.4 m/day within the trial area. This percolation rate must be factored into the cycloned sand placement strategy, particularly when the drained sandy tailings are used to construct confining berms for containment of successive layers of sand. These results indicate that 1 to 3 weeks of drainage will be required in order to allow adequate drainage to occur in the top 2 to 4 meters of the sand deposit.

The Phase 2 trial area was prepared by excavating the toe of the previously deposited cycloned sand with a backhoe and placing it along the inside of the Phase 1 rockfill berm to a height of about 2 meters. This berm served to contain cycloned sand during the second phase of deposition. As shown on Figure 3.1, the cycloned sand was deposited at an angle of repose of approximately 5.5H:1V, which was similar to the slopes formed on the Upstream Trial Berm.

The flow rates from outlet drains OD-4, 5, and 6 were also monitored during cycloned sand placement in the downstream trial area, and are included in Appendix B. A peak flow rate of about 3 l/s was measured during the trial program. Extrapolation of this peak flow rate to full scale operations using six cyclones yields an estimated water recovery rate of 15 l/s to 20 l/s. An independent check on this extrapolated value can also be obtained by calculating the volume of water that will drain from the cycloned sand. Assuming a steady state cycloned sand production rate of 3,200 m^3/day, an initial pulp density of 75%, and a final average moisture content of 10% after drainage, a steady state drainage rate of 16 l/s is derived. Drainage recycle systems are discussed further in Section 5.6.

3.4 CYCLONED SAND SUITABILITY

3.4.1 General

Cycloned tailings sand deposited in the Downstream Trial Berm were evaluated by means of field and laboratory testwork. The field testwork has been described in the preceding sections.

Eight (8) bulk samples of cycloned sand were collected from the downstream trial area and tested at the Knight Piésold commercial laboratory in Denver, Colorado. Five (5) of the samples were collected from the two trenches excavated within the Downstream Trial Berm. The remaining three (3) samples were collected from the Phase 1 sand surface, at the top, middle and bottom of a cyclone discharge cone. This testwork provides information on the particle size distributions, permeability, compressibility and shear strength of the cycloned sand materials. Locations of the cycloned sand samples are shown on Figure 3.1. Results of the laboratory testing are summarized in Table 3.1.

3.4.2 Index Properties

The cycloned sand material is typically comprised of a uniform non-plastic fine sand with about 23 to 26% silt sized particles. The specific gravity is approximately 2.87. The particle size distribution for the cycloned sand samples are shown on Figure 3.2

? low

3.4.3 Density, Moisture Content and Permeability

Field density and moisture content information was collected during excavation of the two trenches in the trial berm as discussed in the previous sections of this report. These results showed that the moisture content typically increased with depth and extrapolation of the data suggests that the steady state in-situ moisture content of the drained pile will be in the order of 10 to 12%.

A Standard Proctor compaction test was also completed on each of the trench samples. These tests indicated that the maximum dry density of the sand was 1.72 t/m^3 for Trench No 1 sample and 1.77 t/m^3 for the Trench No. 2 sample. The in-situ field dry densities determined by the nuclear densometer testwork show that the cycloned sands are typically deposited to a dry density that is about 95% of the Standard Proctor Maximum value. depth.

Two flexible wall permeameter tests were also conducted on representative samples collected from Trench Nos. 1 and 2. Permeability values were determined at confining pressures of 200, 400 and 600 kPa for each sample, in order to evaluate the reduction in permeability with depth. These data indicate that the permeability of the sand is typically in the order of about 7 x 10^{-4} cm/sec at the lower confining stresses and decreases slightly to about 5 x 10^{-4} cm/s at the higher confining stress. The permeability was also found to be slightly lower for the sand sample obtained from Trench No. 2, and is attributed to the higher fines content in this sample.

3.4.4 Triaxial Testwork

Two triaxial tests (1 CU and 1 CD) were completed on bulk samples obtained from the trial area. These results indicate that the effective friction angle is approximately 37 to 39 degrees over an appropriate range of normal stresses. This correlates well with previous shear strength testwork conducted during October of this year, wherein a cycloned sand sample provided a friction angle of 38 degrees.

3.4.5 Cone Penetration Testing

A Cone Penetration Test (CPT) program was undertaken to assess the in-situ geotechnical properties of cycloned sand and bulk tailings materials. Upstream of the Main and Perimeter embankments, all CPT holes were pushed from the upstream trial berms. An electronic piezocone was advanced through the cycloned sand berms, and into the underlying tailings beaches. Within the downstream trial area, CPT tests were performed within cycloned sand materials only.

The CPT program was carried out in November 1999. A total of 23 holes were pushed within various areas of the tailings facility. Seven (7) holes were pushed from each of the Main and Perimeter embankment upstream cycloned sand trial berms. An additional nine (9) CPT holes were positioned within the trial berm area downstream of the Perimeter embankment. The program included shear wave velocity measurement within selected holes, in order to assess the stiffness characteristics of the cycloned sand and bulk tailings materials. In addition, pore pressure dissipation measurements were carried out at select depths within all holes. Figure 3.3 shows the location plan of cone penetration testwork and the results are included in Appendix C

Pore pressure dissipation tests were carried out at all 9 CPT locations (CPT99-1 to 9) within the Perimeter Embankment Downstream Trial Area. The locations of these CPT test holes are shown on Figure 3.1. Results of the CPT pore pressure dissipations indicate that the trial area is well drained, with minimal pore pressures remaining within the cycloned sand deposit. Measured pore pressures were in good agreement with the vibrating wire piezometer located within the downstream trial area, as included in Appendix B.

Dissipation tests were also carried out within all CPT holes (CPT99-10 to 16) along the Perimeter Embankment Upstream Trial Berm. Measured pore pressures were generally close to hydrostatic conditions within the underlying beach tailings, except near surface where some higher excess pore pressures remain in the fresher, less consolidated, tailings. The overlying cycloned sands were well drained.

Pore pressures were also measured within all CPT holes (CPT99-17 to 23) along the Main Embankment Upstream Trial Berm. Pore pressure results within these holes were consistent, with the top 3 to 4 meters of cycloned sand deposit being well drained. As expected, hydrostatic conditions were identified within the lower tailings beaches below the cycloned sand berm.

Based on the measured cone tip resistance, the relative density of the cycloned sands was estimated to be approximately 30 – 50%. This is typical for hydraulically placed cycloned sands and is also indicative of a relatively narrow range of void ratios for these uniform sands. Measured shear wave velocities within the cycloned sands range from approximately 80 – 120 m/s. In the upstream beach tailings the shear wave velocities generally increase with depth from about 90 to 160 m/s. Shear wave velocities within the cycloned sands will likely increase with depth with values similar to the beach tailings once a greater depth of material is achieved. The measured shear wave velocity profiles are included in Appendix C.

3.4.6 Summary

The field and laboratory testing indicates that the cycloned sand materials have suitable geotechnical properties and that hydraulic placement of these materials results in acceptable in-situ dry density values. The relatively fine nature of the materials results in permeability values of about 5×10^{-4} to 7×10^{-4} cm/sec, which are slightly less than the value of 1×10^{-3} cm/sec that was assumed in previous studies. The field and laboratory testing does, however, indicate that the cycloned sands will be free draining and will be consolidated within a reasonable timeframe after cycloning. The shear strength characteristics of the cycloned sand are better than assumed in previous studies.

3.5 CYCLONED SAND AVAILABILITY

The upstream cycloned tailings program during 1999 resulted in the placement of approximately 200,000 m^3 of sand upstream of the Main Embankment in about four months. The rate of underflow discharge from all four operating cyclones was measured four times during the cyclone operation within the Phase 1 Downstream Trial Berm. The average cyclone underflow discharge rate was approximately 27 m^3/hour per cyclone. The average solids content of the underflow was 75% by weight. The availability that was achieved during the operation of the cyclones during 1999 was, therefore, between 40 and 50 percent based on an underflow split of 35%. A significant portion of the total slurry flow was likely discharged as bulk tailings from a point discharge at the end of the tailings header pipeline.

The open end of the operating section of the pipeline has controlled the pressure in the header pipeline. This operating procedure ensures that the header pipeline is not over pressurized, but results in a significant loss of bulk tailings to the cyclone operation. The single point discharge resulted in a reduction in cyclone availability of 30 to 40 percent based on the cyclone underflow discharge rate measurements. Cyclone operation has to be optimized in order to ensure that a sufficient volume of cycloned sand is produced for construction of the Stage 3 Main and Perimeter Embankment downstream shell zones.

SECTION 4.0 – EMBANKMENT STABILITY AND SEEPAGE ANALYSES

4.1 GENERAL

The stability and seepage models previously developed for the tailings embankments have been updated to reflect the revised geometry and construction materials. The additional water discharging from the hydraulically placed cycloned sand in the downstream shell zone also influences these analyses. Therefore, the initial evaluation presented in this Section considers the rate of drainage from the hydraulically deposited cycloned sand and considers the particular drainage features that will be required to manage the flows and to maintain a depressed phreatic surface in the downstream shell zone during construction.

The stability analyses presented in this section have incorporated similar modelling techniques as described in the "Updated Design Report" (Knight Piésold Ref. No. 1627/2) June 6, 1997, and the seepage modelling has incorporated similar geologic models as in previous studies, but also considers the influence of additional tailings water discharge due to pore water drainage from the cycloned sand.

4.2 LONGITUDINAL AND FINGER DRAIN SPACING

4.2.1 General

Longitudinal and finger drains will be constructed in order to safely convey the excess water from the cyclone underflow to the seepage recycle ponds. The drains will be spaced sufficiently close so that the phreatic surface cannot build to levels that could compromise the stability of the embankment. The two key parameters that govern the drain spacing will be the application rate of water from the underflow and the permeability of the cycloned sand.

4.2.2 Application Rate

The application rate is the steady flow rate that will be applied to the overall cycloned sand mass. It has been calculated by taking the underflow mass of water and dividing it by the number of cyclones operating and the assumed average cycloned sand base area of 2500 m^2. The underflow mass of water was calculated by taking the underflow total mass and subtracting the underflow solid mass, leaving the water component of the underflow.

Two application rates have been analysed for the calculation of drain spacing. The first case is that of the maximum operational application rate of 1.35×10^{-4} cm/sec as calculated by the method above. The second case is the maximum operational application rate with a 24 hr 1:100-year storm event (2 mm/hr) superimposed. This results in an application rate of 1.91×10^{-4} cm/s for a 24 hour period. These two rates will therefore bound typical application rates anticipated during the cyclone construction operations.

What % excess capacity?

4.2.3 Cycloned Sand Permeability

Based on laboratory test results included in Appendix B, average cycloned sand permeability is 7×10^{-4} cm/s. This value has therefore been used in the modelling but sensitivity to a decrease in permeability has also been evaluated.

4.2.4 Modelling Techniques and Results

The drain widths were modelled at 5 meters spacing for ease of construction of the drains with mine equipment. The Dupuit equation (Freeze and Cherry, 1979) was used to assess how variability of cyclone tailings application rate, cyclone sand permeability, and drain spacing affect the steady state phreatic surface height, or groundwater mounding beneath the embankments.

Based on a sensitivity analysis, a 20 meter centre-to-centre spacing has been determined to be appropriate. In order to more accurately determine the steady state phreatic surface height, SEEP/W was used to model the 20 meter drain spacing as shown on Figure 4.1. From this model it has been demonstrated that the maximum phreatic surface height for steady state deposition will be about 2 meters. If the 24 hour 1:100-year storm event occurs during construction, it is estimated that the phreatic surface would temporarily rise to a maximum height of approximately 2.8 meters. Both these values are acceptable, and consequently a 20 meter drain spacing has been adopted.

- Redundancy
- sensitivity
- blockage + loss of drain

A sensitivity analysis has indicated that if the permeability is decreased to 1×10^{-4} cm/s the phreatic surface will rise to the surface, which would be unacceptable. Therefore, part of the quality control process will be to ensure that the percent fines in the cyclone sands remain low enough to achieve a permeability of at least 7×10^{-4} cm/s. The sensitivity analysis also shows that if the application rate increases an order of magnitude the phreatic surface will again become unacceptably high. and....

4.3 STABILITY ANALYSIS

4.3.1 General

Embankment stability analyses were conducted using the limit equilibrium computer program SLOPE/W. This program performs a systematic search to obtain the minimum factor of safety from a number of potential slip surfaces. Factors of safety were computed using Bishop's Simplified Method of Slices.

Analyses were performed to investigate the stability of the Main Embankment for the following conditions:

Downstream Stability:

- Static conditions during Stage 3, during the final year of operations and during post-closure. Minimum acceptable factors of safety of 1.3 (during operations) and 1.5 (post-closure with drains blocked) have been adopted for these cases.

- Earthquake loading during operations and post-closure. The stability of the embankment under earthquake loading was analysed by the pseudostatic method by applying a horizontal seismic coefficient (acceleration) to the potential sliding mass. Factors of safety greater than 1.0 imply that there will be no significant deformations of the embankment initiated by earthquake loading. Both the Operational Basis Earthquake (OBE) and the Maximum Design Earthquake (MDE) were considered, as determined by the hazard classification for the Tailings Storage Facility. The peak ground accelerations corresponding to the OBE and MDE events are included in Table 2.2. The tailings storage facility would be expected to function in a normal manner after the OBE. For the MDE, damage to the tailings dam is acceptable, provided the integrity and stability of the dam is maintained and release of impounded tailings is prevented (ICOLD, 1995).

Upstream Stability:

The upstream static and seismic stability of the Main Embankment has also been evaluated for Stage 3 and at closure for the final embankment configuration.

Based on the results of previous consolidation analyses (reported in the "Updated Design Report Ref. No. 1627/2") the tailings were assumed to be partially consolidated during operations. An appropriate undrained shear strength was assigned to the tailings. Tailings effective strength parameters were used for the long-term post-closure condition when complete consolidation has been achieved.

4.3.2 Material Parameters and Assumptions

The following parameters and assumptions were used in the stability analyses:

- Bulk unit weights for the embankment and foundation materials are based on test work conducted on representative samples as part of the 1995 geotechnical investigations. The results were originally presented in the "Report on 1995 Geotechnical Investigations for Mill Site and Tailings Storage Facility" (Knight Piésold Ref. No. 1623/1). An average bulk unit weight for the tailings deposit adjacent to the embankment was estimated from the results of the consolidation analysis. The cycloned sands (Zone CS) were assigned a value based on the report "Evaluation of Cycloned Tailings for Embankment

Construction" (Knight Piésold Ref. No. 11162/11-1) and recent test work that is included in Appendices A and B.

- Effective strength parameters for the embankment fill and foundation materials were obtained from consolidated-undrained triaxial test work performed on representative samples obtained during the 1995 geotechnical investigations and reported in the "Report on 1995 Geotechnical Investigations for Mill Site and Tailings Storage Facility" (Knight Piésold Ref. No. 1623/1). The downstream shell zone has conservatively been assumed to comprise glacial till materials only, and no additional strength allowance has been included for rock fill materials, which will likely be incorporated.

- An effective friction angle of 26° was used to conservatively represent the strength parameters of the top three metres of the Main Embankment foundation soils. These strength parameters account for long-term consolidation conditions of the foundation soils. This value was based on the consolidated undrained triaxial test work performed on glacial till samples. These samples were obtained during the 1995 geotechnical investigations and reported in the "Report on 1995 Geotechnical Investigations for Mill Site and Tailings Storage Facility" (Knight Piésold Ref. No. 1623/1).

- A conservative effective friction angle of 32° was adopted for the cycloned sands (Zone CS). Recent laboratory results from cyclone sands taken during the trial operations and CPT test demonstrate that the friction angle is closer to approximately 38°.

- Based on 1999 CPT data an average effective friction angle of 32° was adopted to represent the coarse beach tailings underlying the on-going embankment raises. These coarser, free-draining tailings will consolidate rapidly, and will therefore exhibit drained strength parameters. Modelling has shown that these tailings achieve complete consolidation shortly after placement of the embankment raise.

- Partially consolidated finer tailings during operations were assigned typical undrained shear strengths ranging from 10 kPa to 55 kPa at depth. These are based on lower bound strengths from in-situ Shear Vane and Cone Penetration Testing obtained at other mine sites for similar tailings materials. For fully consolidated tailings an average effective friction angle of 30° was adopted.

- The location of the phreatic surface has been estimated from steady-state seepage analyses. The details of these analyses are provided in Section 4.4. Critical variable.

- Fifty percent of the peak ground acceleration in the cycloned sand zone (as determined from SHAKE analyses) was applied to the seismic modelling for both the OBE (α_{max}= 0.074g, k = 0.037) and MDE (α_{max} = 0.12g, k = 0.06) events, (see Section 4.3.3).

The geometry, material parameters and location of the phreatic surface for the stability analyses are illustrated on Figure 4.2.

4.3.3 Seismic Response Analyses

A preliminary seismic ground response analysis was carried out to determine the ground accelerations imposed on the tailings embankment by the design earthquakes and the cyclic stresses within the cycloned sands. The program SHAKE was used to compute profiles of maximum acceleration and cyclic shear stress. Estimated values of soil stiffness (shear modulus) required in the analysis were calculated using the SPT blow count (N) data measured during the 1996 foundation investigations. Appropriate earthquake acceleration time history records were used in the analysis, scaled to the peak acceleration values of 0.037g and 0.065g for the OBE and MDE events respectively.

It has been estimated from the SHAKE analyses that the cyclic stress ratios within the cycloned sands would range from 0.04 to 0.07 for the OBE event and 0.07 to 0.11 for the MDE event. Based on the CPT results the cyclic resistance ratio of the cycloned sands is typically around 0.05 to 0.10. Saturated sandy materials are potentially liquefiable when the cyclic stresses exceed the cyclic resistance. However, it is expected that the cyclic resistance of the cycloned sands will improve with time as the material continues to consolidate due to increases in effective stress as more material is placed. The trial berms indicate that the cycloned sands are well drained with only minor, if any, pore water pressures. Liquefaction of these materials would only be a concern if they were to remain saturated.

and when saturated

when!

The average peak accelerations computed for the OBE and MDE events were 0.074g and 0.12g respectively. These values represent the average peak acceleration computed along the potential slip surface passing through the cycloned sand zone.

For seismic loading from the Operating Basis Earthquake and the Maximum Design Earthquake, pseudostatic analyses were carried out using an appropriate seismic coefficient. Typically, a seismic coefficient equal to 30% to 75% of the peak acceleration is used for pseudostatic (seismic) analyses, depending on the design earthquake magnitude. The design earthquake magnitude for both the OBE and MDE events is 6.5. For the Operating Basis Earthquake the seismic coefficient was taken to be 50% of the average peak acceleration. For an average peak acceleration of 0.074g the seismic coefficient is 0.037. Similarly for the Maximum Design Earthquake the seismic coefficient was also taken to be 50% of the average peak acceleration. For an average peak acceleration of 0.12g the seismic coefficient is 0.06.

4.3.4 <u>Results of Stability Analyses</u>

<u>Downstream Stability</u> - A minimum static factor of safety of 1.58 was calculated for the Stage 3 case during operations. This value increases to 1.67 for the final year of operations. A factor of safety to 1.60 for the post-closure conditions is due to a gain in strength of the consolidated tailings being offset by the increased phreatic levels in the foundations after closure. The location of potential slip surfaces during operations and post-closure are given on Figures 4.3 to 4.5. These figures show that the minimum factor of safety requirements as stated in Section 4.3.1 have been satisfied.

Minimum factors of safety of 1.38 and 1.26 respectively were calculated for the OBE and MDE events for Stage 3 operations. These minimum factors of safety increased to 1.48 (OBE) and 1.35 (MDE) for the final year of operations. Minimum factors of safety of 1.41 (OBE) and 1.29 (MDE) were calculated for the post-closure condition. The location of the potential slip surface for each case is shown on Figures 4.6 to 4.8. For all earthquake (pseudostatic) cases, the calculated minimum factors of safety were greater than 1.0, which implies that the embankment will be stable with no significant deformations during either earthquake event.

Upstream Stability - The minimum upstream static and seismic factors of safety for the Stage 3, final year of operation and post-closure conditions were evaluated, with the results shown on Figures 4.3 to 4.8. The loss of freeboard failure surfaces are all minor slips located near the top of the embankment due to the centreline construction method and well-drained sandy material being deposited close to the embankment. Minimum factors of safety of 1.90 (static), 1.71 (OBE) and 1.58 (MDE) were calculated for the Stage 3 operational condition. Minimum factors of safety of 1.73 (static), 1.56 (OBE) and 1.45 (MDE) were obtained for the final year of operations and post-closure conditions. For all of the above cases the factor of safety requirements as stated in Section 4.3.1 were achieved.

The following table summarizes the factors of safety obtained for the various cases mentioned above:

	Downstream			**Upstream**		
	Static	**OBE**	**MDE**	**Static**	**OBE**	**MDE**
Stage 3	1.58	1.38	1.26	1.90	1.71	1.58
Ultimate	1.67	1.48	1.35	1.73	1.56	1.45
Post-Closure	1.60	1.41	1.29	1.73	1.56	1.45

4.4 SEEPAGE ANALYSES

4.4.1 General

Seepage analyses were performed using the finite element computer program SEEP/W. The objectives of the analyses were:

- To determine the pore water pressures within the embankments for stability analyses,
- To calculate the seepage losses (to groundwater) from the tailings storage facility during operations and post-closure, and
- To calculate the drainage rate during downstream cycloning and cycloned sand placement in order to determine the recycle pumping requirements.

The seepage analyses were conducted for three cases: Stage 3 operations, ultimate operation and post-closure conditions. For the three cases, analyses were conducted for the Main Embankment configuration using the representative maximum cross-section shown on Figure 4.9, which included a glaciofluvial sand in the foundation. A second seepage analysis was also conducted for the ultimate operation condition of the Main Embankment at a more representative section. This second section excludes the glaciofluvial sand unit from the foundation; a condition that is representative of approximately 80 percent of the length of the Main Embankment. The extent of these two foundation zones is shown on Figure 4.10. The glaciofluvial sand unit has only been found at the Main Embankment.

4.4.2 Summary of Parameters

The saturated and unsaturated hydraulic conductivities were determined for each material in the embankment and foundation zones. The parameters used in the seepage analyses are shown on Figure 4.9. In assigning unsaturated and partially saturated hydraulic conductivity values for the seepage analysis, typical conductivity functions for similar soil types were used. These functions were adjusted to correspond with the actual saturated conductivity of the material. Hydraulic conductivity values for the tailings mass, embankment and foundation were determined as follows:

- The tailings mass was sub-divided into three zones with decreasing hydraulic conductivity with depth to account for the less permeable consolidated tailings at depth.

- Hydraulic conductivity values for the various zones of the embankment and foundation soils were estimated based upon typical values for similar materials.

4.4.3 Boundary Conditions and Flux Sections

Boundary conditions were imposed on the modelled sections to more accurately represent hydrogeologic conditions in the field. These conditions are demonstrated on Figure 4.11, which shows the seepage model for the ultimate operational condition. The conditions are summarised as follows:

- A hydrostatic pore pressure profile corresponding to the height of the supernatant pond was assigned along the left boundary of the model (upstream of the embankment) for all models.

- A total head boundary was imposed at the tailings surface to model a supernatant pond for the Stage 3 and Ultimate operational models.

- The upstream embankment toe drain was modelled by applying a no-head condition at that location for the Stage 3 and Ultimate operational cases. For the post-closure case it was assumed that this drain would be blocked, and no pore pressure conditions were assigned at that location.

- Foundation drains were modelled by applying no-head nodes at drain locations for the Stage 3 and Ultimate operational cases. For the post-closure case it was conservatively assumed that these drains would be blocked.

- A hydrostatic pore pressure profile, with the water table at surface, was assigned to the right boundary of the model (downstream of the embankment) for the Stage 3 and Ultimate operation conditions. The post-closure condition used a hydrostatic pore pressure profile that models an artesian condition of 4 meters above the ground surface. This condition has conservatively assumed that all pressure relief wells and trenches have been blocked.

Flux sections were included in the model to estimate seepage flow across the various geological units, as well as the engineered components. The following locations, in particular, were examined closely:

- seepage inflow to the upstream toe drain;
- seepage flow collected by foundation drains; and
- seepage flow that bypasses the seepage collection systems.

The flows collected by the seepage collection systems (i.e. the upstream toe drain and foundation drains) will drain to the Main, Perimeter and South Embankment Seepage Collection Ponds. These seepage flows will be recycled to the tailings impoundment. The seepage flows that bypass the seepage collection systems are the only component that will be lost to groundwater.

4.4.4 Results

All seepage flow estimates are projected increases over baseline flow rates. In particular, the embankment foundation drains include a baseline groundwater flow component, which is not included in the following flow projections.

Case 1 modelled the Main Embankment Stage 3 geometry with the glaciofluvial foundation. This case corresponds to the worst case foundation conditions, which are representative of only 20% of the length of the Main Embankment. The total solution seepage flux of approximately 0.17 litres/ minute per metre length of embankment was calculated from the seepage analysis. Approximately 55 percent of the flow was collected in the upstream toe drain and embankment foundation drains, while the remaining 45 percent of the seepage flowed through the foundation. In case 1, the seepage flow to each of the components is predicted to be as follows:

- The upstream toe drain collects approximately 5 percent (0.006 litres/ minute per metre length of embankment).

- The embankment foundation drain system collects approximately 50 percent (0.09 litres/minute per metre length of embankment).

- Seepage loss through the foundation is predicted to be 45 percent (0.07 litres/minute per metre length of embankment).

To check the calibration of the model, the Stage 3 model fluxes were compared to existing average flows in the foundation drains. For FD1 and 2, which are in the till foundation, the model predicts average flows per drain of 3 to 4 litres/minute. The observed values ranged from 1 to 4 litres/minute and are therefore in good agreement with the model. For the glaciofluvial foundation drains FD3, 4 and 5 the model predicts a flow per drain of 3 to 8 litres/minute. Observations were slightly higher than the model's prediction seeing average flows between 2 to 16 litres/minute but are still in reasonable agreement.

Case 2 modelled the Main Embankment Ultimate geometry with the glaciofluvial foundation as shown on Figure 4.10. The total solution seepage flux of 0.3 litres/minute per metre length of embankment was calculated from the seepage analysis. Approximately 75 percent of the flow was collected in the upstream toe drain and the embankment foundation drains while the remaining 25 percent of the solution flowed through the foundation. In Case 2, the seepage flow contribution made by each of the components is predicted to be as follows:

- The upstream toe drain collects approximately 25 percent (0.07 litres/minute per metre length of embankment).

- The embankment foundation drain system collects 50 percent (0.16 litres/minute per metre length of embankment).

- Seepage loss through the foundation is predicted to be approximately 25 percent (0.07 litres/minute per metre length of embankment).

Ignoring the upstream toe drain flux component, the seepage losses through the foundation are predicted to be approximately 25%, while the foundation drains capture the remaining 75%.

Case 3 modelled the Main Embankment Ultimate geometry without the glaciofluvial zone in the foundation. This configuration represents the majority (80%) of the length of the Main Embankment. The total solution seepage flux of 0.14 litres/minute per metre was calculated from the seepage analysis. Approximately 95 percent of the flow is predicted to be collected in the upstream toe drain and the embankment foundation drains while the remaining 5 percent of the solution is predicted to flow through the foundation. In Case 3, the solution flow contribution made by each of the components is as follows:

- The upstream toe drain collects approximately 35 percent (0.05 litres/minute per metre length of embankment).

- The embankment foundation drain system collects approximately 60 percent (0.08 litres/minute per metre length of embankment).

- Seepage loss through the foundation is predicted to be less than approximately 5 percent (0.05 litres/minute per metre length of embankment).

Ignoring the upstream toe drain flux component, the seepage losses through the foundation are estimated to be approximately 10% while the foundation drains capture the remaining 90%.

Case 4 modelled the Main Embankment Ultimate geometry with the glaciofluvial foundation for the post-closure conditions. The total solution seepage flux of 0.19 litres/minute per metre length of embankment was calculated from the seepage analysis. Approximately 80 percent of the flow is predicted to be collected in the embankment chimney and blanket foundation drains, while the remaining 20 percent of the seepage is predicted to flow through the foundation. In Case 4, the solution flow contribution made by each of the components is as follows:

- The upstream toe drain is blocked and therefore collects none of the potential seepage.
- The embankment chimney drain and blanket foundation drain system collects approximately 80 percent (0.15 litres/minute per metre length of embankment).
- Seepage losses through the foundation are estimated to be approximately 20 percent (0.04 litres/minute per metre length of embankment).

The overall seepage flow due to infiltration and continued tailings consolidation over the 233 hectares of the tailings storage facility system has been calculated to be approximately 150 litres/minute.

To predict the portion of the seepage flows that will likely report to each of the three embankments (Main, Perimeter, South) a simple weir analogy was used.

The total predicted seepage flow of 150 litres per minute was attributed to each of the three embankments according to:

- Current knowledge of the hydrogeological conditions at each of the three embankment alignments,

- The length of each embankment or each component of the embankments according to the foundation conditions, and

- The relative elevations of the embankment low points (i.e. the "weir" elevations).

The results of this relative comparison of the three embankments suggest that approximately 80% (120 litres/minute) of the flow will be towards the Main Embankment, 15% (20 litres/minute) of the flow will be towards the Perimeter Embankment, and 5% (10 litres/minute) of the flow will be towards the South Embankment.

Based on the results of Case 3, it has been estimated that 10% of the flow will be seepage loss through the foundations of the South and Perimeter Embankment. For the Main Embankment, a seepage loss of 20% has been calculated based on the relative contributions of the two different foundation conditions to the total seepage.

As a result it is estimated that seepage losses through the foundations will be as follows:

- Main Embankment 24 litres/minute,
- Perimeter Embankment 2 litres/minute,
- South Embankment 1 litres/minute.

Seepage reporting to the Ponds through the foundation drains, excluding the upstream toe drain flows will be:

- Main Embankment 96 litres/minute,
- Perimeter Embankment 18 litres/minute,
- South Embankment 9 litres/minute.

It is not expected that the supernatant water from the cycloning operations will significantly affect the predicted seepage loss rates. In the area of the glaciofluvial sands an artesian condition of 4 meters head is present. Based on the calculations for drain spacing a hydrostatic head of no more than two meters is expected. As a result seepage gradients continue to be expected to be upwards, into the cycloned sand. In other areas the foundation materials consist of a thick till layer with a hydraulic conductivity of approximately 1 x 10^{-7} cm/s. As a result flows through these zones due to the cycloning operations are expected to be insignificant.

To ensure that the water quality and seepage losses are acceptable and as predicted, strategically placed monitoring wells must continue to be routinely checked by the Mine to ensure compliance. If any water quality problems were to arise, additional drainage works could quickly be implemented to intercept detected flows.

4.5 DESIGN SUMMARY

The results of the seepage and stability design can be summarised as follows:

1) The proposed cycloning operations will result in flatter overall slopes with improved stability during both static and seismic loading conditions.

2) Four seepage cases have been analysed, including two representative sections that were used to predict the portion of seepage flows reporting to drains and seepage recycle systems versus flows lost to the environment. The cases compare favourably to existing flows.

3) Total seepage from the entire Tailings Storage Facility has been estimated to be approximately 150 litres/minute, of which less than 20 percent is expected to bypass the seepage collection and recycle systems. The majority of the estimated seepage losses are through the Main Embankment (24 litres/minute) with approximately 2 litres/minute and 1 litre/minute being lost to the environment from the Perimeter and South Embankments respectively.

4) The seepage flows reporting to the ponds are insignificant in comparison to flows resulting from the cycloning operations and storm events. As such, these seepage flows do not contribute to the sizing of the ponds and pumps.

5) On-going monitoring and confirmation of parameters and performance are being conducted by MPMC and their specialist sub-consultant.

SECTION 5.0 - CYCLONED SAND EMBANKMENT CONSTRUCTION

5.1 GENERAL

The use of cycloned tailings sand has been proposed for construction of the downstream shell zones of the Main and Perimeter Embankments. Hydraulic placement of the cycloned sand is the most efficient and cost-effective method of cycloned tailings sand construction. Therefore, the construction methodology and cyclone system design and operation should be optimized to enable hydraulic placement of cycloned tailings sand to the maximum practical extent.

The design and operation of the cyclone discharge system and the detailed construction methodology is outside the scope of this report and will be finalized by MPMC. However, Knight Piésold will evaluate the construction methods and operation of the cyclones to the extent that they influence the geotechnical characteristics of the Tailings Storage Facility embankments. This will include evaluation of the on-going suitability of the underflow product produced by the cyclones, the stability of the embankments, and on-going provision of sufficient freeboard to safeguard against overtopping of the embankments. submit.

The following sections present a construction sequence and methodology that is based on the geometric and geotechnical embankment design criteria and the cyclone operating system that was used during the 1999 upstream and downstream cyclone test program. The construction sequence and methodology has been included for evaluation of the on-going embankment designs and development of a risk assessment with full recognition that the construction methodology and cyclone operating system will have to be revised by MPMC to address the Stage 3 and on-going construction requirements.

5.2 CONSTRUCTION SEQUENCING

The hydraulic placement of cycloned sand during the 1999 upstream and downstream cyclone program resulted in cones with average slopes of about 5.5H:1V. The downstream shell zones of the embankments will be placed at a slope of 3H:1V to optimize the use of the annual cycloned sand production. The desired slope of the downstream embankment face will be achieved by hydraulic and mechanical placement of cycloned tailings sand in a sequence of construction cells. The first cells, the foundation cells, will be delineated using rockfill confining berms. All subsequent cell confining berms will be constructed using cycloned sand.

It is anticipated that it will be possible to mobilize construction equipment within a cell for construction of the next confining berms for the subsequent cell within 14 to 21 days after deposition within the existing cell has been completed. The construction sequence and on-going cell arrangement are, therefore, based on the cyclone sand target production rate of 3,200 m^3/day and the criteria that cycloning cannot resume within a specific area within 3 weeks of cycloned sand placement in that area. The three week waiting period is required to allow sufficient time for the deposited sand to drain in order to enable an excavator to construct the confining berm for the next (overlaying) cell. The construction methodology is illustrated on Figure 5.1.

At the outset of construction, cycloned sand will be discharged within a cell such that typical cycloned sand cones with 5.5H:1V slopes will intersect the top (with allowance for a 0.5m freeboard) of the confining berm at the downstream toe of the embankment. Preparation for each lift thereafter will consist of the construction of a 2-metre high longitudinal cycloned sand confining berm at the downstream toe of the previous lift. Lateral confining berms between cells will only be required if excessive overlap of cycloned sand between cells makes these necessary. The proposed sequence and layouts of the Main and Perimeter Embankment construction cells are illustrated on Figures 5.2 to 5.8.

The cycloned sand downstream shell zones will be constructed up to the elevation of the Stage 2C crest. The Stage 3 embankment raise will be completed by constructing the Zone S core zone and the upstream and downstream Zone B shell zones once the cycloned sand shell zone has drained sufficiently. The material for construction of Zone S and B will be borrowed from Borrow Areas 2 and 4. The locations of these borrow areas are shown on Drawing 11162-12-100

5.3 FOUNDATION PREPARATION

Foundation preparation will involve the clearing, grubbing and stripping of the footprint for the embankments to the lines and grades shown on the Drawings. The foundation will then be excavated down to firm or stiff glacial till of low permeability. Criteria for foundation excavation in the glacial till includes achieving a minimum in-situ density objective of approximately 2 tonnes/m^3 and a grain size distribution that corresponds to a permeability value of less than or equal to 5 x 10^{-6} cm/s. In-situ density and moisture content tests, as well as laboratory permeability tests will be carried out to ensure that the design objectives are met.

5.4 TOE AND FINGER DRAINS

The current road located at the toe of the Stage 2C Embankments is built out of a well drained material (Zone T). This road will be ripped with a Dozer to enhance its drainage capability and will act as the first in a series of longitudinal drains. The Stage 3 toe confining berms of the foundation construction cells will form the next longitudinal drain. These berms will be built out of a well drained material (Zone T). The foundation toe confining berms for future stages of the embankments will also be constructed from Zone T material. As a result, a maximum longitudinal drain spacing of 20 m will be maintained with construction of each additional confining toe berm.

Finger drains will consist of the confining berms between the foundation cycloned sand construction cells, which will also be built out of Zone T material and will be perpendicular to the embankment centreline. These berms will be extended with each stage of construction to ensure that the drains are continued to the toe of the final embankment.

5.5 CYCLONED SAND CELL CONSTRUCTION

Hydraulic placement of the cyclone underflow (coarse tailings fraction) will start within a cell once the cell confining berms have been completed. The method of hydraulic placement has been assumed to consist of six operational 20 inch cyclones being operated from the crest of the embankment with the underflow being discharged directly into the cell and the overflow being discharged into the Tailings Storage Facility, based on the 1999 cyclone operating system. The confining berms for the next lift, or layer of cells, will be constructed from the cycloned sand within that cell once the cycloned sand has drained sufficiently to allow access for an excavator, as illustrated schematically on Figure 5.1.

The cycloned sand cells will be constructed from hydraulically placed cycloned tailings sand as far as practically possible. However, hydraulic placement of cycloned sand in the uppermost cells becomes increasingly difficult as the shell zone width becomes narrow. The geometry of the embankments, especially the fairly narrow Perimeter Embankment, and the maximum practical height of the confining berms eventually results in high advancement rates for the cyclones along the Perimeter and Main Embankment crests. If the methodology that was used for the 1999 upstream and downstream trial berms is confirmed, the cyclones could have to be moved daily during construction of the last cells on the Main Embankment and after construction of the foundation cells on the Perimeter Embankment. The rate of construction and estimated daily advancement rate for the Main and Perimeter Embankments are summarised in Tables 5.1 and 5.2 respectively. The required advancement rates are high, with maximum rates of about 100 and 78 metres per day along the Perimeter and Main Embankments respectively. These advancement rates affect the cyclone operating system significantly, especially as these rates have to be achieved with only six operating cyclones.

It may be possible to increase the moisture content of the underflow and rely on spigotting the sand into near horizontal layers in order to reduce the number of cyclone moves. However, this option would increase the requirements for flow routing and recycle of drainage water from the cycloned sand cells. The increased volume of water would also require careful consideration regarding decant of water from the active cells, erosion protection of the downstream embankment face, removal of slimes from the low areas within a cell, and the eventual collection and recycle of these increased flows.

It is likely that the final lifts, at least lift 7 of the Main Embankment and lift 3 of the Perimeter Embankment, will have to be placed mechanically if hydraulic placement is not feasible. As a result, a significant volume of the Stage 3 cycloned sand, in the order of 120,000 m^3, would have to be placed mechanically. A cycloned sand stockpile could be developed on the left abutments of the Main and Perimeter Embankments for haul, placement and compaction of the drained cycloned sand.

The construction of the downstream cycloned sand shell zones of the Main and Perimeter Embankments is dependent on the construction methods and cyclone operating system employed. The construction methods and cyclone operating system described are based on the current operating system. Alternative operating systems and construction methods could be considered to minimize costs and optimize construction of the Stage 3 Embankment and on-going stages. The most suitable construction method will have to be selected on the basis of ease of execution and construction and operating costs.

The cycloned tailings underflow could be re-slurried to reduce the solids content and the cycloned sand could then be deposited by spigotting along the crest of the embankment. This construction method would enable the use of discharge spigots along the embankment with the cyclones being operated from a high point on one of the embankment abutments. This method would minimize the required cyclone moves and thereby enable higher cyclone availability. However, the reduction of the solids content of the cyclone underflow would introduce significantly higher volumes of drainage water from the cycloned sand with corresponding higher seepage recycle system construction and operating costs. The time required for the cycloned sand to drain sufficiently to allow access to construction equipment could also increase due to the higher underflow water content, which would negatively affect the construction schedule.

The hydraulically placed cycloned sand from the trial embankments was achieving a density of approximately 95% of the Standard Proctor Compaction. A similar density will be required for the mechanically placed cycloned sand. This will be achieved by spreading the cycloned sand in lifts no thicker than 1 metre with the appropriate moisture content. Vibratory compaction will also be required in order to achieve the 95% Standard Proctor Compaction. A complete list of material specifications can be found on Drawing 11162-12-104.

5.6 DRAINAGE COLLECTION AND RECYCLE

5.6.1 General

Efficient drainage of the cycloned tailings sand is key to the successful construction of the on-going embankment raises. Therefore, the management of the drainage water resulting from hydraulic placement of cycloned sand in the construction cells is an important aspect of the design, construction and operation of the cycloned sand embankments. Water from the placed cycloned sand must be drained vertically through the cycloned sand shell zone for maximum consolidation of the material and minimum erosion of the downstream face. The drainage water will be collected by an underdrainage system and routed to the Seepage Collection Ponds and pumped into the Tailings Storage Facility. Factors that affect the ability to achieve efficient vertical drainage of all the cyclone underflow water and precipitation that will be applied to the downstream shell zone include:

- permeability of the cycloned tailings underflow product,
- application rate of the cycloned tailings underflow,
- aerial extent of active cycloned sand deposition (size of construction cell),
- solids content of the cycloned tailings underflow,
- drained down residual moisture content of the cycloned sand, and
- efficiency of the underdrain system.

The application rate of the cycloned tailings underflow and the solids content of the underflow have a significant affect on the drainage collection and recycle system design as many of the other factors, such as the permeability of the cycloned sand, are difficult to control. The underdrains have been designed to ensure that the water can be drained at the maximum rate that is achievable given the permeability of the cycloned tailings underflow product. The seepage and recycle system has to be sized to route the expected drainage and run-off water into the Tailings Storage Facility through a combination of attenuation storage and pumping capacity.

5.6.2 Construction Cell Drainage

Water that is applied to a construction cell and does not drain vertically through the cycloned sand will collect at the low areas of the cell, along the toe confining berms. There should be sufficient freeboard capacity along the berms to contain the water within the cell until it drains vertically into the underdrainage system of the shell zone. In instances where the drainage rate through the cycloned sand is insufficient or the collection of slimes at the toe prevents efficient drainage, discrete outlets will be provided along the downstream toe berm to route water and slimes to the water collection pond without eroding the face of the embankment. These outlets could be culverts, or similar decants, with erosion protection down the embankment face to route drainage water into the toe collection ditch.

5.6.3 Seepage Collection and Recycle System

The seepage collection and recycle system returns seepage, drainage and run-off water collected from the downstream cycloned sand, foundation drains, chimney drains and upstream toe drains to the tailings impoundment. The system consists of seepage collection ponds and pumping systems at the Main and Perimeter Embankments. The underdrains, toe berms and toe collection ditches will route drainage, seepage and runoff to the collection ponds. The water that is collected in the ponds is pumped into the Tailings Storage Facility. The seepage recycle pumping systems include sumps, pumps and pipelines. Seepage recycle sumps have been installed at the Main and Perimeter Embankment Seepage Collection Ponds. The sumps house the seepage recycle pumps, which are connected to six inch diameter HDPE pipes that extend from the pumps to the crest of the tailings embankment. The water from the seepage collection ponds is discharged directly onto the tailings beach.

Three additional ponds will be constructed during construction of the Stage 3 and 4 embankment raises. The first two ponds will be located on either side of the Main Embankment Seepage Collection Pond to provide capacity for settling of tailings fines from the downstream cyclone operation. These ponds will be constructed during Stage 3 and are shown on Drawing 11162-12-110. An access causeway may also be built into the ponds in order to facilitate cleaning out operations. An alternative layout and section of the south western settling pond are presented in Figure 5.9. This alternative arrangement would include constructing the south western settling pond with earthfill berms on competent foundation material and might be necessary if sandy material is encountered that could prohibit excavation of the pond. Also, a low permeability dividing berm could be constructed across the Seepage Collection Pond during on-going raises if the fines content of the drainage water remains high. This dividing berm would hydraulically separate the downstream and upstream portions of the pond to ensure that the highest quality drainage water is in the section of the pond that is adjacent to the emergency discharge point.

The Main Embankment seepage recycle pumping system will be upgraded to accommodate the increased flow from the cycloned sand drainage. The third additional Seepage Collection Pond and seepage recycle pumping system will be constructed at the toe of the South Embankment. This South Embankment Seepage Recycle System will likely be constructed during the Stage 4 embankment raise.

5.7 CORE ZONE AND ZONE B PLACEMENT

The core zone (Zone S) and Zone B will be placed once the cycloned sand placement within the downstream shell zone has been completed and the sand has drained sufficiently to accommodate construction. These zones will consist of moist, well graded glacial till of low permeability, placed in 300 mm lifts and compacted to a minimum of 95% and 92% of the Standard Proctor Maximum Dry Density for Zones S and B respectively. Suitable borrow materials are available in Borrow Areas 2 and 4 to complete construction of these zones of the embankments. The approximate locations of the borrow areas for embankment construction are shown on Drawing 11162-12-100.

A significant drilling program in Borrow Area 2 was undertaken by Knight Piésold in August, 1999 to further evaluate borrow sources for the construction of the core zone of the embankments. Detailed investigation programs were completed within Borrow Area 4 in 1997 and 1998. Results from this borrow investigation program are presented in Knight Piésold Reports "Stage 2A Tailings Storage Facility Construction, Selected Excerpts From Reference Information, Ref. No. 11162/9-2" and "Report on 1998 Construction and Annual Inspection, Ref. No. 11162/10-1". The objective during construction will be to use materials from borrows that are situated close to the area of placement. Borrow investigation results show that there is a substantial supply of moist, low permeability glacial till to the North and to the East of Borrow Area 2. It is anticipated that there is enough material to complete construction of the final embankment with the material identified in Borrow Area 2 and the effective use of Borrow Area 4 before it is inundated with tailings.

5.8 STAGE 3 AND ON-GOING CONSTRUCTION SCHEDULE

A preliminary Stage 3 construction schedule has been developed to evaluate the time required for construction of Stage 3 and to determine whether the cell construction sequence is achievable within a seven month cyclone operation period. The construction schedule includes the following assumptions:

- The cyclone operating system will be similar to that used during the 1999 upstream and downstream cyclone program.

- A cycloned sand production rate of approximately 3,200 m^3/day.

- A three week waiting period is required to allow sufficient time for the deposited cycloned tailings sand to drain before construction of the confining berms for the next (overlaying) cell or mechanical placement of fill on the cycloned sand.

- The cell construction sequence presented in Section 5.2.

- The cyclones will be able to be operated from the beginning of April to the end of October.

- The cyclone down-time for moves are already included in the assumed availability of 75% and no additional time for cyclone moving and relocation has been allowed in the schedule.

The construction schedule is shown in Figure 5.10. The required volume of cycloned sand production for Stage 3 can be achieved within the available seven month period by cycloning stockpiles of sand for mechanical placement when hydraulic placement within the embankment construction cells is not possible due to the time required for draining of the cycloned sand. However, there is no float in the schedule for unexpected delays and the construction of Zones S and B would have to be completed in November when the onset of winter conditions could cause further delays. Also, additional storage capacity and freeboard is only gained at the start of construction of the core zone raise after the cycloned sand downstream shell zone construction has been completed and the cycloned sand has drained sufficiently to enable construction of the downstream Zone B shell zone.

As in the Stage 3 construction, future raises will be built within construction time frames. If during the summer, the cycloned sand cannot be placed on the embankments, a cycloned sand stockpile should be used. When the cycloning season is over, the stockpiled cycloned sands can then be used to mechanically place the remaining material required in order to complete the construction staging for the year. Future layouts for the embankments are discussed further in Section 9.5

5.9 SUMMARY

Cycloned tailings sand will be used to construct the downstream shell zones of the Main and Perimeter embankments by hydraulic placement of the sand in cells to form a 3H:1V downstream slope. The first cells will be delineated by rockfill confining berms that will be constructed on the approved shell zone foundation. Cycloned sand in subsequent cells will be confined by berms that will be constructed from drained cycloned sand. This construction method allows for the placement of the required volume of cycloned sand in the available 7-month cyclone operating period and would result in the construction of embankments that meet all of the design criteria.

SECTION 6.0 - TAILINGS DISTRIBUTION AND RECLAIM SYSTEM

6.1 TAILINGS PIPELINE AND HEADER

The tailings pipeline extends approximately 7,000 metres from the Mill Site to the right abutment of the Main Embankment. The system is designed for gravity flow for the full mine life, to the final tailings embankment crest El. 962 metres. The pipeline has a continuous downhill grade to ensure it is free draining and to prevent potential sanding and freezing problems. The pipe diameter was selected for gravity flow over a range of operating conditions. All pipework is butt fusion welded High Density Polyethylene (HDPE) pipe of varying diameter. Pipe wall thickness (pressure rating) was selected to accommodate the anticipated operating pressures and vacuum conditions and includes an allowance for internal abrasive wear.

A dropbox (T2) is provided for surge protection and to allow the addition of waste dump runoff from the Southeast Sediment Pond to the tailings stream. The dropbox also functions as an overflow for the reclaim booster sump. Additional surge protection might be required at this location in a future stage by the addition of a vent pipe that would be located on high ground upstream from the emergency tailings dump pond. This additional surge protection would enable sufficient head for the operation of the cyclones during on-going embankment construction. The overflow into the T2 Drop Box could then be closed with a knife gate valve to allow additional head in the tailings pipeline, but the additional vent pipe would limit the maximum head.

Spill containment is provided for the full length of all pipelines. The pipelines are buried through the Mill Site area and are laid in a pipe containment channel cut into or lined with glacial till from the Mill Site to the Tailings Storage Facility. The pipelines are sleeved at the Bootjack Creek crossing for additional spill containment.

The tailings pipeline has two sections, with different pressure ratings and diameters. The first section extends from the Mill Site to the T2 Dropbox and is comprised of 22 inch (556 mm) DR 17 HDPE pipe. The second section extends from the T2 Dropbox to the Tailings Storage Facility and comprises 24 inch (610 mm) DR 15.5 HDPE pipe. Two sections of 30 inch (762 mm) DR 15.5 HDPE pipe are also included at the start of the two pipeline sections (at the Mill Site and at the T2 Dropbox) to ensure that flows are not restricted at the inlets.

6.2 CYCLONE OPERATION

The cyclone tailings discharge system was operated as follows during the 1999 cycloned tailings program:

- Four 20-inch diameter cyclones were operational and two standby cyclones were used to facilitate moves.

- The pressure to each cyclone was controlled at about 40 psi using pinch valves. Bulk tailings that were not discharged through a cyclone were discharged from the end of the operational section of the tailings header pipeline.

- The cyclone off-takes from the tailings header pipeline consisted of steel T-sections with two cyclones connected to a single off-take.

- Tailings were periodically discharged from a single point outlet at the location of the Upper Dump Valve in order to facilitate maintenance and major pipeline and cyclone moves.

The open end of the operating section of the pipeline has controlled the pressure in the header pipeline. This operating procedure ensures that the header pipeline is not over pressurized, but results in a significant loss of bulk tailings to the cyclone operation. The single point discharge resulted in a reduction in cyclone availability of 30 to 40 percent based on the cyclone underflow discharge rate measurements. Cyclone operation has to be optimized in order to ensure that a sufficient volume of cycloned sand is produced for construction of the Stage 3 Main and Perimeter Embankment downstream shell zones. In order to maximize the availability of the cyclones, the following changes to the header pipeline and cyclone operating system are suggested:

- The pressure in the header pipeline should be controlled by a pinch valve off-take at the location of the Upper Dump Valve and a knife gate valve located in the header pipeline, after the last cyclone, to ensure that the maximum number of cyclones are operated. It should be possible to operate six cyclones with a mill production rate of 20,000 tonnes per day and an operating pressure of 40 psi at the location of the furthest cyclone off-take along the header pipeline. This could be accomplished by isolating the operational section of the header pipeline with the knife gate valve and pressurizing the header pipeline by controlling flow from the pinch valve at the Upper Dump Valve location.

- The header pipeline would be protected from over pressurization in two ways. The first would be a vent pipe, consisting of a gooseneck standpipe located on high ground within the Tailings Storage Facility catchment in the vicinity of the Upper Dump Valve. This vent pipe would ensure that the pressure in the header pipeline is maintained at sufficient levels for operation of the last cyclone but would protect the pipeline from over pressurizing as a result of sanding in the pipeline or surges in the mill feed. An 18 inch diameter HDPE, DR 21 vent pipe would be sufficient to discharge the total bulk tailings flow in the case of a blockage in the header pipeline. The vent pipe outlet should be located at an elevation of approximately 975 m. The rupture disk that is located at the Upper Dump Valve would provide the second level of protection. The rupture disk should be rated at a pressure that is 10 to 15 percent less than the rated pressure of the pipeline (i.e. approximately 90 psi).

- Additional cyclones should be added to the system as all six existing cyclones are expected to be operational. The additional cyclones would facilitate the movement of cyclones without losing production time.

- Additional steel T-section off-takes should be provided at frequent intervals along the header pipeline to minimise the length of the cyclone off-take flexible pipeline and to provide maximum flexibility for cyclone placement. Off-takes could be provided about every 100 m to 150 m with an isolating knife gate valve in the header pipeline after every third off-take. The knife gate valves will be required to prevent sanding in the header pipeline downstream of the last cyclone.

- The distance between the cyclone off-takes should be optimized during operation to avoid sanding in the header pipeline due to low flow velocities.

The changes that are discussed above are illustrated schematically on Figure 6.1.

6.3 WINTER OPERATION

The cyclones will be operated during the summer only to construct the downstream shell zones. During winter, all tailings will be spigotted along the upstream faces of the embankments to maintain competent beach development for on-going embankment raises. The tailings header pipeline will be located along the upstream edge of the embankment crests. Tailings will be discharged from movable spigot sections with six 150 mm off-takes that will allow controlled deposition of tailings over the length of the embankment. The pipeline has a number of flanged connections where the movable discharge section will be installed. The tailings pipeline could be secured on the embankment crest by concrete blocks or guide posts to restrict thermally induced movements.

Tailings discharge will be rotated so that tailings beaches are established over the full length of the Perimeter and Main Embankments. Following construction of the South Embankment during Stage 3, a bifurcation will be added to the tailings pipeline and a new pipeline section will be installed along the South Embankment. Tailings deposition will be concentrated from the South Embankment at this time in order to blanket the near surface bedrock with a layer of low permeability tailings.

6.4 RECLAIM PIPEWORKS AND OPERATION

The reclaim system was designed to provide adequate pipeline and pumping capacity to recycle process water from the Tailings Storage Facility to the Mill Site in order to meet process requirements. Reclaim pipework includes the reclaim pipeline, a reclaim booster pump station and a pump barge in the Tailings Storage Facility. All pipework is butt fusion welded High Density Polyethylene (HDPE) pipe of varying diameter. Pipe wall thickness (pressure rating) was selected to accommodate the anticipated operating pressures.

The reclaim pipeline is HDPE pipe which decreases in thickness (pressure rating) as the booster pump station is approached and the pressure head is decreased. Nominal 24 inch (610 mm) HDPE pipe with varying pressure ratings was selected to provide the required water transfer capacity.

The reclaim booster pump station is at the midpoint of elevation to reduce pressure rating requirements. An inter-linked control system co-ordinates pump operations with process water demand at the Mill Site. The control system and pipework design includes the necessary provisions for spill prevention.

The reclaim barge is a prefabricated floating pump station complete with perimeter trash screens, internal wet wells, pumps, valving, piping, electrical power, instrumentation and control circuitry. A hinged walkway/pipe bridge is provided for access to the barge from the side of the reclaim barge channel. The reclaim barge was designed by Chamco Industries Ltd. Identical pumps were used at the barge and booster station to reduce spare part requirements and to simplify maintenance.

SECTION 7.0 - WATER MANAGEMENT

7.1 WATER MANAGEMENT PLAN

The water management plan is essentially unchanged from that presented in the Knight Piésold Updated Design Report (Ref. No. 1627/2). The only change is that the placement of cycloned sand downstream of the Main and Perimeter Embankment core zones results in an additional volume of water that has to be collected by the Seepage Recycle Systems and pumped into the Tailings Storage Facility. The additional flow rate that results from the drainage of the cycloned sand is about 16 l/s, as discussed in Section 3.0.

The components of the water management plan include disturbed and undisturbed areas at the Open Pits, Waste Dump, Mill Site, Tailings Storage Facility, the undisturbed catchment area immediately upstream of the Tailings Storage Facility and the diverted areas downstream of the tailings embankments. A water management plan schematic is shown on Figure 7.1.

The objective of the water management plan is to monitor and release selected surface water inflows in order to manage the final volume of ponded water in the tailings impoundment at closure. These objectives will be met by:

(i) Maximize the capture of surface and groundwater flows from within the project area.

(ii) Maximize the use of the poorest quality water recovered from within the project area in the milling process and in associated activities (such as dust suppression).

(iii) Minimize the deliberate introduction of excess clean fresh water from Polley Lake and Hazeltine Creek.

(iv) Monitor the quality of surface runoff from disturbed areas and groundwater flows within the project site.

(v) Release only the best quality water from within the project boundaries and in accordance with permitted requirements, as is necessary to maintain an overall project water balance under prevailing hydrometeorological conditions.

(vi) Manage the operation of the tailings supernatant pond to optimize the volume of water stored on the tailings surface during operations and at closure.

(vii) Develop and maintain a detailed data base to allow water balances for the site to be as accurate as possible and thereby become useful tools for predicting annual make-up water requirements and for scheduling releases of clean surface runoff water as appropriate.

The key to the water management plan implementation is the development and maintenance of a detailed data base so that water balances are as accurate as possible. This enables the water balance to be a useful tool for predicting annual make-up water requirements and for scheduling releases of clean surface runoff water.

7.2 WATER BALANCE

The overall project water balance was originally presented in the Knight Piésold Report on Project Water Management (Ref. No. 1624/1). The current water balance is maintained by MPMC and has been modified slightly from the original version to account for operating conditions. The supernatant pond is surveyed twice a year to ensure that the water balance reflects operating conditions accurately. The water balance closely tracks the actual pond volumes and continues to be a useful predictive and management tool.

SECTION 8.0 – RISK ASSESSMENT

8.1 GENERAL

A shift of embankment construction methodology from conventional earthfill to cycloned sand will require adjustment to the operation of the Tailings Storage Facility and ancillary components. Affected components will include the tailings pipeline, the performance of the Main, Perimeter and South embankments, the reclaim water system, and the water management features and procedures. Any such shift in operations and construction methods requires an appropriate commitment to training and careful observation to optimize the operation and to minimize the potential for problems to the greatest extent possible.

In general the adoption of a cycloned sand construction method imposes an incremental and inherent risk to the environment, operations (costs) and safety over the risks associated with conventional earthfill. Some risks, including large scale embankment failure for example, are reduced in comparison with the risks of the conventional earthfill embankment. The inherent and incremental risks to the environment, operations (costs) and safety are related to:

- Placement of a portion of the tailings outside of the confines of the embankment core zone,
- Construction of a large portion of the downstream embankment shell zone with a consistently graded material but in a less controlled manner,
- Greater reliance upon adequate storm water management and sediment control structures, and
- Greater requirement for careful construction scheduling, and tailings (underflow and overflow) discharge locations, timing and pressures.

These risks must be understood and mitigated where possible, with appropriate contingency plans in place for the continued protection of the potentially impacted values and resources (environment, operations, and safety).

The risk associated with a potential failure mode, such as rupture of a tailings pipeline due to overpressurization for example, is assessed in accordance with two factors:

1) the likelihood, or probability, of occurrence of the failure mode, and
2) the consequences of the failure mode.

In a qualitative risk assessment the likelihood and consequences of each failure mode are combined to produce a descriptive code for the relative risks associated with each component of the operation. Although apparently simplistic, a qualitative risk assessment may provide valuable insight to the vulnerability of various project components where insufficient or potentially misleading quantitative data is available. At very least, a qualitative assessment is a structured method of accounting for and communicating the potential problems associated with an operation.

8.2 QUALITATIVE RISK ASSESSMENT METHOD

As discussed, risk is comprised of likelihoods and consequences of various failure modes. Table 8.1 provides a framework for the ranking of these two risk factors. In this case, the likelihood of occurrence (probability) of a failure mode is described using one of four ordinal codes from Very Low (VL) likelihood to High (H) likelihood of occurrence. Similarly, the consequences of such an occurrence are described using one of three ordinal codes from Low (L) consequences to High (H) consequences.

The occurrence of a failure mode may result in potential consequences (losses) for the environment, to operations (costs), and/or safety. As such, a consequence code is separately assigned to each of these values and resources for each failure mode. Once assigned, the likelihood (Very Low to High) and consequence (Low to High) ratings may be combined as shown in Table 8.1. The table has been colour coded to visually demonstrate the resulting risk of each combination, with the highest risk (high likelihood combined with high consequences) being signified by solid red shading, and the lowest risk (very low likelihood combined with low consequences) being left unshaded.

8.3 COMPONENTS AND FAILURE MODES

The potential problems (sources of risk) associated with each of the mine components that are considered to be affected by a shift to a cycloned sand operation are categorized and listed in the left-most columns of Table 8.2 (Column A). The potentially affected mine components include: the tailings pipeline, the Main, Perimeter and South Embankments, the reclaim water system, water management, and the cycloning operation itself.

The potential problems associated with each of these components include such failure modes as pipe wear and rupture, malfunctioning of safety equipment, excessive seepage, embankment instability, dusting, erosion, water quality and quantity problems, and construction schedule and materials balance problems, amongst others.

8.4 LIKELIHOODS AND CONSEQUENCE CATEGORIES

As described, the risk associated with each potential problem (failure mode) is the combination of likelihood and consequence. The likelihood of occurrence of each potential problem has been estimated using a qualitative scale from 'Very Low' to 'High' according to the 'Likelihood Rating' scale of Table 8.1, and as listed in Column F of Table 8.2.

The consequences of occurrence of each potential problem are scaled from 'Low' to 'High' for each of the three consequence categories: Environmental, Operational, and Safety. The qualitative consequence ratings are listed in Columns C, D and E of Table 8.2 using the scale provided in Table 8.1.

8.5 RISKS AND MITIGATION

The interpreted risk of each potential problem is determined through the combination of likelihood and consequence ratings of Table 8.2 using the matrix provided in Table 8.1. The resulting risks are provided in Columns G, H and I of Table 8.2, and are shaded from light red to solid red for the 'Moderate', 'Moderate to High' and 'High' risk categories respectively, and unshaded for the "Very Low", "Low" and "Low to Moderate" risk categories.

From the last three columns of Table 8.2 it is observed that the greatest risks associated with the adoption of the cycloned sand embankment construction method are related to the operations and potential for increased costs. In particular, the following potential problems represent the greatest operational risks:

- Excessive wear and rupture of the tailings pipeline.
- Sanding of the low-gradient, low-velocity portions of the tailings pipeline.
- Costs and operational issues associated with the correction of dusting or surface erosion at the Main and Perimeter Embankments.
- Excessive turbidity in the reclaim water.
- Water management.
- Costs and operational issues associated with the correction of erosion of the Main or Perimeter Embankment due to excessive bulk tailings or cycloned flows resulting from pipeline rupture or operational error.
- Material balance and construction schedule.

Not all of these operational risks are incremental in comparison with the current operation.

The most significant environmental risks are associated with the likelihood and consequences of tailings pipeline ruptures due to excessive wear, dust generation from the Main and Perimeter Embankments, and the potential for erosion of the Main or Perimeter Embankment due to excessive tailings flows resulting from pipeline rupture or operational error (pipeline draining, valves left open, etc.). The environmental risks of the cycloned sand operation are not necessarily incremental to those associated with the current construction method and are discussed here for completeness and to allow a discussion of potential mitigative measures.

The environmental risks associated with a rupture of the tailings pipeline can be mitigated through the continued frequent monitoring and inspection of the tailings pipeline and verification of the culvert annulus capacities. Specifically, the routing of tailings flow within ditches and through culverts in the event of a rupture must be verified over the length of the tailings pipeline. For example, a rupture of the tailings pipeline upstream of the M1a offtake (Upper Dump Valve) could cause tailings to flow through the culvert underneath the Polley Lake access road and to the containment ditches on the downstream side of the Perimeter Embankment. This tailings flow, if large enough, could overwhelm the single culvert at the Polley Lake access road, diverting some flow over the road or northeast towards Polley Lake. The capacity of this culvert should therefore be checked to ensure flow of the tailings to the Perimeter Embankment ditches and eventually the Seepage Collection Pond in the unlikely event of a major and unnoticed tailings pipeline failure at this location.

Similarly, near the intersection of the Haul Road and the Reclaim Pipeline Road, the tailings pipeline passes through the road prism in a single 900-millimetre diameter culvert. The capacity of the annulus between the tailings pipeline and the culvert must be verified in order to ensure the safe passage of the full tailings flow towards the Tailings Storage Facility in the event of a major and unnoticed pipeline failure.

As an added feature to mitigate the effects of a tailings pipeline rupture or overtopping of the proposed T2 drop box gooseneck, the small, flooded pond between the T2 drop box and the Bootjack crossing (immediately southeast of the access road to the explosives facility) should be excavated and adopted as an emergency dump pond to contain released tailings.

The tabulated risks of Table 8.2 are, to a great extent, manageable and simply mitigated. However, the greatest incremental risks associated with the proposed shift in embankment construction methodology are to the operation of the Tailings Storage Facility, and specifically the resulting costs of insufficient cycloned sands for construction and construction scheduling problems. Risk management and mitigation with careful planning, progress reporting and the development of contingency plans will, however, significantly minimize these inherent risks.

SECTION 9.0 - ON-GOING REQUIREMENTS

9.1 GENERAL

The cycloned sand tailings embankments will continue to be raised incrementally, with the design and construction procedures adjusted as appropriate based on operating experience and updated operating projections. Therefore, although the construction materials and embankment geometry have been revised slightly in the current embankment design, the design philosophy still incorporates the observational approach wherein the specific design details and construction sequences are adjusted based on operational performance and projected on-going storage requirements. In the observational approach, additional data from geotechnical and environmental monitoring is incorporated into the on-going design concept, along with additional information on the actual filling schedule, construction materials and construction methods. The estimated quantities for on-going staged expansion of the tailings embankments are summarized in Table 9.1.

An overview of the geotechnical and environmental monitoring results are provided in this section, along with preliminary design concepts for on-going expansion of these data collection programs. Revised procedures for on-going construction monitoring are also presented, along with contingency plans to provide additional flexibility for the use of alternative construction materials in the event that cycloned sand production rates are lower than anticipated. The post-closure implications for reclamation of the tailings impoundment are also discussed.

9.2 GEOTECHNICAL INSTRUMENTATION AND MONITORING

9.2.1 General

The current tailings impoundment incorporates numerous monitoring features, including:

- Numerous vibrating wire piezometers for monitoring pore pressure fluctuations in tailings beaches, foundations, embankment fill zones, and drainage zones.

- Flow monitoring provisions for evaluation of variations in flow rates in foundation and embankment drainage systems.

- Settlement monuments for evaluation of embankment settlements during construction and on-going operations.

These monitoring systems will be expanded as appropriate during the on-going staged development of the tailings impoundment. Details of the existing Instrumentation and Monitoring systems are included on Drawings 11162-12-150 through 159. A brief description and summary of results for the instrumentation systems is presented below:

9.2.2 Piezometers

To date a total of 45 vibrating wire piezometers have been installed to assist in assessing the performance of the Tailings Storage Facility. An additional 10 piezometers will be installed within the tailings facility during the current Stage 2C construction. The piezometers are grouped into tailings piezometers, embankment foundation piezometers, embankment fill piezometers and drain piezometers for monitoring the embankment performance. Results are discussed below.

Tailings Piezometers:

A total of 6 piezometers have been installed in the tailings to date. The pore pressures in the tailings beaches typically track the tailings pond elevation, which is consistent with expectations for a water retaining impoundment. It is anticipated that the tailings pore pressures will tend to stabilize once the upstream toe drains in the Main and Perimeter embankments become operational.

Embankment Foundation Piezometers:

A total of 16 piezometers have been installed in the embankment foundations to date. No unexpected pore pressure increases have been observed. The highest water level indicated by the foundation piezometers to date was recorded in C2-PE2-01 at the Main Embankment, with an artesian level of 4.6m being recorded. Other pore pressure levels of note at the Main Embankment include 3.6m in A2-PE2-01, 2.7m in B2-PE2-02 and 1.2m in C2-PE2-02. None of these piezometric levels have reached the 'trigger levels' of 6.0m artesian pressure (relative to original ground) which were delineated in previous studies. The trigger levels were based on embankment stability analyses conducted for the previous embankment design concept which incorporated a 2H:1V slope The updated design concept includes a flatter downstream slope of 3H:1V which provides additional buttressing and improved foundation stability.

Embankment Fill Piezometers:

A total of 13 piezometers have been installed in the embankment fill materials to date. This includes 9 in low permeability Zone S or B glacial till and 4 in the high permeability Zone T. No unexpected pore pressure increases have been observed to date. No pore pressure increases have been observed in fill piezometers located downstream of the chimney drain. The Zone T embankment fill piezometers that are functioning are showing slightly negative pore pressures, indicating that the zone is not saturated.

Drain Piezometers:

A total of 10 piezometers have been installed in components of the embankment drains to date including foundation drains, chimney drain and outlet drains. All functioning drain piezometers are showing slightly negative pore pressures, indicating that the zones in which they are installed are not saturated, and that the drainage zones are performing as intended.

9.2.3 Drain Flow Data

Flows from the Foundation Drains at the Main Embankment are monitored on a weekly basis (as long as the Seepage Collection Pond is maintained at a level that is lower than the Foundation Drain outlet pipes in the Drain Monitoring Sump). The results indicate that the flows have remained relatively low as compared to baseline conditions. The only exception is flows in FD-5, which have fluctuated since it was installed. However, this can be attributed to the fact that FD-5 is covered by rockfill and is therefore affected by rainfall. Even with the rainfall that enters FD-5, the plot shows that the Foundation Drain flows have remained relatively low. The maximum total flow is less than 0.7 litres/second (42 litres/minute) even though the tailings pond level has risen to about El. 936 m. It is anticipated that the flow rates in FD-5 will increase during cycloned sand deposition, as drainage water from the downstream cells will report to these foundation drains.

The flow monitoring data indicates that the impounded water has not greatly influenced the underlying soils and that the glacial till liner (natural and constructed basin liner) is performing as intended. The Seepage Collection Pond must be operated at a low water level so that flow monitoring can be conducted.

Seepage flows from the three Outlet Drains for the Main Embankment Chimney Drain were found to be flowing at a very low rate of about 1 litre/min in OD-1 and about 0.5 litre/min in OD-2 and OD-3 during the 1999 dam inspection. The flows in OD-1 are higher than in the other two locations since this drain extends into the foundation materials along the right abutment. A high groundwater table and more permeable foundation soils were encountered in this area. The very low flow rates measured in OD-2 and OD-3 illustrate the extremely low permeability nature of the embankment core zone materials and demonstrate the effectiveness of the chimney drain in depressurizing the downstream shell zone of the Main Embankment.

The Perimeter Embankment Outlet Drains have been constructed, but the Chimney Drain has not been installed, and will no longer be required once cycloned sand is utilized for construction of the downstream shell zone of the embankment. Two of these outlet drains have since been covered by the Downstream Cycloned Sand Trial Berm.

9.2.4 Survey Monument Data

Eight (8) survey monuments were installed on the Main Embankment crest during 1998. Total movements ranged from 5 to 25 mm. Settlements typically ranged from 0 to 5 mm. These settlement values are significantly lower than the predicted maximum settlements of 200 to 400 mm, and are well within design tolerances.

These monitoring programs will be maintained and/or expanded for the updated embankment development plan. In particular, the piezometers and flow monitoring systems will be adjusted to provide additional information on pore pressures and drainage flow rates from the downstream cycloned sand shell zones. The settlement monitoring data will be less significant for the updated design concept, as ongoing construction of the core zone will incorporate vertical extensions rather than the upstream sloping core zone included in the previous design concept. Therefore, differential settlements in the upstream tailings beaches will not cause vertical deformation of the core zone.

9.3 WATER QUALITY MONITORING

MPMC staff regularly conduct water quality monitoring. Monitoring includes surface water quality from ditches, streams, creeks and lakes, as well as groundwater quality from monitoring wells. In addition, the water quality of the supernatant water in the Tailings Storage Facility is regularly checked. The results of the monitoring have been reported by Mount Polley in the report "1998 Annual Environmental Report, Effluent Permit 11678". This report has been submitted to the appropriate agencies (Ministry of Environment, Lands and Parks and Ministry of Energy and Mines). Conclusions from this report are summarized below.

Surface Water Quality (including tailings water)

Water quality monitoring has indicated that most surface water samples have levels of Total Aluminum, Total Copper and Total Iron that exceed the criteria set out by the B.C. 1995 Approval and Working Criteria for Water Quality (AWCWQ) and the 1995 Canadian Council of Ministers of the Environment (CCME).

Testing of the tailings water from the supernatant pond indicated that this water has Total Aluminium and Total Iron values, which exceed the Provincial Discharge Objectives (PDO) criteria. These results do not affect current or ongoing operations because there is no requirement for discharge of excess water from the Tailings Storage Facility.

Groundwater Quality

Water quality monitoring has indicated that most groundwater samples from the Tailings Storage Facility area have relatively high alkalinity. However, the alkalinity has not changed significantly from the levels recorded in the December, 1996 baseline samples and no adverse water quality impacts are anticipated.

For the new South Embankment three monitoring wells will be installed. One well will be installed adjacent to the future (Stage 4) seepage collection pond. The other two will be located downstream of the final South Embankment toe at a spacing to be determined in the field. A new installation in the sandy unit of the Main Embankment foundation may also be required during a later stage.

9.4 CONSTRUCTION MONITORING

Knight Piésold personnel assist with the supervision, inspection and testing duties during earthworks construction. Key items addressed by Knight Piésold include foundation inspection and approval prior to fill placement, assessment of borrow material suitability, inspection of fill placement procedures, in-situ testing of the placed fill for moisture content and density, record and control testing at the required frequencies, and monitoring of all construction instrumentation. Results of the Quality Assurance and Quality Control (QA/QC) program are typically presented in detail in a Construction Report after each construction program. The QA/QC results have typically shown that the design objectives are consistently achieved.

The QA/QC testing programs were expanded during 1999 to enable additional records to be routinely collected during placement of the cycloned tailings sand in the Upstream Trial Berm. Both the bulk and cycloned tailings were sampled frequently during 1999 to provide a database of information regarding the nature and variability of cycloned sand characteristics.

The usual QA/QC activities carried out by KP as part of the routine construction supervision procedures used during construction of the various staged expansions of the impoundment are outlined in the Knight Piésold Ltd. Report "Site Inspection Manual", (Ref. No. 1625/2). These procedures will be updated to include for specific QA/QC testing required during placement of cycloned sand fill materials.

9.5 ON-GOING CONSTRUCTION

The on-going staging of the Main and Perimeter Embankments is shown on Figures 5.5 and 5.8. It is envisaged that each stage will consist of a lower hydraulically placed cycloned sand zone and a upper mechanically placed cycloned sand zone. Every effort will be made to place cycloned sand in a hydraulic fashion for as long as possible since this is the most cost effective construction method. When this can no longer be achieved, however, due to the geometry configuration or high cyclone advancement rates, mechanically placed cycloned sand from stockpiles will be used to complete the remaining staged construction. As can be seen on the Figures 5.5 and 5.8 the top of the hydraulically place zones has a 1V:5.5H slope. This reflects the angle of repose of the cycloned sand, which was measured during the 1999 cyclone sand trial program. The actual elevation for the boundary between the mechanically and hydraulically place cycloned sand zones has been estimated using the assumed parameters listed in Table 2.2 but the actual elevations will be determined in large part by the actual cycloning performance in the field and the actual material availability from the mill site.

9.6 CONSTRUCTION MATERIALS CONTINGENCY PLAN

The current embankment design concept is based on a certain availability of cycloned sand for use in the downstream shell zones of the Main and Perimeter Embankments. The construction materials balance projections presented in Section 5 assume that at least 100,000 m^3 of cycloned sand will be produced each month and that a total volume of 700,000 m^3 can be produced during each 7 month operating season. A shortfall in this sand production rate will result in additional requirements for other embankment construction materials. The material balance will be evaluated on a monthly basis in order to determine whether construction material shortfalls will occur, and whether it will be necessary to supplement cycloned sand fill quantities with glacial till materials from the local borrow areas. Depending on the material gradings, there may also be the need for a transitional material in order to establish a proper filter relationship.

The cell construction sequence described in Section 5, has been designed to facilitate development of a relatively horizontal fill zone along the Main and Perimeter embankments. In the event that insufficient cycloned sand is available to construct the embankment, then it will be relatively straight forward to replace the upper section of the cycloned sand shell zone with well graded glacial till. Placement of glacial till materials in the upper cells will ensure that the embankment crest raise can be constructed to provide the necessary freeboard for the subsequent years of operation. Also, it may be necessary to concentrate cycloned sand placement along the Main Embankment and to construct the perimeter embankment entirely with imported fill materials, particularly during Stages 3 and 4 when it may prove to be difficult to place the required volumes of cycloned sand. The material balances for subsequent impoundment expansions after Stages 3 and 4 are less critical, in that it will be possible to produce more than the required volume of cycloned sand required for construction of the downstream shell zones.

9.7 RECLAMATION AND CLOSURE

The existing reclamation plan for the tailings impoundment will remain essentially unchanged, except that the reclamation plan will also include for revegetation of the flatter cycloned sand embankment slopes. MPMC have initiated a variety of reclamation study programs to address various aspects of closure and reclamation. These programs will be adjusted after appropriate consultation with the regulatory authorities.

In accordance with requirements under the *B.C. Mines Act* and *Health, Safety and Reclamation Code for British Columbia*, the primary objective of the proposed Reclamation Plan will be to return the tailings impoundment to an equivalent pre-mining use and capability. This comprises forested wildlife habitat that supports grazing, hunting, guiding, trapping and recreational uses. The following goals are implicit in achieving this primary objective:

- Long-term preservation of water quality within and downstream of decommissioned operations.
- Long-term stability of the tailings impoundment.

- Re-grading of all access roads, ponds, ditches and borrow areas not required beyond mine closure.

- Removal and proper disposal of all pipelines, structures and equipment not required beyond mine closure.

- Long-term stabilization of all exposed materials susceptible to erosion. Reclamation of the cycloned sand embankment slopes will include for establishing a suitable erosion resistant cover during final reclamation.

- Natural integration of disturbed lands into the surrounding landscape, and restoration of the natural appearance of the area after mining ceases, to the greatest possible extent.

- Establishment of a self-sustaining vegetative cover consistent with existing forestry, grazing and wildlife needs.

As an overall approach to achieving these objectives, the Reclamation Plan is sufficiently flexible to allow for future changes in the mine plan and to incorporate information obtained from ongoing reclamation research programs such as trial tailings re-vegetation plots.

SECTION 10.0 - CONCLUSIONS AND RECOMMENDATIONS

MPMC utilized six 20-inch diameter cyclones to conduct extensive cycloning trial programs during 1999. These programs included construction of an Upstream Trial Berm along the entire length of the Main Embankment and partially along the Perimeter Embankment during May through September, and construction of a small Downstream Trial Berm along the Perimeter Embankment in September and October. These trial programs provided an ideal opportunity to refine operating procedures and to obtain geotechnical data to support the development of a revised design concept for the on-going staged expansion of the Tailings Storage Facility.

The geotechnical evaluation of the cycloned sand products developed during the trial programs indicates that the fine silty sand underflow, once it has drained, represents a suitable construction material for incorporation in the embankment shell zones. However, this underflow material was typically deposited at a relatively flat angle of repose of about 5.5H:1V and contains about 25 to 30% silt sized particles, which restrict the rate of drainage. The cycloned sand material was also found to have reasonably good shear strength characteristics, and acceptable densities of about 95% of the Standard Proctor Maximum Dry Density were achieved during hydraulic placement.

Although the geotechnical characteristics of the cycloned sand product were found to be acceptable for embankment construction, it was also recognized that there are significant operational challenges associated with using these materials to construct the embankment shell zones. In particular, the following items represent key operational considerations:

- It is important to maximize the operational efficiency of the cyclone operations in order to maximize the volume of cycloned sand produced during the next 2 to 3 years of operations. The transition from the existing 2H:1V earthfill embankment slope to the flatter 3H:1V cycloned sand slope requires a substantial volume of product, and will require improved operating procedures in order to produce the volumes of material required.

- The flat angle of repose of the cycloned sand slopes of 5.5H:1V results in a requirement for the use of confining berms in order to limit the downstream slope of the embankment to about 3H:1V. This cell construction technique is required in order to confine the area of disturbance and to reduce the volume of cycloned sand needed to establish the downstream shell zone.

- The cycloned sand deposited in the deposition cells typically has a high moisture content and is not trafficable to construction equipment until the pile has drained. It is also necessary to provide a waiting period of approximately 2 to 3 weeks to allow the sands to drain adequately so that they can be used for construction of the confining berms.

- Once the initial 5.5H:1V slopes have been established on the deposited tailings, the thickness of subsequent layers will be controlled by the height of the confining berms. It has been estimated that a reasonable practical height for these confining berms is 2 meters. Subsequent deposition of cycloned sand into these ongoing cells occurs relatively rapidly and thus necessitates frequent moving of the cyclones and/or distribution pipework. Flushing lines!

- The construction schedule must be carefully controlled in order to sequence the cycloned sand deposition into areas where the previously deposited sand has been allowed to drain and cell construction has been completed. The width of these operating cells decreases near the crest of the embankment stage, and results in a requirement for frequent advancement of about 100 metres per day.

- Ultimately, the fundamental objective of the construction schedule is to increase the height of the embankment within a designated time period, in order to provide additional incremental storage capacity for on-going disposal of tailings. Therefore, the filling schedule for the impoundment, along with the freeboard requirements, will dictate when the height of the embankment must be raised. Examinations of the Stage 3 and 4 construction schedules suggest that it may be necessary to interrupt the cycloning operations to allow construction of the core zone and completion of the crest raise.

It is recognized that there will be additional operational challenges associated with the proposed cycloned sand embankment construction method. Careful planning and NB efficient operating practices will mitigate these to a great extent. Modifications to the pipeworks systems and the 1999 operating procedures will be required to improve the operational efficiency and to minimize operating risks. NB

It is recommended that MPMC review the intended operating procedures for on-going embankment construction using cycloned sand. It may be more appropriate to incorporate a hybrid approach wherein cycloned sand deposition is limited to the downstream shell zone of the Main Embankment in 1999, and that the entire Perimeter Embankment be constructed from glacial till and/or rockfill. Also, it may be simpler and easier to modify the cycloned sand placement strategy to allow placement of cycloned sand to the ultimate toe of the final embankment. The Stage 3 construction material shortfall could be made up by placing compacted glacial till and/or rockfill directly on top of the deposited drained cycloned sand into the upper sections of the shell zone. Finally, if rockfill materials are used, appropriate transition materials will be required in order to ensure proper filter relationships between adjacent materials.

SECTION 11.0 – REFERENCES

Surface Water Regime (Ref. No. MISC0168), January 7, 1990.

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1998 Annual Environmental Report, Effluent Permit 11678.

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Mt. Polley Project, Report on 1995 Geotechnical Investigations for Mill Site and TSF (Knight Piésold Ref. No. 1623/1), March 14, 1995.

Mt. Polley Project, Report on Project Water Management (Knight Piésold Ref. No. 1624/1), February 6, 1995.

Mt. Polley Project, TSF Design Report, Volume I – Main Report, Volume II – Appendices (Knight Piésold Ref. No. 1625/1), May 26, 1995.

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Mt. Polley Project, Site Inspection Manual (Knight Piésold Ref. No. 1625/2), May 26, 1995.

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Stage 2A Tailings Facility Construction Selected Excerpts from Reference Information (Knight Piésold Ref. No. 10162/9-2), November 11, 1997.

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Evaluation of Cycloned Tailings Embankment Construction (Knight Piésold Ref. No. 11162/11-1, Rev.0), June 16, 1999.

SECTION 12.0 - CERTIFICATION

This report was prepared and approved by the undersigned.

Prepared by: ______________________

John Wilkinson, P.Eng.
Senior Engineer

Approved by: ______________________

Ken J. Brouwer, P.Eng.
Director

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TABLE 2.1

MOUNT POLLEY MINING CORPORATION
MT. POLLEY MINE
TAILINGS STORAGE FACILITY

EMBANKMENT FILL QUANTITIES - STAGE 3

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10-Dec-99

	ITEM	UNITS	Main Embankment		Perimeter Embankment		South Embankment		1999 TOTAL	2000 TOTAL
			1999	2000	1999	2000	1999	2000		
	Cyclone Sand									
1a	Hydraulically Placed	m^3		355,100		105,500				**460,600**
1b	Mechanically Placed	m^3		183,300		140,200				**323,500**
2	**Foundation Preparation**	m^2	20,000	24,000		41,000		9,200	**20,000**	**74,200**
	Rockfill									
3a	Longitudinal Confining Berms	m^3	8,580	11,000		27,500			**8,580**	**38,500**
3b	Cross Drain	m^3	1,000	1,000		900			**1,000**	**1,900**
3c	Additional Drainage Berm Works	m^3		24,640		7,590				**32,230**
4	**D/S Zone C**	m^3						1,210		**1,210**
5	**Core Zone**	m^3		32,120		44,330		3,520		**79,970**
6	**U/S Fill**	m^3		34,760		48,070		1,210		**84,040**
7	**Geotextile**	m^2	7,200	13,100		24,570			**7,200**	**37,670**
8	**Ditch Excavation**	m^3	300	200		1,600			**300**	**1,800**
	Pond Excavation									
9a	East	m^3	5,300						**5,300**	
9b	West	m^3		5,300						**5,300**

Notes:

1) Zone C (Item 4) volume added for chainage between 26+00 and 28+00, 15+00 to 16+00; cyclones will not be placed in these areas.
2) 30% wasteage and overlap contingency included in geotextile quantities (Item 7). 10% contingency added to fill materials.
3) Contingency for additional drainage berm works included in Rockfill quantities (Item 3c).

Revised 12/10/1999
Revision 0

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TABLE 2.2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY PROJECT

UPDATED DESIGN BASIS AND OPERATING CRITERIA

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ITEM	DESIGN CRITERIA
1.0 GENERAL DESIGN CRITERIA	
Scope	Generally applicable to all components and structures.
Regulations	MEI MELP (Water Management Branch)
Codes and Standards	NBC and related codes CAN/CSA HSRC (Health, Safety and Reclamation Code for Mines in B.C.) ASTM ACI ANSI
Design Life	14 Years
Operational Criteria: General	 NBC where relevant
Rainfall/Precipitation:	(Section 2.1 Ref. No. 1625/1) and (Ref. No. 1624/1)
Seismic:	
OBE (operations)	M = 6.5, A max. = 0.037 g, (Section 2.3 Ref. No. 1627/2)
MDE (closure)	M = 6.5, A max. = 0.065 g, (Section 2.3 Ref. No. 1627/2)
2.0 TAILINGS BASIN	
Site Selection	(Section 4.0 Ref. No. 1627/2), (Ref. No. 1625/1) and (Ref. No. 1621/1) • Capacity and filling characteristics. • Hydrology and downstream water usage. • Hydrogeology and groundwater regime. • Aesthetics and visual impact. • Foundation conditions. • Construction requirement. • Closure and reclamation requirements. • Capital and operating costs.
Geological and Geotechnical Conditions	(Section 5.0 Ref. No. 1627/2), (Ref. No. 1625/1) and (Ref. No. 1623/1).
Basin Liner	• Compacted glacial till with frost protection layer required in areas with <2 m in-situ glacial till. • Liner placed in 3 - 150 mm lifts. • Liner compacted to 95% Std. Proctor max. dry density (ASTM D698) at optimum moisture content minus 2% to plus 2%.
Embankment Foundation Drains	• Installed in Main Embankment Foundation. • Geotextile wrapped 1000 mm x 800 mm gravel/drain with 100 mm perforated CPT drain pipe. • Drain conveyance pipes are solid HDPE. • Discharge to Main Embankment Seepage Collection Pond via Drain Monitoring Sump.
Stripping	• Required at areas directly affected by construction (embankments, basin liners, seepage collection ponds, reclaim barge channel, stockpiles, roads etc.). • Remove organic soil to topsoil stockpiles.
3.0 TAILINGS EMBANKMENT	

TABLE 2.2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY PROJECT

UPDATED DESIGN BASIS AND OPERATING CRITERIA

Function	• Storage of tailings and process water for design life. • Provide storage for 24 hour PMP storm. • Provision for routing PMF at closure.
Embankment Crest Width	8 m starter dam and 6 m final dam.
Embankment Height (Max): Starter	15 m (Crest El. 927 m), Figure 2.2
Final	50 m (Crest El. 962 m), Figure 2.2
Embankment Crest Length: Starter	1000 m
Final	4500 m
Main Embankment	• Use cycloned sand for downstream shell • Final downstream slope at 3H:1V Drg. 11162-12-111
Perimeter Embankment	• Use cycloned sand for downstream shell • Final downstream slope at 3H:1V Drg. 11162-12-121
South Embankment	• Use Zone S fill for initial Stage 3 construction • Stage 3 downstream slope at 2H:1V Drg. 11162-12-123
Cycloned Sand Angle of Repose	5.5H:1V
Design Tonnage	7,300,000 tpy (20,000) tpd , Figure 2.2
Solids Content of Tailings Stream	35% (before Millsite and waste dump runoff added to tailings stream)
Pulp Density of Cycloned Sand Underflow	75%, (Ref. No. 11162-11-1)
Average Cyclone Availability	75%
Cyclone Underflow/Overflow Split	35% / 65%, (Ref. No. 11162-11-1)
In-Situ Dry Density of Cycloned Sand Underflow	1.6 t/m^3, (Ref. No. 11162-11-1)
Cycloned Sand Permeability	7 x 10^{-4} cm/s, Appendix C, (Ref. No. 11162-11-1)
Freeboard: Operations	24 hour PMP event (679,000 m^3) plus 1.0m wave runup on 2.5 million m^3 operational storage pond.
Closure	Sufficient to provide routing of PMF plus wave run-up.
Storage Capacity	84.5 million tonnes.
Tailings Density: Year 1	1.1 t/m^3
Year 2	1.2 t/m^3
Year 3-13	1.3 t/m^3
Tailings Specific Gravity	2.78
Borrow Material Properties	(Section 6.3.3 Ref. No. 1627/2), 1995 Site Investigation Report (Ref No 1623/1), and (Ref No 1625/1).
Construction Diversion	Not required.
Emergency Spillway Flows: Operations	Not required.
Closure	Design flow for routing PMF event.
Filling Rate	Figure 2.2 and 2.3, (Figure 6.1 and 6.2 Ref. No. 1627/2), Figure 6.3 (Ref. No. 1625/1).
Fill Material Properties	Drg. No. 11162-12-104, (Drg. No. 1625.212 Ref. No. 1627/2)
Compaction Requirements	Drg. No. 11162-12-104, (Drg. No. 1625.211 Ref. No. 1627/2)
Geotechnical Data	Appendix A, B, C & D, (Ref. No. 11162-11-1), (Sections 6.3, 6.4 and 6.5 Ref. No. 1627/2) , 1995 Site Investigation Report (Ref. No. 1623/1), and

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MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY PROJECT

UPDATED DESIGN BASIS AND OPERATING CRITERIA

	Section 5.1 (Ref. No. 1625/1).
Stability Analysis	Section 4.3, (Section 6.8 Ref. No. 1627/2) and (Ref. No. 1625/1).
Seepage Analysis	Section 4.4, (Section 6.9 Ref. No. 1627/2) and (Ref. No. 1625/1).
Sediment Control	Primary control from Main Embankment. Main Embankment Seepage Collection Ponds provides secondary sediment control.
Seepage Control	Seepage collection ponds and pumpback well systems.
Seismic Parameters	(Section 2.3 Ref. No. 1627/2), and (Ref. No. 1625/1).
Spillway Discharge Capacity	Not required during operations.
Settlement	(Section 6.6 Ref. No. 1627/2) and (Ref. No. 1625/1).
Surface Erosion Protection	Revegetation with grasses on final embankment slope.
4.0 PIPEWORKS	
4.1 Tailings Delivery and Discharge Pipework	(Section 8.0 Ref. No. 1627/2) and (Ref. No. 1625/1).
Function	Transport tailings slurry and mill site and waste dump runoff to Tailings Storage Facility (TSF).
Tailings Pipeline	• Free draining, gravity flow pipeline. • Butt fusion welded HDPE with 30" DR15.5, 22" DR17 and 24" DR15.5.
Spigots	• Movable discharge section placed on tailings embankment crest.
Cyclones	• 6 – 20 inch cyclones in operation
Flow Rate	• Design throughput 900 tonnes/hr dry solids. • Slurry solids content 35%. • Design flow 19.6 cfs ($0.55m^3/s$). Increases to 23.8cfs ($0.67m^3/s$) at 30% solids content with addition of 4.2cfs storm water runoff.. • Waste dump and Millsite runoff will be added to tailings stream, increasing flow and decreasing solids content.
Spill Containment: - Mill site to Bootjack Creek - Bootjack Creek Crossing - Bootjack Creek to TSF	 • Pipeline laid in pipe containment channel. There is an overflow pond for the T2 dropbox. • Pipeline sleeved in pipe containment channel. • Pipeline laid in pipe containment channel.
4.2 Reclaim Water System	
Function	Primary source of water for milling process. (Pump and Barge System Designed by Others.)
Reclaim Barge	• Prefabricated pump station on barge in excavated channel in TSF. • Local and remote control from Millsite.
Reclaim Pipeline	• 24" HDPE pipeline with varying pressure ratings along length.
Reclaim Booster Pump Station	• Prefabricated pump station located between TSF and Millsite. • Identical pumps, sensors and controls as reclaim barge for ease of maintenance.
Spill Containment	• See Item 4.1 above, all same for pipelines. • Booster pump station has closed sump.
4.3 Seepage Recycle System	
Function	Return seepage and foundation drain flows and cycloned sand drainage water to TSF.

UPDATED DESIGN BASIS AND OPERATING CRITERIA

Drain Monitoring Sumps	Flow quantity and water quality measurements on individual drains.
Seepage Collection Ponds	• Sized to hold 10 times max. weekly seepage flow quantity. • Excavated in low permeability natural soil liner, operated as groundwater sink. • Storm volumes are as reported in (Ref No. 1627/2) • Additional storage Volume provided at the Main Embankment for 48 hrs of cycloned sand drainage water • No provision for cycloned drainage water at the Perimeter Embankment • Pumps to be resized to handle an additional 16 l,/s from cycloned sand drain water
Seepage Recycle Pumps	• Set in vertical pump sumps. • Submersible pumps, system by Others. • Pumps discharge back to TSF via 150 mm HDPE pipes.
5.0 MAKE-UP WATER SUPPLY	
5.1 General	
Function	To direct runoff from the Millsite and Southeast Sediment pond to the TSF, providing additional water for recycle to the mill. Also, to implement the Polley Lake Pump Station when and as required to meet the project Water Management Plan objectives.
5.2 Millsite Sump	
Catchment Area	Approx. 20 ha direct catchment, plus pit dewatering.
Design Storm	1.5 x 1 in 10 yr. 24 hour event runoff (6,000 m^3)
Sump Cross-Section	3:1 inside slope, 2:1 outside slope, 4m crest width.
Normal Operating Level	1102.7 m
Maximum Operating Level	1106.2 m
Flow Control Structures	See (Drg. No. 1625.232 Ref. No. 1627/2) for layout details.
Discharge Pipe	300 mm HDPE DR 21 to plant or tailings line.
Flow Monitoring	None.
5.3 Southeast Sediment Pond	
Catchment Area	Approx. 150 ha direct catchment.
Design Storm	1 in 10 yr. 24 hour event runoff (25,000 m^3)
Sump Cross-Section	3:1 inside slope, 2:1 outside slope, 4m crest width.
Normal Operating Level	1054.5 m
Maximum Operating Level	1057.4 m
Flow Control Structures	See(Drg. No. 1625.232 Ref. No. 1627/2) for layout details.
Discharge Pipe	250mm HDPE DR 21 to Reclaim sump or T2 dropbox
Flow Monitoring	None.
5.4 Polley Lake Pump Station	Report and Drawings soon to be issued.
Max. Volume to be extracted	1,000,000 m^3 annually
Period for water extraction	Freshet
Max. Intake Velocity	0.11 m/s
Intake Screen Opening	0.1 inch (No. 8 Mesh wire cloth)
Spill Containment at Pump	Collection into a Holding Basin
Discharge Pipe	22 ½ inch ID, 350 ft of 19 ½ inch ID and 5200 ft of 17 ½ inch ID pipe.

TABLE 2.2

Knight Piésold CONSULTING

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY PROJECT

UPDATED DESIGN BASIS AND OPERATING CRITERIA

Max. Flow	5,500 US GPM
Flow Monitoring	Flows in Hazeltine Creek, water level on Polley Lake, pumping hours times measured flow rate.
Security and Access	Signs for buried or submerged components, buoys attached to intake in Polley Lake.
6.0 INSTRUMENTATION AND MONITORING	
6.1 General	
Function	To quantify environmental conditions and performance characteristics of the TSF to ensure compliance with design objectives.
6.2 Geotechnical Instrumentation and Monitoring	
Piezometers	• Measure pore pressures in drains, foundations, fill materials and tailings. • Vibrating wire piezometers. • Installed by qualified technical personnel. • Three instrumentation planes for Main Embankment and one for Perimeter Embankment and South Embankment.
Survey Monuments	• Deformation and settlement monitoring of embankments.
6.3 Flow Monitoring	• To provide data for on-going water balance calculations. • Drain flows regularly monitored. • Reclaim and seepage pump systems flow meters. • Tailings output monitored at millsite. • Streamflow monitoring.
6.4 Water Quality Monitoring	• To ensure environmental compliance. • Water quality samples taken at regular intervals from sediment ponds, drains (at drain monitor sump), groundwater monitoring wells, seepage ponds and tailings pond. • Upstream and downstream samples for impact analysis.
6.5 Hydrometeorology	• Operator weather station for input to water balance calculations. • Precipitation (rain and snow). • Evaporation. • Air quality monitoring (dust, etc.).
6.6 Operational Monitoring	• Quantify operation of tailings storage facility. • Rate of tailings accumulation in terms of mass and volume. • Tailings characteristics and water recovery. • Supernatant pond (depth, area and volume).
7.0 CLOSURE REQUIREMENTS	
7.1 General	Return impoundment to equivalent pre-mining use and productivity by establishing a wetland area adjacent to a final spillway and re-vegetating remainder of tailings surface with indigenous species of trees, shrubs and grasses adjacent to embankment grading to aquatic species along and adjacent to final pond. Establish vegetation on embankment slopes.
7.2 Spillway	Two stage spillway with lower channel outlet designed to pass 1 in 200 yr. 24 hour flood event and upper wider outlet section designed to pass Probable Maximum Flood without overtopping embankments.

TABLE 2.2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY PROJECT

UPDATED DESIGN BASIS AND OPERATING CRITERIA

Notes:

1. The closure plan will remain flexible during operations to allow for future changes in the mine plan and to incorporate information from on-going reclamation programs.

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TABLE 3.1

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY PROJECT

SUMMARY OF SOILS LABORATORY TESTWORK

M:\1162\12\data\[labtest.xls]Summary

10/12/99 8:52

Sample Data				Specific Gravity	Optimum Moisture Content	Maximum Dry Density	Gradation				Permeability Tests			Consolidation Tests				Shear Strength Tests
Sample Data	Location	Depth (m)	Interpreted Soil Type		(t/m^3)	(t/m^3)	% Gravel	% Sand	% Silt	% Clay	Permeability k (cm/sec) @200 kPa	@400 kPa	@600 kPa	Coefficient of Consolidation (Cv) (m2/year) 150kPa	300kPa	600kPa	1200kPa	Effective Friction Angle @600 kPa (degrees)
TR 1 Blend	Trench 1	avg. 1.5	Silty Sand	2.87			0	72	26	2	6.2E-04	5.2E-04	4.2E-04					39
TR 2 Blend	Trench 2	avg. 1.5	Silty Sand	2.87			0	76	24	0	7.9E-04	6.7E-04	4.9E-04	4.7E+01	3.1E+01	2.9E+01	1.4E+01	38
Top of Cone	Phase 1 Surface	surface	Silty Sand				0	70	29	1								
Middle of Cone	Phase 1 Surface	surface	Silty Sand				0	74	26	1								
Toe of Cone	Phase 1 Surface	surface	Silty Sand				0	75	24	2								
B2	Trench 2	1.1	Silty Sand		17.6	1.67	0	76	23	1								
C1	Trench 1	1.4	Silty Sand		16.5	1.77	0	76	23	2								
E2	Trench 2	1.5	Silty Sand		16.1	1.72	0	65	34	1								

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TABLE 5.1

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY PROJECT

STAGE 3 - MAIN EMBANKMENT
CYCLONED TAILINGS RATE OF DEPOSITION

M:\11162\12\data\[cellqsched.xls]MainSumry 10-Dec-99

Lift	Elevation (m)(1)	Assumed Placement Length (m)(2)	Placement Volume (m^3)	Advance Rate Along Crest (m/day)	Discharge Locations(3)	Days for Placement of Lift
1	924	900	132,100	22.4	9.8	40.3
2	926	900	64,000	46.1	10.7	19.5
3	929	775	52,300	48.6	10.4	15.9
4	931	525	35,400	48.6	8.2	10.8
5	934	375	23,500	52.4	6.0	7.2
6	936	200	17,300	38.0	3.8	5.3
7	944	MP(4)	166,600	-	-	-

Notes:
1. Refers to highest elevation of cycloned sand at existing embankment.
2. Assumed length of embankment crest from which cycloned sand will be spigotted.
3. Number of points along the embankment at which sand will need to be spigotted.
4. Cycloned sand assumed to be stockpiled and mechanically placed.

Revised: 12/10/1999
Revision 0

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TABLE 5.2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY PROJECT

STAGE 3 - PERIMETER EMBANKMENT
CYCLONED TAILINGS RATE OF DEPOSITION

M:\11162\12\data\[cellqsched.xls]PerimeterSumry 10-Dec-99

Lift	Elevation (m)(1)	Assumed Placement Length (m)(2)	Placement Volume (m^3)	Advance Rate Along Crest (m/day)	Discharge Locations(3)	Days for Placement of Lift
1	938	1,700	71,000	78.5	35.6	21.7
2	940	1,000	33,000	99.4	17.7	10.1
3	944	MP(4)	62,000	-	-	-

Notes:
1. Refers to highest elevation of cycloned sand at existing embankment.
2. Assumed length of embankment crest from which cycloned sand will be spigotted.
3. Number of points along the embankment at which sand will need to be spigotted.
4. Cycloned sand assumed to be stockpiled and mechanically placed.

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TABLE 8.1

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

CYCLONED SAND EMBANKMENT CONSTRUCTION
QUALITATIVE RISK ASSESSMENT CODING AND SHADING

10/12/99 10:09

M:\11162\12\data\[risk.xls]LookupRisk

	Consequence Rating		
Likelihood Rating	**L**	**M**	**H**
VL	VL	L	L-M
L	L	L-M	M
M	L-M	M	M-H
H	M	M-H	H

Notes:

VL: Very Low
L: Low
L-M: Low to Moderate
M: Moderate
M-H: Moderate to High
H: High

TABLE 8.2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

CYCLONED SAND EMBANKMENT CONSTRUCTION
QUALITATIVE RISK ASSESSMENT RESULTS

	A	B	C	D	E	F	G	H	I
COMPONENT and POTENTIAL PROBLEMS		RISK MANAGEMENT and MITIGATION	CONSEQUENCES			LIKELIHOOD	RISKS		
			Environmental	Operational	Safety		Environmental	Operational	Safety
		TAILINGS PIPELINE							
1.	a. Wear	Frequent monitoring and systematic replacement with flanges. Verification of culvert annulus capacities and routing.	L	H	L	H	M	H	M
	b. Overpressurization	Frequent maintenance and testing. Implementation of simple, fail-safe surge relief gooseneck. Verification of culvert annulus capacities and routing.	H	H	M	L	M	M	L-M
	c. Malfunction of Rupture Disk and Safety Features	Regular maintenance and grading of ditches, culverts and dump valves. Verification of culvert annulus capacities and routing.	M	M	M	L	L-M	L-M	L-M
	d. Sanding or Inadequate Capacity	Careful observation and development of operating manual, followed by training and establishment of procedures for regular flushing and monitoring.	L	H	L	M	L-M	M-H	L-M
	e. Exceedance of T2 Drop Box and Dump Pond Capacities	Regular maintenance and implementation of downstream safety measures. Verification of culvert annulus capacities and routing.	M	M	L	M	M	M	L-M
		MAIN EMBANKMENT							
2.	a. Excessive Seepage	Long-term well and foundation drain monitoring and continued installation of pressure relief wells and drains as required.	H	M	L	L	M	L-M	L
	b. Instability	Continued instrumentation, quality assurance and design review.	H	H	H	VL	L-M	L-M	L-M
	c. Dusting	Monitoring and potential installation of sprinkler system, and possible use of dust suppression additives.	H	H	L	M	M-H	M-H	L-M
	d. Erosion	Careful observation and development of storm water management procedure. Establishment of cycloned sand deposition methodology to promote rapid water infiltration and/or pipe conveyance.	M	M	L	M	M	M	L-M
		PERIMETER EMBANKMENT							
3.	a. Excessive Seepage	Same as main embankment.	M	M	L	VL	L	L	VL
	b. Instability	Same as main embankment.	H	H	M	VL	L-M	L-M	L
	c. Dusting	Same as main embankment.	H	H	L	M	M-H	M-H	L-M
	d. Erosion	Same as main embankment.	M	M	L	L	L-M	L-M	L
		SOUTH EMBANKMENT							
4.	a. Excessive Seepage	Same as main embankment.	M	M	L	L	L-M	L-M	L
	b. Instability	Same as main embankment.	H	H	M	VL	L-M	L-M	L
		RECLAIM WATER SYSTEM							
5.	a. Excessive Turbidity	Careful beach development and scheduled reclaim barge moves.	L	H	L	M	L-M	M-H	L-M
	b. Overpressurization	Monitoring and testing.	M	H	M	VL	L	L-M	L
		WATER MANAGEMENT							
6.	a. Excessive Supernatant Pond Water	Continued detailed bathymetric and topographic surveys, pond measurements and water balance modeling. Continued forecasting and commitment to construction schedules.	M	M	L	M	M	M	L-M
	b. Insufficient Makeup Water	Continued detailed bathymetric and topographic surveys, pond measurements and water balance modeling. Continued forecasting and commitment to construction schedules.	L	H	L	M	L-M	M-H	L-M
	c. ME Insufficient Pump-back Capacity or Pump(s) Failure	Installation of larger pumps and careful establishment of trigger levels. Development of comprehensive storm water management procedure.	M	M	L	M	M	M	L-M
	d. PE Insufficient Pump-back Capacity or Pump(s) Failure	Installation of larger pumps and careful establishment of trigger levels. Development of comprehensive storm water management procedure.	M	M	L	M	M	M	L-M
		CYCLONING OPERATION							
7.	a. Insufficient Cycloned Sands	Careful control of operations to maximize availability and minimize bypass to point discharge. Efficient berm construction and cycloned sand placement. Commitment to construction schedules. On-going material balance and progress reporting with consideration of cycloning to Main Embankment only and other contingencies.	L	H	L	M	L-M	M-H	L-M
	b. Erosion of Embankment due to Excessive Tailings Flows (Rupture or Operating Error)	Frequent monitoring and maintenance of safety devices, including rupture discs, overpressurization gooseneck, and signage or protection of tailings, underflow and overflow pipelines.	M	H	M	M	M	M-H	M
	c. Insufficient Time for Construction of Core Zone	Commitment to construction schedules and early determination of equipment and contract requirements. Continued adherence to cold-weather construction specifications. On-going material balance and progress reporting with consideration of cycloning to Main Embankment only and other contingencies.	L	H	L	M	L-M	M-H	L-M

M:\1162\12\data\[risk.xls]Assessment

10/12/99 10:07

Notes:

ME: Main Embankment
PE: Perimeter Embankment
VL: Very Low
L: Low

L-M: Low to Moderate
M: Moderate
M-H: Moderate to High
H: High

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TABLE 9.1

MOUNT POLLEY MINING CORPORATION
MT. POLLEY MINE
TAILINGS STORAGE FACILITY

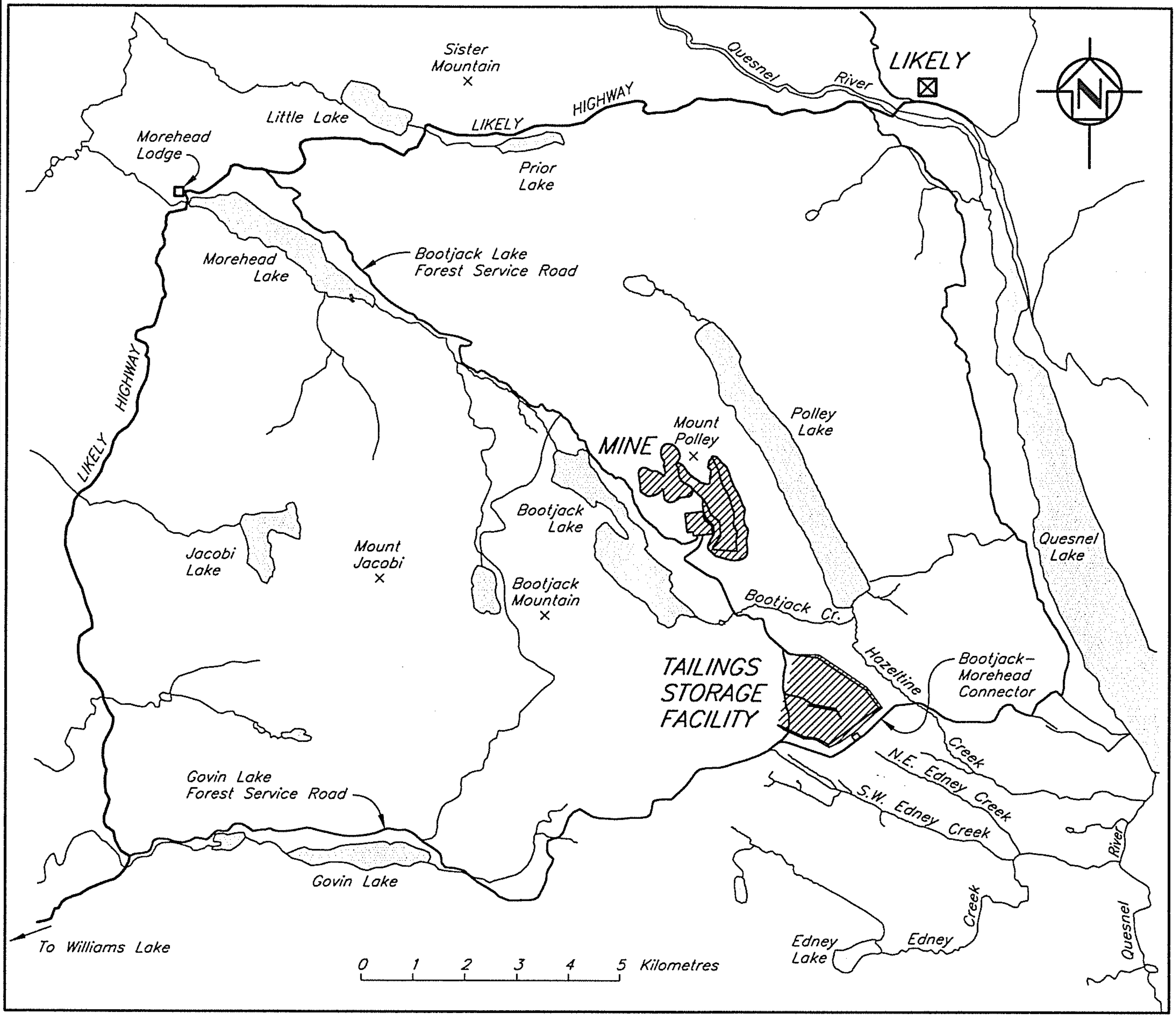
EMBANKMENT FILL QUANTITIES - STAGES 4 TO 7

M:\1162\12\data\[quantities.xls]Stage 4-7

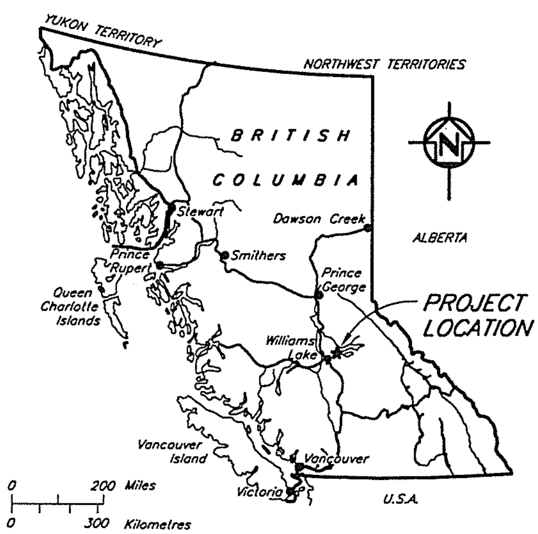
10-Dec-99

	ITEM		UNITS	Main Embankment	Perimeter Embankment	South Embankment	Totals
Stage 4	1	**Cyclone Sand**					
	1a	Hydraulically Placed	m^3	396,400	292,400		**688,800**
	1b	Mechanically Placed	m^3	10,700	15,700		**26,400**
	2	**Foundation Preparation**	m^2	13,530	18,920	7,810	**40,260**
	3	**Rockfill**	m^3	21,780	31,570		**53,350**
	4	**Downstream Zone C**	m^3			7,260	**7,260**
	5	**Core Zone**	m^3	24,090	34,760	12,100	**70,950**
	6	**Upstream Fill**	m^3	24,090	34,760	12,100	**70,950**
	7	**Geotextile**	m^2	18,330	25,688		**44,018**
Stage 5 - Elevation 951 m	1	**Cycloned Sand**					
	1a	Hydraulically Placed	m^3	190,800	81,300		**272,100**
	1b	Mechanically Placed	m^3	70,600	102,300		**172,900**
	2	**Foundation Preparation**	m^2	17,490	26,180	14,630	**58,300**
	3	**Rockfill**	m^3				
	4	**Downstream Zone C**	m^3			33,440	**33,440**
	5	**Core Zone**	m^3	32,120	48,510	22,440	**103,070**
	6	**Upstream Fill**	m^3	37,400	56,650	25,960	**120,010**
	7	**Geotextile**	m^2				
Stage 6a	1	**Cycloned Sand**					
	1a	Hydraulically Placed	m^3	384,100	303,100		**687,200**
	1b	Mechanically Placed	m^3				
	2	**Foundation Preparation**	m^2	20,900	34,100	12,100	**67,100**
	3	**Rockfill**	m^3	21,054	31,350		**52,404**
	4	**Downstream Zone C**	m^3				
	5	**Core Zone**	m^3				
	6	**Upstream Fill**	m^3				
	7	**Geotextile**	m^2	18,018	26,819		**44,837**
Stage 6b - Elevation 956 m	1	**Cycloned Sand**					
	1a	Hydraulically Placed	m^3	115,000	87,600		**202,600**
	1b	Mechanically Placed	m^3	122,000	186,400		**308,400**
	2	**Foundation Preparation**	m^2				
	3	**Rockfill**	m^3				
	4	**Downstream Zone C**	m^3			88,330	**88,330**
	5	**Core Zone**	m^3	40,150	63,690	33,660	**137,500**
	6	**Upstream Fill**	m^3	53,460	84,964	44,880	**183,304**
	7	**Geotextile**	m^2				
Stage 7a	1	**Cycloned Sand**					
	1a	Hydraulically Placed	m^3	367,200	352,000		**719,200**
	1b	Mechanically Placed	m^3				
	2	**Foundation Preparation**	m^2	26,510	41,250	16,720	**84,480**
	3	**Rockfill**	m^3	23,430	35,200		**58,630**
	4	**Downstream Zone C**	m^3				
	5	**Core Zone**	m^3				
	6	**Upstream Fill**	m^3				
	7	**Geotextile**	m^2	19,773	29,003		**48,776**
Stage 7b - Elevation 962 m	1	**Cycloned Sand**					
	1a	Hydraulically Placed	m^3	371,300	319,800		**691,100**
	1b	Mechanically Placed	m^3	110,300	177,600		**287,900**
	2	**Foundation Preparation**	m^2				
	3	**Rockfill**	m^3				
	4	**Downstream Zone C**	m^3			185,130	**185,130**
	5	**Core Zone**	m^3	48,114	81,400	42,570	**172,084**
	6	**Upstream Fill**	m^3	72,160	122,067	63,855	**258,082**
	7	**Geotextile**	m^2				

Notes:
1) 10% Contingency added to fill quantities.
2) Geotextile quantities based on the use of 9 transversal confining berms (8 cells) to build the first cycloned sand lift of each stage. 30% contingency included for waste and overlap.



LOCATION MAP



KEY MAP

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

PROJECT LOCATION AND ACCESS PLAN

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC	CHC	KJB

REVISIONS

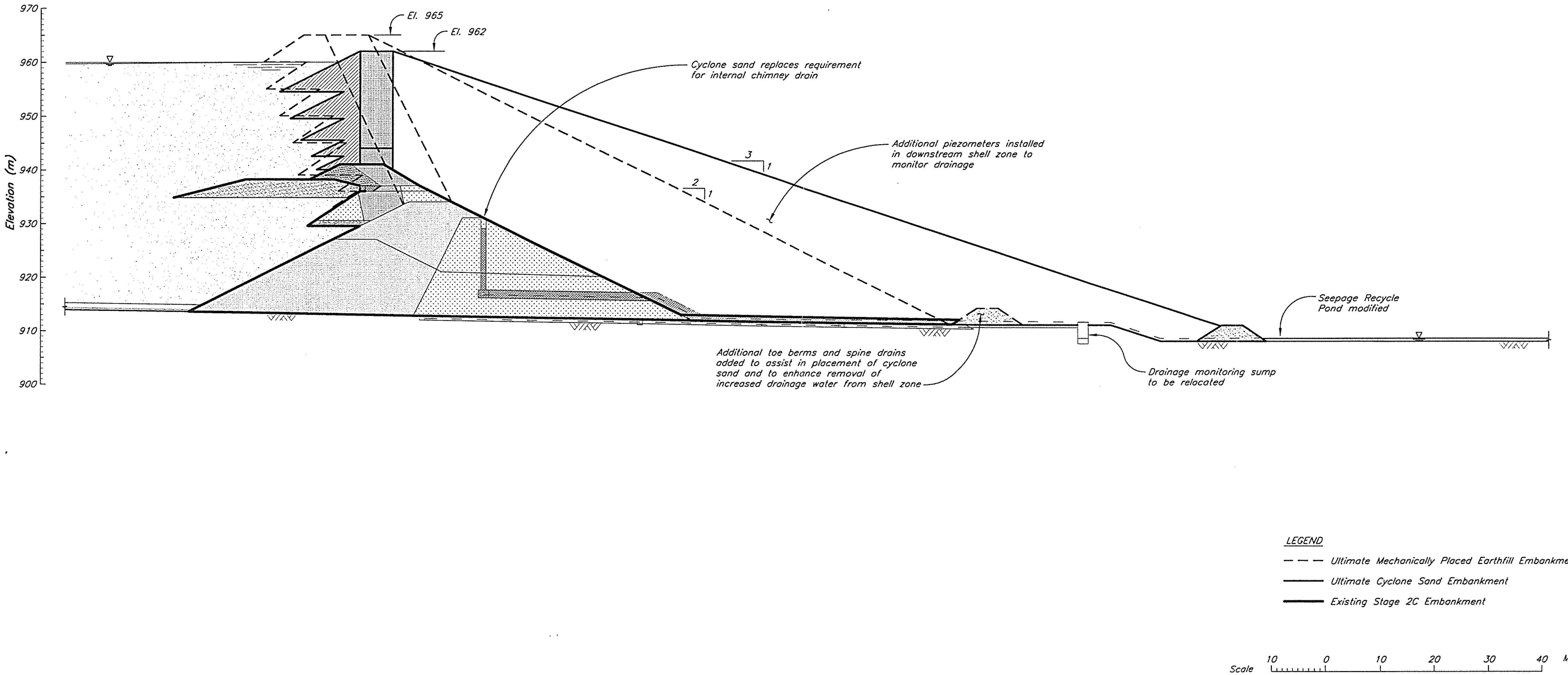
Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 1.1

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\A04.dwg 1=125000 PLOT 1-1(PS) 08/12/99 by:scheung Time @ 08:32

XREF FILE :



REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	NSD	CHL	KJB

REVISIONS

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

MODIFICATION TO EXISTING EMBANKMENT DESIGN

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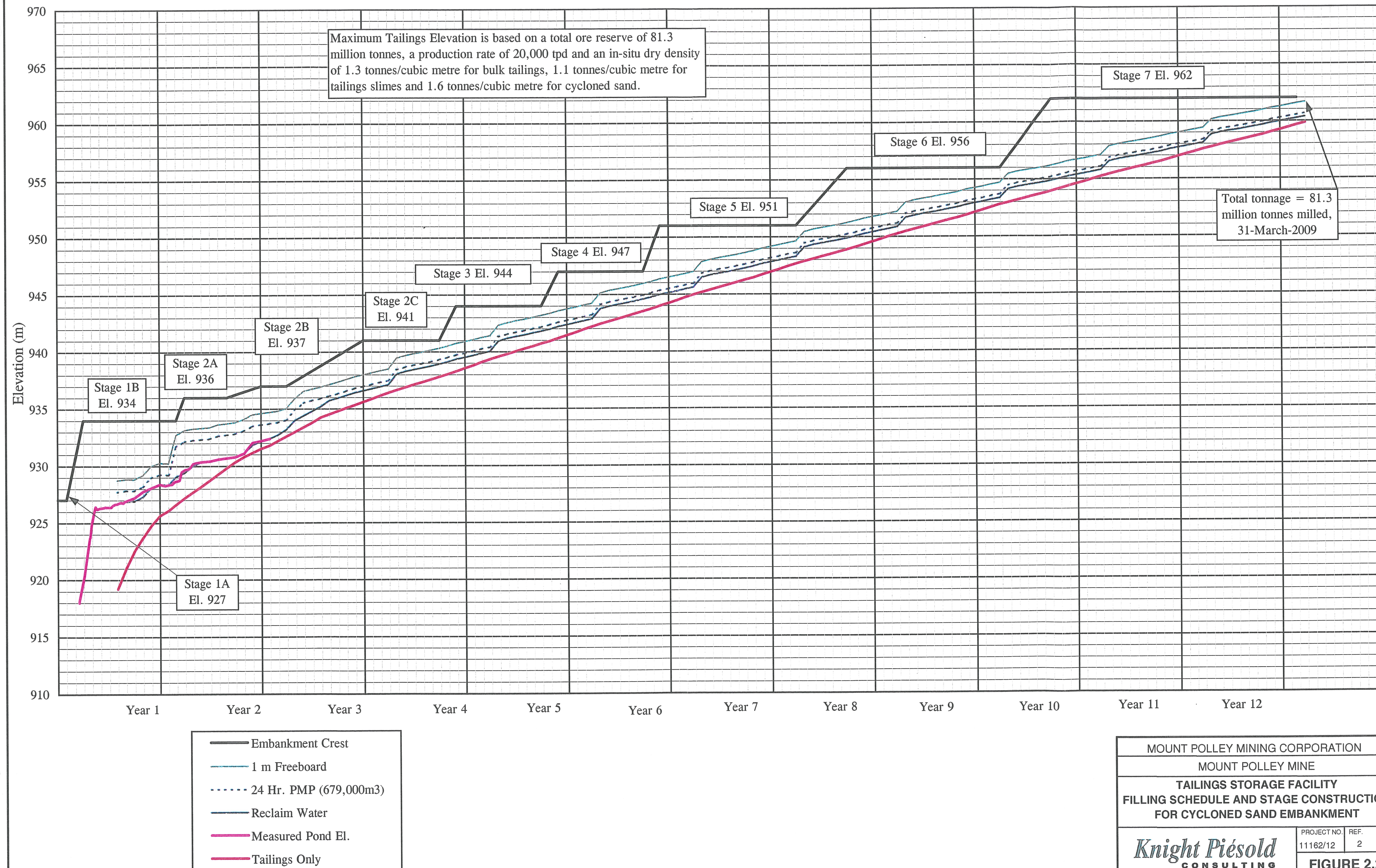
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 2.1

m:\11162\12\data\DACCYC.xls fillsch (cycloned sand)

Print Date : 12/9/99 8:34 AM



MOUNT POLLEY MINING CORPORATION

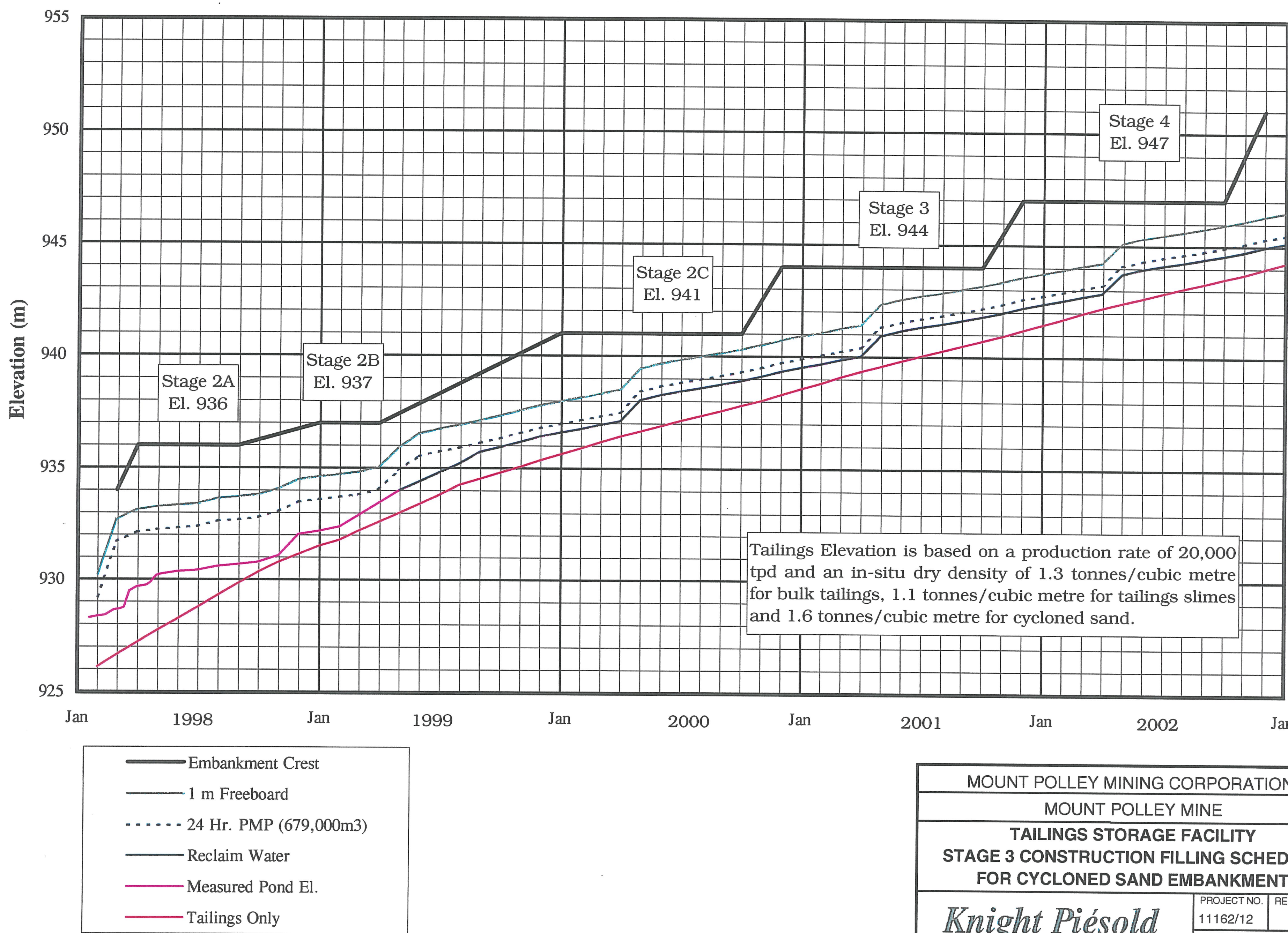
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY FILLING SCHEDULE AND STAGE CONSTRUCTION FOR CYCLONED SAND EMBANKMENT

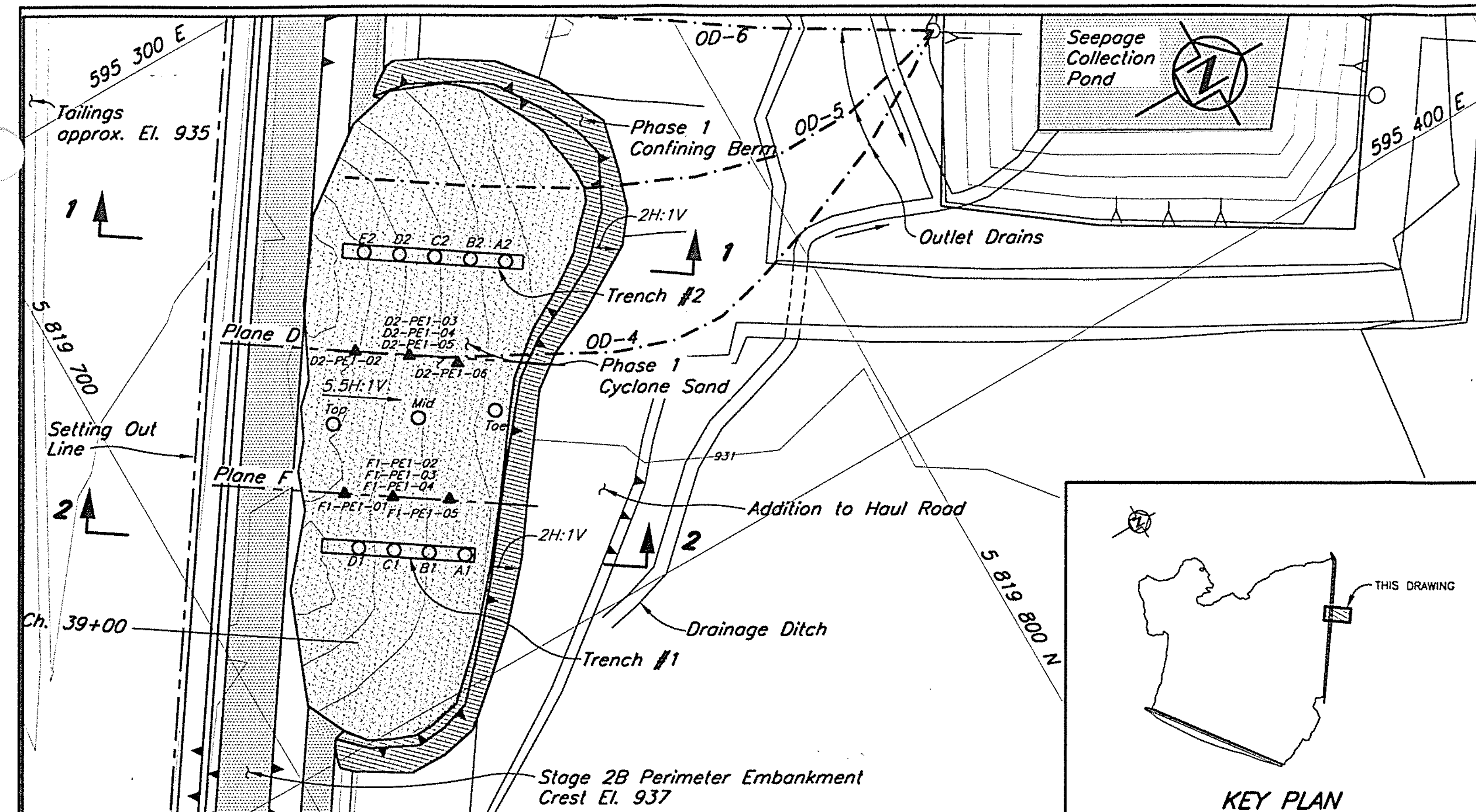
Knight Piésold CONSULTING

PROJECT NO.	REF.	REV
11162/12	2	0

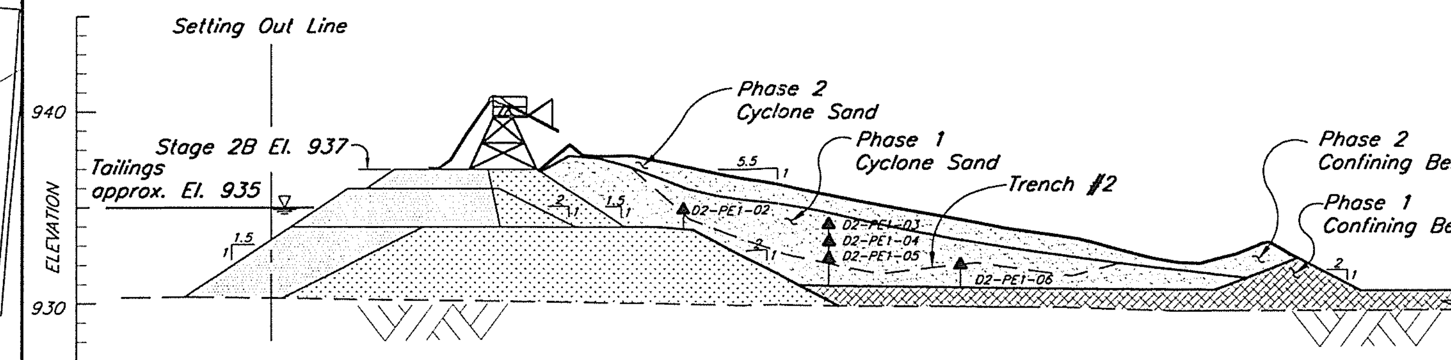
FIGURE 2.2



MOUNT POLLEY MINING CORPORATION		
MOUNT POLLEY MINE		
TAILINGS STORAGE FACILITY STAGE 3 CONSTRUCTION FILLING SCHEDULE FOR CYCLONED SAND EMBANKMENT		
Knight Piésold CONSULTING	PROJECT NO. 11162/12	REF. NO. 2 / REV 0
	FIGURE 2.3	

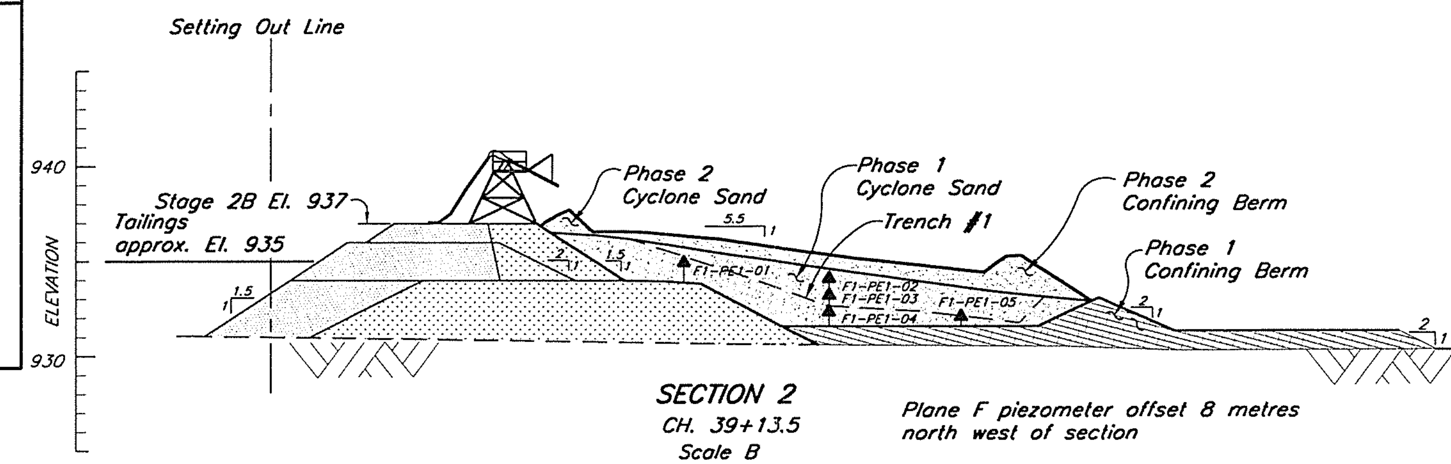


PHASE 1
Scale A



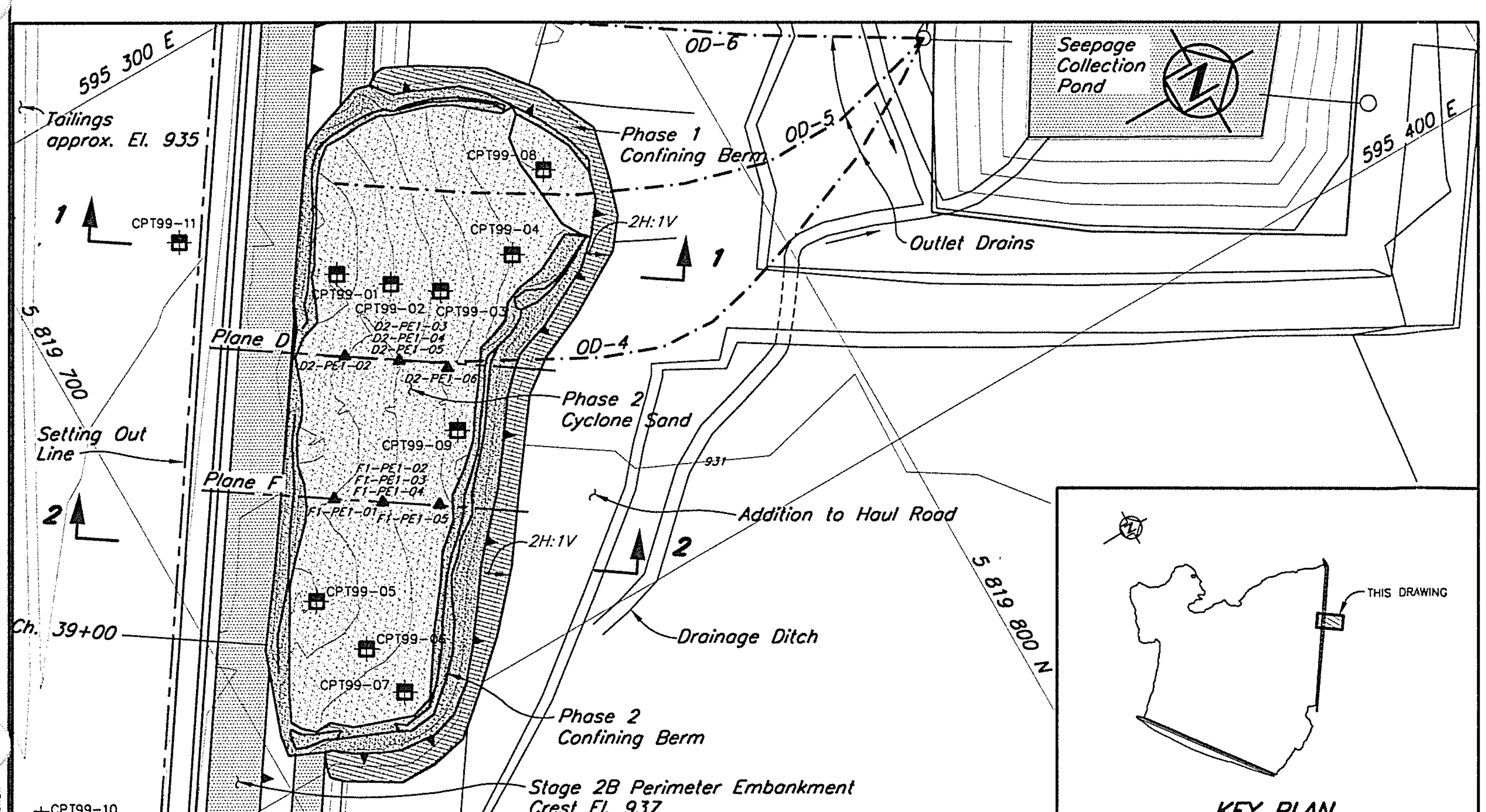
SECTION 1
CH. 39+55.5
Scale B

Plane D piezometer offset 14 metres south east of section



SECTION 2
CH. 39+13.5
Scale B

Plane F piezometer offset 8 metres north west of section



PHASE 2
Scale A

ZONE	LOCATION	MATERIAL TYPE
S	Core Zone	Glacial till
B	Fill Zone	Glacial till, glaciolacustrine or granular material
T	Transition Zone	Mine Rock
	Cyclone Sand	Cyclone Underflow

LEGEND

- CPT99-10 Cone Penetration Test Locations
- ▲ D2-PE1-01 Vibrating Wire Piezometer Location
- ○ Laboratory Sample Location

Scale A 10 0 10 20 30 40 50 m

Scale B 5 0 5 10 15 20 m

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	LAG	DSR		

REVISIONS

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

PERIMETER EMBANKMENT
1999 DOWNSTREAM CYCLONED SAND TRIAL PROGRAM
LOCATION AND PHASING

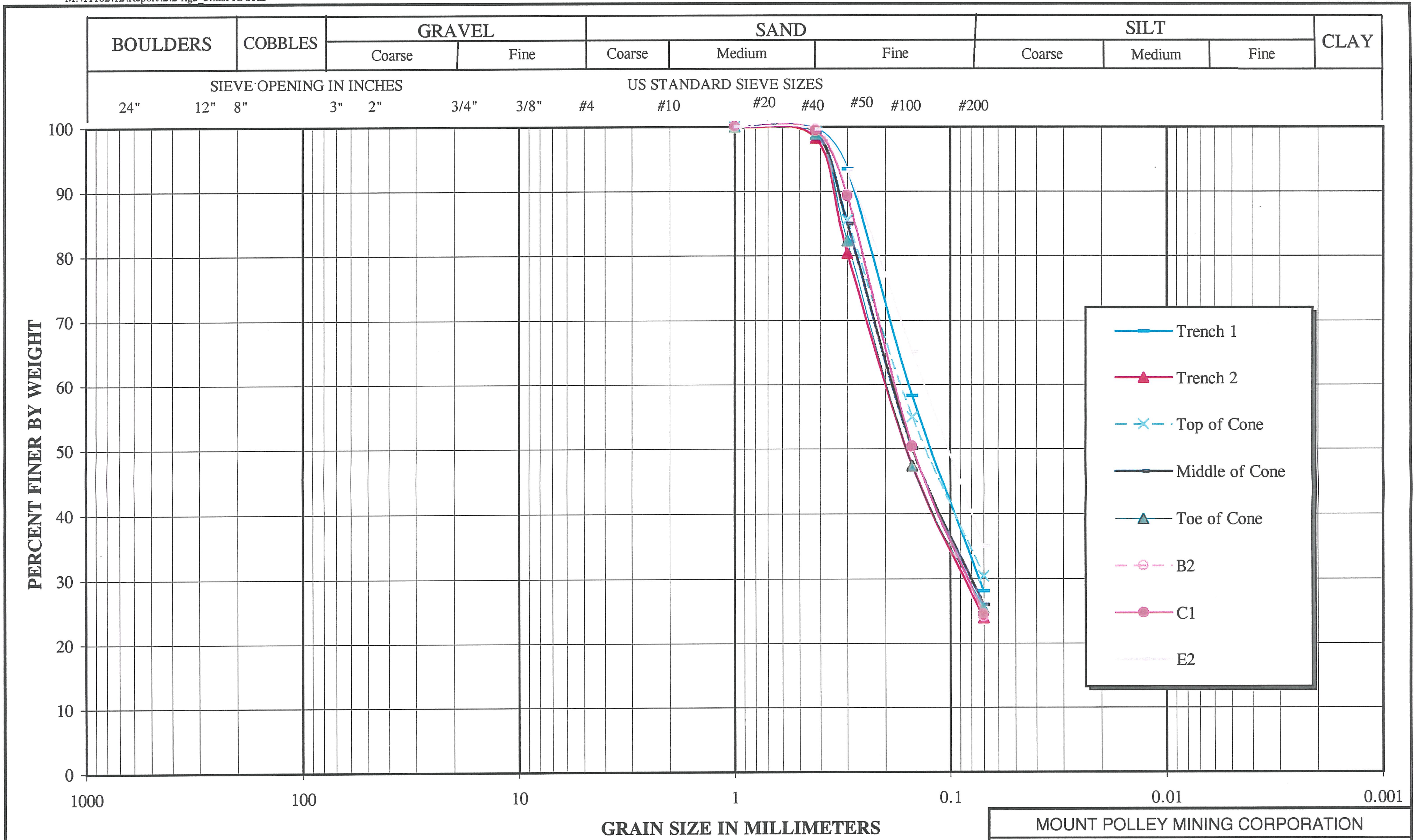
Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

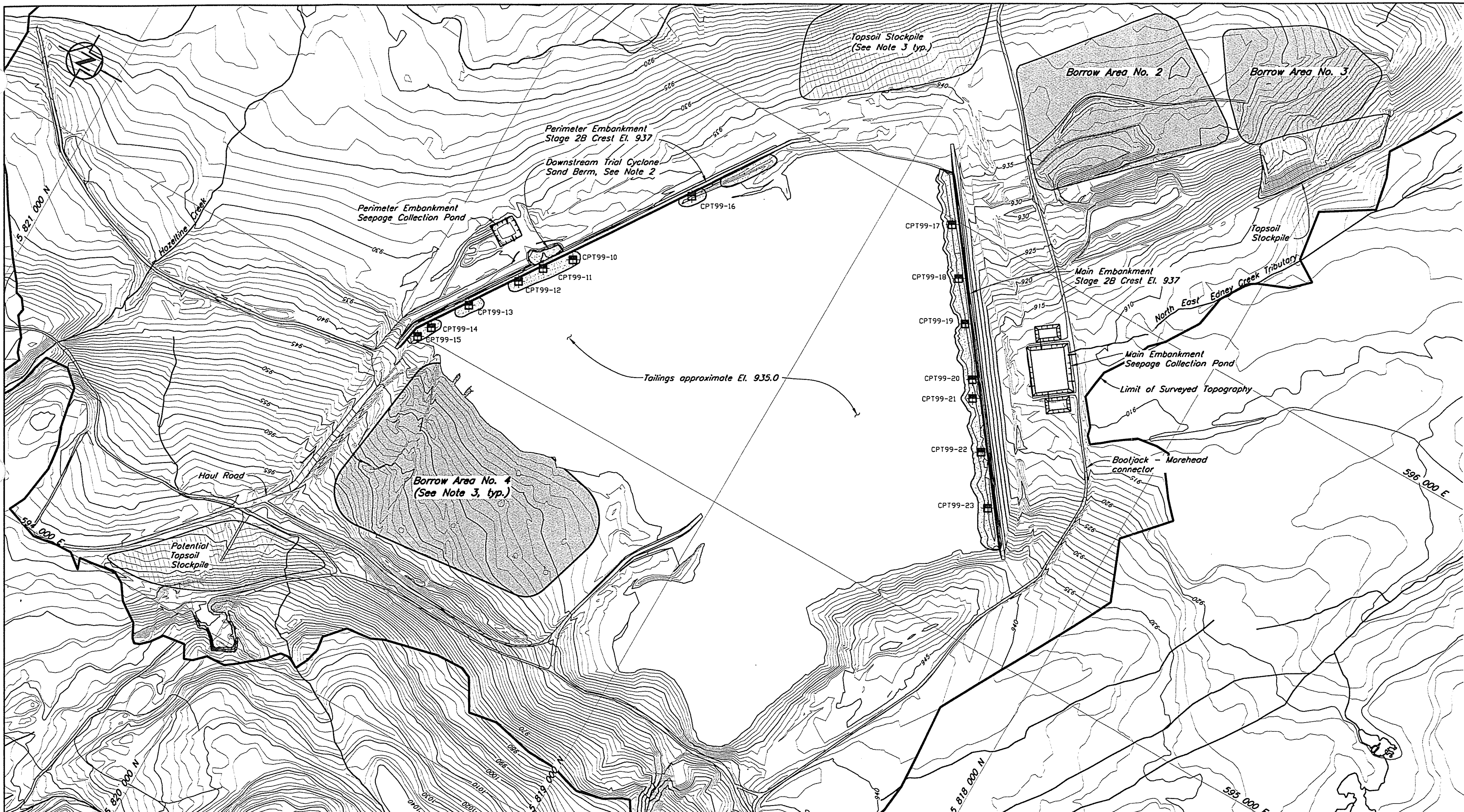
FIGURE 3.1

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B21.dwg 1=400 & 1000 PLOT 1=1(PS) 08/12/99 by:ac @ 08:50

XREF FILE: TOPONEW



MOUNT POLLEY MINING CORPORATION		
MOUNT POLLEY PROJECT		
TAILINGS STORAGE FACILITY CYCLONED SAND PARTICLE SIZE DISTRIBUTION		
PROJECT NO. 11162/12	REF. NO. 2	REV 0
Knight Piésold CONSULTING	**FIGURE 3.2**	



LEGEND

CPT99-10 1999 Cone Penetration Test Locations

NOTES

1. Topography at TSF generated from points and break lines sent from MPMC in July 1999. The Topography outside the TSF area is from 1997 flyover.
2. For CPT locations on the Downstream Trial Cyclone Sand Berm see Figure 3.1.
3. Current size and location of potential and existing Borrow Areas and Topsoil Stockpiles are to be confirmed.

Scale 100 0 100 200 300 400 500 m

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	LAG	OSR		

REVISIONS

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
1999 UPSTREAM CPT PROGRAM
LOCATION PLAN

Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

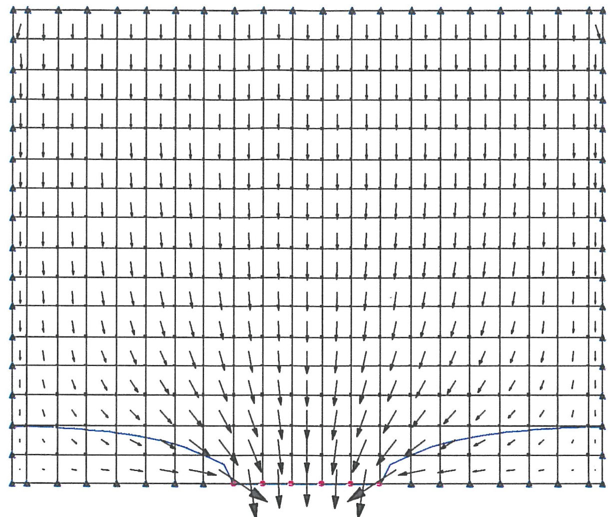
FIGURE 3.3

XREF FILE : TOPO99.STOC

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B31.dwg 1=10000 PLOT 1=1(PS) 08/12/99 byscheung Time @ 08:52

Case 1: Steady State Analysis for Anticipated Operational Conditions

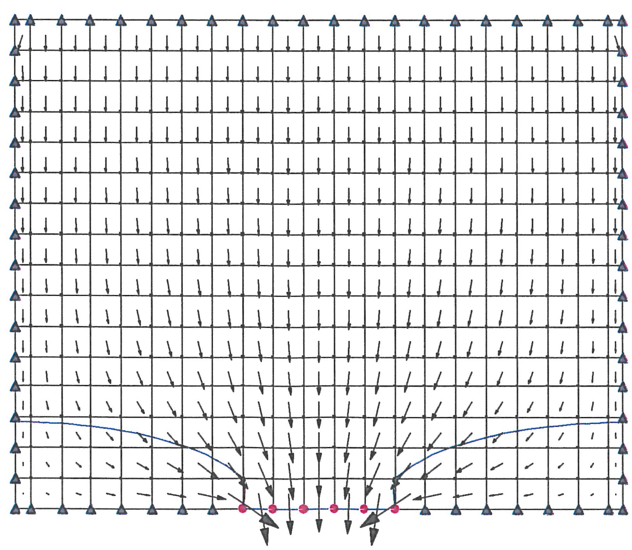
Permeability k = 7 x 10^{-4} cm/s
Aplication rate w = 1.35 x 10^{-4}cm/s (for 6 cyclones in operation)
Drain spacing L = 20 meters c/c



MAXIMUM HEAD BETWEEN DRAINS IS 2.0 METERS

Case 2: Steady State Analysis for Anticipated Operating Conditions with the 24hr 1:100 Year Storm Event Superimposed

Permeability k = 7 x 10^{-4} cm/s
Aplication rate w = 1.91 x 10^{-4}cm/s (for 6 cyclones in operation + 24 hr 1:100 yr Storm Event)
Drain spacing L = 20 meters c/c



MAXIMUM HEAD BETWEEN DRAINS IS 2.8 METERS

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

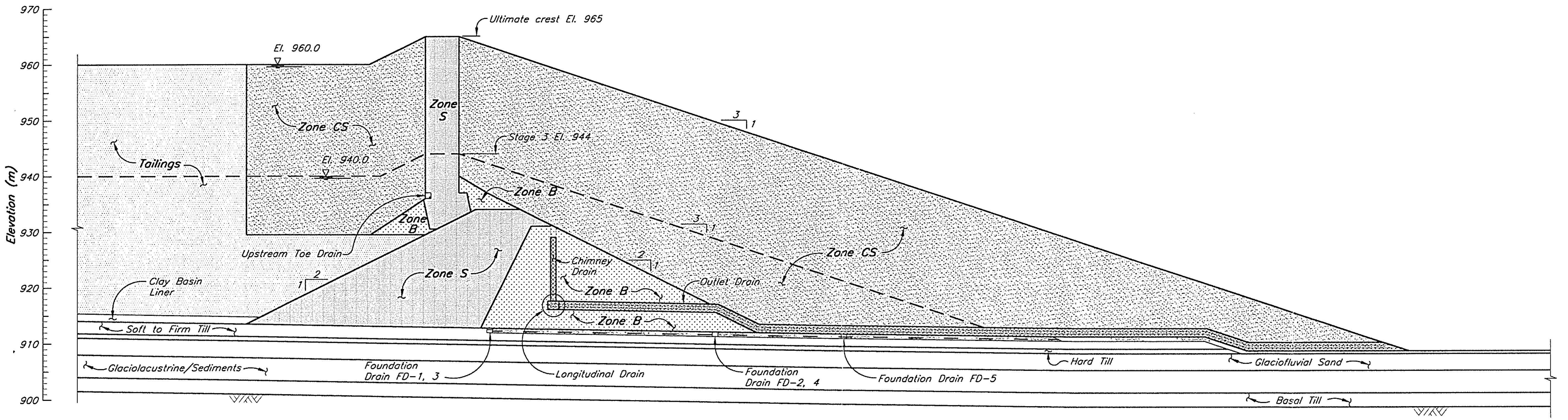
TAILINGS STORAGE FACILITY SEEPAGE DESIGN MODEL FOR DETERMINATION OF MAXIMUM DRAIN SPACING

Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV
11162/12	2	0

FIGURE 4.1

MATERIAL TYPE	Unit wt. (kN/m³)	ø' (degrees)	Cu, C' (kPa)
Tailings:			
Partially Consolidated	18	–	10–55
Fully Consolidated	19	30	0
Zone:			
Zone B	22	35	0
Zone CS	19	32	0
Zone S	22	35	0
Chimney Drain	20	35	0
Foundation:			
Clay Basin Liner	21	26	0
Soft to Firm Till	21	26	0
Hard Till	21	26	0
Glaciofluvial Sand	20	33	0
Glaciolacustrine/Sediments	20	33	0
Basal Till	21	26	0



Scale 5 0 10 20 30 40 m

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

EMBANKMENT STABILITY ANALYSES
GEOMETRY AND MATERIAL PARAMETERS

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC		KJB

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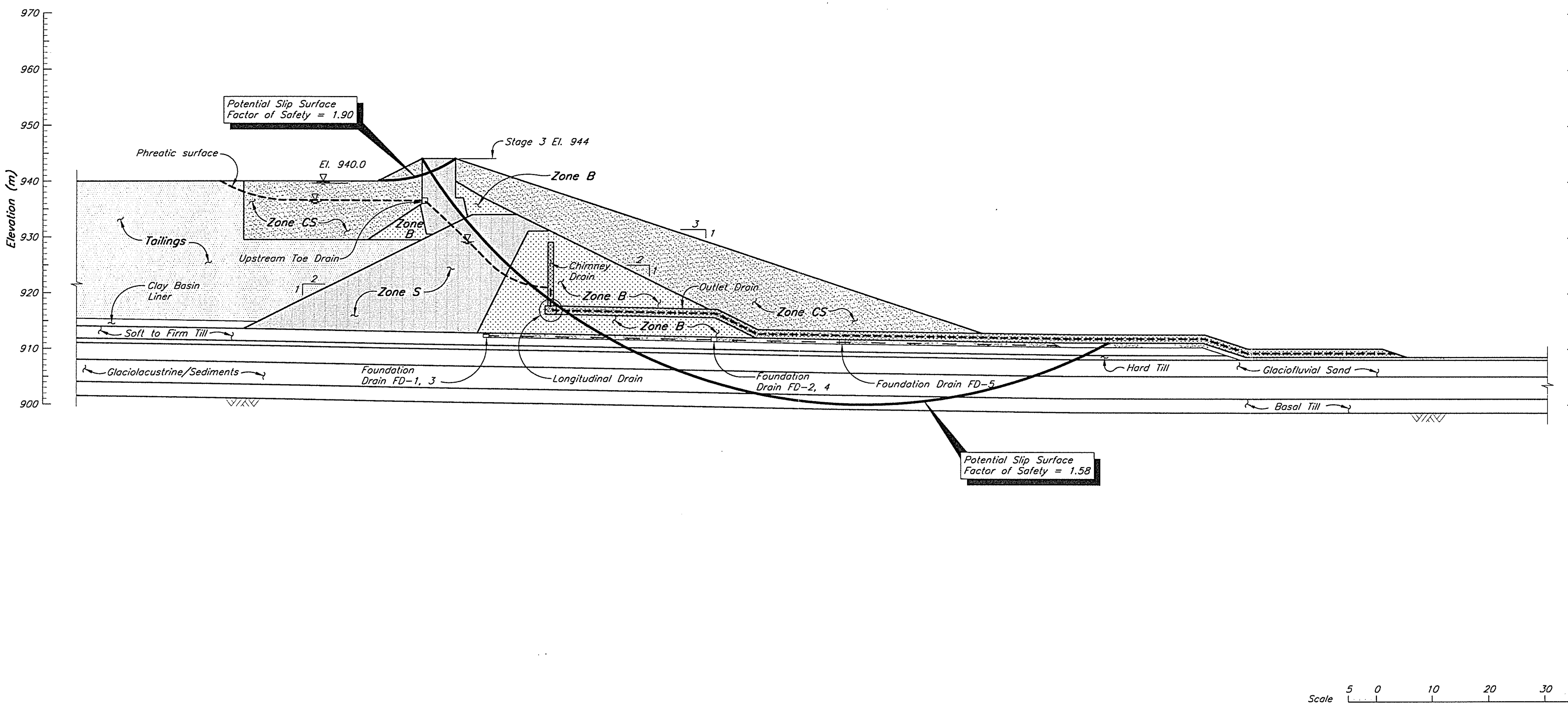
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 4.2



0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC	CH	KJB
REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
		REVISIONS				

MOUNT POLLEY MINING CORPORATION

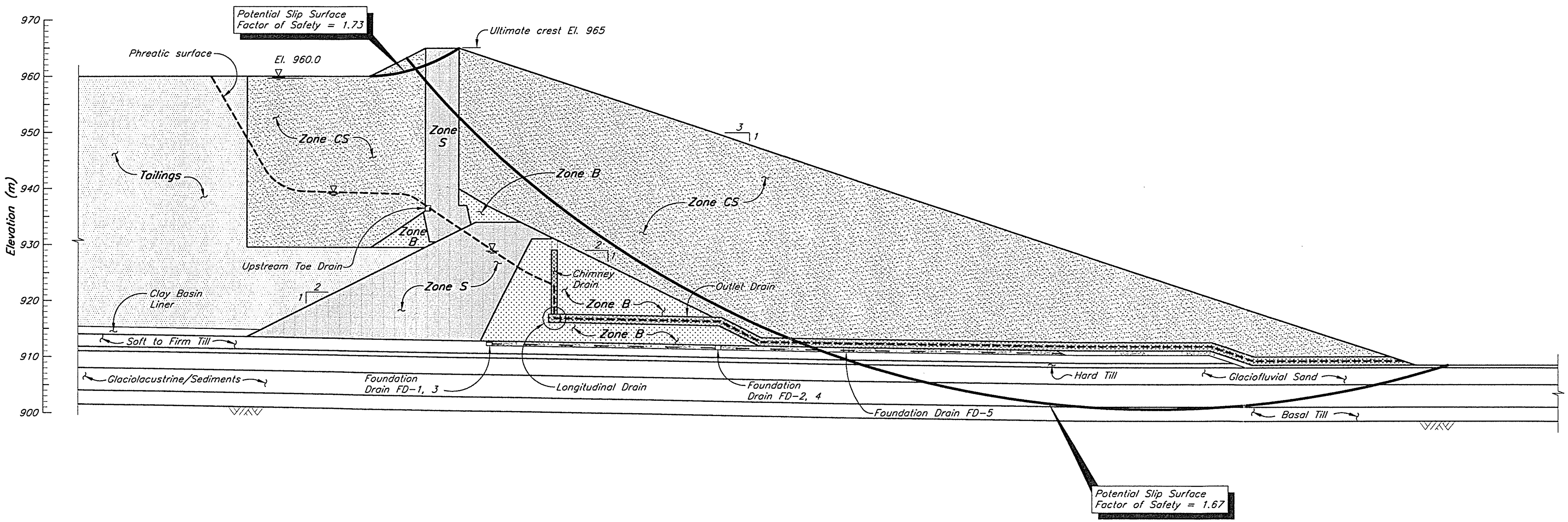
MOUNT POLLEY MINE

EMBANKMENT STABILITY ANALYSES
STAGE 3 OPERATIONAL STATIC STABILITY

Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 4.3



Scale 5 0 10 20 30 40 m

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

EMBANKMENT STABILITY ANALYSES
ULTIMATE OPERATIONAL STATIC STABILITY

Knight Piésold CONSULTING

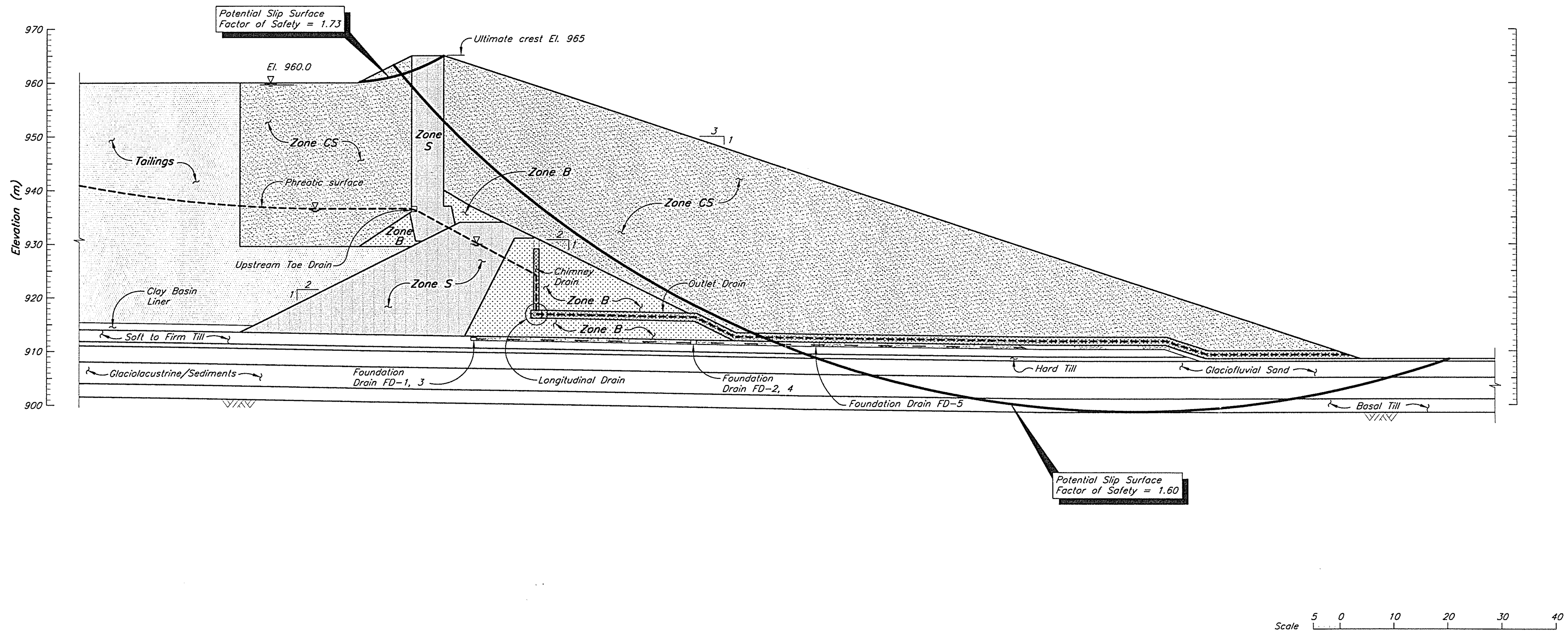
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 4.4

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC	CAC	KJB

REVISIONS

XREF FILE : -



MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

EMBANKMENT STABILITY ANALYSES
POST CLOSURE STATIC STABLILITY

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC	GAH	KJB

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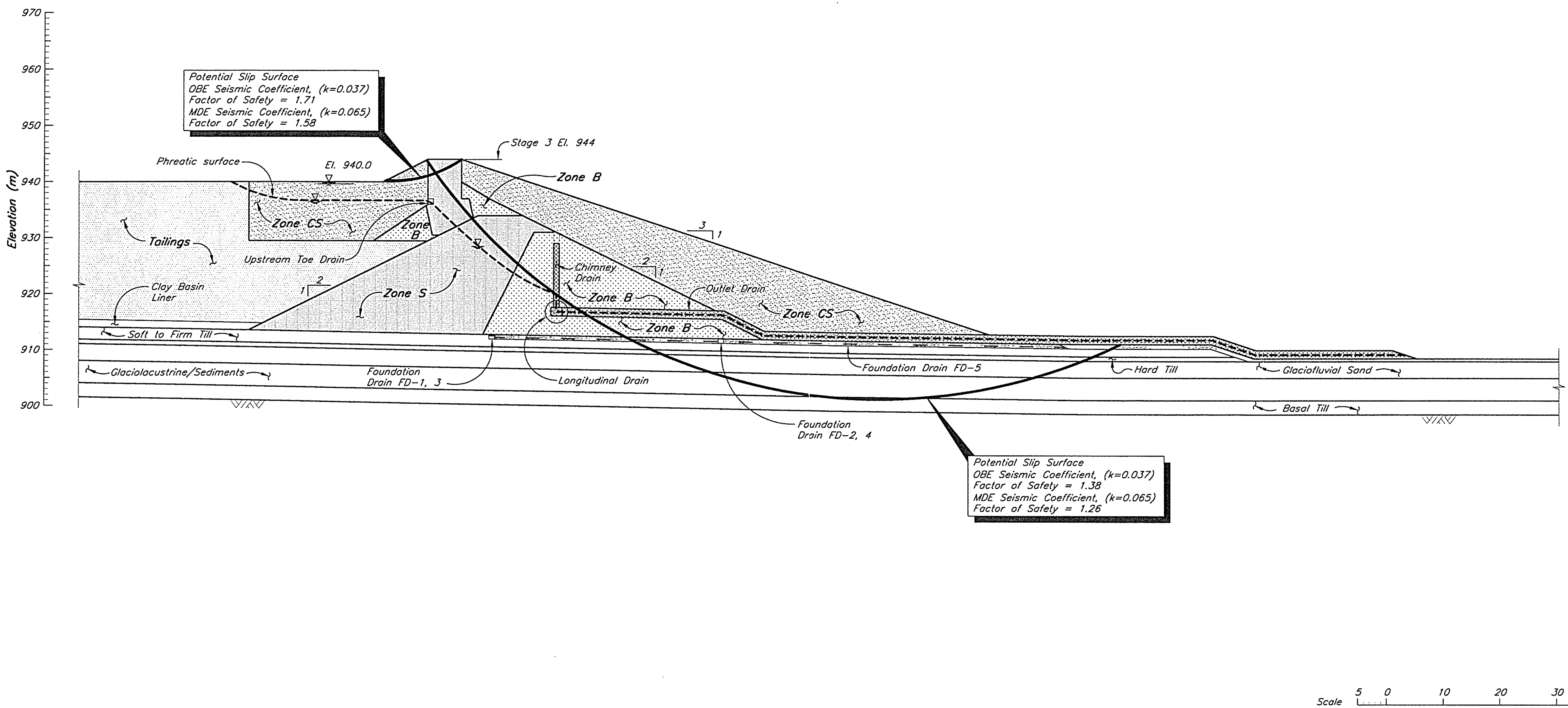
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 4.5

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B22.dwg 1=750 PLOT 1=1(PS) 08/12/99 byscheung Time @ 11:50

XREF FILE : -



MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

EMBANKMENT STABILITY ANALYSES
STAGE 3 OPERATIONAL SEISMIC STABILITY

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC	CHL	KJB

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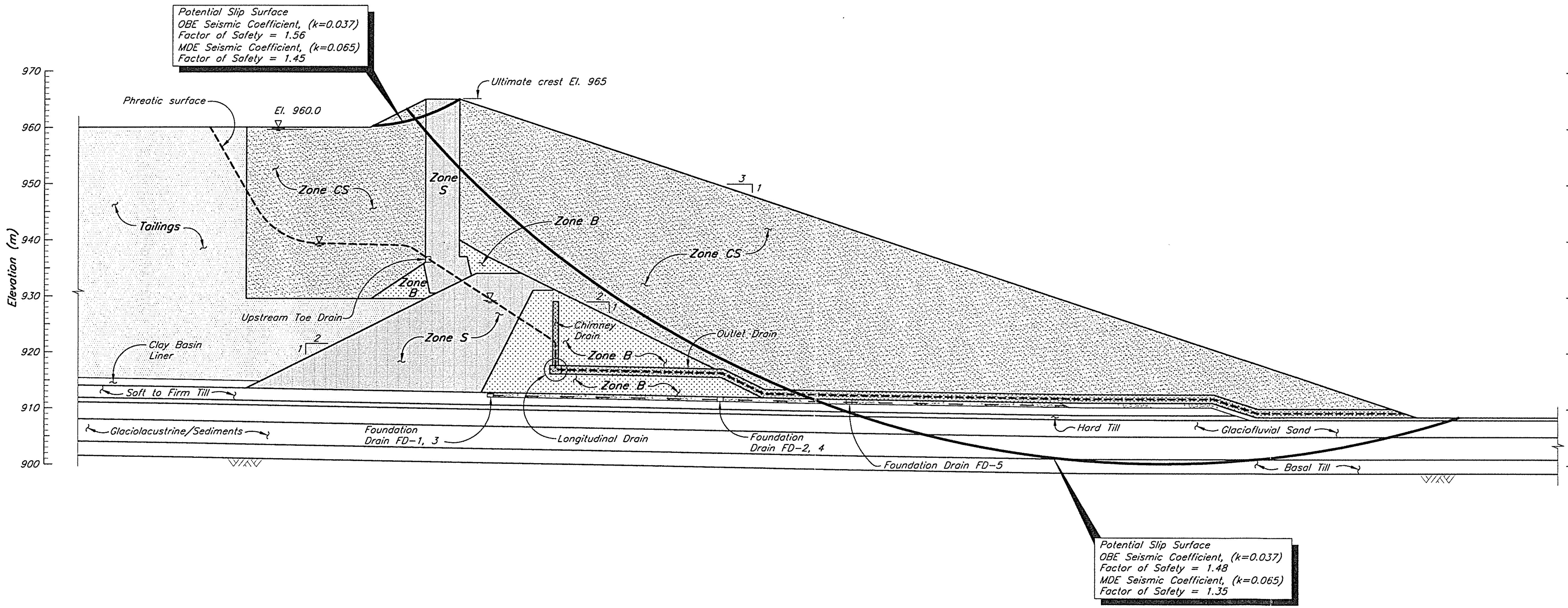
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 4.6

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\823.dwg 1=750 PLOT 1=1(PS) 08/12/99 by:scheung Time @ 11:55

XREF FILE: -



Scale 5 0 10 20 30 40 m

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

EMBANKMENT STABILITY ANALYSES
ULTIMATE OPERATIONAL SEISMIC STABILITY

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC		

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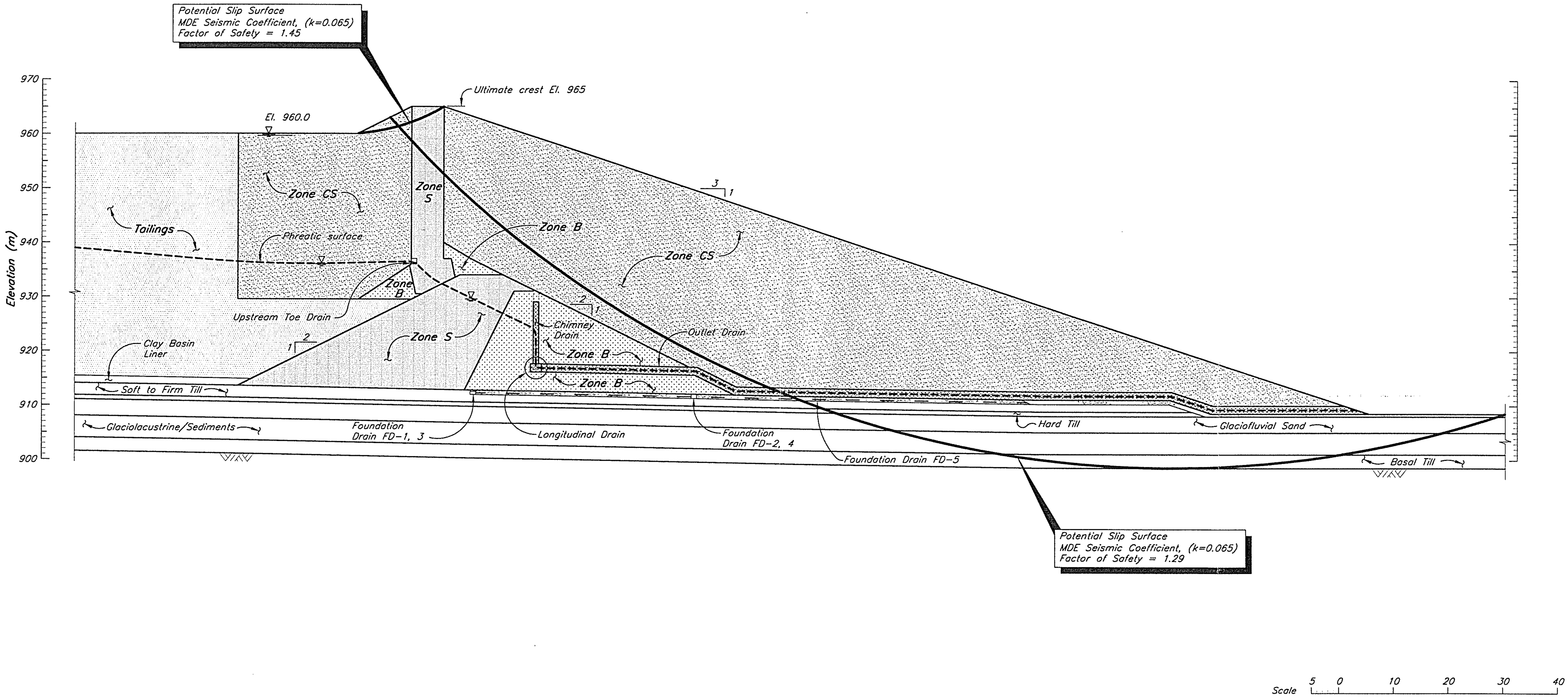
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 4.7

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B24.dwg 1=750 PLOT 1=1(PS) 08/12/99 by:scheung Time @ 12:01

XREF FILE: -



MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

EMBANKMENT STABILITY ANALYSES
POST CLOSURE SEISMIC STABILITY

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC	CAK	KJB

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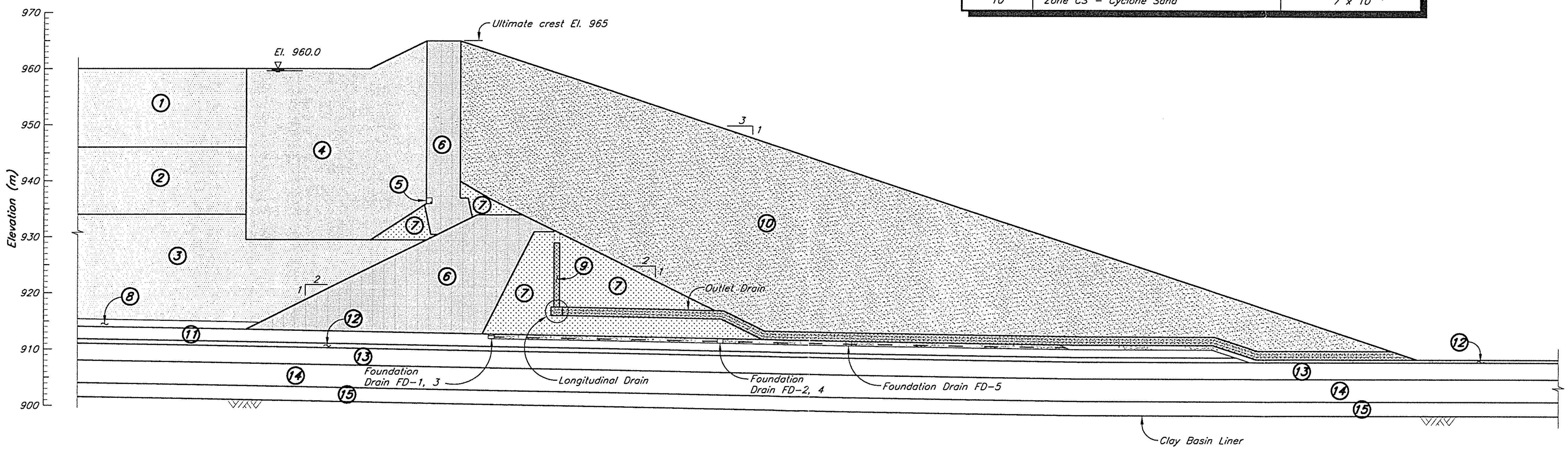
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 4.8

FOUNDATION			
Zone Number	Zone	Depth (m)	Hydraulic Conductivity (cm/s)
11	Soft to Firm Till	0 - 2.2	1×10^{-6}
12	Hard Till	2.2 - 3.0	1×10^{-6}
13	Glaciofluvial Sand	3.0 - 6.0	1×10^{-3}
14	Glaciolacustrine Silt, Silty Sand	6.0 - 10.0	1×10^{-4}
15	Basal Till	10.0 - 12.5	1×10^{-6}

EMBANKMENT FILL		
Zone Number	Zone	Hydraulic Conductivity (cm/s)
1	Tailings El. > 946m	1×10^{-5}
2	Tailings El. 934-946m	5×10^{-6}
3	Tailings El. < 934m	1×10^{-6}
4	Coarse Tailings	7×10^{-4}
5	Filter Drain	1×10^{-4}
6	Zone S - Low Permeability Glacial Till	1×10^{-7}
7	Zone B - Glacial Till	1×10^{-7}
8	Clay Liner	1×10^{-6}
9	Chimney Drain	1×10^{-2}
10	Zone CS - Cyclone Sand	7×10^{-4}



0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC	CHL	KJB
REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

REVISIONS

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

EMBANKMENT SEEPAGE ANALYSES
SUMMARY OF MATERIAL PARAMETERS

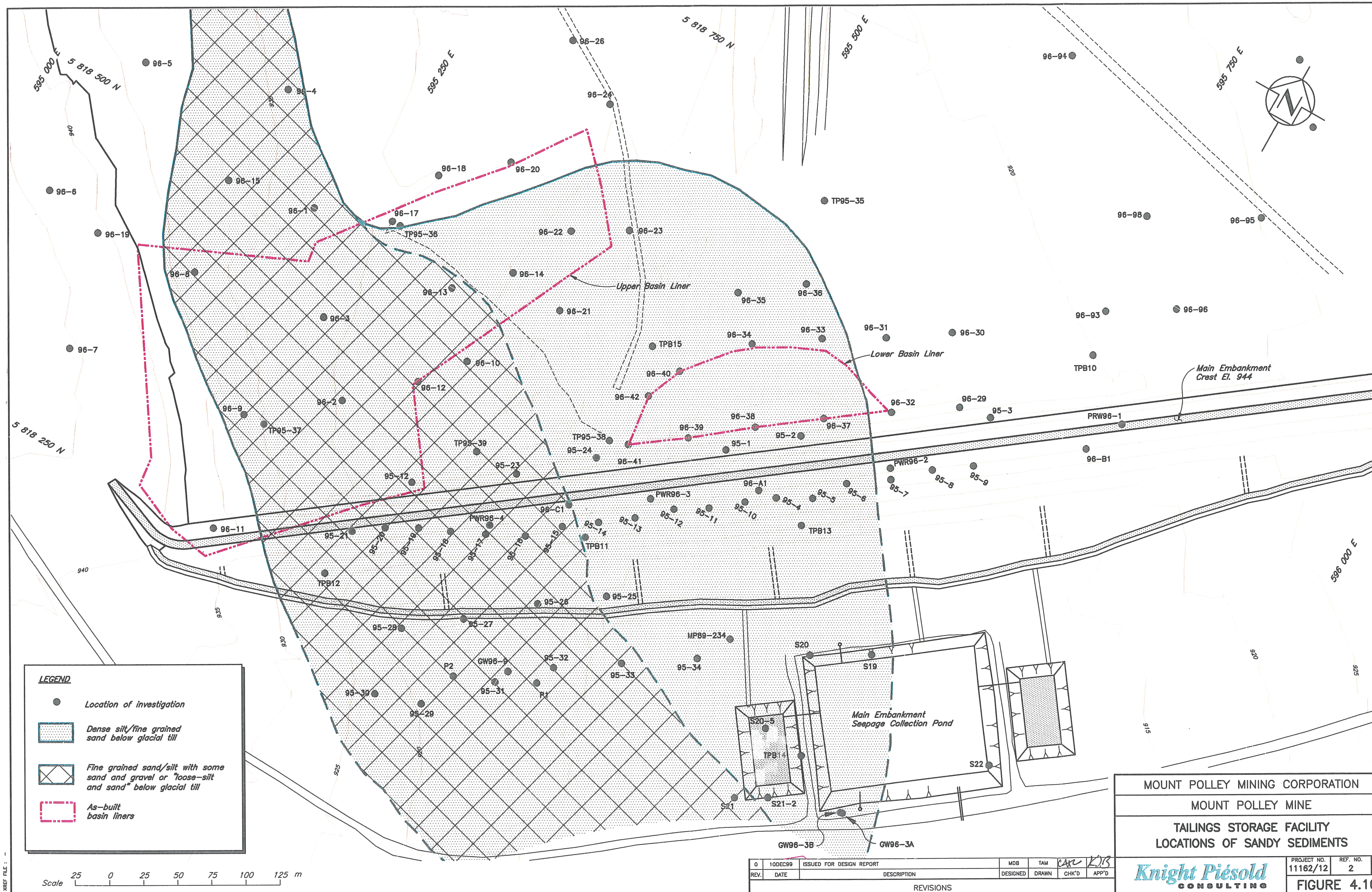
Knight Piésold CONSULTING

PROJECT NO. 11162/12 | REF. NO. 2 | REV. 0

FIGURE 4.9

CAD FILE: M:\11162\12\ACAD\FIGS\B27.dwg 1=750 PLOT 1=1(PS) 08/12/99 bryscheung Time @ 13:03 VANCOUVER B.C.

XREF FILE : -

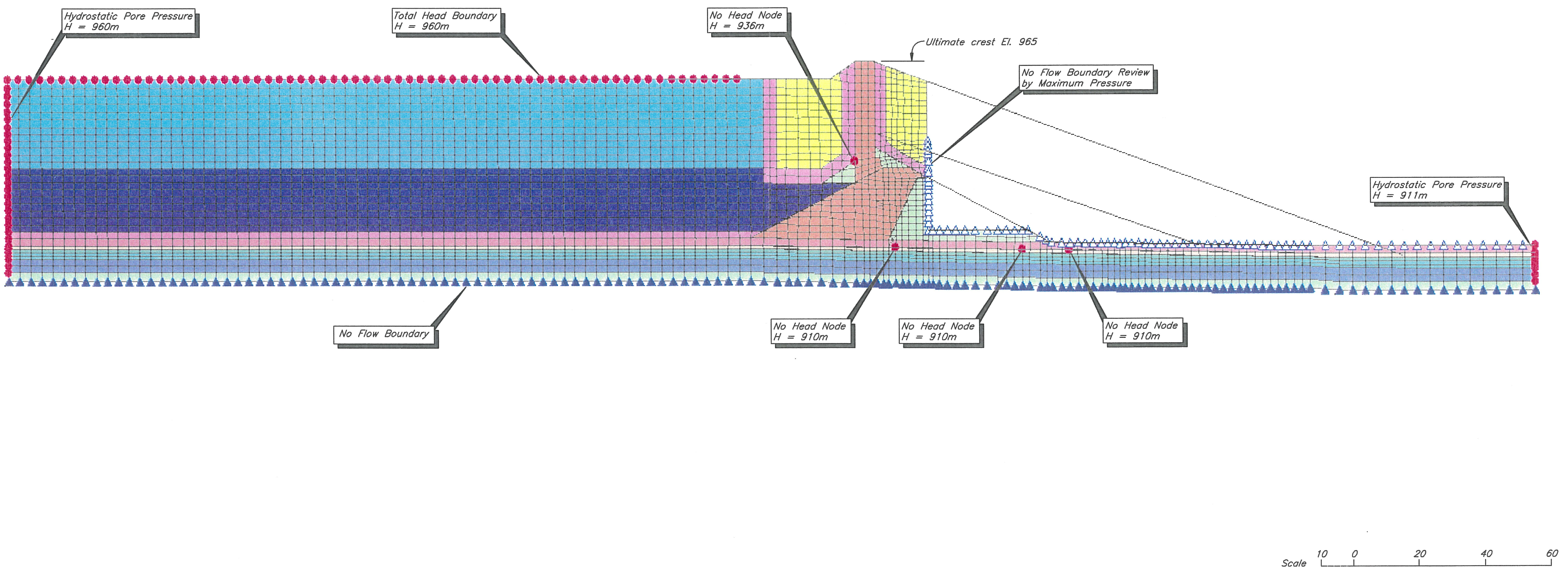


MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
LOCATIONS OF SANDY SEDIMENTS

FIGURE 4.10



MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

EMBANKMENT SEEPAGE ANALYSES
SEEPAGE MODEL FOR ULTIMATE OPERATIONAL
WITH GLACIOFLUVIAL FOUNDATION

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	SC	CH	KB

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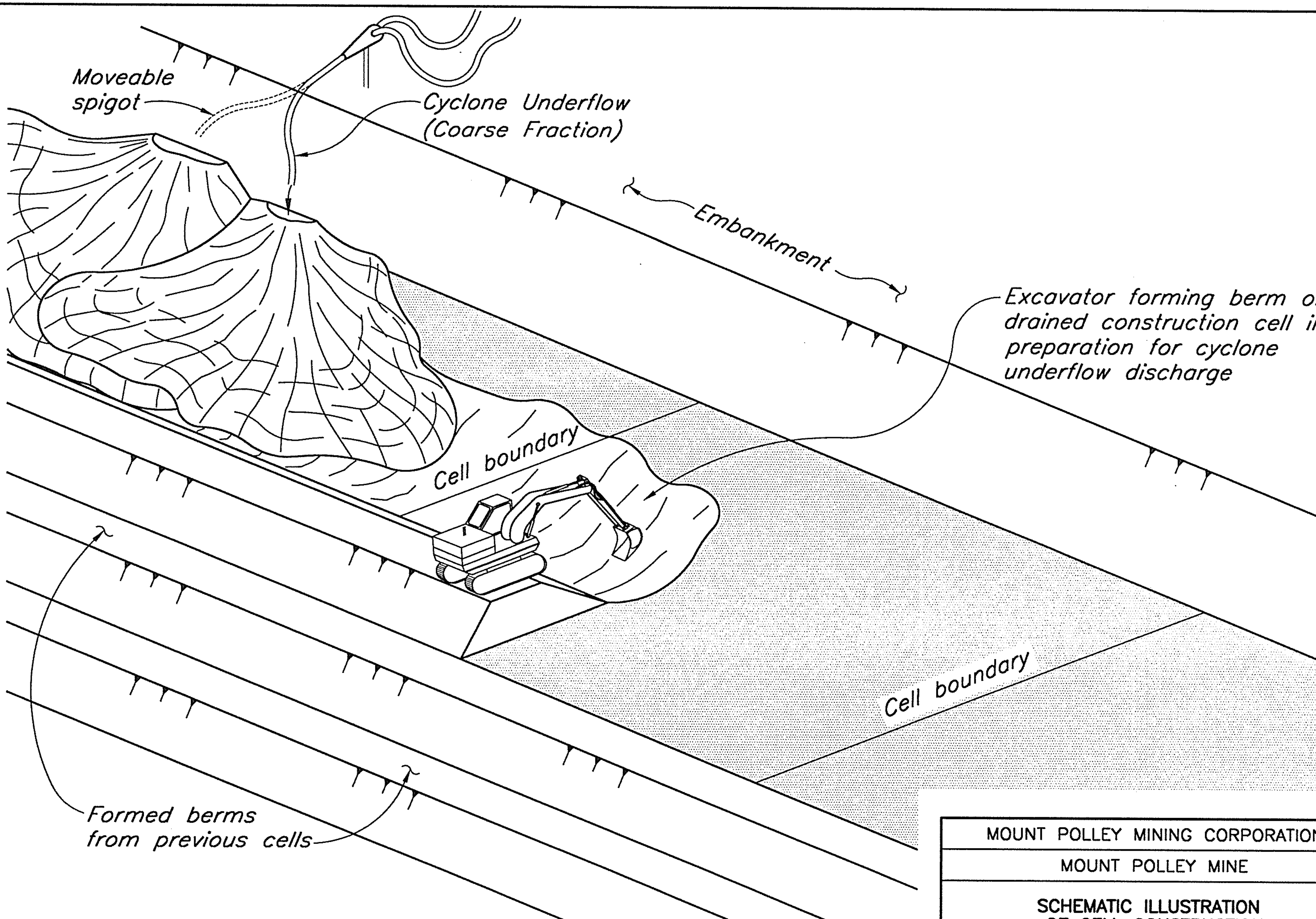
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 4.11

XREF FILE : ULT-ME-MODEL

XREF FILE :



0	10DEC99	ISSUED FOR DESIGN REPORT	LAG	TAM		
REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

REVISIONS

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

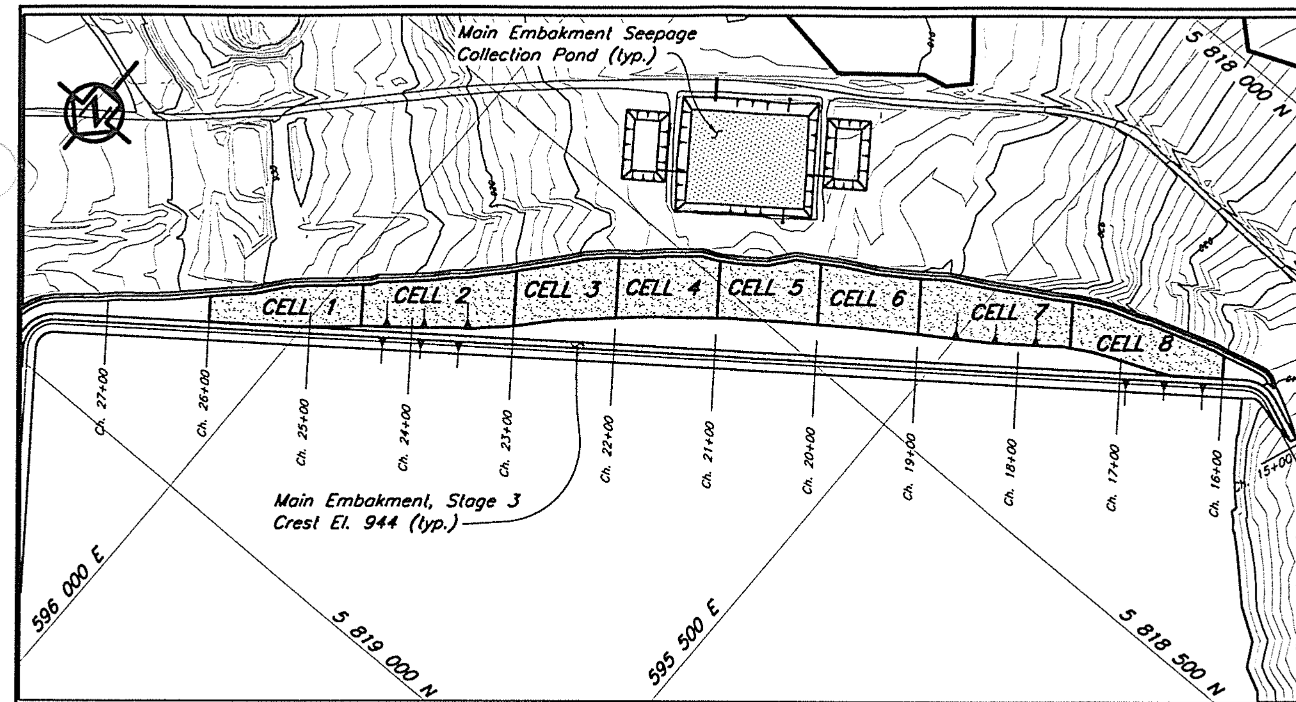
SCHEMATIC ILLUSTRATION OF CELL CONSTRUCTION

Knight Piésold CONSULTING

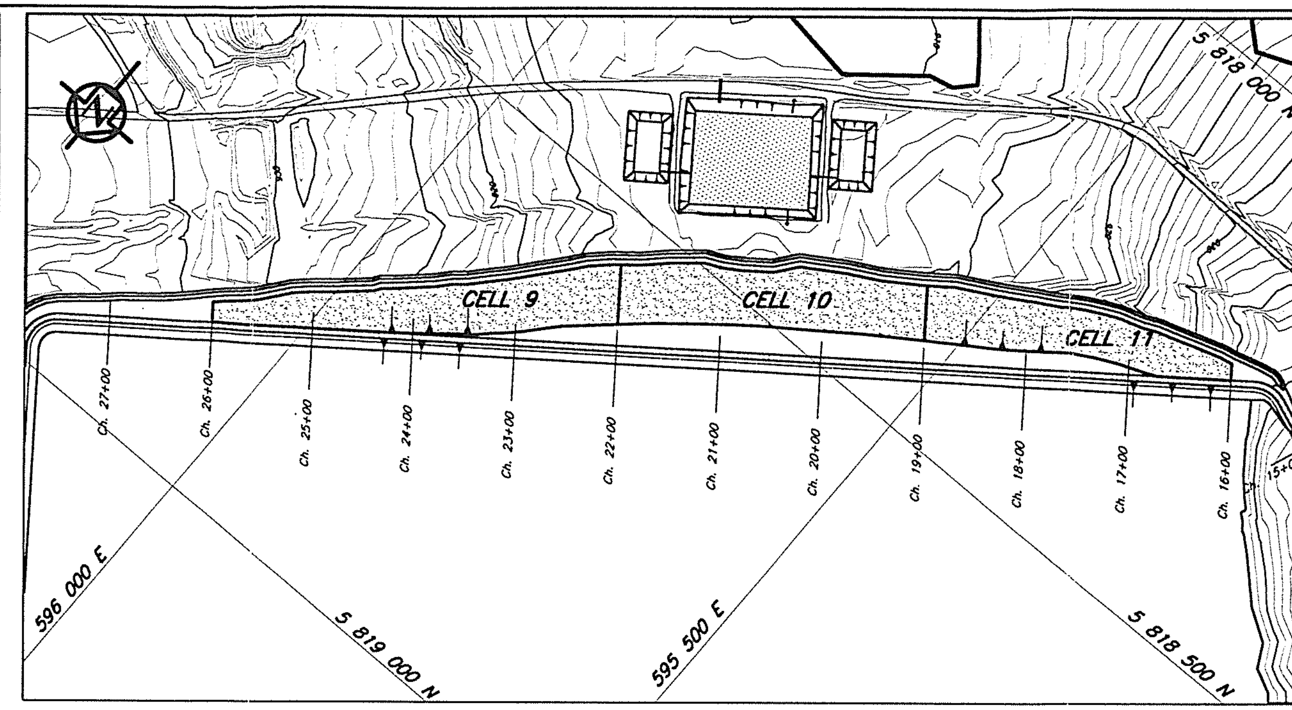
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 5.1

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\A01 NTS PLOT 1=1 10/12/99 tcm



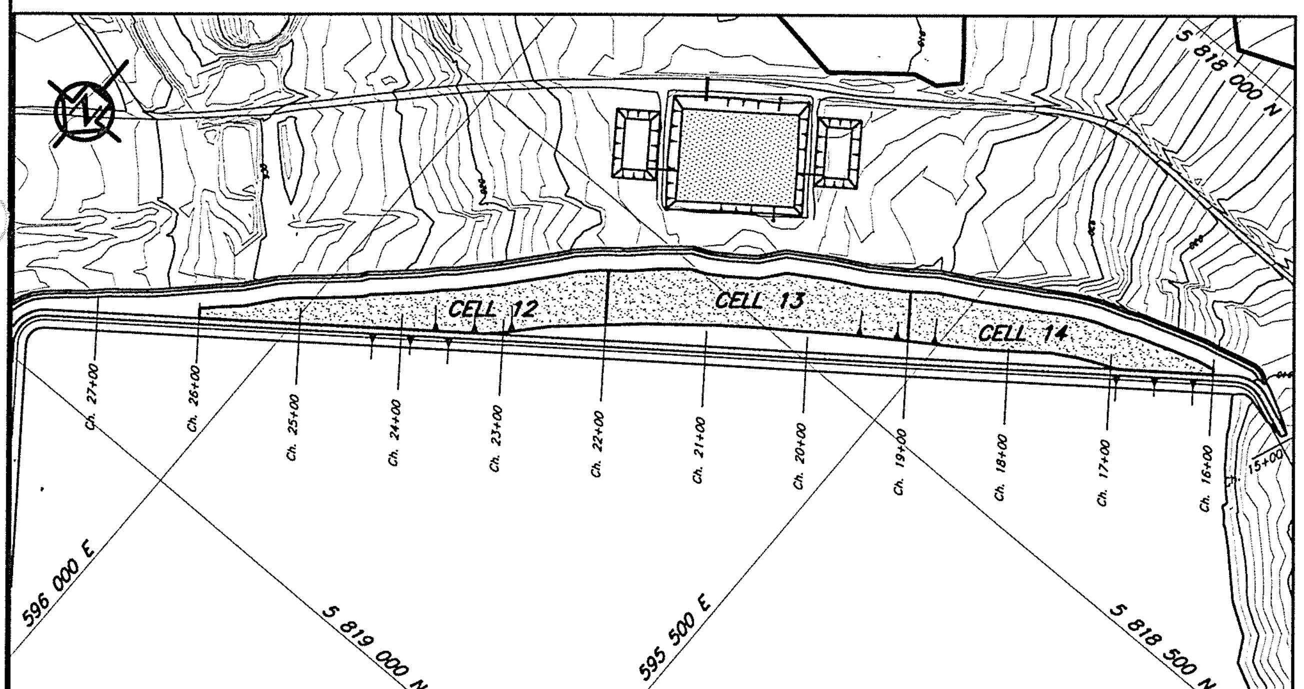
LIFT 1



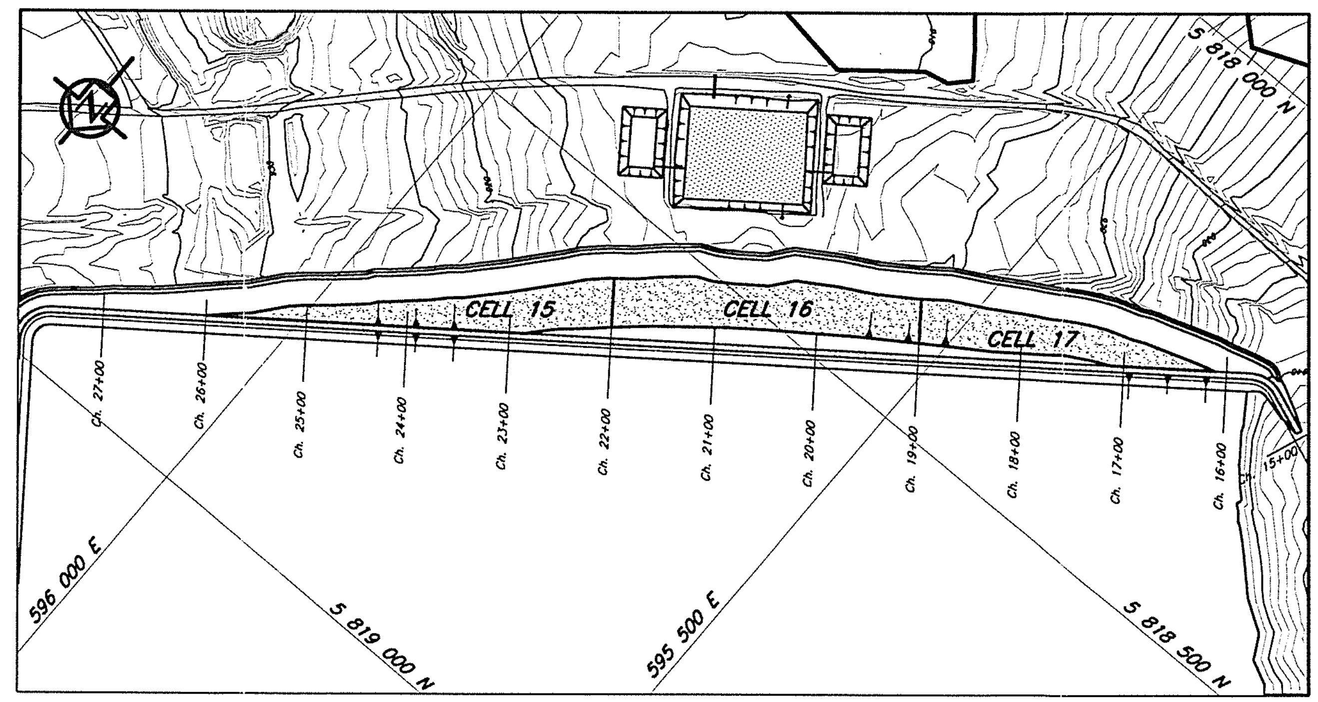
LIFT 2

NOTE

1. Lifts 1 to 4 are hydraulically placed.
2. For Details of Lifts, see Figure 5.4A.



LIFT 3



LIFT 4

Scale 75 0 75 150 225 300 375 m

0	10DEC99	ISSUED FOR DESIGN REPORT	AGN	DSR	GHC	KJB
REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

MAIN EMBANKMENT – STAGE 3
CELL CONSTRUCTION SEQUENCES
PLAN – SHEET 1 OF 2

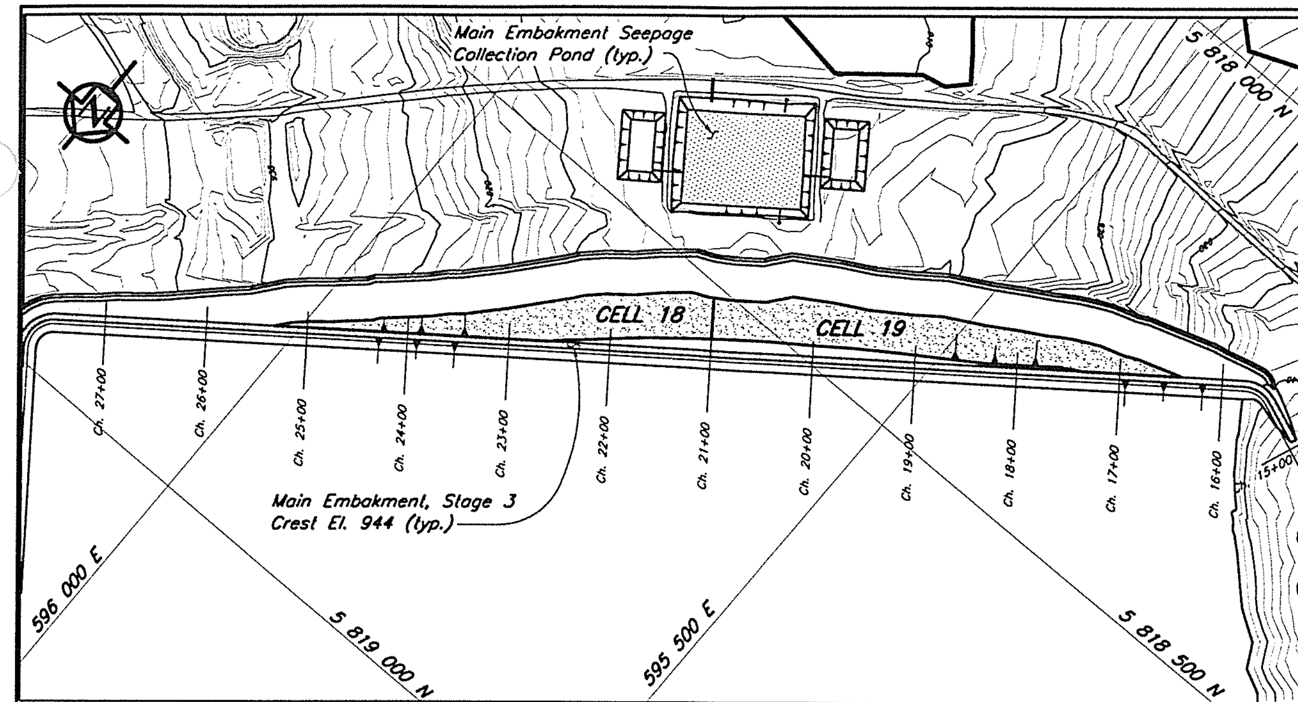
Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

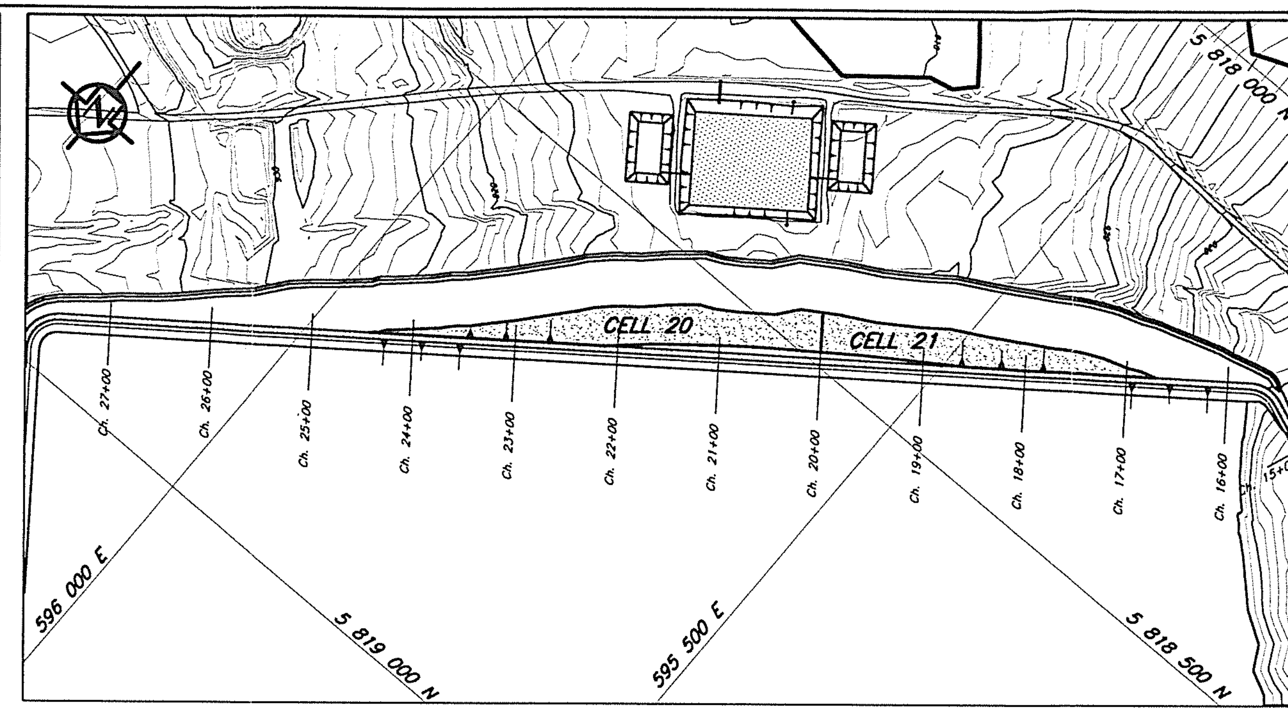
FIGURE 5.2

VANCOUVER B.C. CAD FILE: K:\11162\12\ACAD\FIGS\816 1=7500 Plot 1=1(PS) 06/12/99 lom

XREF FILE : topo99



LIFT 5

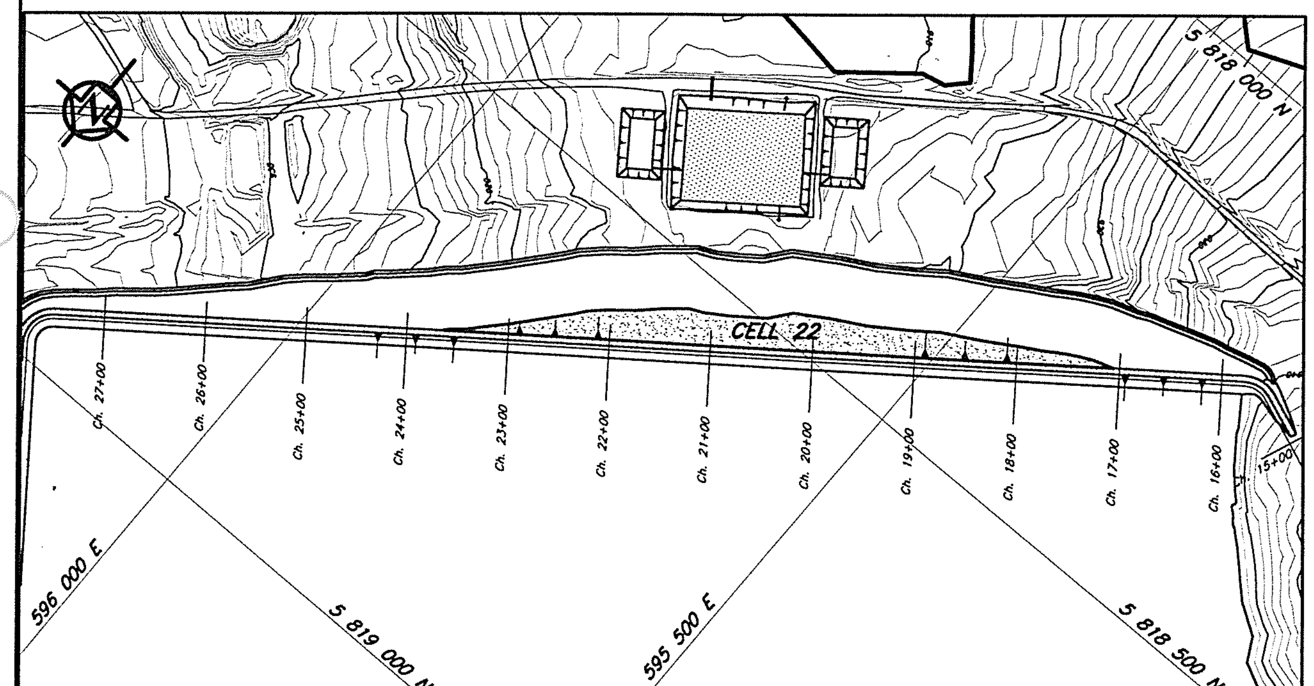


LIFT 6

NOTE

1. Lifts 5 and 6 are hydraulically placed and Lift 7 is mechanically placed.

2. For Details of Lifts, see Figure 5.4A



LIFT 7

Scale 75 0 75 150 225 300 375 m

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	AGN	DSR	CH	KJB

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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

MAIN EMBANKMENT – STAGE 3
CELL CONSTRUCTION SEQUENCES
PLAN – SHEET 2 OF 2

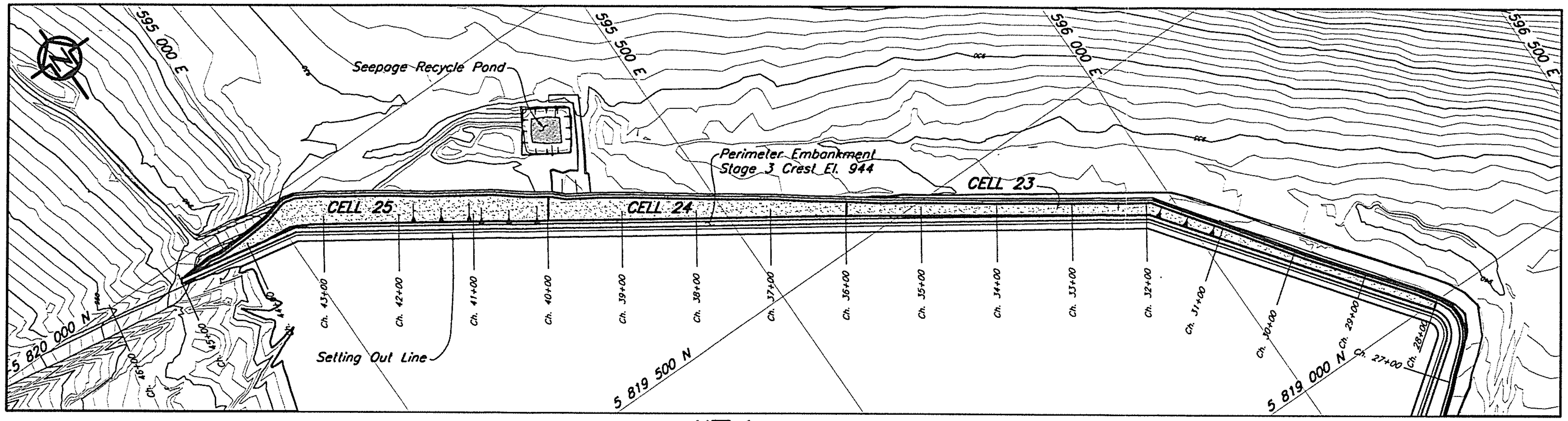
Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

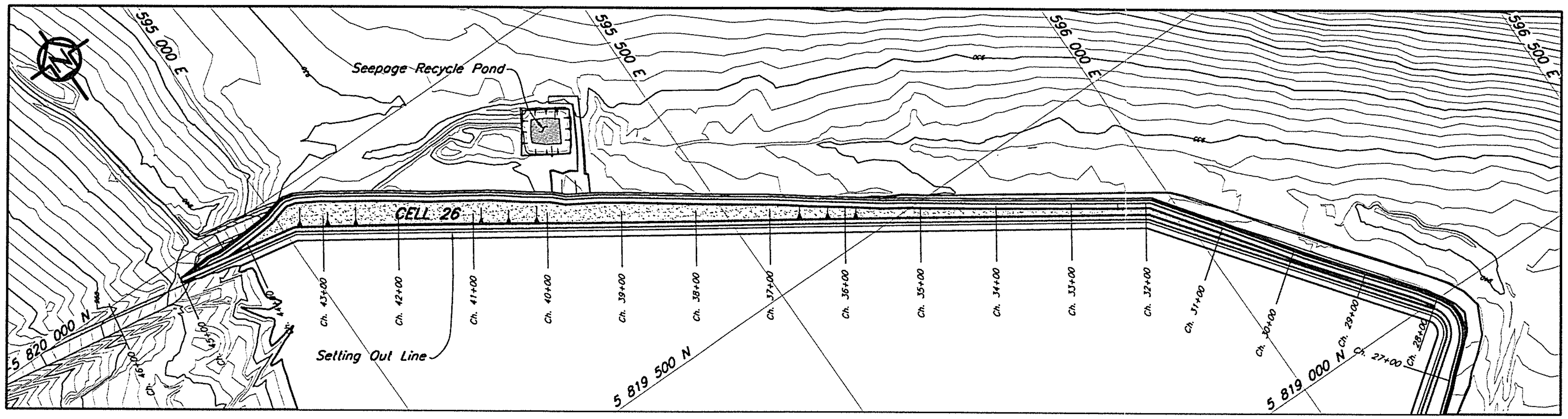
FIGURE 5.3

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B19 1=7500 Plot 1=1(PS) 06/12/99 tom

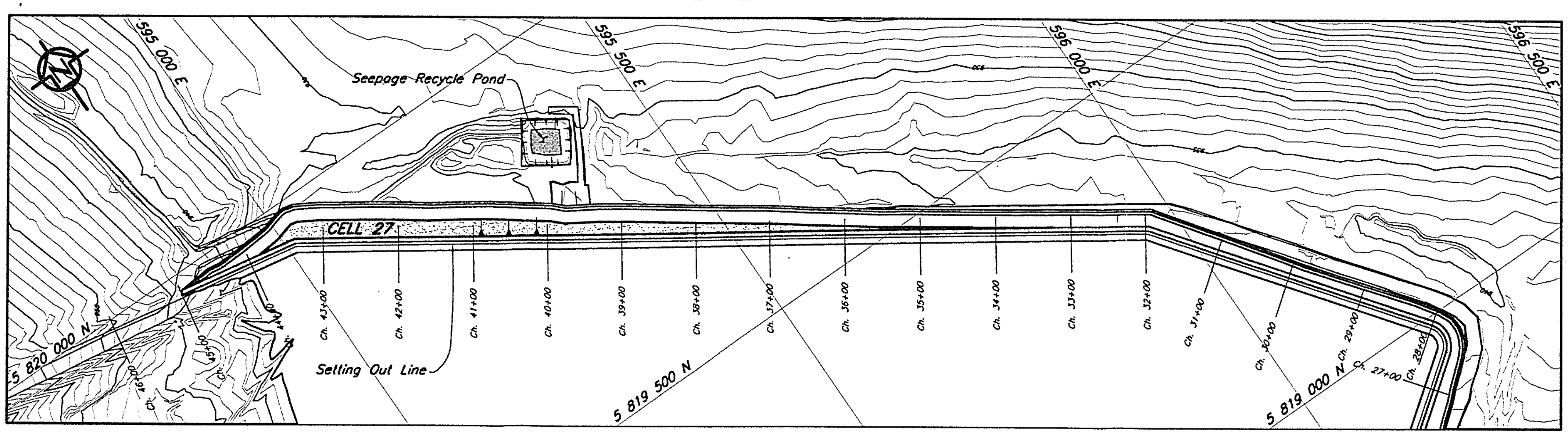
XREF FILE : topo99



LIFT 1



LIFT 2



LIFT 3

NOTE

1. Lifts 1 and 2 are hydraulically placed and lift 3 is mechanically placed.

Scale 75 0 75 150 225 300 375 m

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

PERIMETER EMBANKMENT – STAGE 3
CELL CONSTRUCTION SEQUENCES
PLAN

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	AGN	DSR		

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PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 5.6

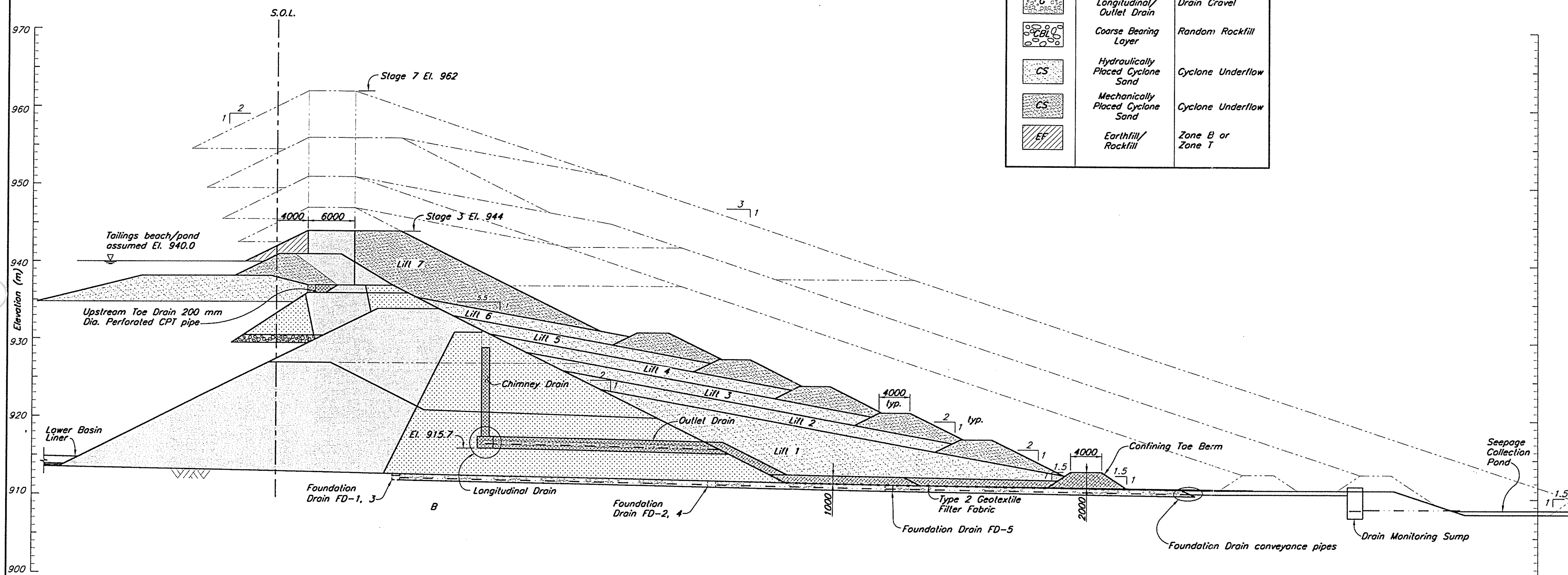
VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B18 1=7500 PLOT 1=1(PS) 06/12/99 tom

XREF FILE : TOPO99

ZONE	LOCATION	MATERIAL TYPE
S	Core Zone	Glacial till
B	Fill Zone	Glacial till, glaciolacustrine or granular material
T	Transition Zone/ Confining Toe Berm	Mine Rock
F	Chimney/ Longitudinal/ Outlet Drain	Filter sand
G	Foundation/ Longitudinal/ Outlet Drain	Drain Gravel
CBL	Coarse Bearing Layer	Random Rockfill
CS	Hydraulically Placed Cyclone Sand	Cyclone Underflow
CS	Mechanically Placed Cyclone Sand	Cyclone Underflow
EF	Earthfill/ Rockfill	Zone B or Zone T

NOTES

1. Berms for Lifts 2 to 6 constructed from cycloned sand deposited during previous lift.
2. Mechanically placed cycloned sand will be stockpiled and drained before being placed as fill.



TYPICAL MAIN EMBANKMENT SECTION THROUGH SEEPAGE COLLECTION POND

Scale 5 0 5 10 15 20 25 m

VANCOUVER B.C. CAD FILE: \11162\12\Acad\Fig\013... PLOT 1=0.5 1=500 06/12/99 tam

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	AGN	DSR	CHC	KJB

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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

MAIN EMBANKMENT – STAGE 3
CELL CONSTRUCTION SEQUENCES
TYPICAL CROSS-SECTION

Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 5.4

XREF FILE :

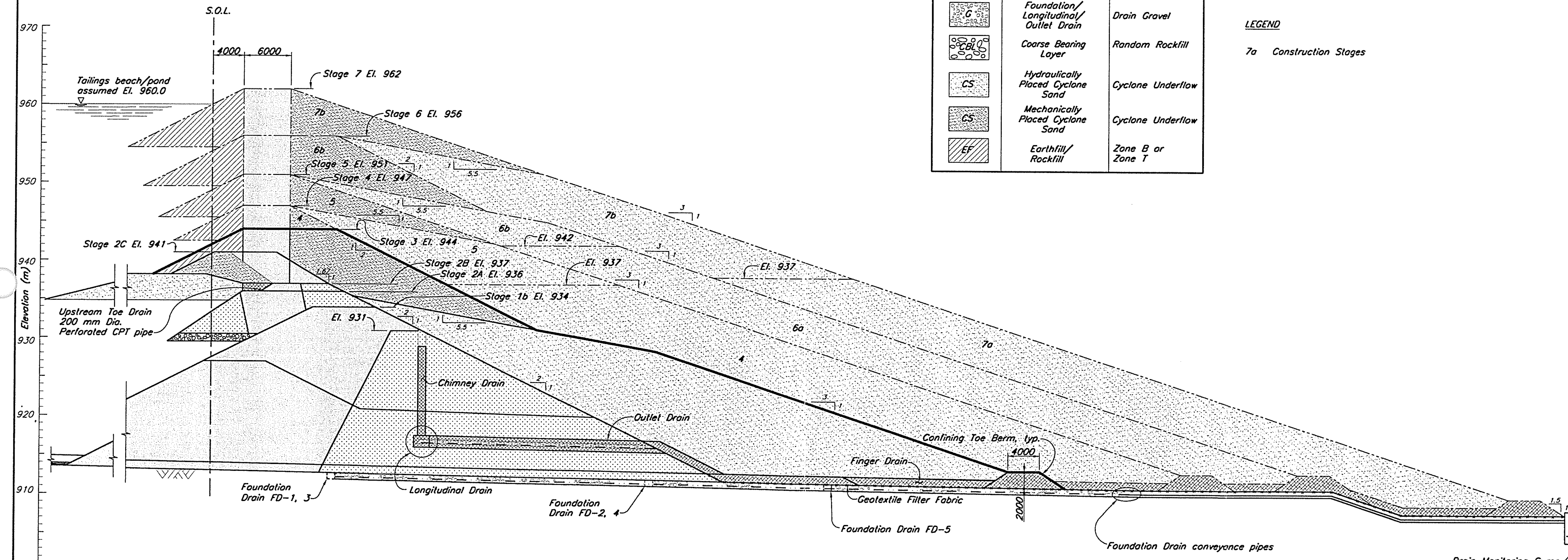
ZONE	LOCATION	MATERIAL TYPE
S	Core Zone	Glacial till
B	Fill Zone	Glacial till, glaciolacustrine or granular material
T	Transition Zone/ Confining Toe Berm	Mine Rock
F	Chimney/ Longitudinal/ Outlet Drain	Filter sand
G	Foundation/ Longitudinal/ Outlet Drain	Drain Gravel
CBL	Coarse Bearing Layer	Random Rockfill
CS	Hydraulically Placed Cyclone Sand	Cyclone Underflow
CS	Mechanically Placed Cyclone Sand	Cyclone Underflow
EF	Earthfill/ Rockfill	Zone B or Zone T

NOTES

1. Transverse Rockfill Berms, used to isolate cells in Lift 1 of each stage, will become Finger Drains as they are covered with cycloned material.
2. See Note 2 on Perimeter Section Figure 5.6.

LEGEND

7a Construction Stages



TYPICAL MAIN EMBANKMENT SECTION

Scale 5 0 5 10 15 20 25 m

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	JEV	TAM	KAG	KJB

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MOUNT POLLEY MINE

MAIN EMBANKMENT – STAGES 4 TO 7
CONCEPTUAL CONSTRUCTION SEQUENCES
TYPICAL CROSS SECTION

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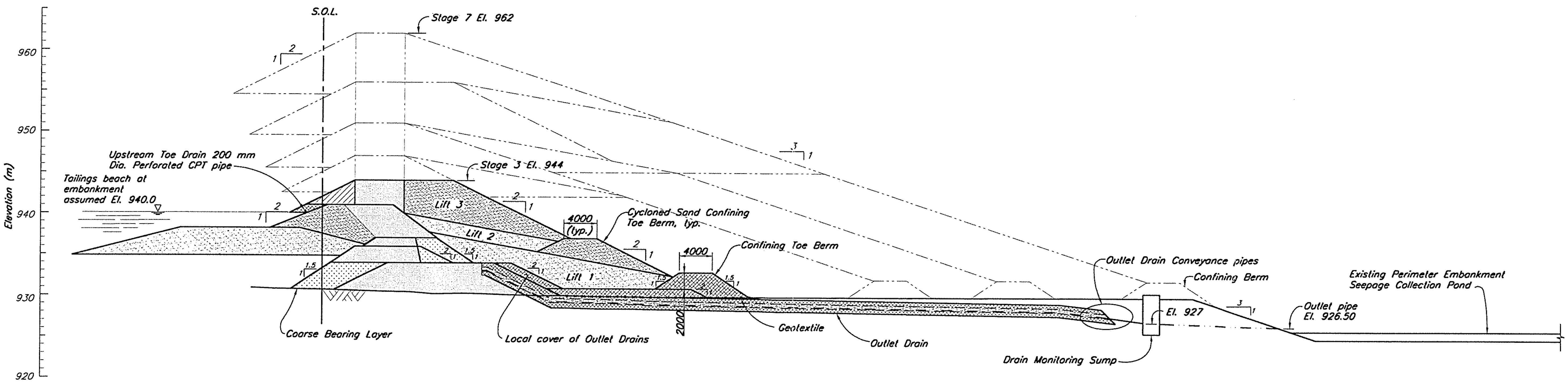
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 5.5

ZONE	LOCATION	MATERIAL TYPE
S	Core Zone	Glacial till
B	Fill Zone	Glacial till, glaciolacustrine or granular material
T	Transition Zone/ Confining Berm	Mine Rock
F	Chimney Longitudinal/ Outlet Drain	Filter Sand
G	Foundation/ Longitudinal/ Outlet Drain	Drain Gravel
CBL	Coarse Bearing Layer	Random Rockfill
CS	Hydraulically Placed Cyclone Sand	Cyclone Underflow
CS	Mechanically Placed Cyclone Sand	Cyclone Underflow
EF	Earthfill/ Rockfill	Zone B or Zone T

NOTES

1. Berm for Lift 2 constructed from cycloned sand deposited during previous lift.
2. Mechanically placed cyclone sand will be stockpiled and drained before being placed as fill.



TYPICAL SECTION THROUGH SEEPAGE COLLECTION POND

Scale 5 0 5 10 15 20 25 m

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	06DEC99	ISSUED FOR DESIGN REPORT	AGN	DSR	CHC	KB

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MOUNT POLLEY MINE

PERIMETER EMBANKMENT – STAGE 3
CELL CONSTRUCTION SEQUENCES
TYPICAL CROSS SECTION

Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 5.7

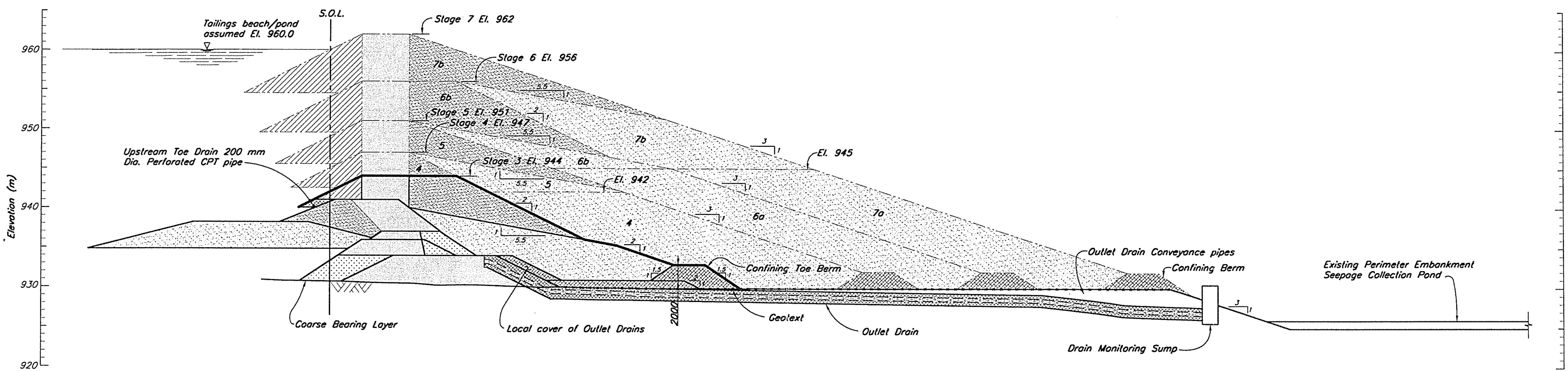
VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\814 1=500 PLOT 1=0.5 06/12/99 tom

XREF FILE :

ZONE	LOCATION	MATERIAL TYPE
S	Core Zone	Glacial till
B	Fill Zone	Glacial till, glaciolacustrine or granular material
T	Transition Zone/ Confining Berm	Mine Rock
F	Chimney Longitudinal/ Outlet Drain	Filter Sand
G	Foundation/ Longitudinal/ Outlet Drain	Drain Gravel
CBL	Coarse Bearing Layer	Random Rockfill
CS	Hydraulically Placed Cyclone Sand	Cyclone Underflow
CS	Mechanically Placed Cyclone Sand	Cyclone Underflow
EF	Earthfill/ Rockfill	Zone B or Zone T

NOTES

1. Transverse Rockfill Confining Berms used to isolate 8 cells in Lift 1 of each stage, will become Finger Drains as they are covered with cycloned sand.
2. Mechanically placed cyclone sand will be stockpiled and drained before being placed as fill.



TYPICAL SECTION THROUGH SEEPAGE COLLECTION POND

Scale 5 0 5 10 15 20 25 m

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	JEV	TAM	CHL	KJB

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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

PERIMETER EMBANKMENT – STAGES 4 TO 7
CONCEPTUAL CONSTRUCTION SEQUENCES
TYPICAL CROSS SECTION

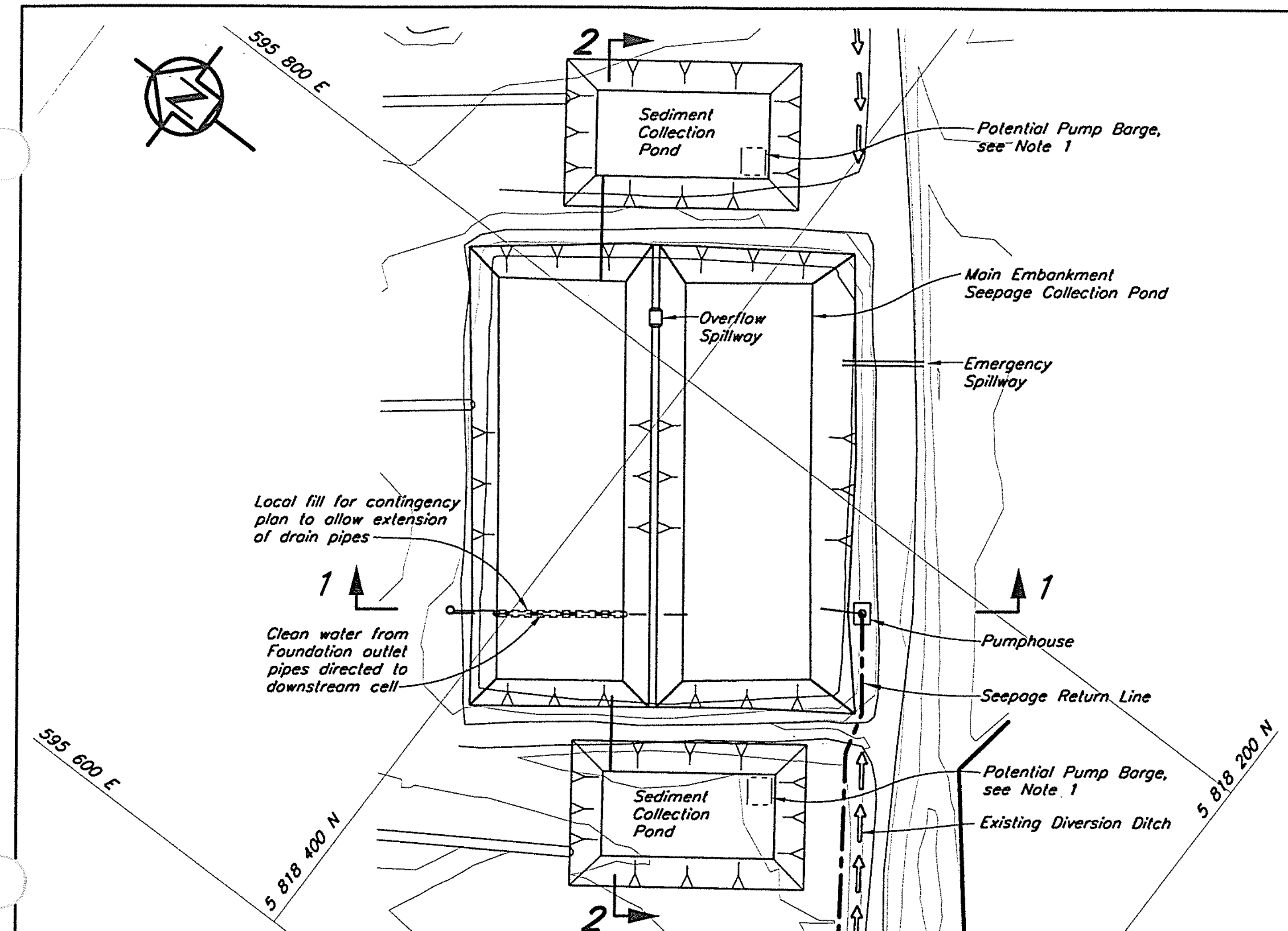
Knight Piésold CONSULTING

PROJECT NO.	REF. NO.	REV.
11162/12	2	0

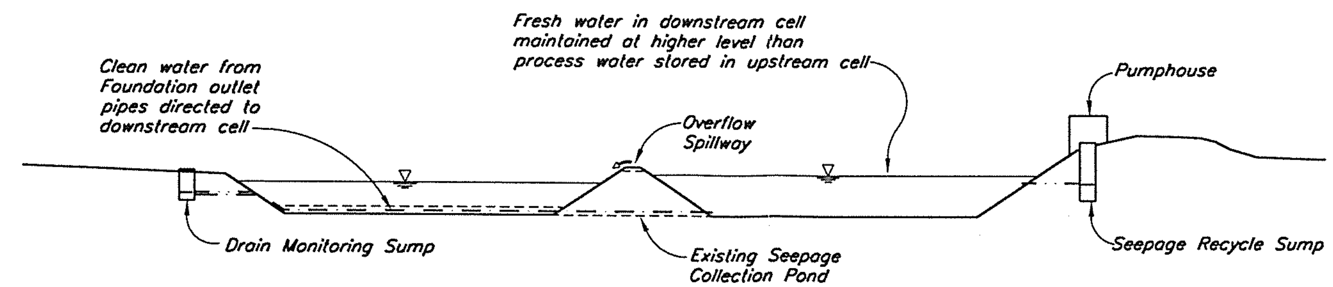
FIGURE 5.8

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B36 1=500 Plot 1=0.5 07/12/99 tam

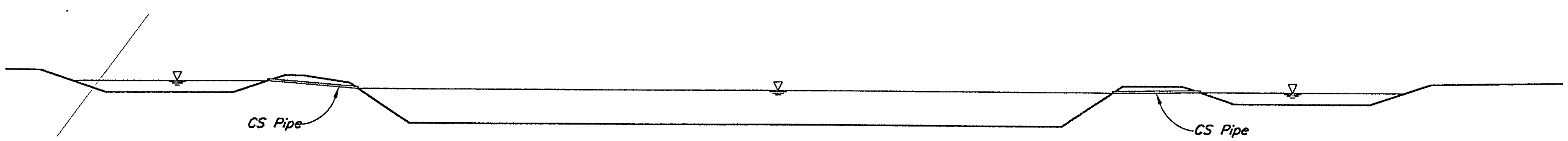
XREF FILE: -



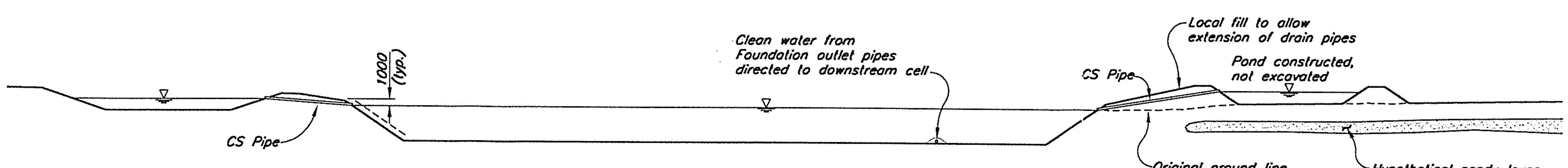
PLAN
Scale A



SECTION 1
Scale B



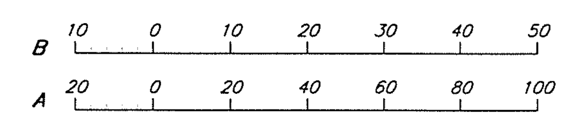
SECTION 2
Scale B



SECTION 2 – CONTINGENCY PLAN
Scale B

NOTES

1. Potential Pump Barges may be added as an alternative method for recycling water back to the tailings storage facility.



REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	LAG	WAL		KJB

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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

MAIN EMBANKMENT
DRAINAGE WATER MANAGEMENT

Knight Piésold CONSULTING

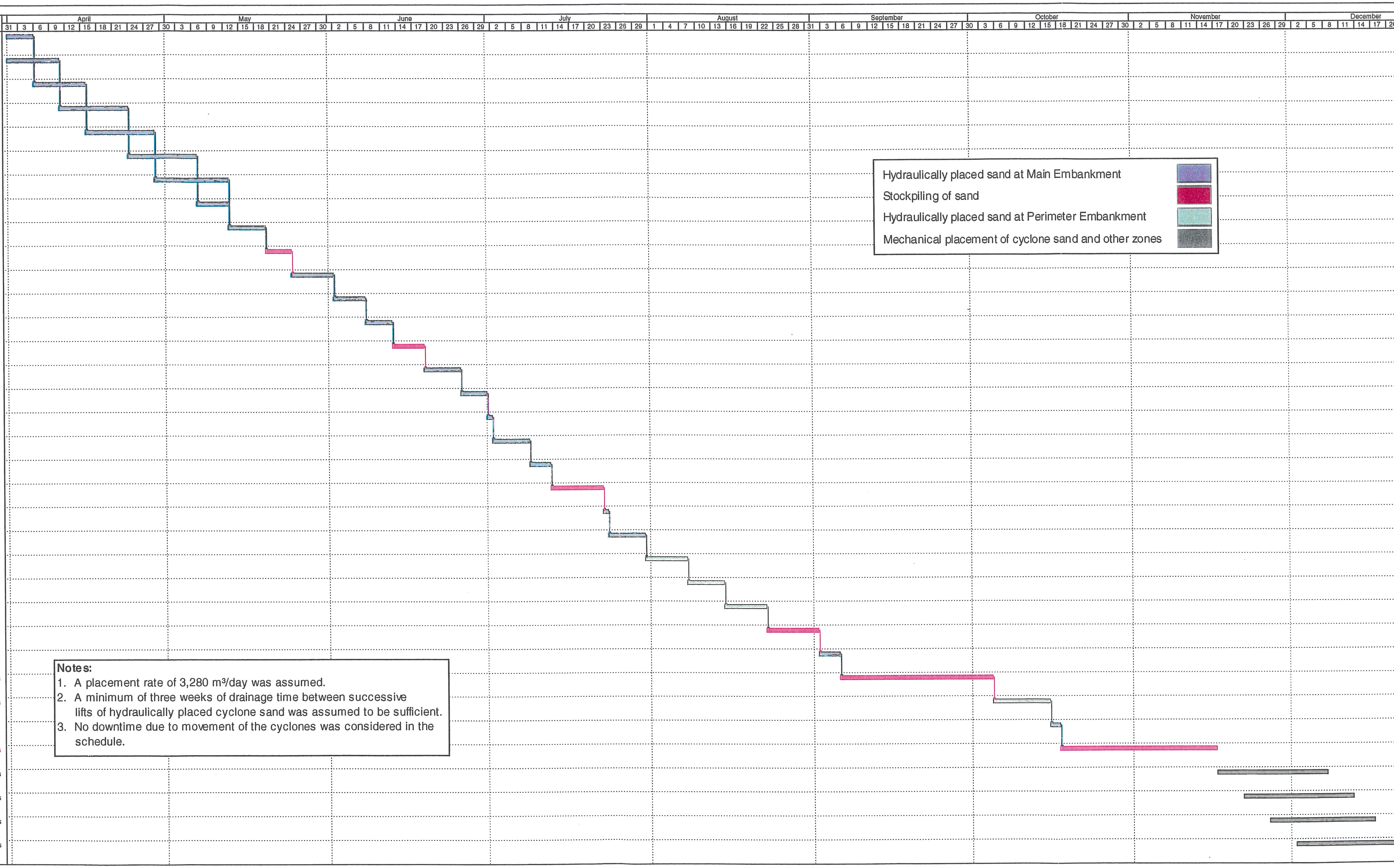
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 5.9

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B32 1=2000 PLOT 1=1(PS) 06/12/99 lam

XREF FILE : -

ID	Task Description	Duration
1	Cell 1 - Cyclones 1 to 3	5 days
2	Cell 2 - Cyclones 4 to 6	10 days
3	Cell 3 - Cyclones 1 to 3	10 days
4	Cell 4 - Cyclones 4 to 6	13 days
5	Cell 5 - Cyclones 1 to 3	13 days
6	Cell 6 - Cyclones 4 to 6	13 days
7	Cell 7 - Cyclones 1 to 3	14 days
8	Cell 8 - Cyclones 4 to 6	6 days
9	Cell 9 - Cyclones 1 to 6	7 days
10	Stockpile at NE abutment of ME (16,400m³) for drainage of fill	5 days
11	Cell 10 - Cyclones 1 to 6	8 days
12	Cell 11 - Cyclones 1 to 6	6 days
13	Cell 12 - Cyclones 1 to 6	5 days
14	Stockpile at NE abutment of ME (19,700m³) for drainage of fill	6 days
15	Cell 13 - Cyclones 1 to 6	7 days
16	Cell 14 - Cyclones 1 to 6	5 days
17	Cell 15 - Cyclones 1 to 6	1 day
18	Cell 16 - Cyclones 1 to 6	7 days
19	Cell 17 - Cyclones 1 to 6	4 days
20	Stockpile at NW abutment of PE (32,800m³) for drainage of fill	10 days
21	Cell 18 - Cyclones 1 to 6	1 day
22	Cell 19 - Cyclones 1 to 6	7 days
23	Cell 23 - Cyclones 1 to 6	8 days
24	Cell 24 - Cyclones 1 to 6	7 days
25	Cell 25 - Cyclones 1 to 6	8 days
26	Stockpile at NE abutment of ME (32,800m³) for drainage of fill	10 days
27	Cell 20 - Cyclones 1 to 6	4 days
28	Stockpile at NW abutment of PE (95,200m³) for drainage of fill	29 days
29	Cell 26 - Cyclones 1 to 6	11 days
30	Cell 21 - Cyclones 1 to 6	2 days
31	Stockpile at NE abutment of ME (98,400m³) for drainage of fill	30 days
32	Mechanically place Lift 7 at ME	21 days
33	Construction of other zones at ME	21 days
34	Mechanically place Lift 3 at PE	20 days
35	Construction of other zones at PE	21 days



Notes:

1. A placement rate of 3,280 m³/day was assumed.
2. A minimum of three weeks of drainage time between successive lifts of hydraulically placed cyclone sand was assumed to be sufficient.
3. No downtime due to movement of the cyclones was considered in the schedule.

REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	JEV	JEV		

REVISIONS

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MOUNT POLLEY MINE

MAIN & PERIMETER EMBANKMENTS – STAGE 3
CYCLONE SAND CONSTRUCTION SEQUENCE
CELL FILLING SCHEDULE

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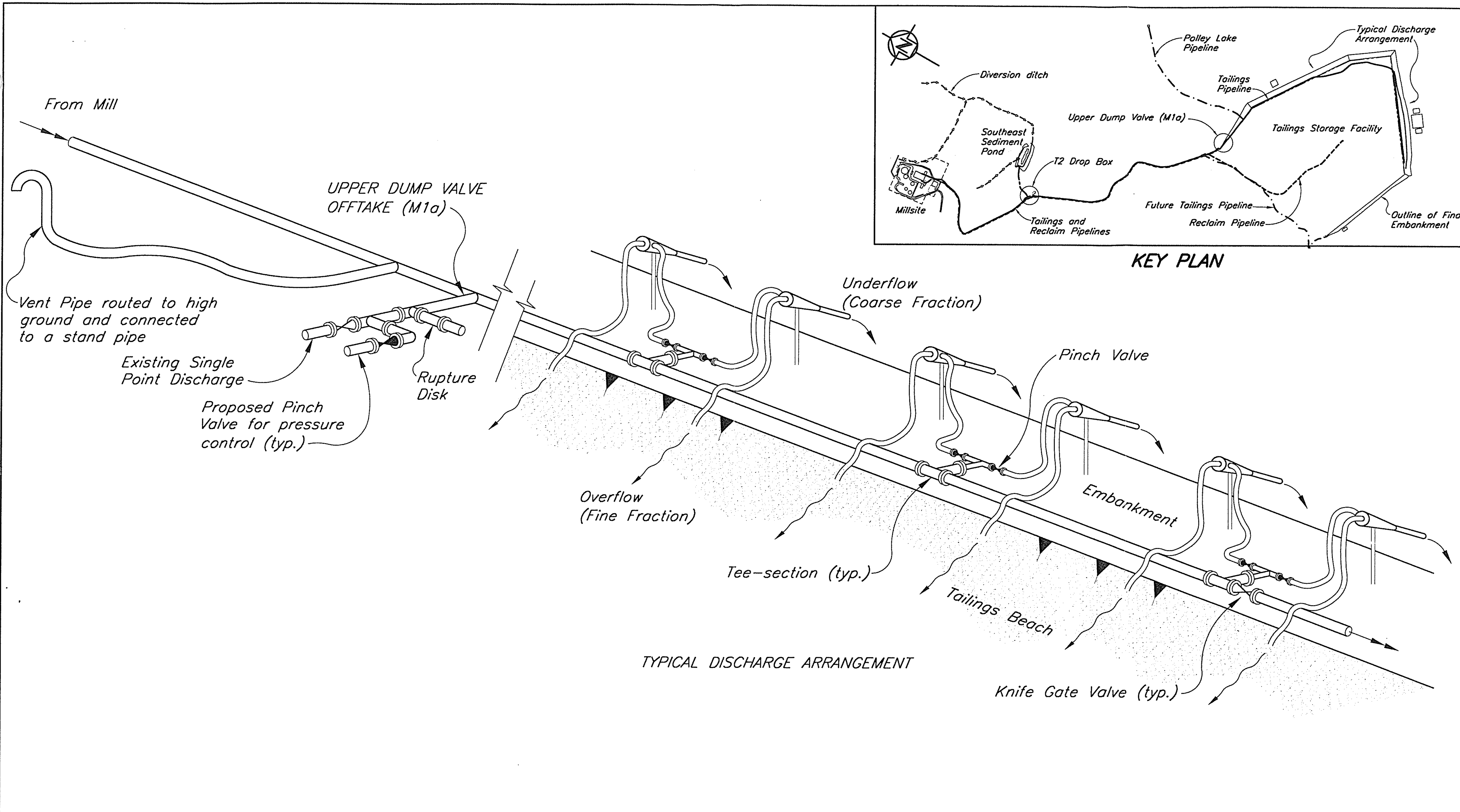
PROJECT NO. 11162/12 | REF. NO. 2 | REV. 0

FIGURE 5.10

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\FIGS\B37 1=1000 PLOT 1=1.0 07/12/99 TAM

XREF FILE: -



REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	LAG	TAM	MDB	KJB

REVISIONS

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MOUNT POLLEY MINE

TAILINGS HEADER PIPE SCHEMATIC

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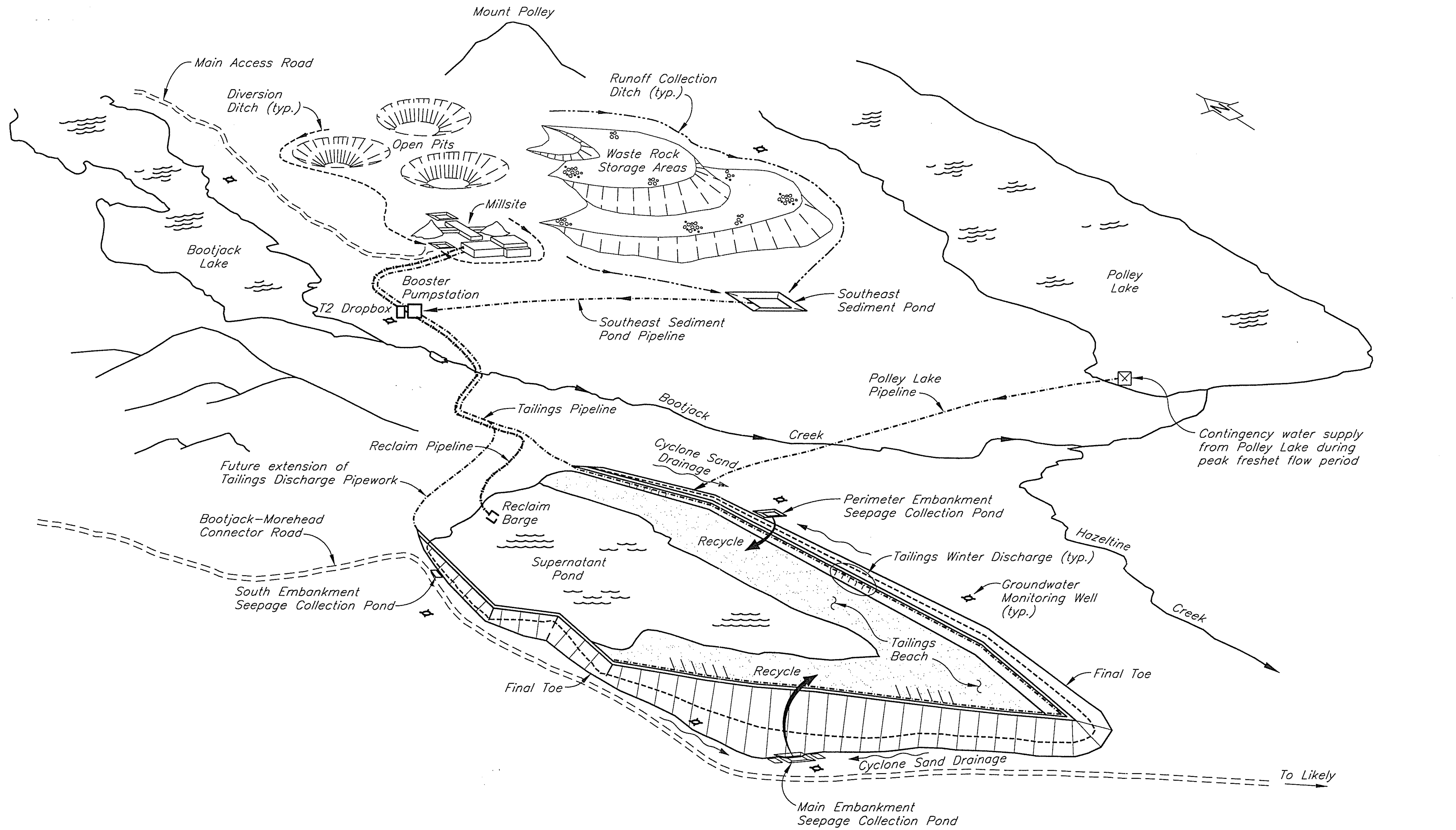
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 6.1



REV.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	LAG	TAM	MDB	KJB

REVISIONS

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MOUNT POLLEY MINING

SITE WATER MANAGEMENT SCHEMATIC

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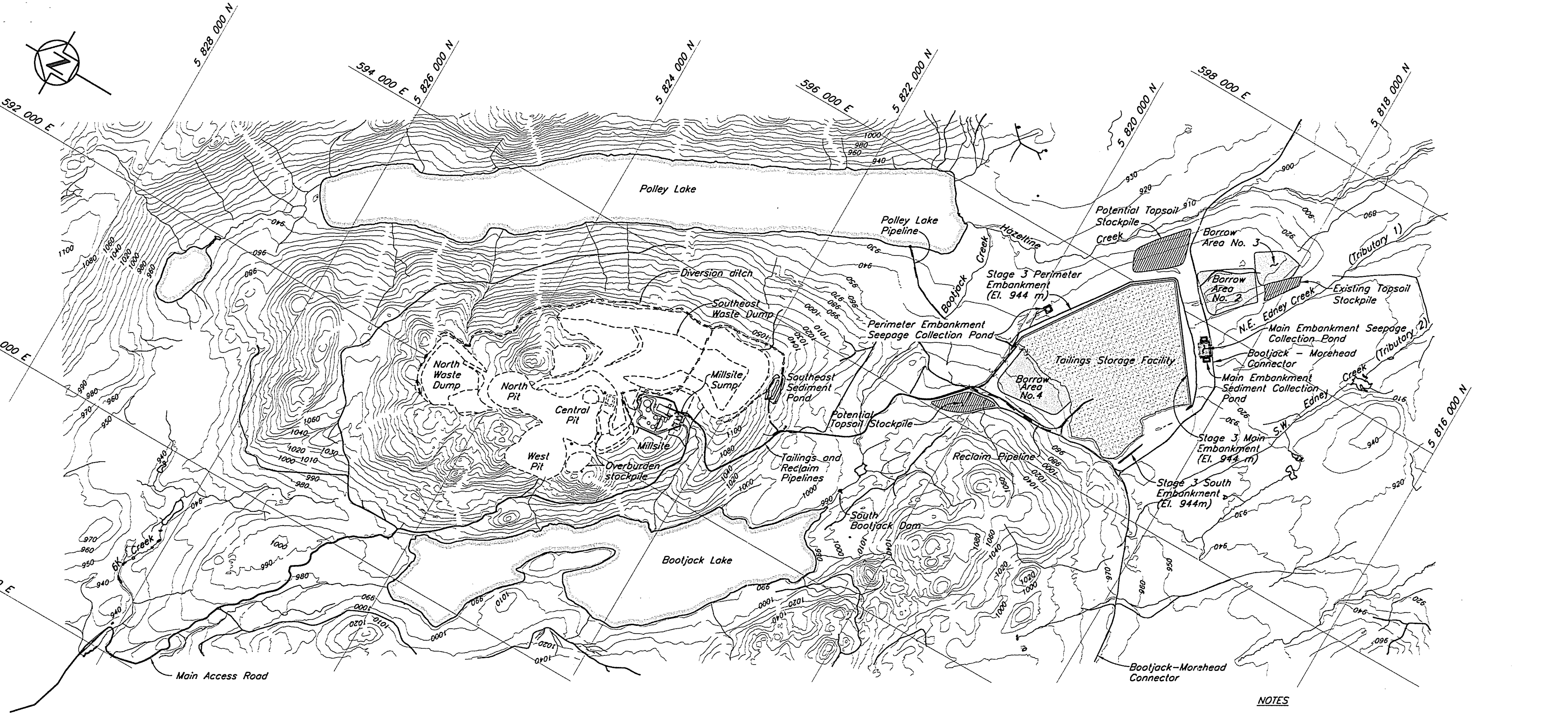
PROJECT NO.	REF. NO.	REV.
11162/12	2	0

FIGURE 7.1



NOTES

1. Open Pits and Waste Dumps are shown in their final configurations.
2. Topography at TSF generated from points and break lines sent from MPMC in July 1999. The topography outside the TSF area is from 1997 flyover.
3. Current size and location of potential and existing Borrow Areas and Topsoil Stockpiles are to be confirmed.

NOT FOR CONSTRUCTION

Scale 1000 500 0 1000 2000 m

VANCOUVER B.C. CAD FILE: M:\11162\12\CAD\dwgs\06\06 1=20000 PLOT 1=20.0 06/12/99 WAL

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TAILINGS STORAGE FACILITY
STAGE 3 TAILINGS EMBANKMENT
OVERALL SITE PLAN

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	WAL	LAG	KJB

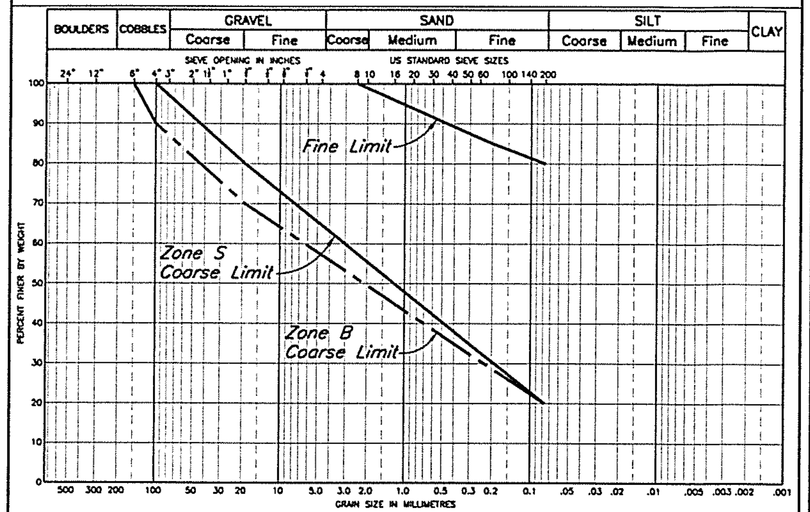
DESIGNED	CHECKED	SCALE	REVISION
MDB	LAG	AS SHOWN	0
DRAWN	APPROVED	DRAWING NO.	
DSR	KJB	11162-12-100	

Knight Piésold CONSULTING

XREF FILE : TOPO99

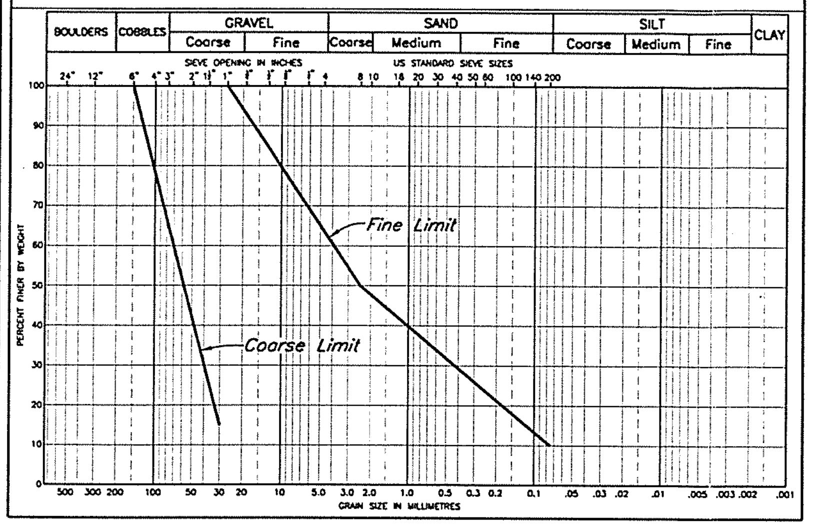
UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT: ZONE S and ZONE B



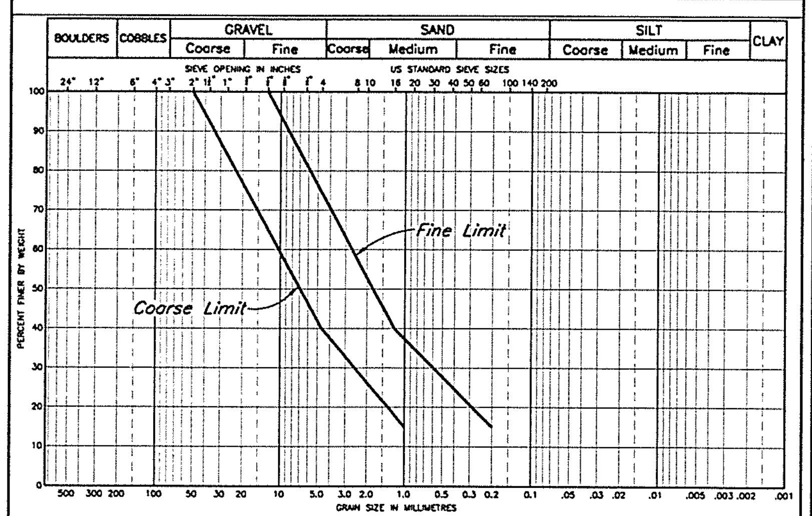
UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT: ZONE T



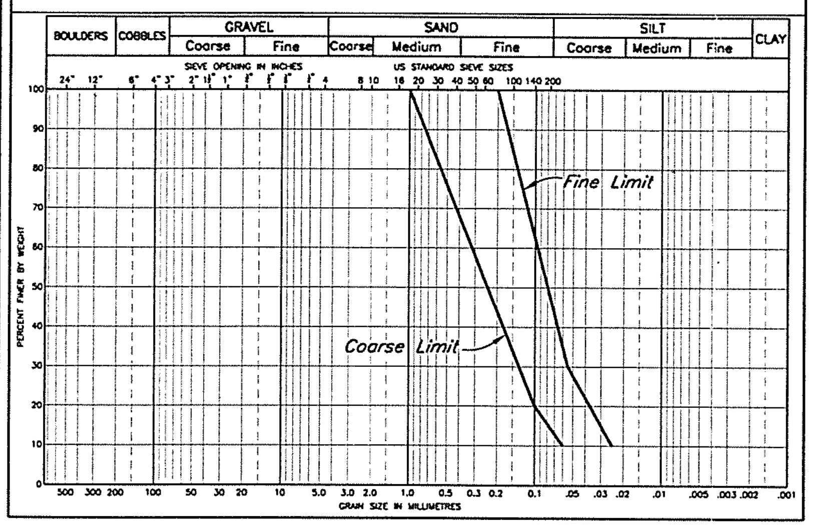
UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT: ZONE F



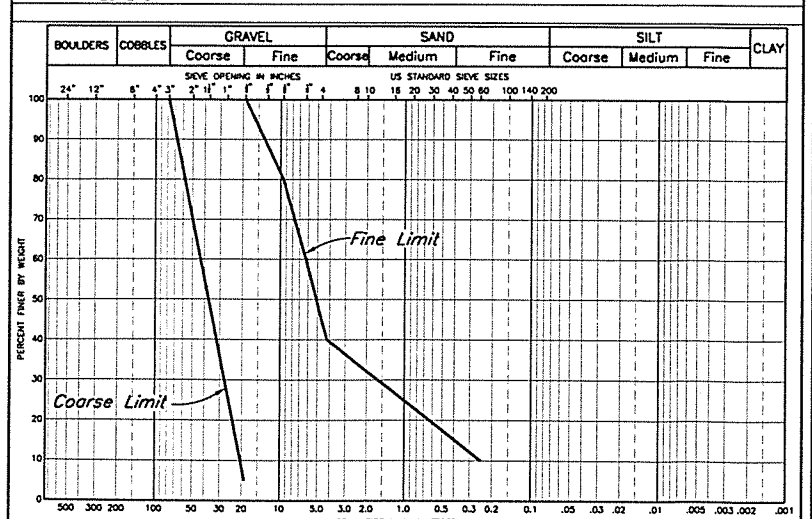
UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT: ZONE CS



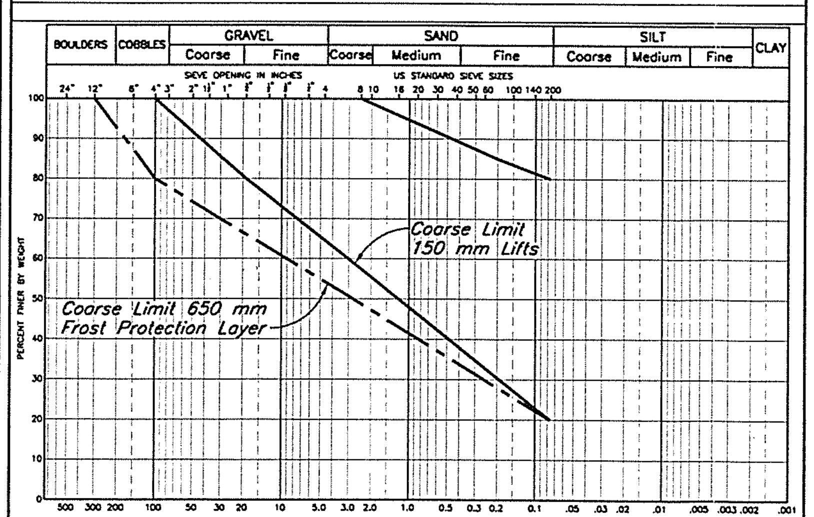
UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT: ZONE G



UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT: BASIN LINER



ZONE	LOCATION	MATERIAL TYPE	PLACEMENT AND COMPACTION REQUIREMENTS
S	Core Zone	Glacial till	Placed, moisture conditioned and spread in maximum 300 mm thick layers (after compaction). Vibratory compaction to 95% of Standard Proctor maximum dry density or as approved by the Engineer.
B	Fill Zone	Glacial till, glaciolacustrine or granular material	Placed, moisture conditioned and spread in maximum 1000 mm thick layers (after compaction). Vibratory compaction to 92% of Standard Proctor maximum dry density or as approved by the Engineer.
T	Transition Zone/ Confining Berm	Mine Rock	Placed and spread in maximum 600 mm thick layers. Compaction as directed by the Engineer.
F	Chimney Drain	Filter sand	Placed and spread in maximum 600 mm thick lifts. Compaction as directed by the Engineer.
F	Longitudinal/ Outlet Drain	Filter Sand	Placed and spread carefully around filter fabric/drain gravel. Compaction as directed by the Engineer.
G	Foundation/ Longitudinal/ Outlet Drain	Drain Gravel	Placed and spread carefully around seepage collection pipes. Compaction as directed by the Engineer.
CBL	Coarse Bearing Layer	Random Rockfill	End dumped and spread as required for trafficability and fill placement.
-	Basin Liner	Glacial till, glaciolacustrine material	Placed and spread in maximum 150 mm thick lifts. Compacted to 92% of the Standard Proctor Maximum Dry Density, or as approved by the Engineer.
-	Basin Liner Frost Protection	Glacial till, glaciolacustrine or granular material	Placed and spread in maximum 300 mm thick lift. Compaction as directed by the Engineer.
CS	Cyclone Sand	Cyclone Underflow	Hydraulically placed material. Nominal compaction by construction equipment
CS	Cyclone Sand	Cyclone Underflow	Mechnically placed material. Placed, moisture conditioned and spread in maximum 1000 mm thick layers (after compaction). Vibratory compaction to 95% of Standard Proctor Maximum Dry Density, or as approved by the Engineer.
	Earth Fill/ Rockfill	Zone B or Zone T	See Zone T or Zone B above for Specifications

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VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\dwgs\07\07 1=1 PLOT 1=1 06/12/99 WAL

DRG. NO.	DESCRIPTION
130	TSF - STAGE 3 SOUTH EMBANKMENT - PLAN AND SECTION
125	TSF - STAGE 3 PERIMETER EMBANKMENT - SECTIONS
115	TSF - STAGE 3 MAIN EMBANKMENT - SECTIONS AND DETAILS

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	WAL	LAG	KJB

REVISIONS

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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 3 TAILINGS EMBANKMENT
MATERIAL SPECIFICATIONS

DESIGNED: MDB | CHECKED: LAG | DRAWN: DSR | APPROVED: KJB

Knight Piésold CONSULTING

SCALE: AS SHOWN | REVISION: 0

DRAWING NO. 11162-12-104

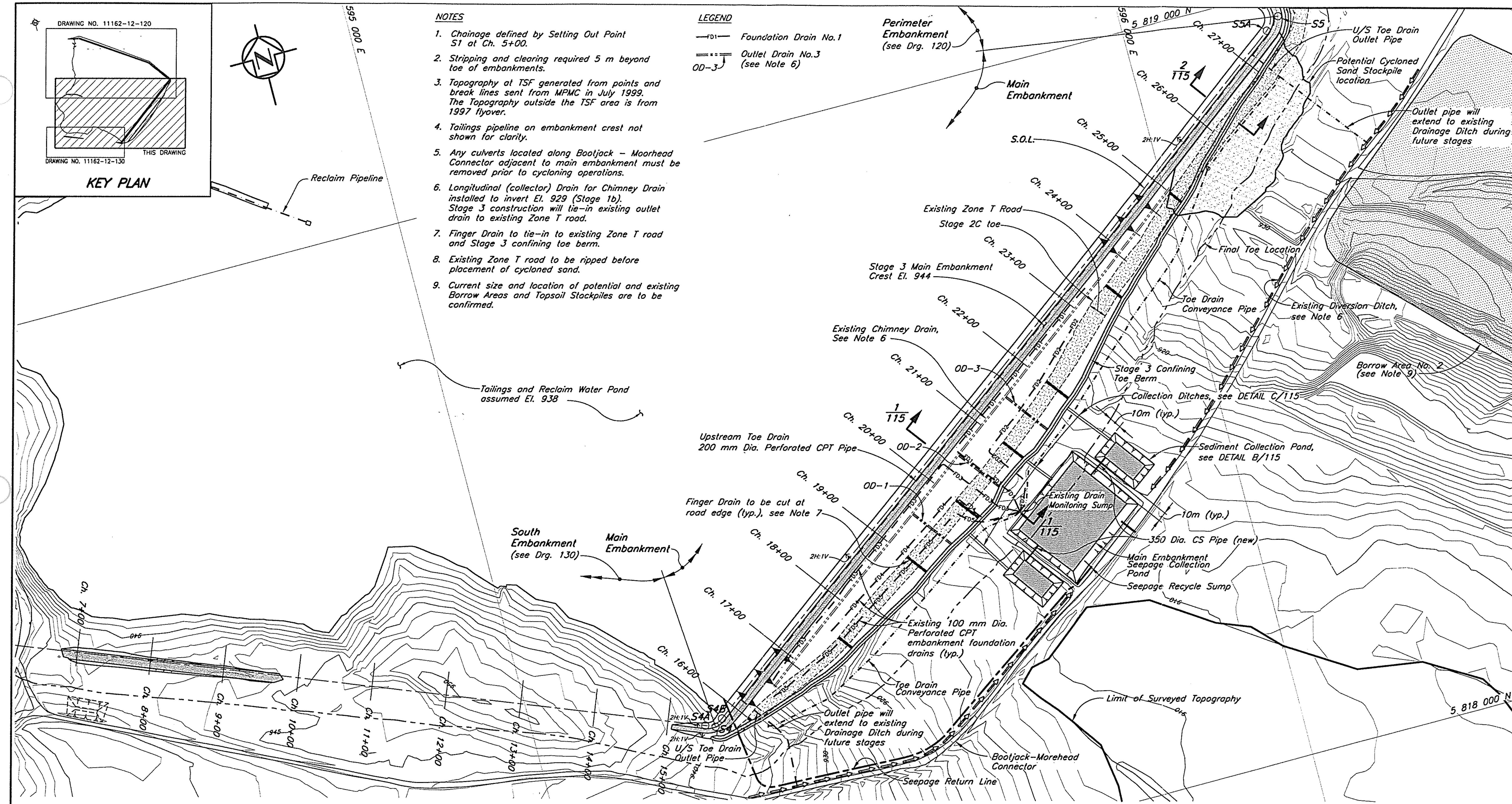
XREF FILE :

NOTES

1. Chainage defined by Setting Out Point S1 at Ch. 5+00.
2. Stripping and clearing required 5 m beyond toe of embankments.
3. Topography at TSF generated from points and break lines sent from MPMC in July 1999. The Topography outside the TSF area is from 1997 flyover.
4. Tailings pipeline on embankment crest not shown for clarity.
5. Any culverts located along Bootjack – Moorhead Connector adjacent to main embankment must be removed prior to cycloning operations.
6. Longitudinal (collector) Drain for Chimney Drain installed to invert El. 929 (Stage 1b). Stage 3 construction will tie-in existing outlet drain to existing Zone T road.
7. Finger Drain to tie-in to existing Zone T road and Stage 3 confining toe berm.
8. Existing Zone T road to be ripped before placement of cycloned sand.
9. Current size and location of potential and existing Borrow Areas and Topsoil Stockpiles are to be confirmed.

LEGEND

FD1 — Foundation Drain No.1
OD-3 — Outlet Drain No.3 (see Note 6)



EMBANKMENT SETTING OUT POINTS

Point	Northing	Easting	Chainage
S1	5 818 626.163	594 249.555	5+00.00
S4A	5 818 243.621	595 227.361	15+49.97
S4B	5 818 246.923	595 251.497	15+77.87
S4	5 818 238.539	595 240.350	15+63.92
S5A	5 818 951.971	596 188.906	27+50.83
S5B	5 818 986.958	596 193.873	28+00.78
S5	5 818 966.983	596 208.866	27+75.80
S6	5 819 304.035	595 955.881	31+97.23
S7	5 819 939.748	595 010.249	43+36.69
S8	5 820 053.034	594 396.471	49+60.83

NOT FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
130	TSF – STAGE 3 SOUTH EMBANKMENT – PLAN AND SECTION
120	TSF – STAGE 3 PERIMETER EMBANKMENT – PLAN
115	TSF – STAGE 3 MAIN EMBANKMENT – SECTIONS AND DETAILS

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	WAL	LAC	KJB

REVISIONS

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MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 3 MAIN EMBANKMENT
PLAN

DESIGNED	CHECKED	SCALE	REVISION
JMTW	LAC	AS SHOWN	0
DRAWN	APPROVED	DRAWING NO.	
DSR	KJB	11162-12-110	

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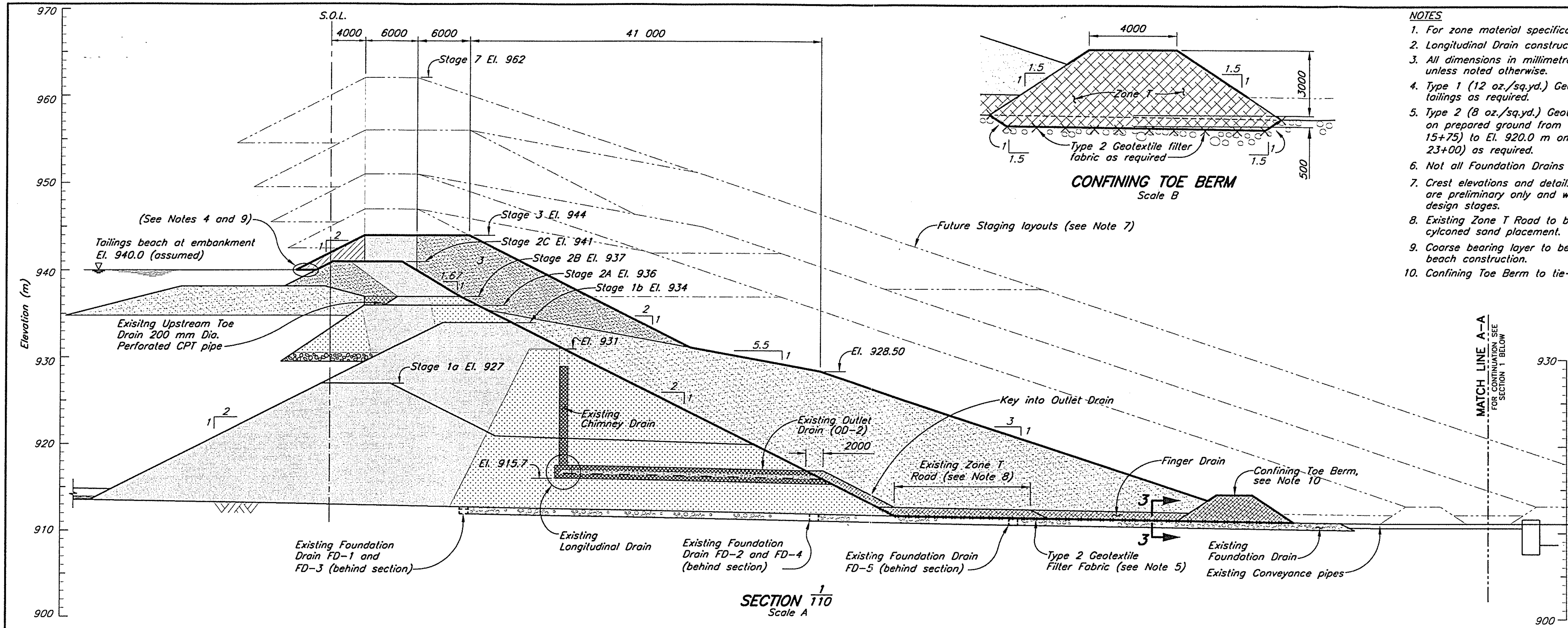
XREF FILE : TOPO99,STOCK99

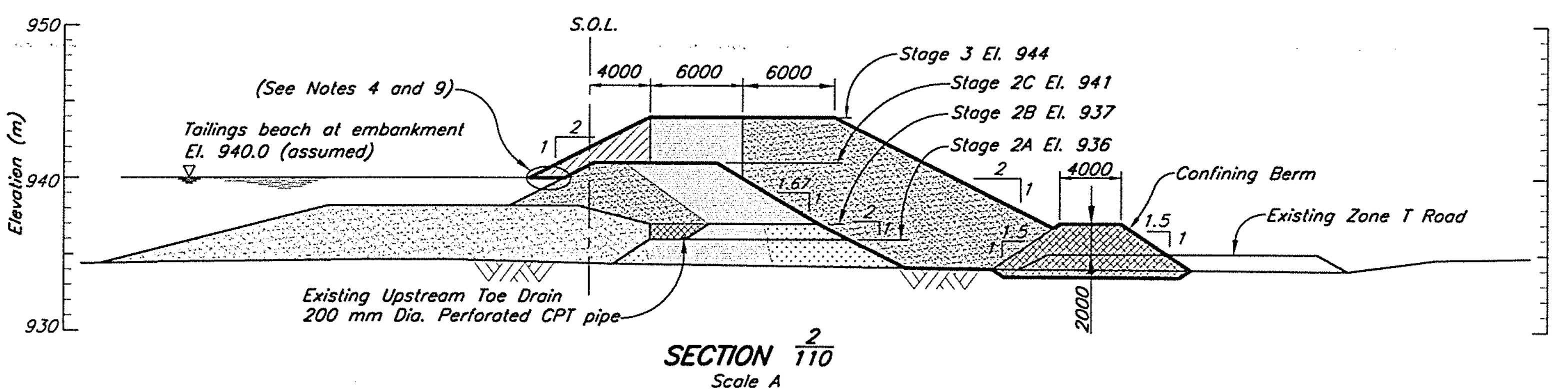


SECTION 1/110
Scale A

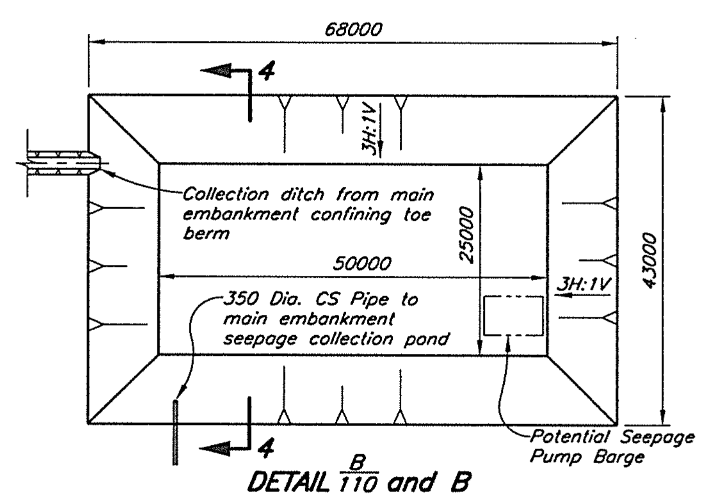
CONFINING TOE BERM
Scale B

NOTES

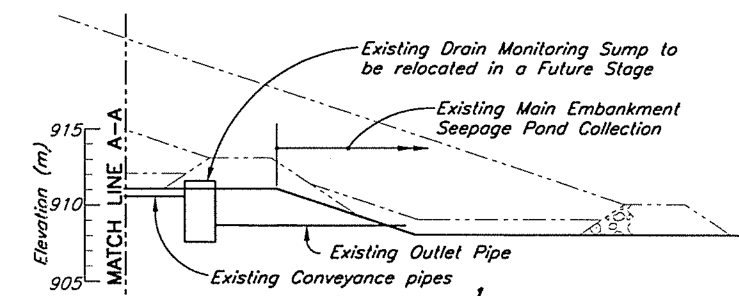
1. For zone material specifications and legend see Drg. 104
2. Longitudinal Drain constructed to invert El. 929 (Stage 1b)
3. All dimensions in millimetres and elevations in metres, unless noted otherwise.
4. Type 1 (12 oz./sq.yd.) Geotextile Filter Fabric placed on tailings as required.
5. Type 2 (8 oz./sq.yd.) Geotextile Filter Fabric to be placed on prepared ground from the right abutment (approx. Ch. 15+75) to El. 920.0 m on the left abutment (approx. Ch. 23+00) as required.
6. Not all Foundation Drains are intersected on these sections.
7. Crest elevations and details of ongoing embankment raises are preliminary only and will be modified during future design stages.
8. Existing Zone T Road to be ripped with dozer, before cylconed sand placement.
9. Coarse bearing layer to be used as required for initial beach construction.
10. Confining Toe Berm to tie-in to existing foundation drain.



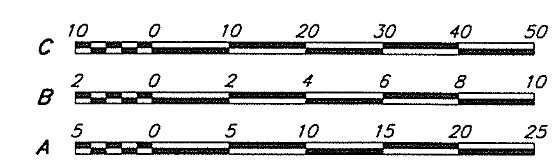
SECTION 2/110
Scale A

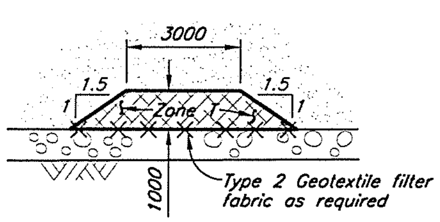


DETAIL B/110 and B
MAIN EMBANKMENT SEDIMENT COLLECTION POND (TYP.)
Scale C

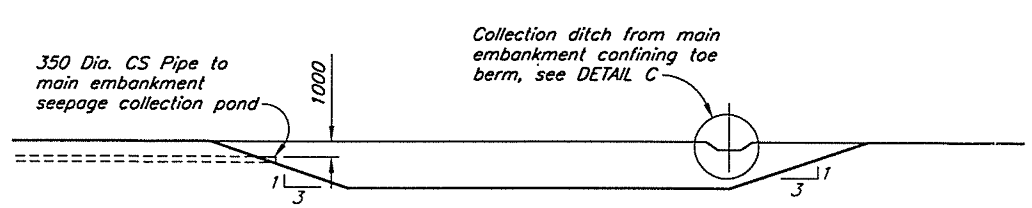


SECTION 1/110
(CONTINUATION OF SECTION 1/110 ABOVE)
Scale A

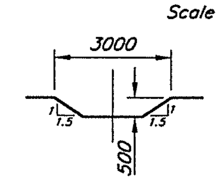




SECTION 3
TYPICAL FINGER DRAIN
Scale B



SECTION 4
Scale A



DETAIL C/110 and C
MAIN EMBANKMENT COLLECTION DITCH (TYP.)
Scale B

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MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 3 MAIN EMBANKMENT
SECTIONS AND DETAILS

DESIGNED	CHECKED	DRAWN	APPROVED
MDB	WAC	DSR	KJB

Knight Piésold CONSULTING

SCALE	REVISION	DRAWING NO.
AS SHOWN	0	11162-12-115

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
110	TSF - STAGE 3 MAIN EMBANKMENT - PLAN
104	TSF - STAGE 3 - MATERIALS SPECIFICATIONS

REVISIONS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	WAL	WAC	KJB

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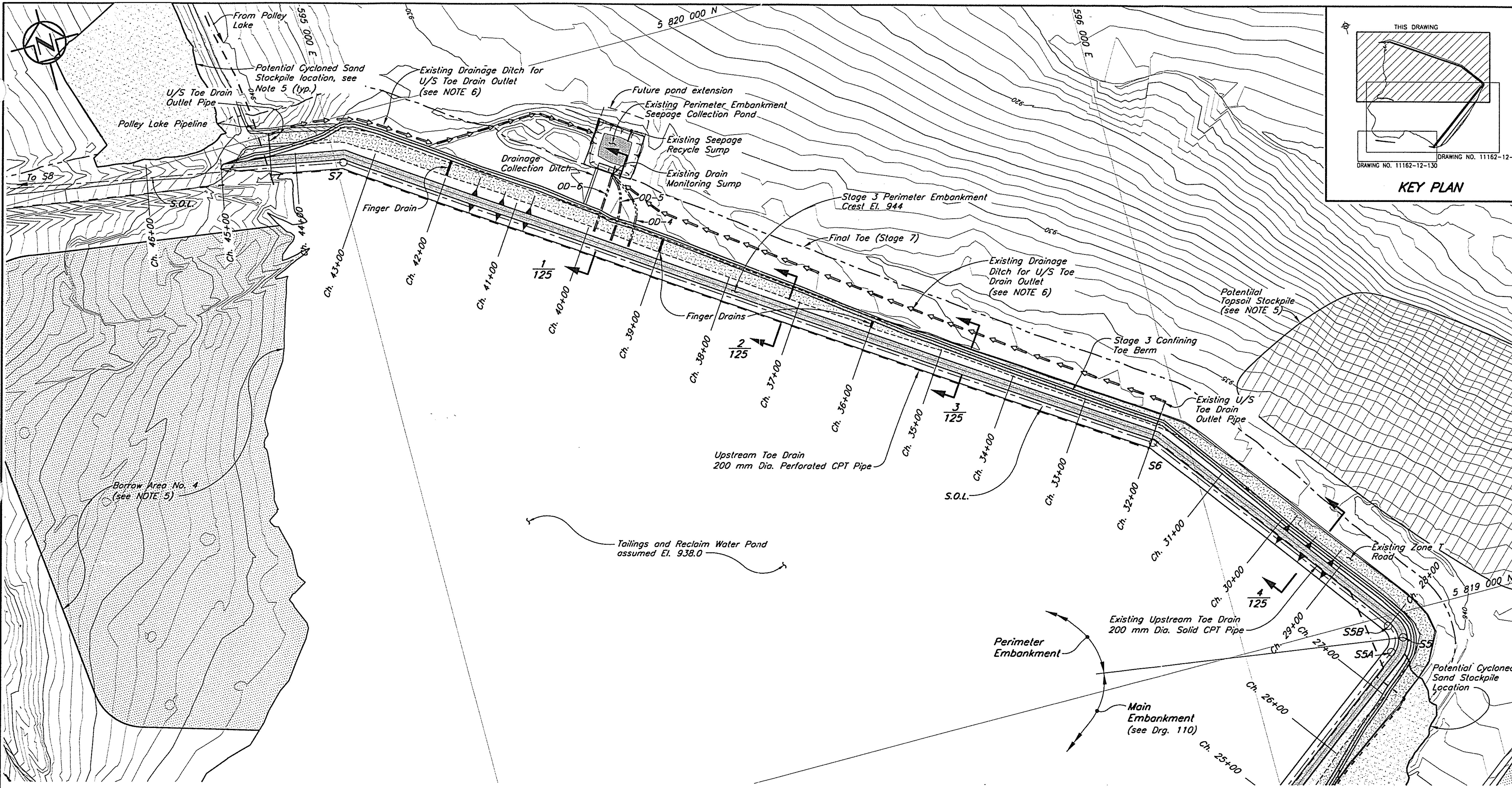

NOT FOR CONSTRUCTION

Scale 50 0 50 100 150 200 250 m

EMBANKMENT SETTING OUT POINTS			
Point	Northing	Easting	Chainage
S1	5 818 626.163	594 249.555	5+00.00
S4A	5 818 243.621	595 227.361	15+49.97
S4B	5 818 246.923	595 251.497	15+77.87
S4	5 818 238.539	595 240.350	15+63.92
S5A	5 818 951.971	596 188.906	27+50.83
S5B	5 818 986.958	596 193.873	28+00.78
S5	5 818 966.983	596 208.866	27+75.80
S6	5 819 304.035	595 955.881	31+97.23
S7	5 819 939.748	595 010.249	43+36.69
S8	5 820 053.034	594 396.471	49+60.83

NOTES

1. Chainage defined by Setting Out Point S1 at Ch. 5+00.
2. Stripping and clearing required 5 m beyond toe of embankments.
3. Topography at TSF generated from points and break lines sent from MPMC in July 1999. The Topography outside the TSF area is from 1997 flyover.
4. Tailings pipeline on embankment crest not shown for clarity.
5. Current size and location of potential and existing Borrow Areas and Topsoil Stockpiles are to be confirmed.
6. U/S Toe Drain Outlet Drainage Ditch to be extended to outlet location.
7. New roadworks for embankment toe access to ore to be determined by MPMC.

LEGEND

OD-4 — Outlet Drain No.4

DRG. NO.	DESCRIPTION
125	TSF - STAGE 3 PERIMETER EMBANKMENT - SECTIONS
115	TSF - STAGE 3 MAIN EMBANKMENT - SECTIONS AND DETAILS
110	TSF - STAGE 3 MAIN EMBANKMENT - PLAN

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D

REVISIONS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	NSD		KJB

REVISIONS

PROFESSIONAL PROVINCE OF BRITISH COLUMBIA K. J. BROUWER ENGINEER

MOUNT POLLEY MINING CORPORATIOON

MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 3 PERIMETER EMBANKMENT
PLAN

DESIGNED	CHECKED	DRAWN	APPROVED
MDB		DSR	KJB

Knight Piésold CONSULTING

SCALE	REVISION	DRAWING NO.
AS SHOWN	0	11162-12-120

XREF FILE : TOPO99.STOCK99

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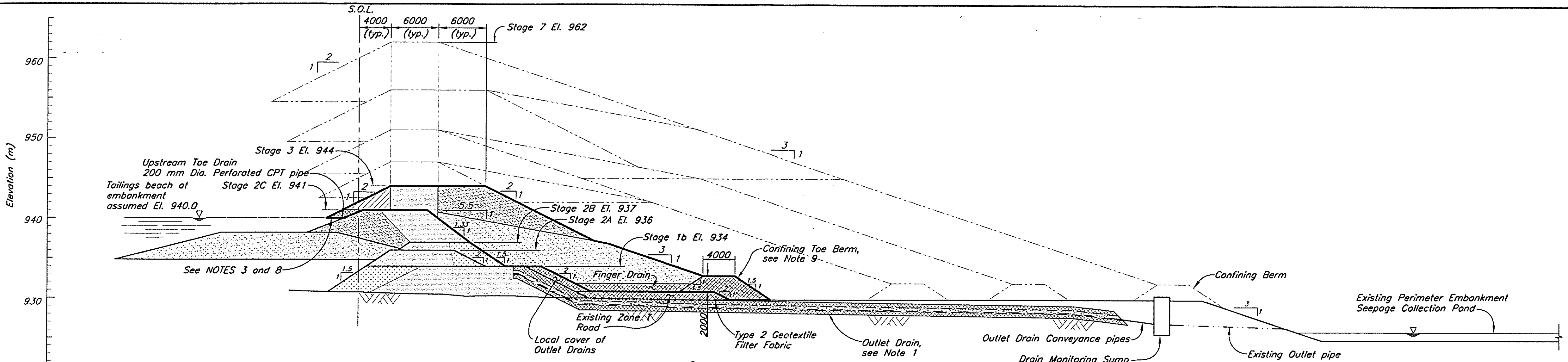
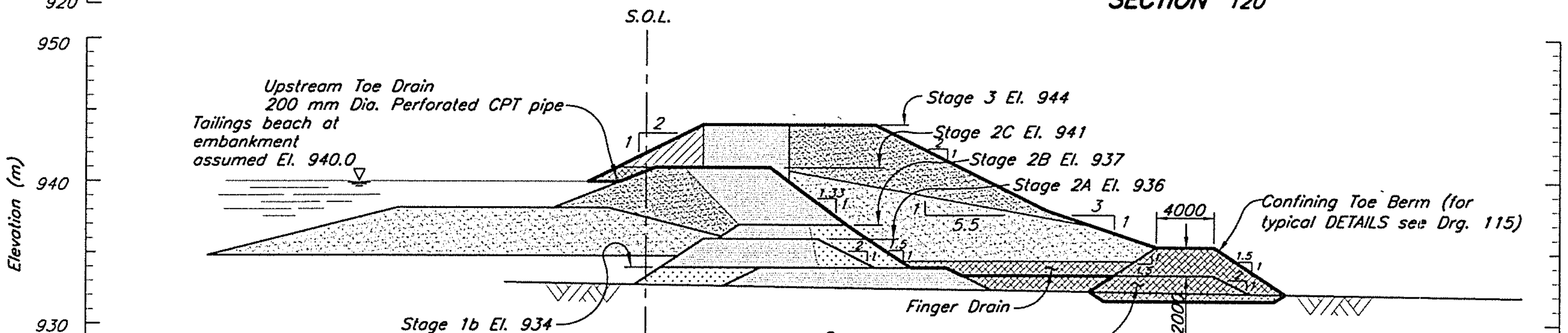
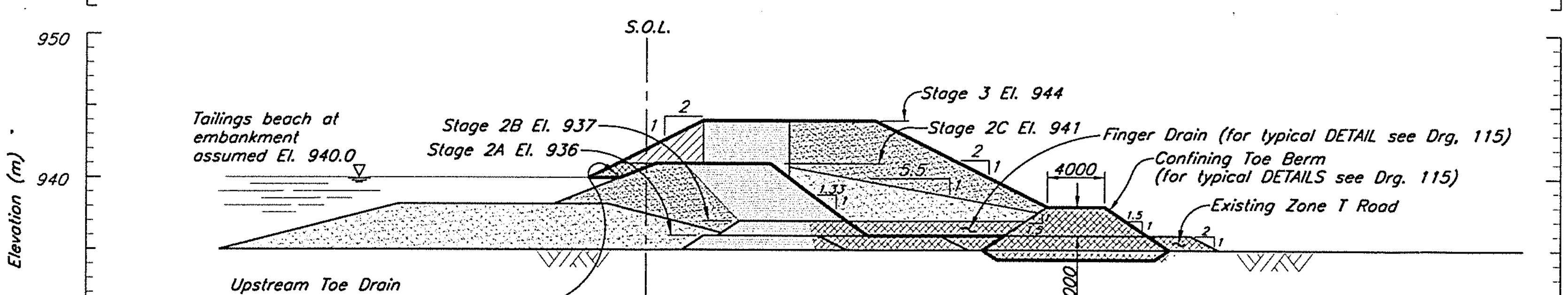


SECTION $\frac{1}{120}$



SECTION $\frac{2}{120}$



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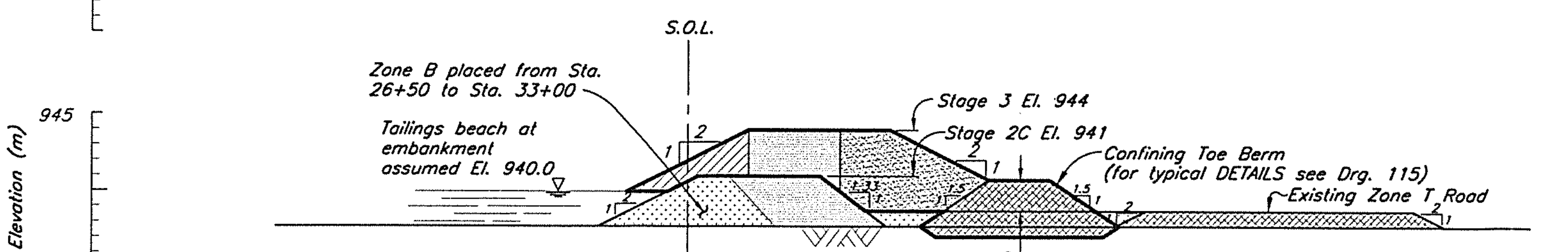

SECTION $\frac{4}{120}$

NOTES

1. Outlet Drains installed to Stage 1b crest during Stage 2A. Penetration at Drain Monitoring Sump already made. Pipe stubs are capped and backfilled.
2. All dimensions in millimetres with elevations in metres, unless noted otherwise.
3. Type 1 (12 oz./sq.yd.) Geotextile Filter fabric placed on tailings as required.
4. Type 2 (8 oz./sq.yd.) Geotextile Filter Fabric to be placed on prepared ground as required.
5. Existing Perimeter Embankment Seepage Collection Pond to be relocated beyond final embankment toe as required.
6. Crest elevations and details of ongoing embankment raises are preliminary only and will be modified during future design stages.
7. For zone material specifications and legend see Drg. 104.
8. Coarse bearing layer to be used as required for initial beach construction.
9. Confining Toe Berm to tie-in to existing foundation drain.

NOT FOR CONSTRUCTION

Scale 5 0 5 10 15 20 25 Metres

CAD FILE: M:\11162\12\ACAD\dwgs\05\05.dwg 1=250 PLOT 1=0.25 07/12/99 by:MAL

VANCOUVER B.C.

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MOUNT POLLEY MINE CORPORATION

MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 3 PERIMETER EMBANKMENT
SECTIONS

DESIGNED	CHECKED	DRAWN	APPROVED	SCALE	REVISION	DRAWING NO.
MDB		DSR		AS SHOWN	0	11162-12-125

Knight Piésold CONSULTING

DRG. NO.	DESCRIPTION
120	TSF – STAGE 3 PERIMETER EMBANKMENT – PLAN
115	TSF – STAGE 3 MAIN EMBANKMENT – SECTIONS AND DETAILS
104	TSF – STAGE 3 – MATERIAL SPECIFICATIONS

REFERENCE DRAWINGS

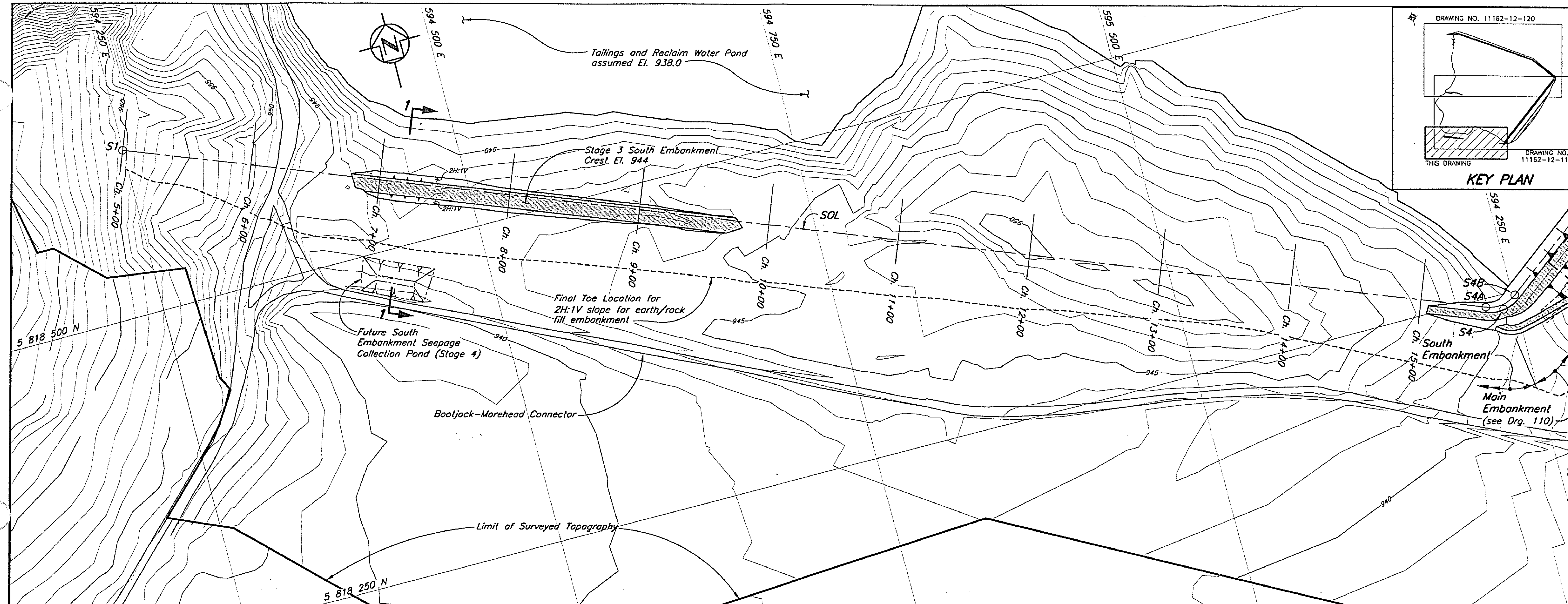
REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D

REVISIONS

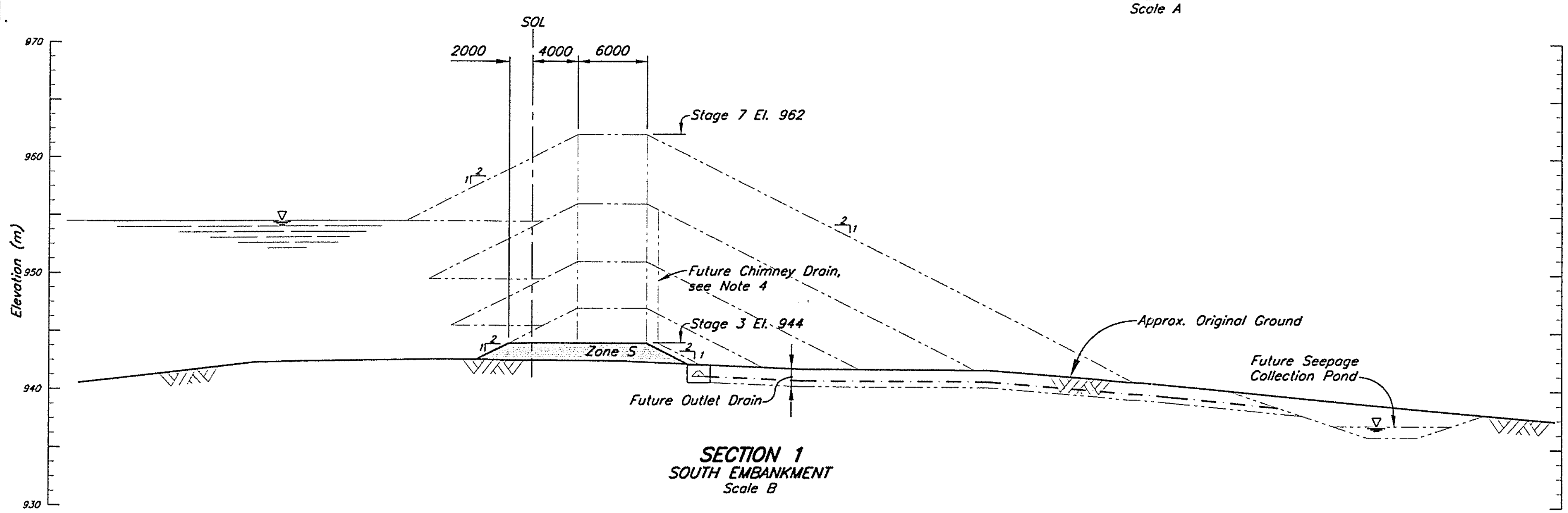
REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	NSD		

REVISIONS

XREF FILE :



PLAN
Scale A



SECTION 1
SOUTH EMBANKMENT
Scale B

NOTES

1. All dimensions in millimeters and elevations in metres, unless noted otherwise.
2. Topography at TSF generated from points and break lines sent from MPMC in July 1999. The Topography outside the TSF area is from 1997 flyover.
3. Chimney Drain, Outlet Drain and Seepage Collection Pond to be constructed in Stage 4.
4. Crest elevations and details of on going embankment raises are preliminary only and will be modified during future design stages.
5. For Setting Out Points coordinates and chainage, see Drg. 110
6. For Zone Materials Specifications and legend, see Drg. 104.

B 5 0 5 10 15 20 25 m

A 30 0 30 60 90 120 150 m

NOT FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
110	TSF - STAGE 3 MAIN EMBANKMENT - PLAN
104	TSF - STAGE 3 - MATERIALS SPECIFICATION

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	NSD	LAG	KB

REVISIONS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA K. J. BROUWER

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY PROJECT

TAILINGS STORAGE FACILITY
STAGE 3 SOUTH EMBANKMENT
PLAN AND SECTION

DESIGNED MDB | CHECKED LAG | DRAWN NSD | APPROVED KB

Knight Piésold CONSULTING

SCALE AS SHOWN | REVISION 0 | DRAWING NO. 11162-12-130

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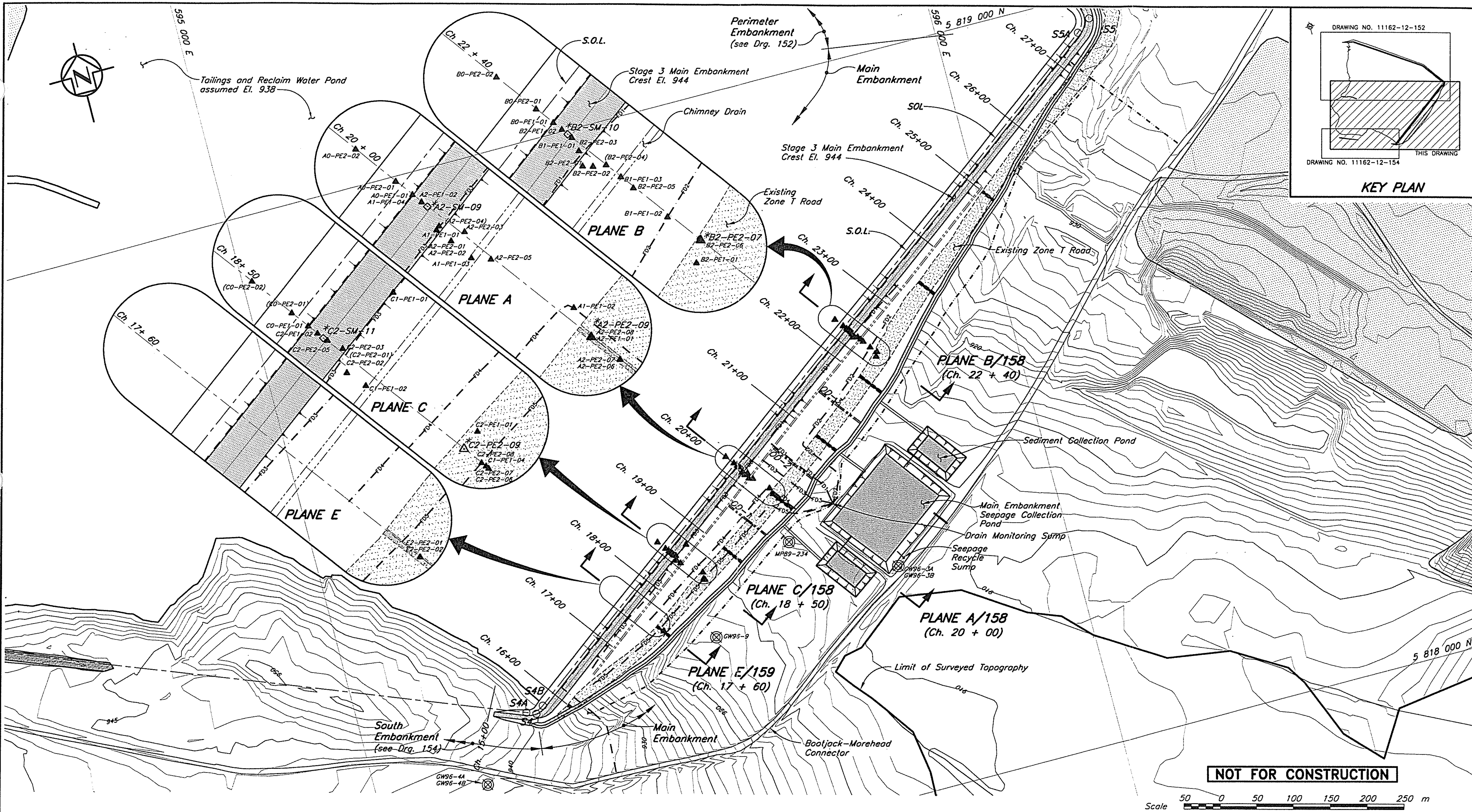

NOTE

1. See Drg. No. 11162-12-156 for Summary of Instrumentation Installations, Typical Details, General Notes and Legend.

DRG. NO.	DESCRIPTION
159	TSF - STAGE 3 TAILINGS EMBANKMENT - INSTRUMENTATION - SECTIONS - SHEET 2 OF 2
158	TSF - STAGE 3 TAILINGS EMBANKMENT - INSTRUMENTATION - SECTIONS - SHEET 1 OF 2
110	TSF - STAGE 3 MAIN EMBANKMENT - PLAN

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	WAL	LAC	KJB

REVISIONS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA K. J. BROUWER

DESIGNED MDB CHECKED LAC DRAWN NSD APPROVED KJB

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 3 MAIN EMBANKMENT
INSTRUMENTATION
PLAN

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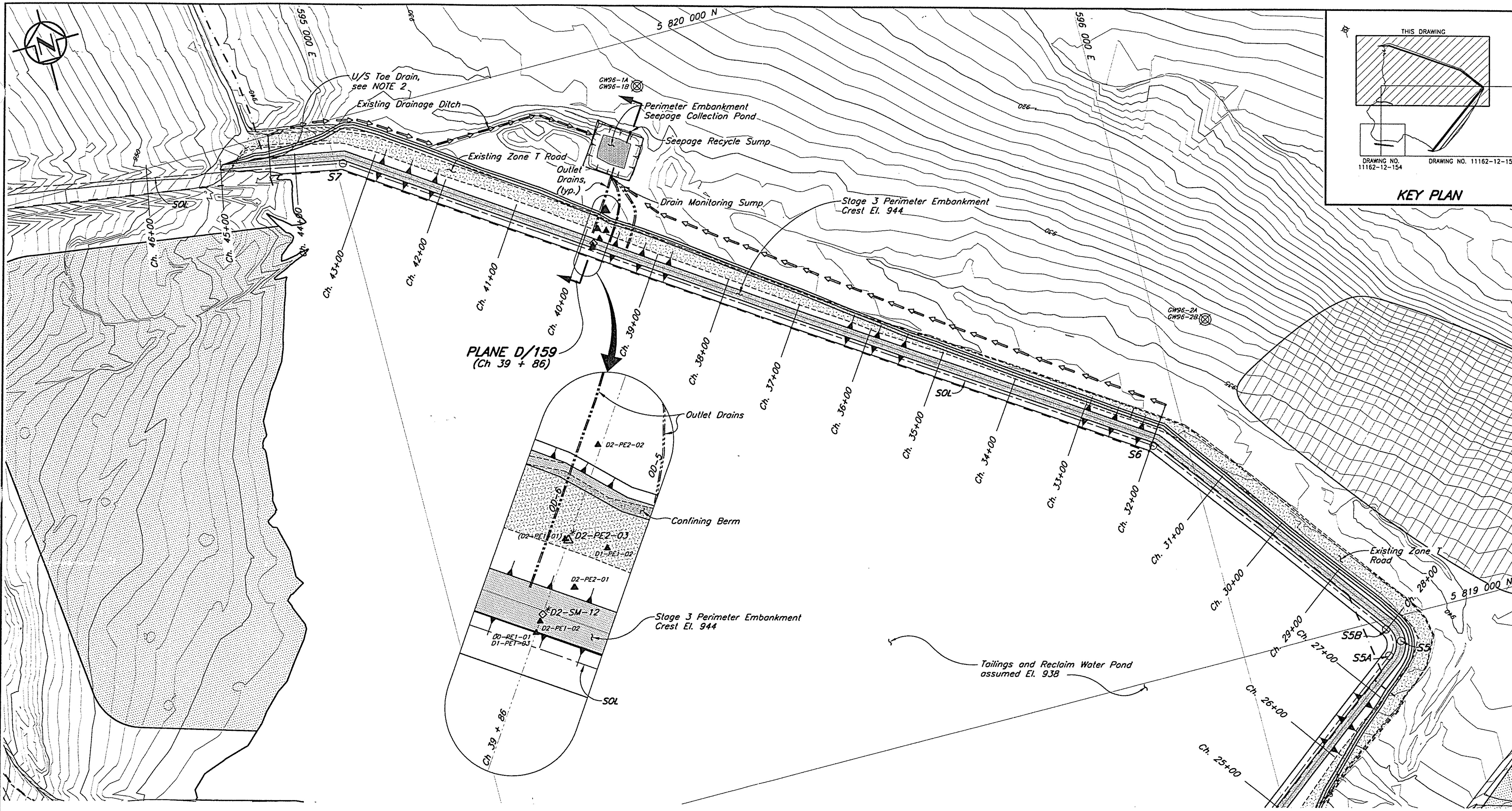
SCALE AS SHOWN REVISION 0
DRAWING NO. 11162-12-150



NOTES

1. See Drg. No. 11162-12-156 for Summary of Instrumentation Installations, Typical Details, General Notes and Legend.
2. Construction delay to Stage 3.

Scale 50 0 50 100 150 200 250 m

NOT FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
159	TSF – STAGE 3 TAILINGS EMBANKMENT – INSTRUMENTATION SECTIONS – SHEET 2 OF 2
120	TSF – STAGE 3 PERIMETER EMBANKMENT – PLAN
110	TSF – STAGE 3 MAIN EMBANKMENT – PLAN

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	NSD	LAC	DB

REVISIONS

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — K. J. BROUWER

MOUNT POLLEY MINING CORPORATIOON

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TAILINGS STORAGE FACILITY
STAGE 3 PERIMETER EMBANKMENT
INSTRUMENTATION
PLAN

DESIGNED	CHECKED	DRAWN	APPROVED	SCALE	DRAWING NO.	REVISION
MDB	LAC	NSD	DB	AS SHOWN	11162-12-152	0

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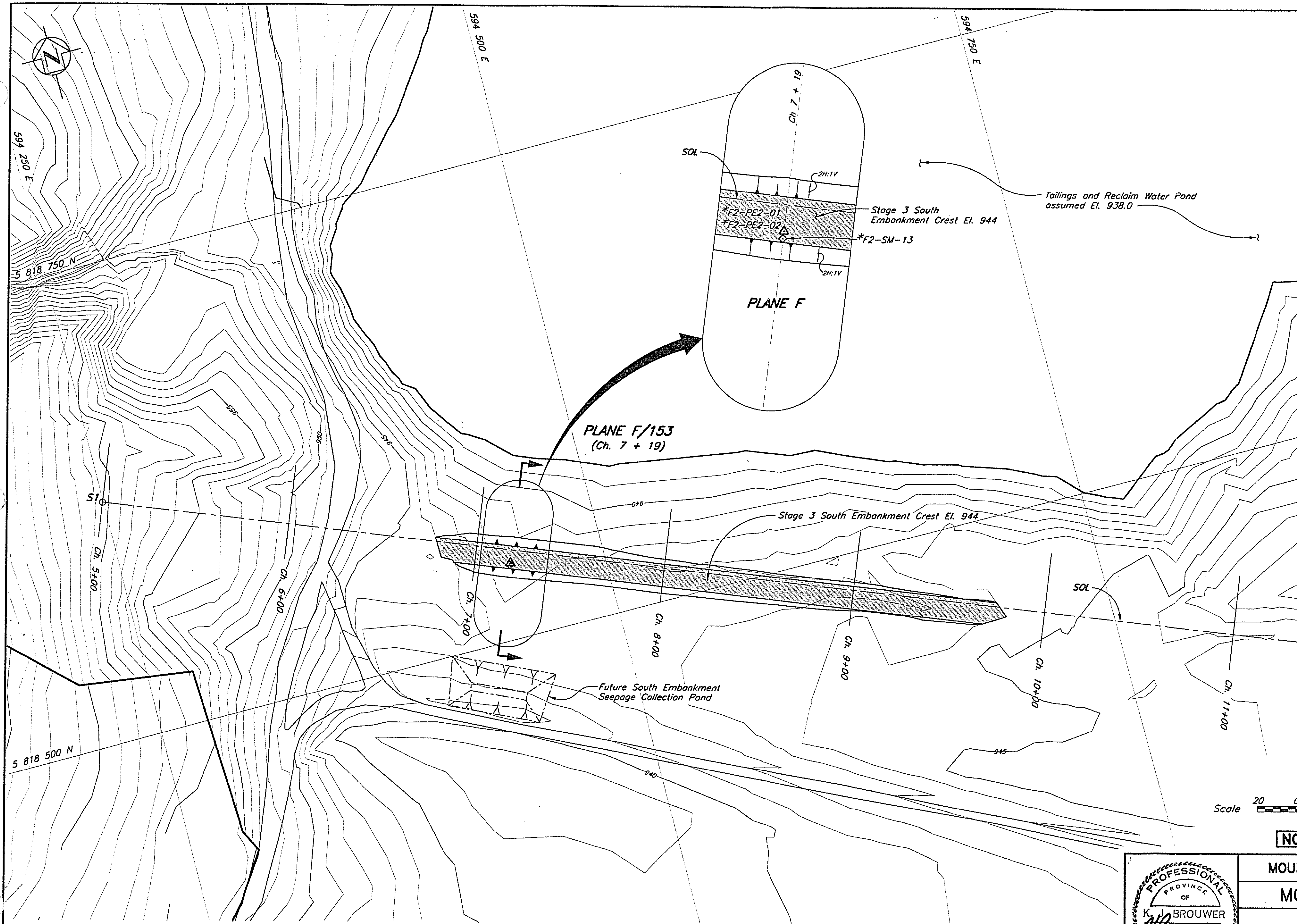

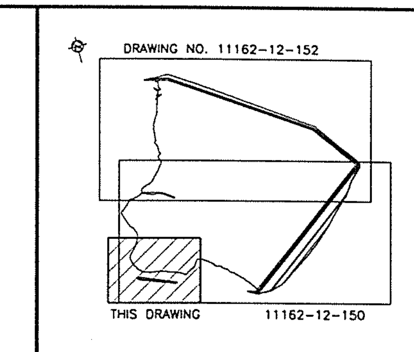

KEY PLAN

NOTES

1. See Drg. No. 11162-12-156 for Summary of Instrumentation Installations, Typical Details, General Notes and Legend.

NOT FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
159	TSF - STAGE 3 TAILINGS EMBANKMENT- INSTRUMENTATION SECTIONS - SHEET 2 OF 2
156	TSF - STAGE 3 TAILINGS EMBANKMENT- INSTRUMENTATION - SUMMARY OF INSTALLATION AND TYPICAL DETAILS
130	TSF - STAGE 3 SOUTH EMBANKMENT- PLAN AND SECTION
110	TSF - STAGE 3 MAIN EMBANKMENT- PLAN

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D

REVISIONS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	NSD	LAG	KJB

REVISIONS

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — K. J. BROUWER

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY PROJECT

TAILINGS STORAGE FACILITY
STAGE 3 SOUTH EMBANKMENT
INSTRUMENTATION
PLAN

DESIGNED	CHECKED	DRAWN	APPROVED
MDB	LAG	NSD	KJB

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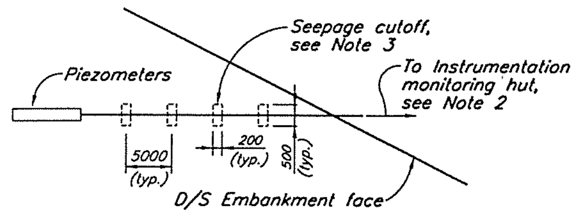
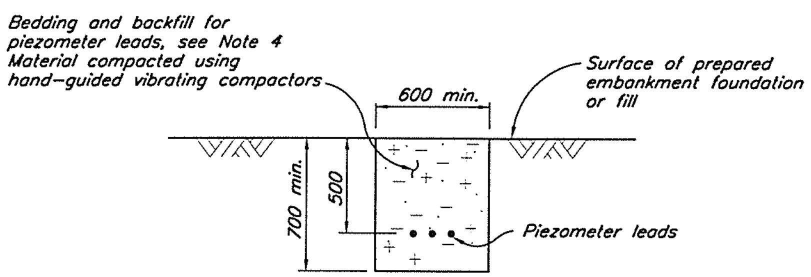
SCALE	REVISION	DRAWING NO.
AS SHOWN	0	11162-12-154

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\dwgs\D11\D11.dwg 1=1000 PLOT 1=1(PS) 15/11/99 by:DSR

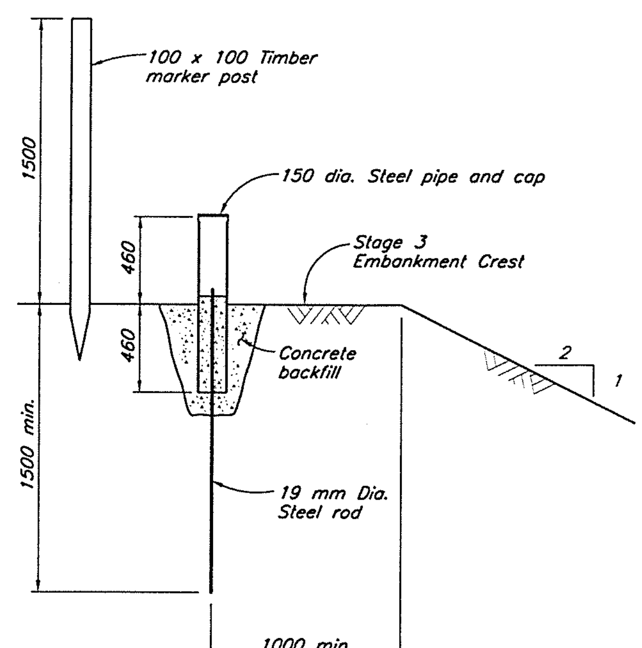
XREF FILE : Topo99, S3_SEM



DETAIL $\frac{A}{158}$
TYPICAL INSTALLATION DETAIL OF SEEPAGE CUTOFF FOR PIEZOMETER LEADS IN GLACIAL TILL
NTS



TYPICAL SECTION THROUGH PIEZOMETER LEAD TRENCH IN PREPARED EMBANKMENT FOUNDATION OR FILL



TYPICAL DETAIL OF SURFACE MOVEMENT MONUMENT

SUMMARY OF INSTRUMENTATION INSTALLATIONS

PIEZOMETER ID	NORTHING	EASTING	ELEV.	DATE INSTALLED
*A0-PE1-01			938.5	
A0-PE2-01	–	–	928	09/03/98
A0-PE2-02	–	–	928	09/03/98
A1-PE1-01	5 818 486.650	595 595.060	912.99	27/08/96
A1-PE1-02	5 818 456.420	595 626.250	912.14	27/08/96
A1-PE1-03	5 818 476.822	595 602.380	917.17	22/10/96
A1-PE1-04	–	–	936.5	
A2-PE1-01	5 818 446.550	595 628.010	912	26/08/98
A2-PE1-02	–	–	938.5	
A2-PE2-01	5 818 482.710	595 598.140	903.7	25/07/96
A2-PE2-02	5 818 482.710	595 598.140	909.8	25/07/96
A2-PE2-03	5 818 484.196	595 598.140	919.43	12/02/97
(A2-PE2-04)	5 818 487.510	595 595.995	926.07	22/02/97
A2-PE2-05	5 818 475.061	595 607.560	921.87	22/02/97
A2-PE2-06	5 818 453.926	595 648.458	903	21/06/98
A2-PE2-07	5 818 453.926	595 648.458	909	21/06/98
A2-PE2-08	5 818 447.045	595 627.758	910	23/06/98
*A2-PE2-09			915	
*A2-SM-09				
B0-PE1-01	–	–	938.5	
B0-PE2-01	–	–	928	06/03/98
B0-PE2-02	–	–	928	06/03/98
B1-PE1-01	5 818 632.550	595 787.910	917.27	10/09/96
B1-PE1-02	5 818 609.040	595 806.770	915.95	10/09/96
B1-PE1-03	5 818 622.780	595 797.260	918.69	22/10/96
B2-PE1-01	5 818 594.940	595 811.260	935	26/08/98
B2-PE1-02	–	–	938.5	
B2-PE2-01	5 818 628.270	595 787.880	902.00	25/07/96
B2-PE2-02	5 818 627.470	595 790.660	909.50	25/07/96
B2-PE2-03	5 818 636.530	595 786.970	921.00	22/10/96
(B2-PE2-04)	5 818 626.940	595 794.190	921.00	22/10/96
B2-PE2-05	5 818 619.014	595 799.804	921.70	14/03/97
B2-PE2-06	5 818 595.767	595 810.605	914.59	23/06/98
*B2-PE2-07			919	
*B2-SM-10				
C0-PE1-01	–	–	938.5	
(C0-PE2-01)	–	–	928	09/03/98
(C0-PE2-02)	–	–	928	09/03/98
C1-PE1-01	5 818 410.500	595 496.070	914.70	28/09/96
C1-PE1-02	5 818 410.500	595 496.070	916.60	22/10/96
C1-PE1-04	–	–	915	03/04/98
C2-PE1-01	5 818 367.670	595 508.900	917	26/08/98
C2-PE1-02			938.5	
(C2-PE2-01)	5 818 392.410	595 478.240	907.50	25/07/96
C2-PE2-02	5 818 392.410	595 478.240	910.50	25/07/96
C2-PE2-03	5 818 399.106	595 478.824	920.97	12/02/97
C2-PE2-05	5 818 402.343	595 475.326	924.84	12/02/97
C2-PE2-06	5 818 359.734	595 513.663	913	18/06/98
C2-PE2-07	5 818 359.734	595 513.663	915	18/06/98
C2-PE2-08	5 818 367.087	595 509.351	935	19/06/98
*C2-PE2-09			920	
*C2-SM-11				
D0-PE1-01			938.5	
D1-PE1-02	5 819 775.449	595 310.522	929	30/01/98
D1-PE1-03			936.5	
(D2-PE1-01)	5 819 775.449	595 310.522	930	26/08/98
D2-PE1-02			938.5	
D2-PE2-01	5 819 756.360	595 316.210	931.00	15/12/96
D2-PE2-02	–	–	922	22/06/98
*D2-PE2-03			933	
*D2-SM-12				
E2-PE2-01	5 818 307.454	595 435.983	908	17/06/98
E2-PE2-02	5 818 307.454	595 435.983	913	17/06/98
*F1-PE2-01			937	
*F2-PE2-02			942.5	
*F2-SM-13				

( ) Piezometer no longer functioning.
* To be installed during Stage 3 construction.

NOTES

1. Dimensions are in millimeters unless otherwise noted.
2. Piezometer leads are to be extended as directed by the Engineer.
3. Seepage cutoffs placed at 5 m intervals with 10% bentonite added to fine grained till backfill.
4. Fine grained till backfill must have all particles exceeding 25 mm removed.

LEGEND

A0-PE1-01
- Plane I.D. (A, B etc.)
- Area (0-Tailings, 1-Drain, 2-Embankment)
- Number I.D.
- Pressure Rating (1-Low, 2-High)
- Type of Instrumentation (PE-Piezometer electric, SM-Survey Monument)

A1-PE1-01 ▲ Previously installed Piezometer
*A2-PE2-06 △ New Stage 3 Piezometer
*A2-SM-02 ◇ New Embankment Survey Monument
A2-SM-01 ◆ Current Embankment Survey Monument

NOT FOR CONSTRUCTION

Scale 1000 500 0 1000 2000 mm

DRG. NO.	DESCRIPTION
158	TSF - STAGE 3 TAILINGS EMBANKMENT - INSTRUMENTATION SECTIONS - SHEET 1 OF 2

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	NSD	LAG	KJB

REVISIONS

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — K. J. BROUWER

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 3 TAILINGS EMBANKMENT
INSTRUMENTATION
SUMMARY OF INSTALLATION & TYPICAL DETAILS

DESIGNED MDB | CHECKED LAG | DRAWN DSR | APPROVED KJB

Knight Piésold CONSULTING

SCALE AS SHOWN | REVISION 0 | DRAWING NO. 11162-12-156

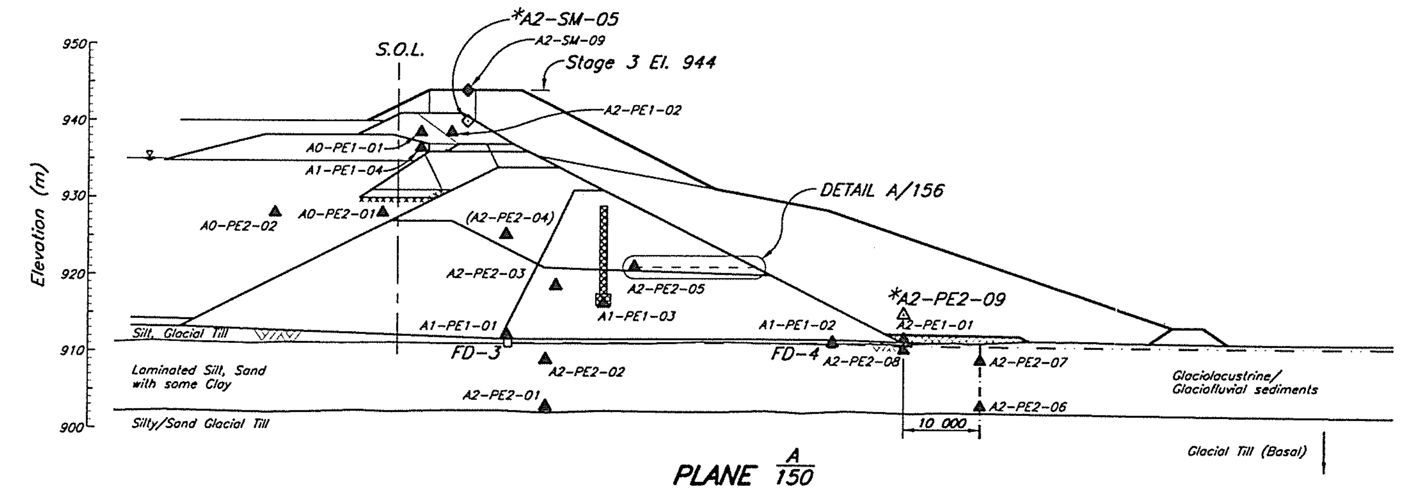
NOTES

1. Piezometers are vibrating wire type, SINCA Model 52611030 and RST Model 45005-0100 with a pressure rating of 100 psi or equivalent, connected to a readout panel via standard non-vented direct burial cable.

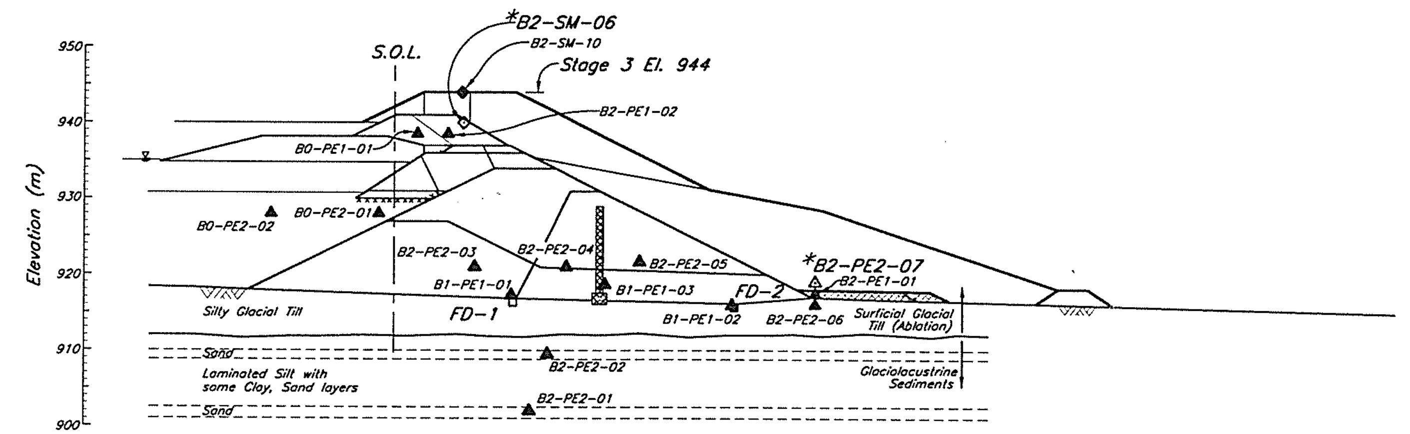
2. Piezometer leads extended as directed by the Engineer.

3. Zone fill materials and drain pipes not shown in drawing for clarity. For Details see Drg. 115, 125 and 130

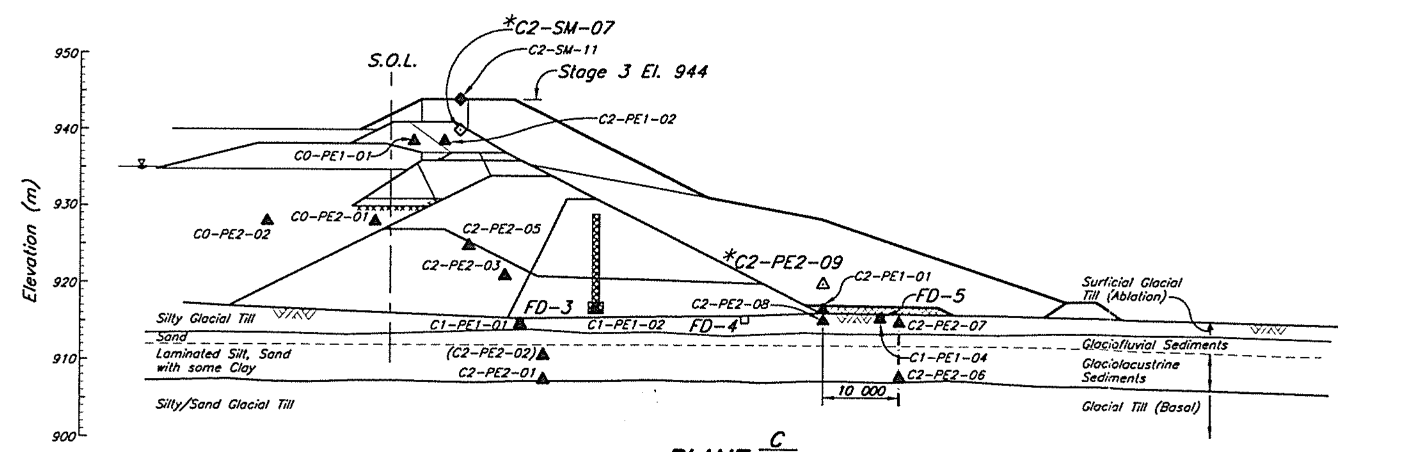
4. See Drg. No. 11162-12-156 for Installation typical details.



PLANE A/150
CH. 20+00



PLANE B/150
CH. 22+40



PLANE C/150
CH. 18+50

NOT FOR CONSTRUCTION

Scale 10 0 10 20 30 40 50 m

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\dwgs\012\012 1=500 Plot 1=0.5 07/12/99 WAL

DRG. NO.	DESCRIPTION
156	TSF - STAGE 3 TAILINGS EMBANKMENT - INSTRUMENTATION - SUMMARY OF INSTALLATION & TYP. DETAILS
150	TSF - STAGE 3 MAIN EMBANKMENT - INSTRUMENTATION - PLAN
115	TSF - STAGE 3 MAIN EMBANKMENT - SECTIONS AND DETAILS

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D

REVISIONS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	WAL	LAG	KJB

REVISIONS

PROFESSIONAL PROVINCE OF BRITISH COLUMBIA K. J. BROUWER ENGINEER

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY MINE

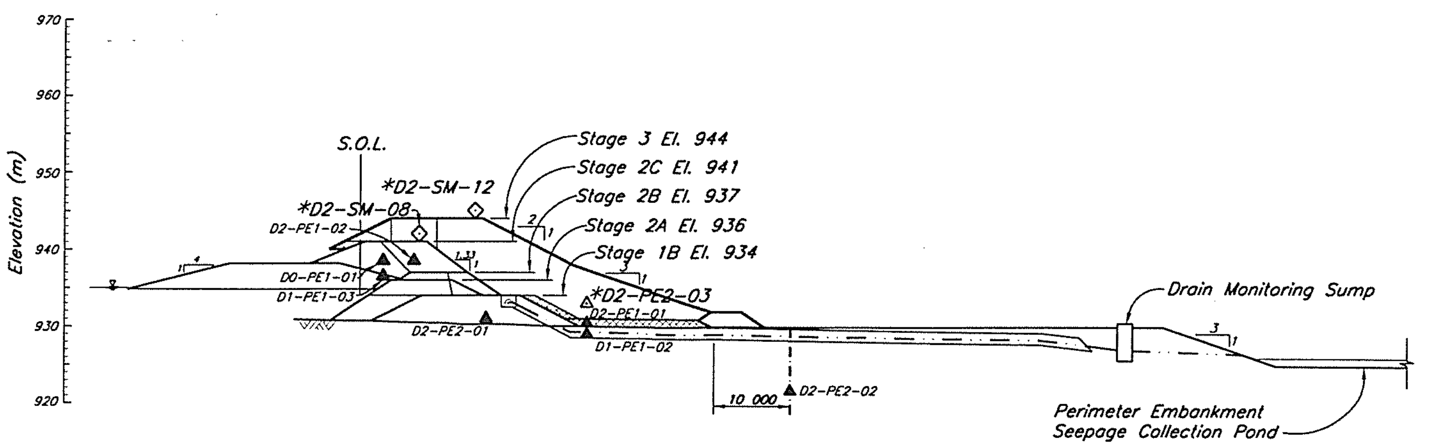
TAILINGS STORAGE FACILITY
STAGE 3 TAILINGS EMBANKMENT
INSTRUMENTATION
SECTIONS - SHEET 1 OF 2

DESIGNED	CHECKED
MDB	LAG
DRAWN	APPROVED
DSR	KJB

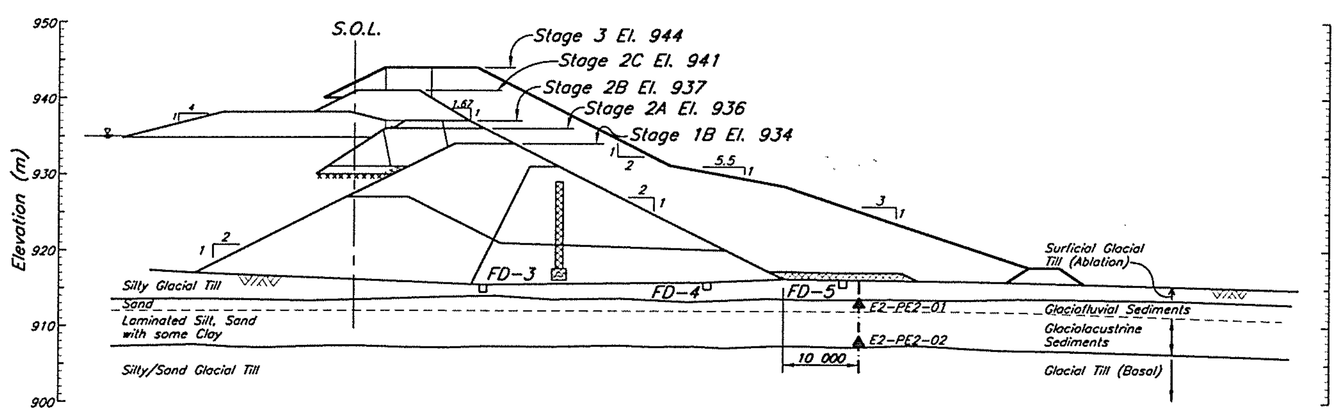
Knight Piésold CONSULTING

SCALE: AS SHOWN
REVISION: 0
DRAWING NO. 11162-12-158

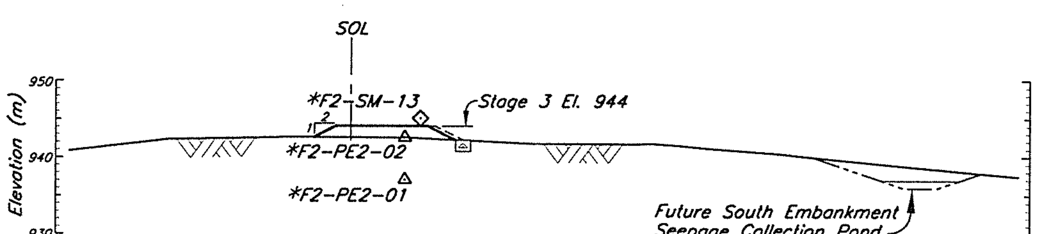
XREF FILE :



PLANE D/152
CH. 39+86



PLANE E/150
CH. 17+60



PLANE F/154
CH. 7+19

NOTE

1. See Drg. No. 11162-12-156 for Summary of Instrumentation Installations, Typical Details, General Notes and Legend.

NOT FOR CONSTRUCTION

Scale 10 0 10 20 30 40 50 m

VANCOUVER B.C. CAD FILE: M:\11162\12\ACAD\dwgs\D13\D13 1=500 Plot 1=0.5 Dec. 6, 1999

DRG. NO.	DESCRIPTION
156	TSF - STAGE 3 TAILINGS EMBANKMENT - INSTRUMENTATION SUMMARY OF INSTALLATION & TYPICAL DETAILS
154	TSF - STAGE 3 TAILINGS EMBANKMENT - SOUTH EMBANKMENT - INSTRUMENTATION PLAN
152	TSF - STAGE 3 TAILINGS EMBANKMENT - PERIMETER EMBANKMENT - INSTRUMENTATION PLAN
150	TSF - STAGE 3 TAILINGS EMBANKMENT - MAIN EMBANKMENT - INSTRUMENTATION PLAN
130	TSF - STAGE 3 SOUTH EMBANKMENT - PLAN AND SECTION
125	TSF - STAGE 3 PERIMETER EMBANKMENT - SECTIONS
115	TSF - STAGE 3 MAIN EMBANKMENT - SECTIONS AND DETAILS

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	JMTW	NSD	LAC	KJB

REVISIONS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA K. J. BROUWER

DESIGNED MDB | CHECKED LAC | DRAWN DSR | APPROVED KJB

MOUNT POLLEY MINING CORPORATION

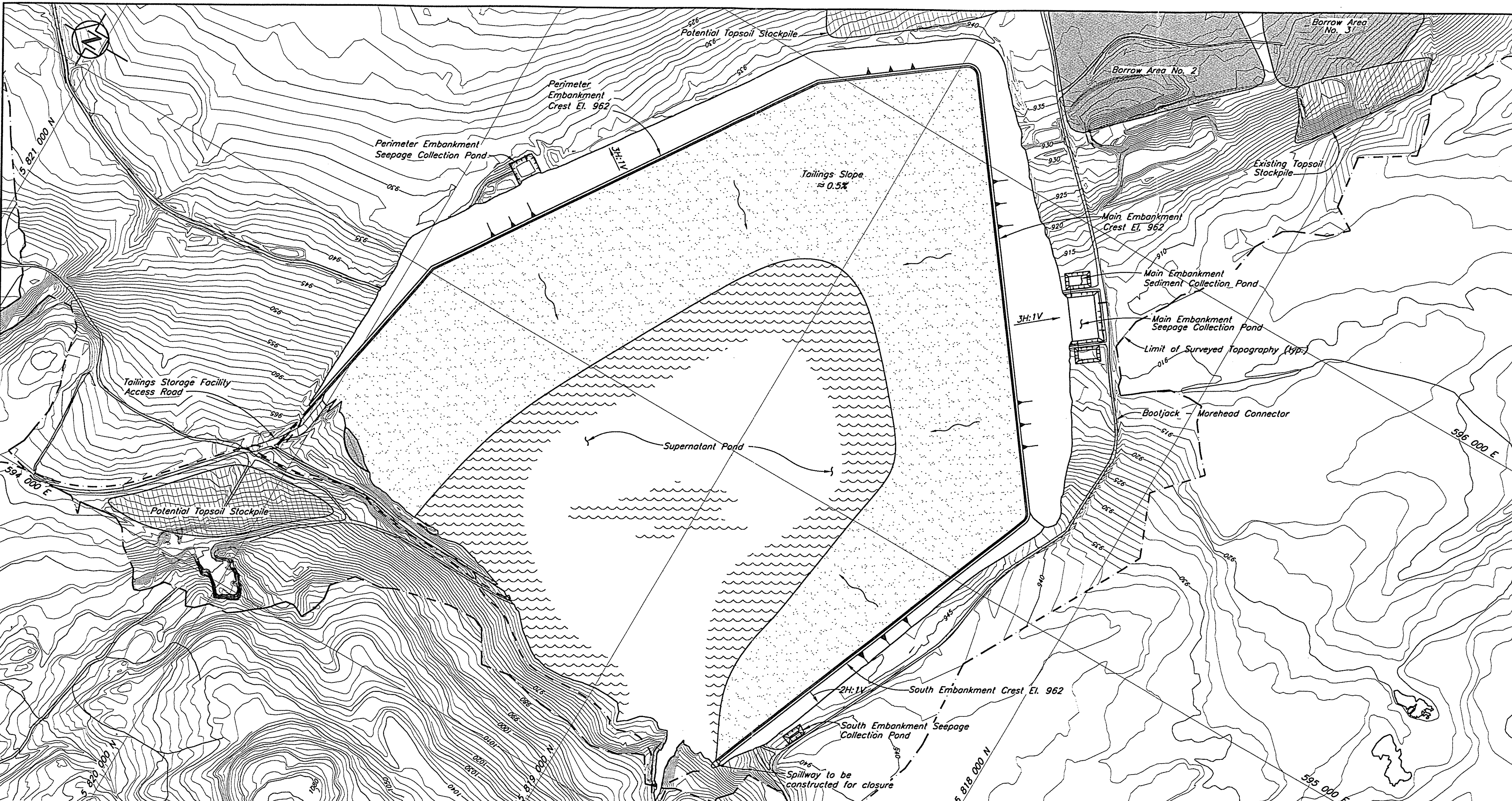
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 3 TAILINGS EMBANKMENT
INSTRUMENTATION
SECTIONS - SHEET 2 OF 2

Knight Piésold CONSULTING

SCALE AS SHOWN | REVISION 0 | DRAWING NO. 11162-12-159

XREF FILE :



NOT FOR CONSTRUCTION

NOTE

1. Final Arangement of topsoil stockpile and borrow areas are approx. only. Details to be finalized in the final stages.

Scale 100 0 100 200 300 400 500 m

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — K. J. BROUWER

MOUNT POLLEY MINING CORPORATION

MOUNT POLLEY PROJECT

TAILINGS STORAGE FACILITY
FINAL (STAGE 7) ARRANGEMENT

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	10DEC99	ISSUED FOR DESIGN REPORT	MDB	NSD	LAC	DB

REVISIONS

DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D

REVISIONS

DESIGNED MDB | CHECKED LAC | DRAWN DSR/NSD | APPROVED DB

Knight Piésold CONSULTING

SCALE AS SHOWN | REVISION 0 | DRAWING NO. 11162-12-200

XREF FILE: TOPO99, STOCK

VANCOUVER B.C.

APPENDIX A

UPSTREAM TRIAL BERM

A1 PHOTOS

A2 UNDERFLOW GRADATIONS

A3 OVERFLOW GRADATIONS

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APPENDIX A1

PHOTOS

Photo No. 1: Upstream Trial Berm – Main Embankment cycloned sand cone.

Photo No. 2: Main Embankment Upstream Trial Berm - Excavation for upstream toe drain.

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Photo No. 3: Main Embankment Upstream Trial Berm and upstream toe drain ditch.

Photo No. 4: Perimeter Embankment Upstream Trail Berm.

Photo No. 5: Perimeter Embankment Upstream Trial Berm.

Photo No. 6: Upstream cycloned sand timed discharge bucket test.

Photo No. 7: Upstream cycloned sand pulp density determination.

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APPENDIX A2

UNDERFLOW GRADATIONS

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 1 UNDERFLOW GRADATIONS

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1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

SHEET : 1 of 1
PERIOD : 31-Aug-99
PROJECT #: 11162/10
AREA : Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES
MATERIAL : D10-1 UNDERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution														Hydrometer		
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	0.001
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400					
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
May 4 - 11, 1999	Cyclone #1	99.9	99.9	99.48	99.00	97.60	92.00	75.60	52.40	36.60	27.10	16.30	14.20	-	-	-	-	-
May 12- 17, 1999	Cyclone #1		100.0	99.50	98.90	96.80	89.50	73.20	53.90	38.50	29.00	16.5	14.3	-	-	-	-	-
May 18- 26, 1999	Cyclone #1			100.0	99.9	99.4	96.6	88.3	68.8	43.2	27.3	17.2	13.5	-	-	-	-	-
May 27- 30, 1999	Cyclone #1		100.0	99.9	99.6	98.2	92.2	75.5	54.6	36.8	23.9	15.6	12.7	-	-	-	-	-
May 31- June 2, 1999	Cyclone #1			100.0	99.9	99.6	98.3	91.4	72.5	50.8	37.1	28.5	25.5	-	-	-	-	-
June 4,1999	Cyclone #1		100.0	99.8	99.2	96.8	91.7	77.4	54.1	35.9	24.4	15.9	12.9	-	-	-	-	-
June 6,1999	Cyclone #1		100.0	99.9	99.6	98.3	95.3	84.9	62.0	40.4	26.5	16.4	13.1	-	-	-	-	-
June15,1999	Cyclone #1		100.0	99.4	99.0	98.1	95.7	86.8	63.5	39.6	27.1	15.3	13.3	-	-	-	-	-
June 16-20, 1999	Cyclone #1		100.0	99.8	99.5	98.5	94.3	81.7	55.8	38.8	27.6	17.0	14.2	-	-	-	-	-
June 23,1999	Cyclone #1			100.0	99.8	99.3	97.7	88.8	65.8	49.0	32.7	19.1	15.4	-	-	-	-	-
June 28,1999	Cyclone #1		100.0	99.5	98.8	96.8	90.9	73.6	50.7	35.4	26.7	15.9	13.7	-	-	-	-	-
July 3,1999	Cyclone #1		100.0	99.4	98.7	97.1	93.7	83.4	59.8	37.6	27.1	16.3	14.2	-	-	-	-	-
July 6,1999	Cyclone #1		100.0	99.8	99.5	98.3	94.7	83.5	60.8	39.6	28.5	17.0	15.0	-	-	-	-	-
July 8-11, 1999	Cyclone #1		100.0	99.7	99.4	97.0	90.8	74.3	50.6	33.1	23.4	12.8	11.1	-	-	-	-	-
July 15,1999	Cyclone #1		100.0	99.7	99.2	94.6	82.0	61.0	42.6	30.4	21.3	13.7	12.0	-	-	-	-	-
July 22,1999	Cyclone #1		100.0	99.9	99.8	99.1	96.1	84.9	60.8	39.9	28.3	20.6	13.1	-	-	-	-	-
July 25,1999	Cyclone #1		100.0	99.6	99.1	97.9	94.1	82.5	59.2	41.9	30.7	19.1	14.3	-	-	-	-	-
July 29,1999	Cyclone #1		100.0	99.8	99.7	98.3	93.9	81.6	60.4	43.6	31.6	19.4	15.4	-	-	-	-	-
August 1,1999	Cyclone #1		100.0	99.9	99.7	98.2	92.7	78.0	55.4	42.4	31.5	19.8	17.6	-	-	-	-	-
August 5,1999	Cyclone #1			100.0	99.9	99.5	99.0	89.6	75.1	56.5	41.0	23.2	17.5	-	-	-	-	-
August 8,1999	Cyclone #1			100.0	99.9	99.0	93.8	79.4	55.8	38.0	27.9	18.1	14.8	-	-	-	-	-
August 12,1999	Cyclone #1			100.0	99.9	99.2	97.9	83.4	60.2	41.5	29.7	18.0	14.2	-	-	-	-	-
August 16,1999	Cyclone #1				100.0	99.4	95.2	79.6	59.6	42.9	31.7	21.3	16.9	-	-	-	-	-
August 18,1999	Cyclone #1		100.0	99.9	99.8	99.3	95.9	84.7	67.2	46.4	32.6	18.2	15.6	-	-	-	-	-
August 23,1999	Cyclone #1			100.0	99.9	99.2	94.9	77.8	55.5	36.8	26.0	14.1	12.0	-	-	-	-	-
August30,1999	Cyclone #1			100.0	99.8	98.3	91.9	74.6	54.5	38.0	27.5	15.8	13.8					
September2,1999	Cyclone #1			100.0	99.9	98.1	90.9	70.8	50.1	34.4	24.9	15.1	13.3					
September19,1999	Cyclone #1		100.0	97.7	97.1	96.3	94.3	84.8	64.0	43.1	30.2	16.4	13.9					
September 26,1999	Cyclone #1				100.0	99.5	96.2	82.3	59.4	39.6	28.2	15.8	13.6					
	MEDIAN	99.9	100.0	99.9	99.7	98.3	94.3	81.7	59.4	39.6	27.9	16.5	14.2	-	-	-	-	-
	MAXIMUM	99.9	100.0	100.0	100.0	99.6	99.0	91.4	75.1	56.5	41.0	28.5	25.5	-	-	-	-	-
	MINIMUM	99.9	99.9	97.7	97.1	94.6	82.0	61.0	42.6	30.4	21.3	12.8	11.1	-	-	-	-	-

Notes: 1) These are 100% limits.

File: d20-1 Summary.xls Sheet: Under Plot Date: 06/10/99 Time Plotted: 2:39 PM

OCT. 7.1999 8:03AM MOUNT POLLEY MINING NO.297 P.11/58

KNIGHT PIESOLD
CONSULTING ENGINEERS

MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-1 UNDERFLOW TAILINGS SAMPLES

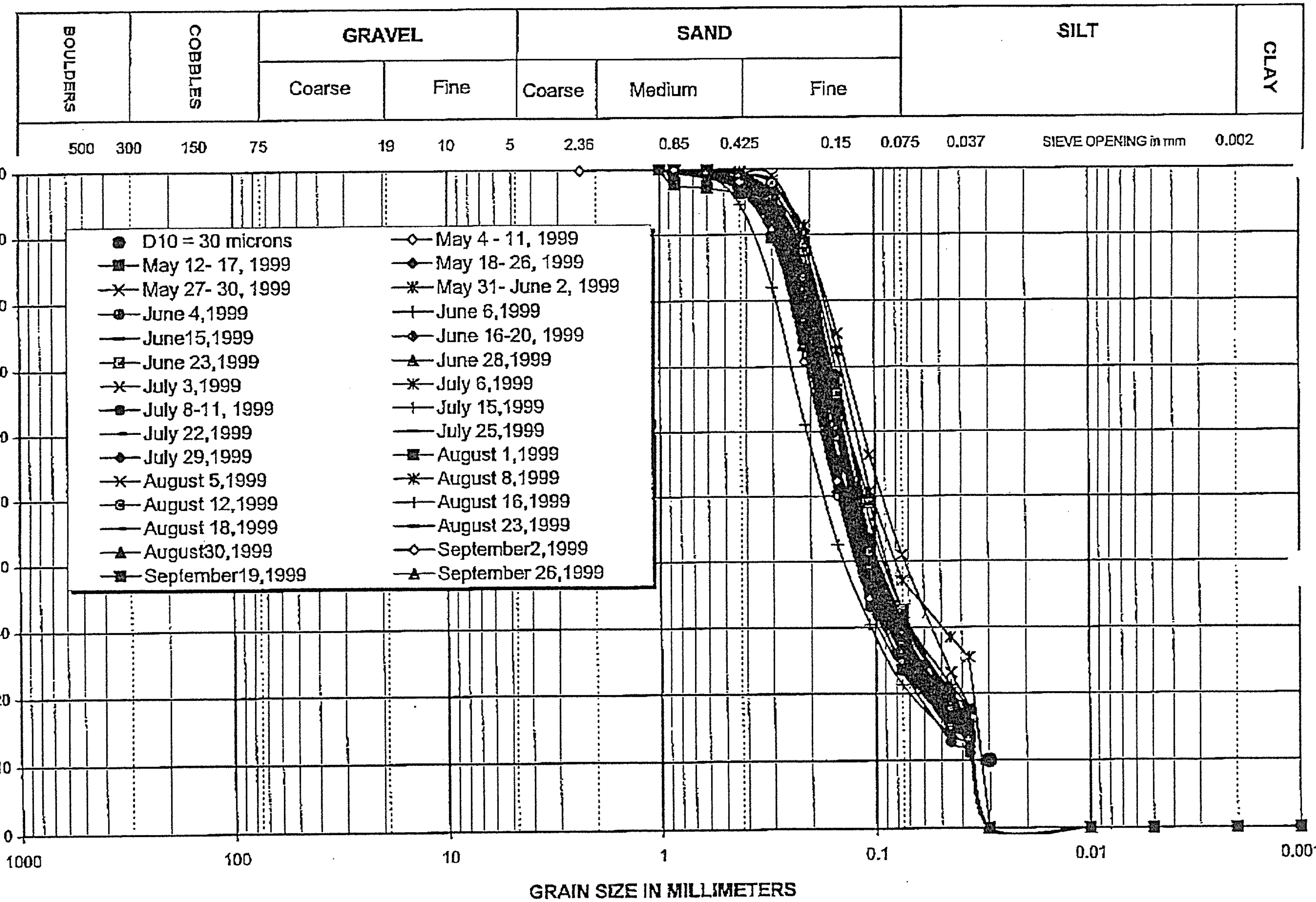


FIGURE D20-1-3

A2-7

A 2-3

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 2 UNDERFLOW GRADATIONS

Knight Piesold CONSULTING

1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

SHEET : 1 of 1
PERIOD : 31-Aug-99
PROJECT #: 11162/10
AREA : Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES
MATERIAL : D20-2 UNDERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution												Hydrometer				
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	0.001
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400					
		%	%	%	%	%	%	%	%	%	%	%		%	%	%	%	%
May 4 - 11, 1999	Cyclone #2			100.00	99.90	99.30	96.30	84.00	58.80	39.00	26.40	16.60	14.40	-	-	-	-	-
May 12- 17, 1999	Cyclone #2		100.0	99.80	99.50	99.10	98.00	92.90	75.30	47.00	26.60	16.1	12.4	-	-	-	-	-
May 18- 26, 1999	Cyclone #2		100.0	99.3	98.3	95.1	86.1	67.8	44.7	28.5	19.3	12.8	10.4	-	-	-	-	-
May 27- 30, 1999	Cyclone #2		100.0	100.0	99.7	98.9	93.5	80.0	51.3	36.4	26.1	14.9	13.1	-	-	-	-	-
May 31- June 2, 1999	Cyclone #2		100.0	99.1	98.3	95.5	88.9	72.9	50.4	33.6	22.4	14.2	11.1	-	-	-	-	-
June 4,1999	Cyclone #2		100.0	98.1	96.6	93.1	87.3	73.6	50.5	33.8	24.1	16.8	14.3	-	-	-	-	-
June 5,1999	Cyclone #2		100.0	99.3	98.3	94.1	84.2	64.9	44.8	32.0	23.6	16.4	13.8	-	-	-	-	-
June 7,1999	Cyclone #2		100.0	98.9	97.8	95.6	89.1	75.1	48.6	35.0	22.9	15.7	12.9	-	-	-	-	-
June 8,1999	Cyclone #2		100.0	99.3	98.5	95.7	93.4	79.4	55.9	37.5	27.3	16.1	13.6	-	-	-	-	-
June 14 - 16, 1999	Cyclone #2		100.0	98.3	98.1	94.6	85.9	68.6	49.2	35.0	26.3	16.2	14.2	-	-	-	-	-
June 15,1999	Cyclone #2		100.0	98.1	96.8	93.5	85.7	69.5	47.8	31.6	22.3	14.1	12.7	-	-	-	-	-
June 16-20, 1999	Cyclone #2		100.0	98.7	97.4	95.4	89.9	77.9	55.5	38.8	26.9	16.4	13.7	-	-	-	-	-
June 23,1999	Cyclone #2		100.0	98.7	97.3	94.0	88.3	71.3	45.8	32.5	22.4	14.1	11.6	-	-	-	-	-
June 28,1999	Cyclone #2		100.0	98.7	97.6	94.6	86.4	66.5	45.7	31.9	23.8	14.0	12.2	-	-	-	-	-
July 3,1999	Cyclone #2			100.0	99.9	99.6	97.2	88.3	71.3	52.9	39.4	22.9	19.5	-	-	-	-	-
July 5,1999	Cyclone #2		100.0	98.9	97.6	92.6	82.5	66.0	50.5	39.2	31.9	23.7	22.1	-	-	-	-	-
July 6,1999	Cyclone #2		100.0	99.1	98.4	96.4	91.8	77.3	52.9	35.1	25.4	15.1	13.5	-	-	-	-	-
July 15,1999	Cyclone #2		100.0	99.9	99.7	97.4	90.0	73.3	55.3	41.0	27.7	16.9	14.8	-	-	-	-	-
July 19,1999	Cyclone #2		100.0	99.9	99.7	98.7	93.4	76.3	53.0	38.1	27.7	21.7	13.6	-	-	-	-	-
July 22,1999	Cyclone #2			100.0	99.9	99.3	96.3	83.3	58.5	40.2	29.2	20.2	13.6	-	-	-	-	-
July 25,1999	Cyclone #2		100.0	99.6	99.2	98.2	97.0	81.3	58.8	44.6	31.7	20.3	18.3	-	-	-	-	-
August 1,1999	Cyclone #2		100.0	99.7	99.2	96.8	91.4	78.9	57.8	44.5	32.5	19.9	17.5	-	-	-	-	-
August 5,1999	Cyclone #2		100.0	99.7	98.3	95.7	86.8	71.5	53.2	40.6	29.2	20.1	15.8	-	-	-	-	-
August 8,1999	Cyclone #2			100.0	99.8	97.8	68.5	68.4	46.9	32.3	23.8	15.5	12.7	-	-	-	-	-
August 12,1999	Cyclone #2		100.0	99.9	99.7	98.0	92.3	73.6	51.8	36.7	27.1	17.3	14.3	-	-	-	-	-
August 16,1999	Cyclone #2			100.0	99.9	98.9	93.1	74.7	55.4	39.4	28.4	20.5	14.6	-	-	-	-	-
August 18,1999	Cyclone #2		100.0	99.9	99.6	97.0	87.6	65.9	47.5	33.9	25.0	15.0	13.1	-	-	-	-	-
August 23,1999	Cyclone #2		100.0	99.9	99.7	97.8	90.3	69.6	49.8	34.7	25.4	14.7	12.7	-	-	-	-	-
August30,1999	Cyclone #2		100.0	99.8	99.5	97.9	90.4	70.0	50.6	35.5	25.8	14.7	12.8					
September5,1999	Cyclone #2			100.0	99.8	98.8	93.7	73.5	52.2	37.6	28.7	18.0	16.0					
September12,1999	Cyclone #2				100.0	99.4	91.2	79.6	51.9	38.4	28.2	19.5	16.8					
September19,1999	Cyclone #2		100.0	99.5	99.3	98.7	97.2	89.2	70.0	46.7	32.0	17.6	15.1					
September26,1999	Cyclone #2				100.0	99.5	96.1	81.3	57.7	39.4	28.5	16.1	13.8					
	MEDIAN	#NUM!	100.0	99.7	99.3	97.4	90.4	73.6	51.9	37.5	26.6	16.4	13.7	-	-	-	-	-
	MAXIMUM	0.0	100.0	100.0	100.0	99.6	98.0	92.9	75.3	52.9	39.4	23.7	22.1	-	-	-	-	-
	MINIMUM	0.0	100.0	98.1	96.6	92.6	82.5	64.9	44.7	28.5	19.3	17.8	10.4	-	-	-	-	-

Notes: 1) These are 100% limits.

KNIGHT PIESOLD
CONSULTING ENGINEERS

MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-2 UNDERFLOW TAILINGS SAMPLES

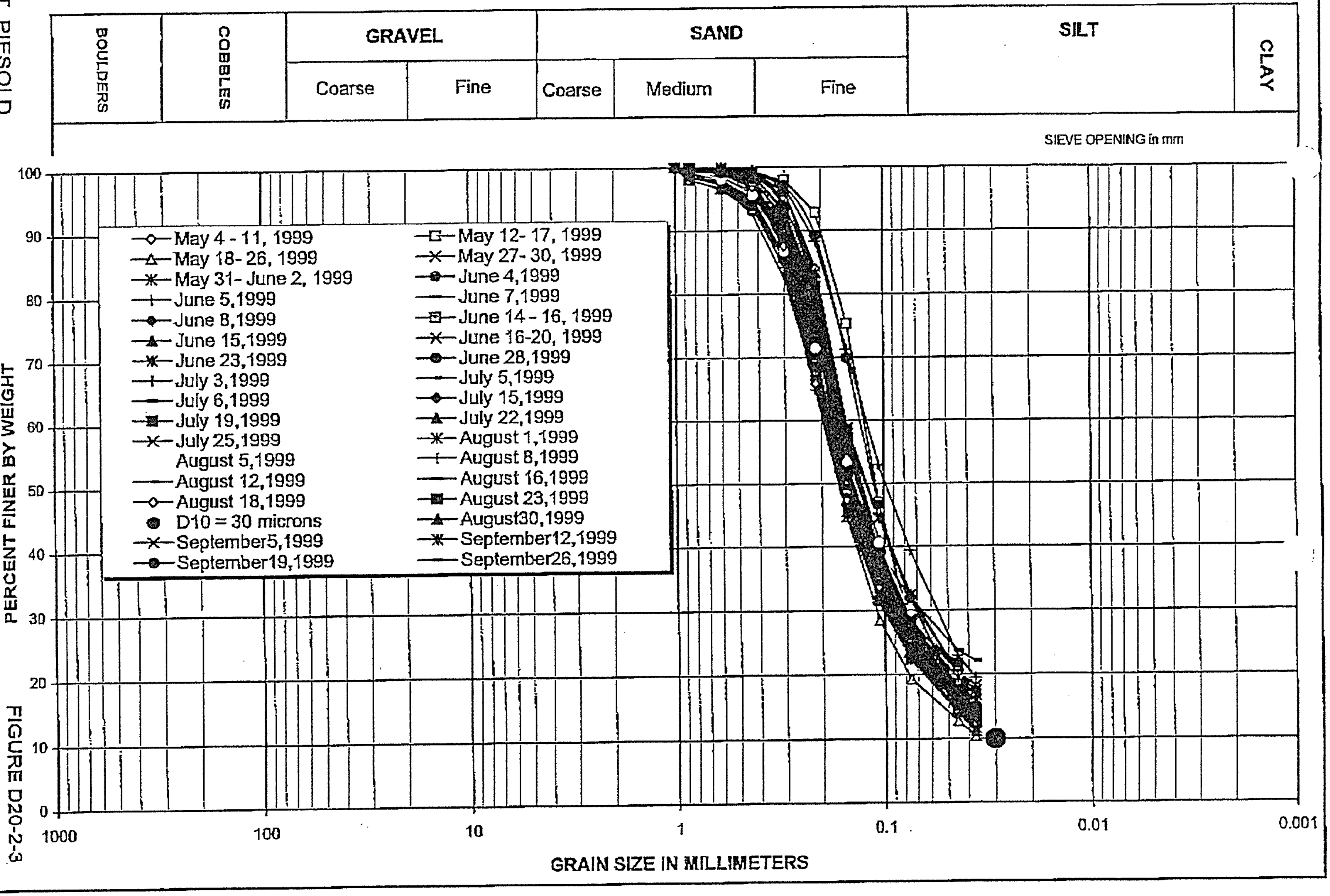


FIGURE D20-2-3

A 2-4

A2-5

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 3 UNDERFLOW GRADATIONS

Knight Piesold CONSULTING

1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

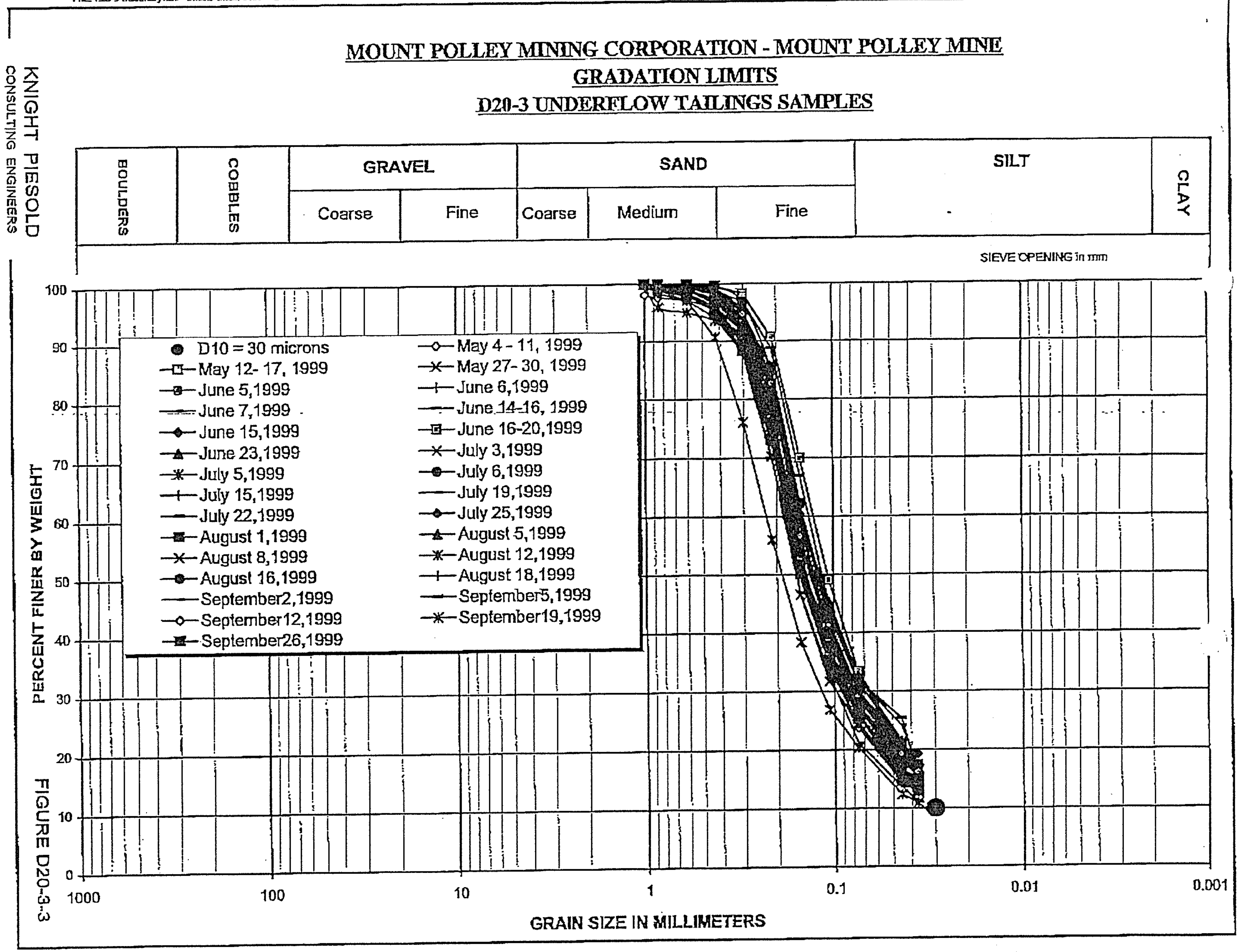
SHEET : 1 of 1
PERIOD : 31-Aug-99
PROJECT #: 11162/10
AREA : Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES
MATERIAL : D20-3 UNDERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution																
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	0.
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400	Hydrometer				
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
May 4 - 11, 1999	Cyclone #3	98.2	98.2	97.65	97.15	95.95	91.95	77.65	52.35	34.95	23.75	14.75	14.50	-	-	-	-	-
May 12- 17, 1999	Cyclone #3	99.9	99.9	99.90	99.90	99.70	98.30	90.70	70.00	49.10	33.40	20.9	16.2	-	-	-	-	-
May 27- 30, 1999	Cyclone #3		100.0	100.0	99.7	98.9	93.5	80.0	51.3	36.4	26.1	14.9	13.1	-	-	-	-	-
June 5,1999	Cyclone #3		100.0	99.6	99.1	97.3	92.0	76.1	53.1	37.3	26.8	18.3	15.5	-	-	-	-	-
June 6,1999	Cyclone #3		100.0	99.9	99.5	98.1	94.4	83.4	59.4	39.5	27.6	18.7	15.7	-	-	-	-	-
June 7,1999	Cyclone #3		100.0	99.8	99.5	98.2	91.9	75.0	46.8	32.9	21.1	13.7	11.1	-	-	-	-	-
June 14-16, 1999	Cyclone #3		100.0	99.8	99.3	96.6	88.1	70.1	49.5	35.2	26.2	15.9	13.9	-	-	-	-	-
June 15,1999	Cyclone #3		100.0	99.5	99.1	97.5	91.5	73.8	51.0	36.7	29.0	20.6	19.4	-	-	-	-	-
June 16-20,1999	Cyclone #3		100.0	99.0	97.9	95.8	90.4	76.8	51.8	36.7	25.8	15.7	13.0	-	-	-	-	-
June 23,1999	Cyclone #3		100.0	99.6	99.3	97.3	93.1	78.1	55.8	39.8	30.1	19.2	17.0	-	-	-	-	-
July 3,1999	Cyclone #3		100.0	99.3	98.5	96.0	88.3	70.3	46.6	31.8	24.2	14.6	12.7	-	-	-	-	-
July 5,1999	Cyclone #3		100.0	99.0	97.1	90.7	76.1	56.1	38.4	26.9	20.4	12.4	11.0	-	-	-	-	-
July 6,1999	Cyclone #3		100.0	99.2	98.8	97.4	93.8	81.8	58.9	38.7	28.0	16.6	14.6	-	-	-	-	-
July 15,1999	Cyclone #3		100.0	98.4	97.1	94.2	88.1	72.9	51.2	36.2	25.6	16.8	14.9	-	-	-	-	-
July 19,1999	Cyclone #3		100.0	99.3	98.9	97.3	93.1	82.0	61.9	44.1	32.2	24.1	17.3	-	-	-	-	-
July 22,1999	Cyclone #3		100.0	99.6	99.4	98.7	97.0	88.9	67.0	44.7	31.9	25.4	15.3	-	-	-	-	-
July 25,1999	Cyclone #3		100.0	99.4	98.7	97.4	94.7	85.7	60.4	43.3	31.7	20.9	16.0	-	-	-	-	
August 1,1999	Cyclone #3		100.0	99.1	98.2	95.2	88.3	73.1	51.8	39.8	29.9	19.4	17.4	-	-	-	-	-
August 5,1999	Cyclone #3		100.0	99.9	99.7	99.0	95.3	83.8	60.7	45.4	32.8	21.4	16.9	-	-	-	-	-
August 8,1999	Cyclone #3		100.0	99.6	99.1	96.6	89.5	74.0	51.3	34.9	25.9	16.4	13.4	-	-	-	-	-
August 12,1999	Cyclone #3		100.0	99.9	99.8	99.2	95.8	82.3	61.2	41.9	30.0	21.4	15.3	-	-	-	-	-
August 16,1999	Cyclone #3			100.0	99.9	98.5	92.7	75.3	55.6	39.8	29.6	20.5	16.9	-	-	-	-	-
August 18,1999	Cyclone #3			100.0	99.8	98.7	95.1	76.4	51.1	34.2	24.4	15.3	12.8	-	-	-	-	-
September2,1999	Cyclone #3		100.0	99.9	99.7	98.1	92.1	74.8	54.1	37.1	26.4	15.4	13.5					
September5,1999	Cyclone #3		100.0	99.9	99.7	99.0	92.8	76.6	51.6	37.5	25.9	16.2	13.6					
September12,1999	Cyclone #3			100.0	99.9	99.2	94.8	82.7	56.7	41.5	29.2	19.3	16.3					
September19,1999	Cyclone #3		100.0	96.0	95.0	93.6	90.7	79.7	59.4	40.0	28.2	15.8	13.6					
September26,1999	Cyclone #3		100.0	99.9	99.9	99.5	96.8	84.8	62.3	42.4	30.5	17.1	14.5					
	MEDIAN	99.0	100.0	99.6	99.3	97.4	92.7	77.2	53.6	38.1	27.8	16.9	14.7	-	-	-	-	-
	MAXIMUM	99.9	100.0	100.0	99.9	99.7	98.3	90.7	70.0	49.1	33.4	25.4	19.4	-	-	-	-	-
	MINIMUM	98.2	98.2	96.0	95.0	90.7	76.1	56.1	38.4	26.9	20.4	12.4	11.0	-	-	-	-	-

Notes: 1) These are 100% limits.

File: d20-3 Summary.xls Sheet: Under Plot Date: 06/10/99 Time Plotted: 2:41 PM



A2-6

OCT. 7.1999 8:05AM MOUNT POLLEY MINING NO.297 P.15/58

A2-7

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 4 UNDERFLOW GRADATIONS

#N/A

Knight Piesold CONSULTING — 1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

SHEET : 1 of 1
PERIOD : 31-Aug-99
PROJECT #: 11162/10
AREA : Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES
MATERIAL : D20-4 UNDERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution																
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400	Hydrometer				
		%	%	%	%	%	%	%	%	%	%	%						
May 4 - 11, 1999	Cyclone #4				100.00	99.70	98.10	89.70	67.10	44.30	28.50	16.10	13.50	-	-	-	-	-
May 12 - 17, 1999	Cyclone #4		100.0	98.60	97.80	95.50	88.40	70.20	49.30	34.00	25.20	14.4	12.3	-	-	-	-	-
May 27 - 30, 1999	Cyclone #4		100.0	99.7	99.2	97.8	94.0	77.0	52.6	34.2	23.0	15.1	12.4	-	-	-	-	-
May 31 - June 2, 1999	Cyclone #4		100.0	99.9	99.7	98.9	95.5	84.7	62.5	39.5	24.2	13.5	9.5	-	-	-	-	-
June 6,1999	Cyclone #4		100.0	98.7	97.6	94.7	90.5	77.7	53.6	35.4	23.8	15.1	12.2	-	-	-	-	-
June 8,1999	Cyclone #4		100.0	99.9	99.8	99.4	96.4	84.7	52.7	38.6	24.2	15.6	12.2	-	-	-	-	-
June 15,1999	Cyclone #4			100.0	99.9	99.2	95.3	80.2	52.4	33.2	23.8	14.4	13.0	-	-	-	-	-
June 16-20, 1999	Cyclone #4		100.0	99.7	99.2	98.0	94.4	83.4	55.8	40.4	28.9	17.5	14.9	-	-	-	-	-
June 23,1999	Cyclone #4		100.0	98.8	98.3	96.5	92.0	74.3	46.9	34.0	23.9	15.5	12.7	-	-	-	-	-
July 3,1999	Cyclone #4		100.0	98.8	98.1	96.6	93.2	82.8	58.0	37.4	26.7	14.9	12.8	-	-	-	-	-
July 5,1999	Cyclone #4		100.0	99.9	99.6	97.6	89.8	71.3	48.5	32.1	22.8	12.6	10.6	-	-	-	-	-
July 6,1999	Cyclone #4		100.0	99.8	99.6	98.4	93.9	78.6	54.0	36.3	26.0	14.5	12.6	-	-	-	-	-
July 8-11, 1999	Cyclone #4		100.0	99.5	99.0	96.9	91.5	75.7	50.4	32.9	23.2	12.9	11.8	-	-	-	-	-
July 15,1999	Cyclone #4		100.0	99.9	99.4	96.3	89.3	73.7	52.7	38.8	28.4	19.3	17.4	-	-	-	-	-
July 19,1999	Cyclone #4		100.0	96.3	95.8	94.8	92.2	72.4	51.8	38.5	29.3	27.4	15.8	-	-	-	-	-
July 22,1999	Cyclone #4		100.0	99.8	99.5	98.7	96.0	84.5	60.5	41.6	30.2	21.9	13.9	-	-	-	-	
July 25,1999	Cyclone #4		100.0	99.6	99.3	98.6	96.7	87.4	62.1	44.7	30.2	16.0	13.6	-	-	-	-	
August 1,1999	Cyclone #4		100.0	99.6	99.1	97.1	92.0	79.3	57.0	44.3	32.6	19.8	17.3	-	-	-	-	-
August 5,1999	Cyclone #4		100.0	99.5	98.7	97.4	94.8	87.4	66.6	51.0	35.8	22.7	18.3	-	-	-	-	-
August16,1999	Cyclone #4			100.0	99.8	98.6	92.6	74.2	54.8	39.2	28.5	18.1	14.6	-	-	-	-	-
August18,1999	Cyclone #4		100.0	99.9	99.7	98.3	91.6	70.7	49.8	34.6	25.2	14.9	13.0	-	-	-	-	-
August 23,1999	Cyclone #4		100.0	99.8	99.7	98.4	91.6	71.2	50.5	35.8	26.9	17.1	15.3	-	-	-	-	-
September 26,1999	Cyclone #4		100.0	99.9	99.8	99.3	95.7	81.6	60.8	42.3	30.5	16.6	14.2					
	MEDIAN	#NUM!	100.0	99.7	99.4	98.0	93.2	78.6	53.6	38.5	26.7	15.6	13.0	-	-	-	-	-
	MAXIMUM	0.0	100.0	100.0	100.0	99.7	98.1	89.7	67.1	51.0	35.8	27.4	18.3	-	-	-	-	-
	MINIMUM	0.0	100.0	96.3	95.8	94.7	88.4	70.2	46.9	32.1	22.8	12.6	9.5	-	-	-	-	-

Notes: 1) These are 100% fines.

File: d20-4 Summary.xls Sheet: Under Plot Date: 06/10/99 Time Plotted: 2:42 PM

KNIGHT PIESOLD
CONSULTING ENGINEERS

MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-4 UNDERFLOW TAILINGS SAMPLES

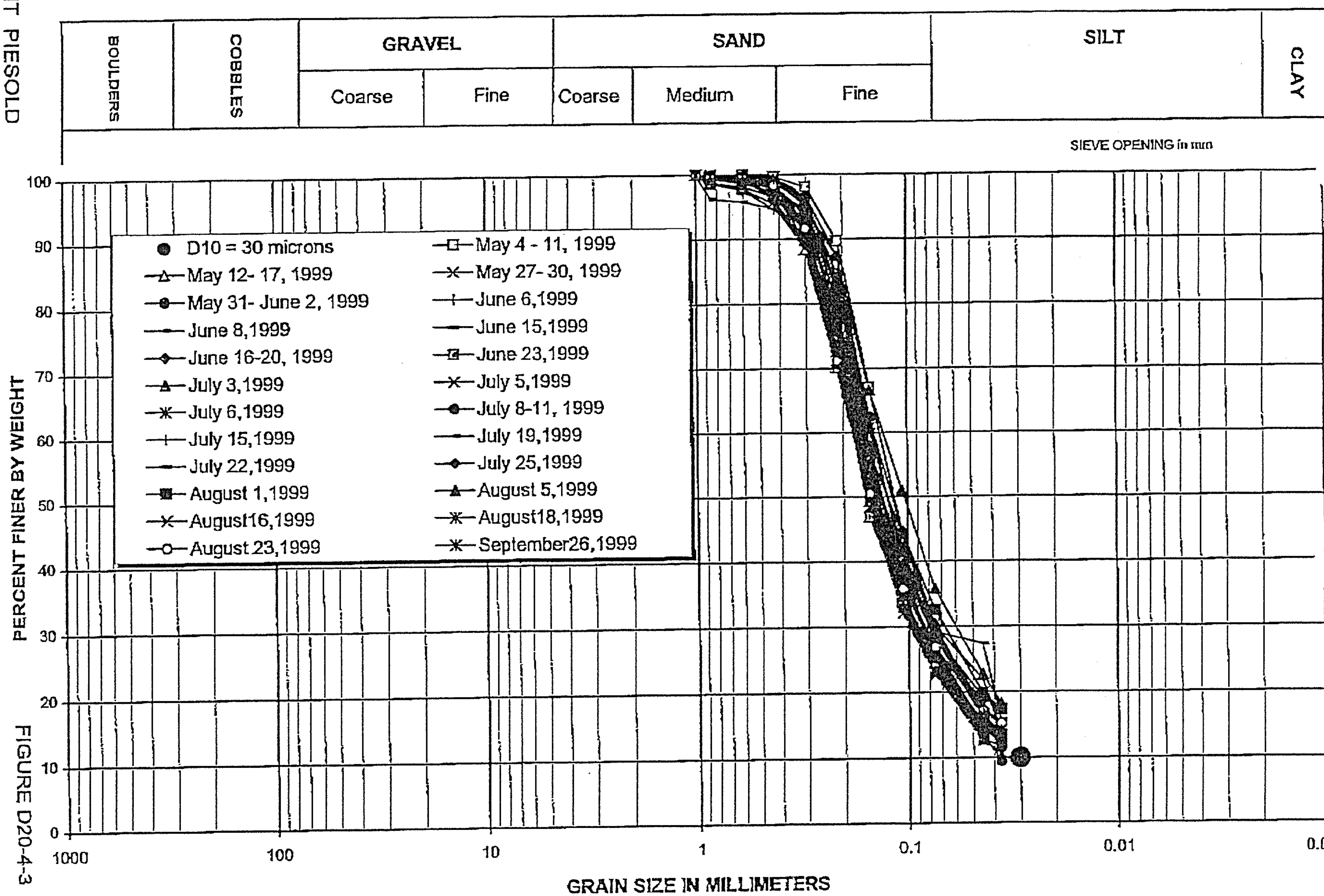


FIGURE D20-4-3

A2-8

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 5 UNDERFLOW GRADATIONS

JWA

Knight Piesold CONSULTING	1999 CONTROL SAMPLE TESTS - SUMMARY SHEET	SHEET :	1 of 1
		PERIOD :	31-Aug-99
PROJECT :	MOUNT POLLEY - CYCLONE TAILINGS ANALYSES	PROJECT #:	11162/10
MATERIAL :	D20-5 UNDERFLOW TAILINGS SAMPLES	AREA :	Tailings Storage Facility

SAMPLE	LOCATION	Particle Size Distribution																
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400	Hydrometer				
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
June 16 - 20, 1999	Cyclone #5		100.0	99.93	99.68	98.70	94.85	83.58	56.80	41.20	27.53	15.53	13.05	-	-	-	-	-
June 23,1999	Cyclone #5		100.0	99.78	99.15	97.43	93.93	80.50	56.68	43.15	31.60	21.1	17.9	-	-	-	-	-
June28,1999	Cyclone #5		100.0	99.93	99.70	98.35	92.08	74.25	51.90	34.75	24.95	14.3	12.4	-	-	-	-	-
July 3,1999	Cyclone #5		100.0	99.95	99.80	98.95	95.90	85.35	62.10	40.58	28.75	15.7	13.3	-	-	-	-	-
July 5,1999	Cyclone #5		100.0	99.13	98.65	96.90	91.38	76.50	53.83	36.03	25.63	14.1	12.1	-	-	-	-	-
July 6,1999	Cyclone #5		100.0	99.88	99.43	97.30	91.70	76.70	56.80	41.50	31.35	20.1	18.1	-	-	-	-	-
July 8-11, 1999	Cyclone #5		100.0	99.75	99.40	96.65	88.48	68.83	46.55	32.38	23.40	13.63	12.70	-	-	-	-	-
July 15,1999	Cyclone #5		100.0	99.98	99.83	98.33	92.23	74.48	52.83	38.03	27.08	18.1	16.1	-	-	-	-	-
July 22,1999	Cyclone #5		100.0	99.88	99.60	98.58	95.08	81.15	56.03	38.20	28.08	23.6	14.0	-	-	-	-	-
July 25,1999	Cyclone #5		100.0	99.95	99.80	99.18	96.05	83.98	61.08	44.05	33.55	23.0	18.2	-	-	-	-	-
July 29,1999	Cyclone #5		100.0	99.99	99.94	99.18	95.02	81.29	59.80	41.90	32.17	21.6	19.9	-	-	-	-	-
August 1,1999	Cyclone #5		100.0	99.98	99.92	98.83	94.45	81.63	61.07	48.92	36.25	22.7	20.2	-	-	-	-	-
August 8,1999	Cyclone #5		100.0	99.88	99.60	97.78	88.88	69.95	49.03	33.75	24.83	15.4	12.6	-	-	-	-	-
August 16,1999	Cyclone #5				100.0	99.8	96.7	80.7	58.1	39.4	27.9	19.2	14.0	-	-	-	-	-
August 18,1999	Cyclone #5			100.0	99.8	97.8	93.8	76.7	57.6	40.0	29.2	18.8	15.8	-	-	-	-	-
August 23,1999	Cyclone #5		100.0	99.9	99.7	97.0	86.7	65.0	46.7	32.0	22.8	12.3	10.5	-	-	-	-	
August30,1999	Cyclone #5			100.0	99.8	98.3	90.9	72.0	50.2	35.8	27.1	18.4	15.5					
September5,1999	Cyclone #5		100.0	99.9	99.7	97.6	89.3	70.8	52.6	38.4	29.0	18.3	16.4					
September26,1999	Cyclone #5		100.0	99.6	99.2	98.1	94.9	82.3	59.4	39.7	28.3	15.7	13.3					
	MEDIAN	#NUM!	100.0	99.9	99.7	98.3	93.8	76.7	56.7	39.4	28.1	18.3	14.0	-	-	-	-	-
	MAXIMUM	0.0	100.0	100.0	100.0	99.8	96.7	85.4	62.1	48.9	36.3	23.6	20.2	-	-	-	-	-
	MINIMUM	0.0	100.0	99.1	98.7	96.7	86.7	65.0	46.6	32.0	22.8	12.3	10.5	-	-	-	-	-

Notes: 1) These are 100% limits.

A2-9

KNIGHT PIESOLD
CONSULTING ENGINEERS

MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-5 UNDERFLOW TAILINGS SAMPLES

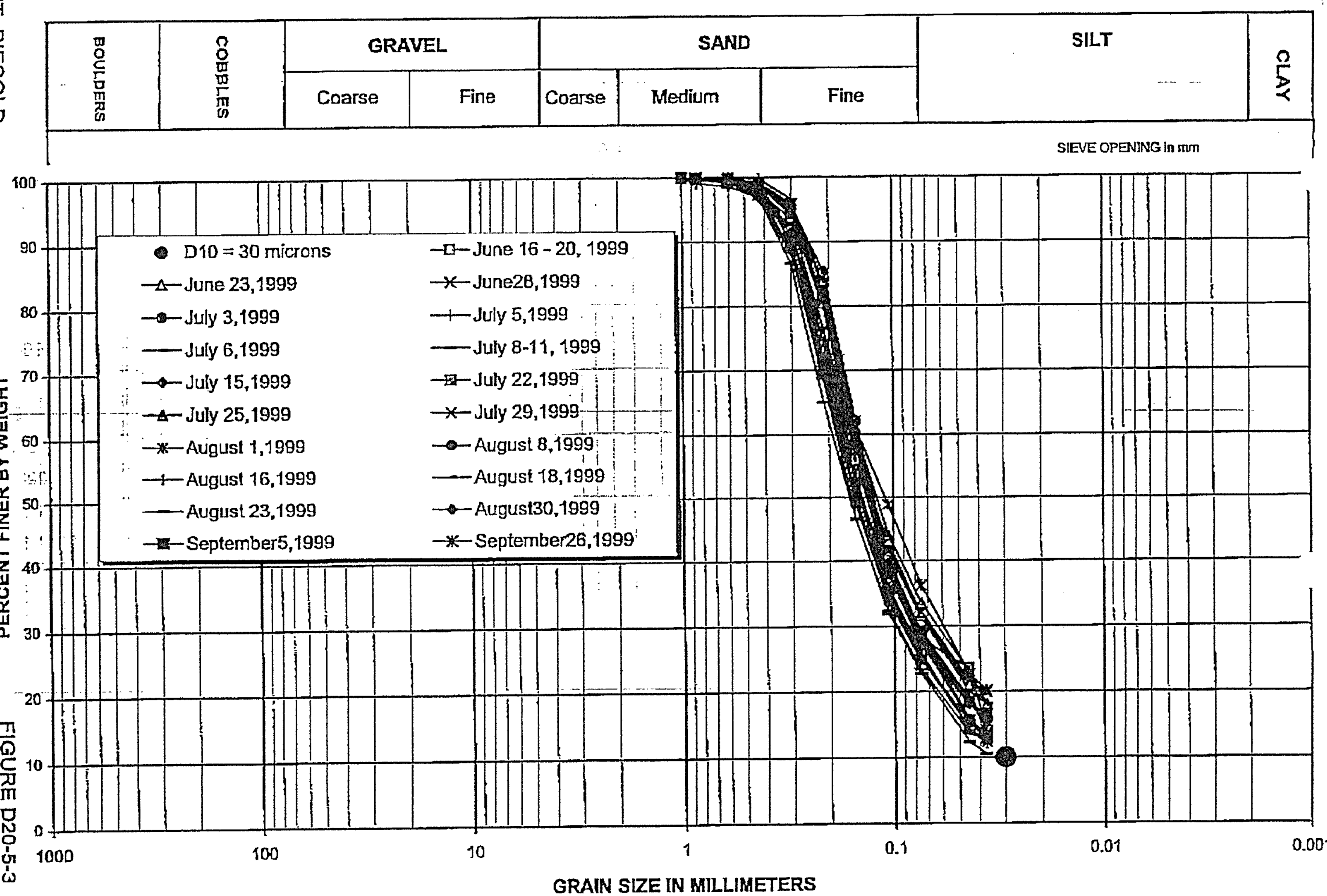


FIGURE D20-5-3

A2-10

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 6 UNDERFLOW GRADATIONS

#N/A

Knight Piesold CONSULTING	1999 CONTROL SAMPLE TESTS - SUMMARY SHEET	SHEET : 1 of 1
		PERIOD : 31-Aug-99
PROJECT :	MOUNT POLLEY - CYCLONE TAILINGS ANALYSES	PROJECT #: 11162/10
MATERIAL :	D20-6 UNDERFLOW TAILINGS SAMPLES	AREA : Tailings Storage Facility

SAMPLE	LOCATION	Particle Size Distribution																
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400	Hydrometer				
		%	%	%	%	%	%	%	%	%	%	%		%	%	%	%	%
June 16 - 20, 1999	Cyclone #6		100.0	99.95	99.80	99.40	96.63	85.15	55.75	39.90	27.65	16.00	12.63	-	-	-	-	-
June 23,1999	Cyclone #6		100.0	99.95	99.88	99.70	98.38	90.33	68.33	45.35	31.73	17.4	14.5	-	-	-	-	-
June 28,1999	Cyclone #6		100.0	99.95	99.70	98.30	92.93	78.58	56.25	37.78	27.65	16.2	14.1	-	-	-	-	-
July 3,1999	Cyclone #6			100.00	99.98	99.88	98.90	93.35	74.25	48.00	31.93	16.7	14.0	-	-	-	-	-
July 5,1999	Cyclone #6		100.0	99.98	99.88	99.30	95.25	80.10	55.20	37.48	27.50	15.8	13.8	-	-	-	-	-
July 6,1999	Cyclone #6		100.0	99.95	99.93	99.75	98.33	90.23	68.55	44.43	31.03	17.1	14.6	-	-	-	-	-
July 8-11, 1999	Cyclone #6		100.0	99.93	99.75	98.95	96.65	84.43	61.55	40.78	28.15	19.2	14.1	-	-	-	-	-
July 15,1999	Cyclone #6		100.0	99.98	99.95	99.78	98.20	88.53	62.95	42.63	29.33	19.0	16.5	-	-	-	-	-
July 19,1999	Cyclone #6			100.00	99.95	99.65	98.00	87.83	65.30	45.55	32.73	24.3	17.7	-	-	-	-	-
July 22,1999	Cyclone #6				100.00	99.88	98.85	91.65	68.98	46.10	32.80	20.6	14.9	-	-	-	-	-
July 25,1999	Cyclone #6		100.0	99.88	99.70	99.00	96.25	87.15	63.60	48.65	37.88	26.3	22.4	-	-	-	-	-
August 1,1999	Cyclone #6		100.0	99.90	99.57	97.30	90.72	73.93	51.68	39.77	29.48	18.7	16.5	-	-	-	-	-
August 5,1999	Cyclone #6		100.0	99.9	99.4	98.8	97.9	83.5	66.3	49.6	37.0	22.9	18.3	-	-	-	-	-
August 8,1999	Cyclone #6		100.0	99.9	99.6	97.2	89.0	71.0	48.2	32.8	24.1	15.6	12.9	-	-	-	-	-
August 12,1999	Cyclone #6			100.0	99.9	99.2	94.2	77.2	55.4	38.4	28.0	21.9	15.1	-	-	-	-	-
August 16,1999	Cyclone #6			100.0	99.9	99.2	93.9	76.7	58.0	42.5	31.4	21.7	17.0	-	-	-	-	
August 23,1999	Cyclone #6		100.0	100.0	100.0	99.9	97.7	85.7	62.8	42.4	30.8	17.9	15.6	-	-	-	-	
August30,1999	Cyclone #6			100.0	99.9	98.9	94.1	77.6	53.5	36.8	26.9	17.1	13.5					
September2,1999	Cyclone #6			100.0	99.9	98.7	92.3	72.0	51.2	36.3	27.4	18.3	16.7					
September5,1999	Cyclone #6				100.0	99.8	96.6	84.2	56.4	40.5	28.5	18.7	16.0					
September26,1999	Cyclone #6		100.0	99.9	99.8	98.9	94.4	78.8	57.4	40.3	30.1	18.3	16.1					
	MEDIAN	#NUM!	100.0	100.0	99.9	99.2	96.6	84.2	58.0	40.8	29.5	18.3	15.1	-	-	-	-	-
	MAXIMUM	0.0	100.0	100.0	100.0	99.9	98.9	93.4	74.3	49.6	37.9	26.3	22.4	-	-	-	-	-
	MINIMUM	0.0	100.0	99.9	99.4	97.2	89.0	71.0	48.2	32.8	24.1	15.6	12.6	-	-	-	-	-

Notes: 1) These are 100% limits.

File: d20-6 Summary.xls Sheet: Under Plot Date: 06/10/99 Time Plotted: 2:43 PM

A2-12

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CONSULTING ENGINEERS

MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-6 UNDERFLOW TAILINGS SAMPLES

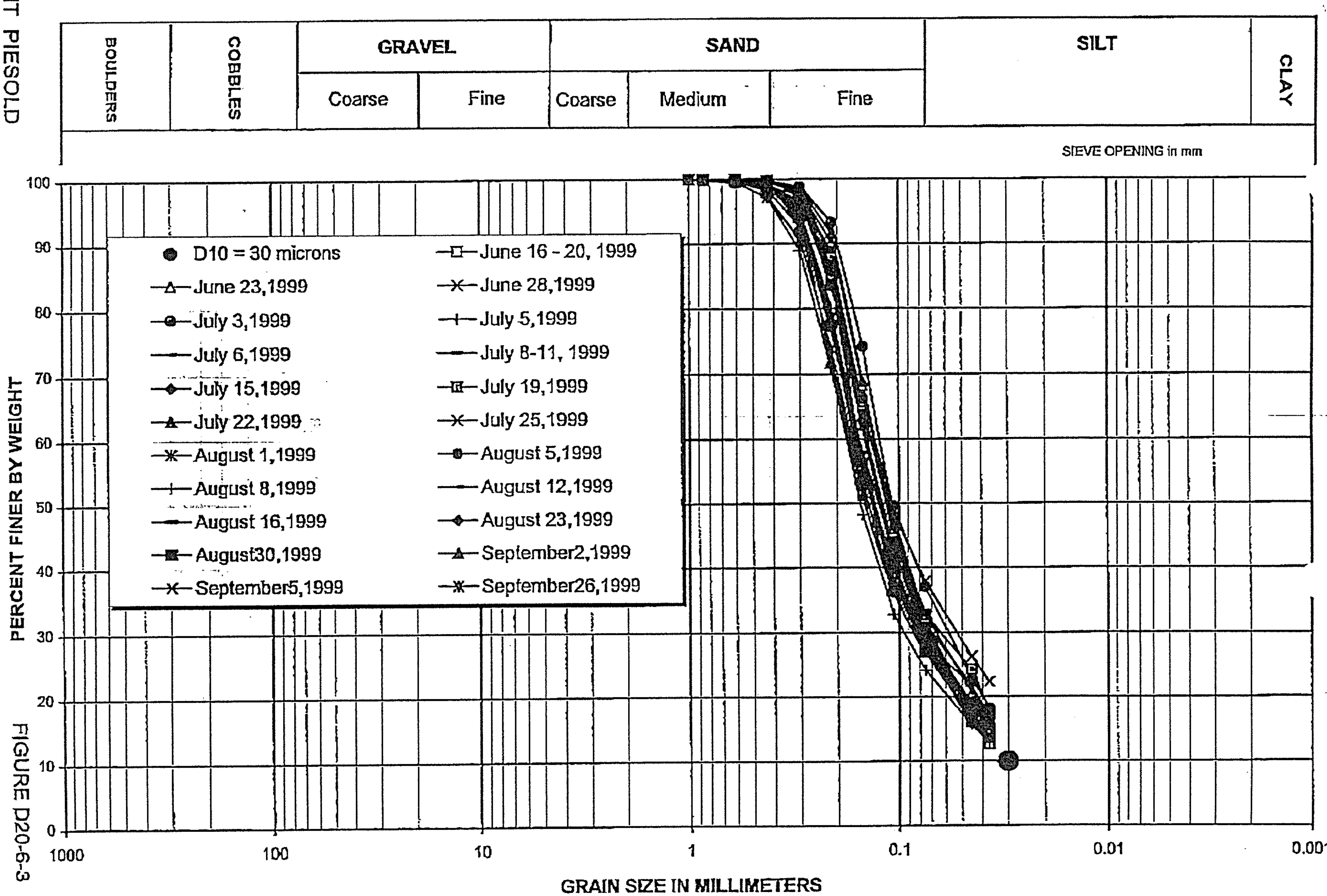

FIGURE D20-6-3

APPENDIX A3

OVERFLOW GRADATIONS

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 1 OVERFLOW GRADATIONS

#N/A

Knight Piesold CONSULTING

1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

SHEET : 1 of 1
PERIOD : 31-Aug-99
PROJECT #: 11162/10
AREA : Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES
MATERIAL : D20-1 OVERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution																
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	(
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400	Hydrometer				
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
May 4 - 11, 1999	Cyclone #1					100.00	99.70	97.60	91.60	83.00	74.20	64.20	61.30	-	-	-	-	-
May 12 - 17, 1999	Cyclone #1		99.9	95.70	95.10	93.20	89.00	77.90	65.80	52.80	44.00	32.0	29.4	-	-	-	-	-
May 27 - 30, 1999	Cyclone #1			100.0	100.0	99.9	99.9	99.3	96.7	89.4	77.6	63.7	56.8	-	-	-	-	-
June16-20, 1999	Cyclone #1				100.0	99.9	99.7	98.7	93.8	84.1	73.0	56.9	50.9	-	-	-	-	-
June23,1999	Cyclone #1		100.0	99.9	99.7	99.1	98.5	96.2	90.1	82.3	73.3	62.1	57.9	-	-	-	-	-
July3,1999	Cyclone #1						100.0	99.6	96.3	87.8	76.8	58.4	53.4	-	-	-	-	-
July6,1999	Cyclone #1		100.0	99.8	99.8	99.7	99.6	98.9	95.4	85.9	73.4	52.6	47.4	-	-	-	-	-
July8-11, 1999	Cyclone #1		100.0	99.8	99.5	99.5	99.2	97.3	90.8	79.2	67.3	48.1	44.7	-	-	-	-	-
July15,1999	Cyclone #1		100.0	99.9	99.8	99.7	99.0	95.5	86.9	75.4	62.6	48.9	45.2	-	-	-	-	-
September2,1999	Cyclone #1					100.0	99.6	97.0	89.6	77.2	64.8	46.2	41.8					
September26,1999	Cyclone #1					100.0	99.8	97.8	91.9	80.9	68.2	47.0	42.0					
	MEDIAN		100.0	99.8	99.8	99.8	99.6	97.6	91.6	82.3	73.0	52.6	47.4	-	-	-	-	-
	MAXIMUM		100.0	100.0	100.0	100.0	100.0	99.6	96.7	89.4	77.6	64.2	61.3	-	-	-	-	-
	MINIMUM		99.9	95.7	95.1	93.2	89.0	77.9	65.8	52.8	44.0	32.0	29.4	-	-	-	-	-

Notes: 1) These are 100% limits.

KNIGHT PIESOLD
CONSULTING ENGINEERS

MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-1 OVERFLOW TAILINGS SAMPLES

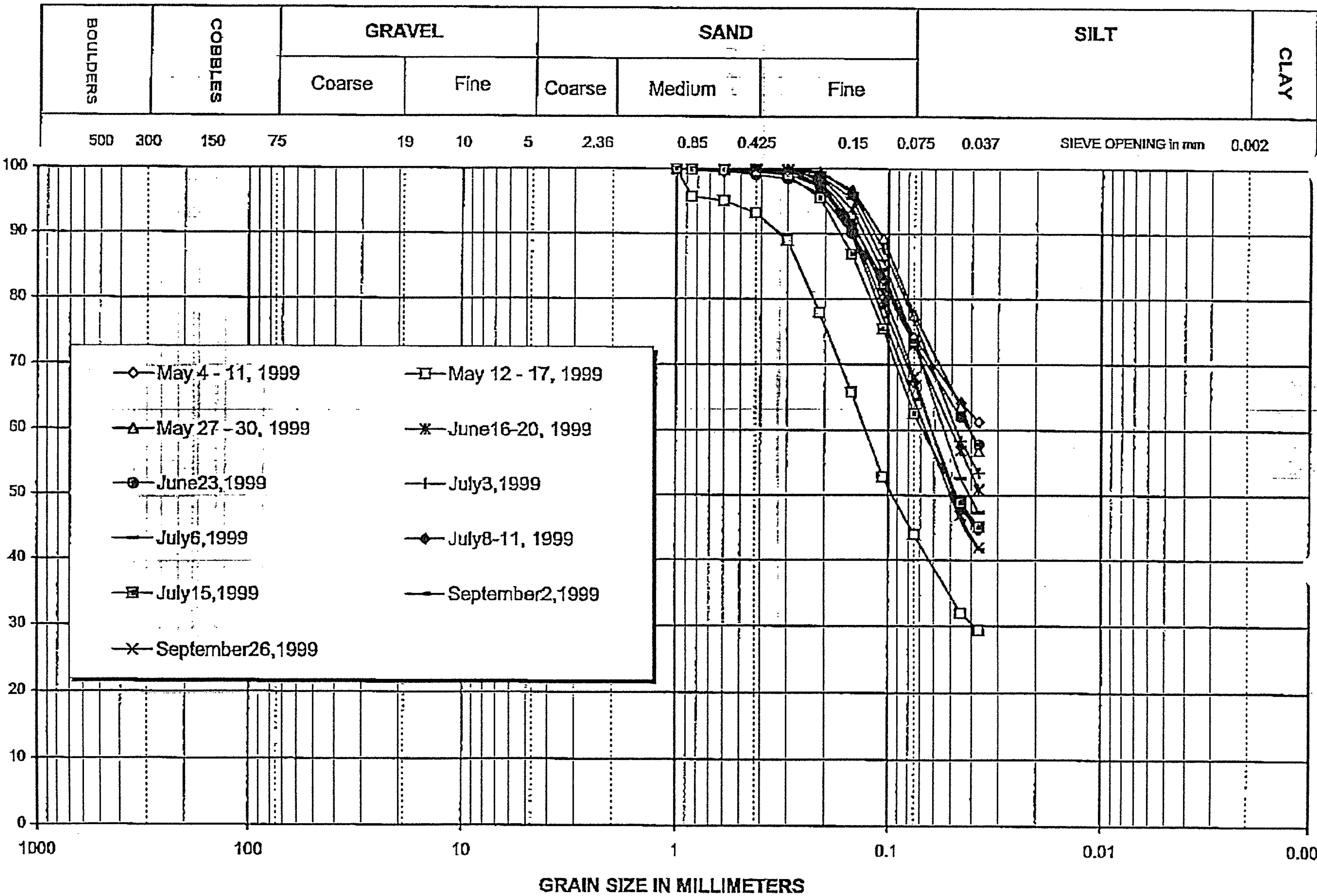

FIGURE D20-1-2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 2 OVERFLOW GRADATIONS

#N/A

Knight Piesold CONSULTING	1999 CONTROL SAMPLE TESTS - SUMMARY SHEET	SHEET :	1 of 1
		PERIOD :	31-Aug-99
PROJECT :	MOUNT POLLEY - CYCLONE TAILINGS ANALYSES	PROJECT #:	1116?/10
MATERIAL :	D20-2 OVERFLOW TAILINGS SAMPLES	AREA :	Tailings Storage Facility

SAMPLE	LOCATION	Particle Size Distribution												Hydrometer				
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	(
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400					
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
May 4 - 11, 1999	Cyclone #2		100.0	99.80	99.50	98.70	96.30	88.20	72.40	59.10	48.70	39.20	36.80	-	-	-	-	-
May 12 - 17, 1999	Cyclone #2			100.00	99.50	97.50	87.90	68.90	50.30	36.20	27.90	17.4	15.3	-	-	-	-	-
May 27 - 30, 1999	Cyclone #2			100.0	99.9	99.8	99.6	98.3	93.1	85.7	77.0	59.1	55.4	-	-	-	-	-
June 16,1999	Cyclone #2		100.0	99.9	99.7	99.5	98.9	96.0	84.9	73.4	60.3	43.3	39.0	-	-	-	-	-
June 16-20, 1999	Cyclone #2				100.0	99.9	99.6	98.5	93.3	83.3	69.0	56.0	49.8	-	-	-	-	-
July 25,1999	Cyclone #2				100.0	99.9	99.4	98.2	93.3	83.1	73.0	68.3	50.6	-	-	-	-	-
August 1,1999	Cyclone #2		100.0	98.8	98.6	98.2	97.5	95.7	90.5	83.5	74.0	60.4	56.1	-	-	-	-	-
August 16,1999	Cyclone #2		100.0	99.9	99.9	99.8	99.2	94.7	82.1	60.7	41.8	24.5	19.2	-	-	-	-	-
August30,1999	Cyclone #2					100.0	99.8	96.7	87.9	75.9	64.7	48.7	40.6					
September2,1999	Cyclone #2					100.0	99.9	98.7	93.6	82.9	70.6	50.4	45.7					
	MEDIAN	#NUM!	100.0	99.9	99.8	99.8	99.3	96.3	89.2	79.4	66.9	49.5	43.1	-	-	-	-	-
	MAXIMUM	0.0	100.0	100.0	100.0	100.0	99.9	98.7	93.6	85.7	77.0	68.3	56.1	-	-	-	-	-
	MINIMUM	0.0	100.0	98.8	98.6	97.5	87.9	68.9	50.3	36.2	27.9	17.4	15.3	-	-	-	-	-

Notes: 1) These are 100% limits.

KNIGHT PIESOLD
CONSULTING ENGINEERS

MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-2 OVERFLOW TAILINGS SAMPLES

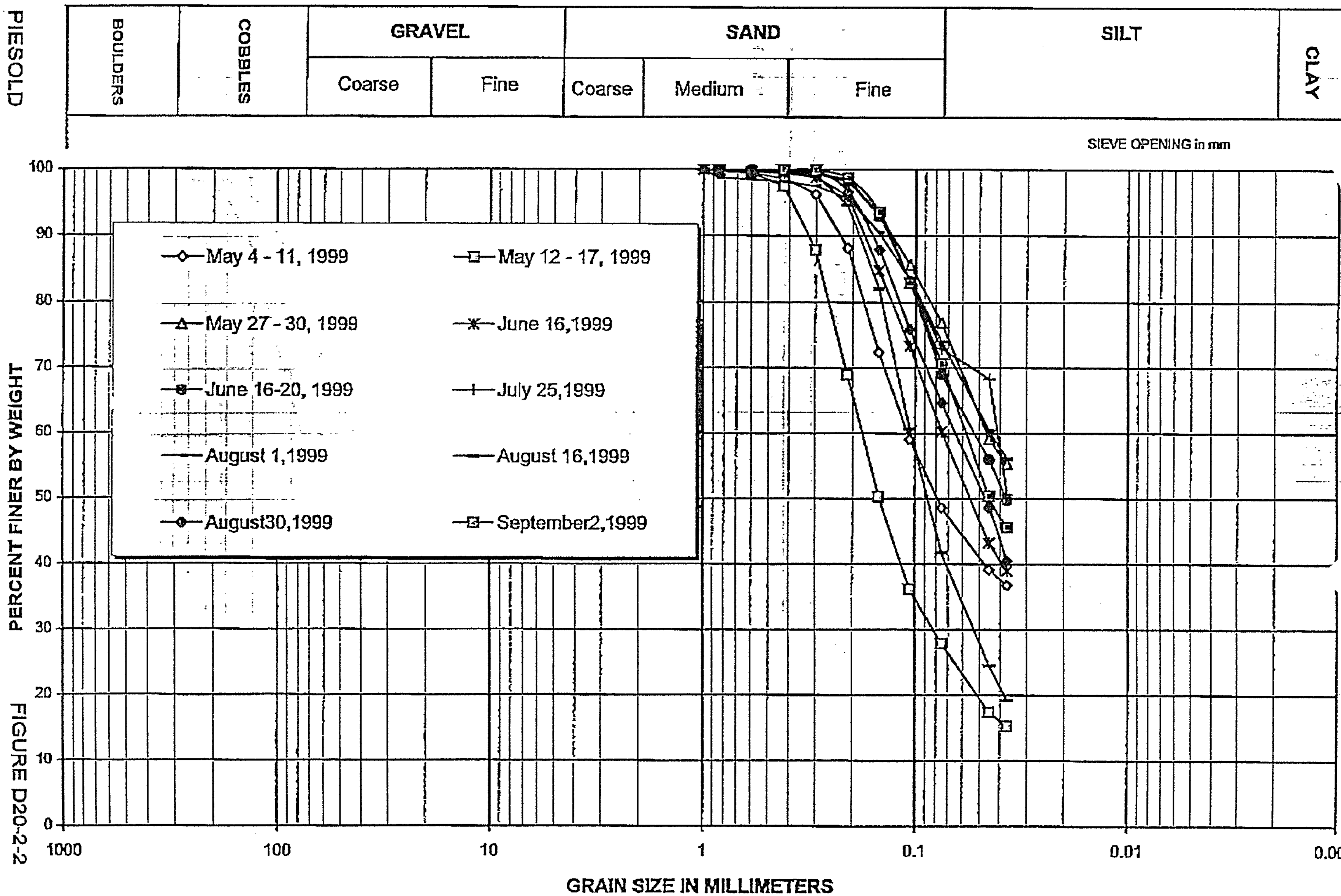

FIGURE D20-2-2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 3 OVERFLOW GRADATIONS

JNA

Knight Piesold
CONSULTING

1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

SHEET :	1 of 1
PERIOD :	31-Aug-99
PROJECT #:	11162/10
AREA :	Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES

MATERIAL : D20-3 OVERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution																
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	0
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400	Hydrometer				
		%	%	%	%	%	%	%	%	%	%	%		%	%	%	%	%
May 4 - 11, 1999	Cyclone #3				100.00	99.90	99.40	97.30	91.60	82.30	70.80	56.40	51.90	-	-	-	-	-
May 12- 17, 1999	Cyclone #3	99.8	99.8	99.00	98.30	96.20	89.00	70.30	46.70	32.30	22.70	15.20	12.40	-	-	-	-	-
June 5,1999	Cyclone #3		100.0	99.7	99.3	97.8	94.2	84.3	67.8	46.5	27.5	16.0	12.4	-	-	-	-	-
June 7,1999	Cyclone #3				100.0	99.8	99.8	96.8	89.2	75.2	60.5	39.6	34.6	-	-	-	-	-
June 8,1999	Cyclone #3			100.0	99.8	98.9	97.0	83.0	56.6	36.2	25.3	13.8	11.5	-	-	-	-	-
June 16-20, 1999	Cyclone #3				100.0	99.9	99.5	98.3	94.6	86.5	73.7	61.2	55.4	-	-	-	-	-
June 23,1999	Cyclone #3		100.0	99.7	99.4	99.0	98.2	95.4	86.8	71.7	57.9	38.2	33.3	-	-	-	-	-
August 1,1999	Cyclone #3			100.0	99.9	99.8	99.1	96.6	88.4	78.9	67.6	53.8	48.8	-	-	-	-	-
August 18,1999	Cyclone #3						100.0	98.3	92.5	81.4	69.7	53.6	48.6	-	-	-	-	-
September2,1999	Cyclone #3					100.0	99.8	98.3	93.4	83.6	72.3	54.1	49.6					
September26,1999	Cyclone #3					100.0	99.9	98.7	94.6	85.3	73.7	54.2	49.2					
	MEDIAN	99.8	100.0	99.7	99.8	99.8	99.4	96.8	89.2	78.9	67.6	53.6	48.6	-	-	-	-	-
	MAXIMUM	99.8	100.0	100.0	100.0	100.0	100.0	98.7	94.6	86.5	73.7	61.2	55.4	-	-	-	-	-
	MINIMUM	99.8	99.8	99.0	98.3	96.2	89.0	70.3	46.7	32.3	22.7	13.8	11.5	-	-	-	-	-

Notes: 1) These are 100% limits.

File: d20-3 Summary.xls Sheet: OVER PLOT Date: 06/10/99 Time Plotted: 2:41 PM

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MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-3 OVERFLOW TAILINGS SAMPLES

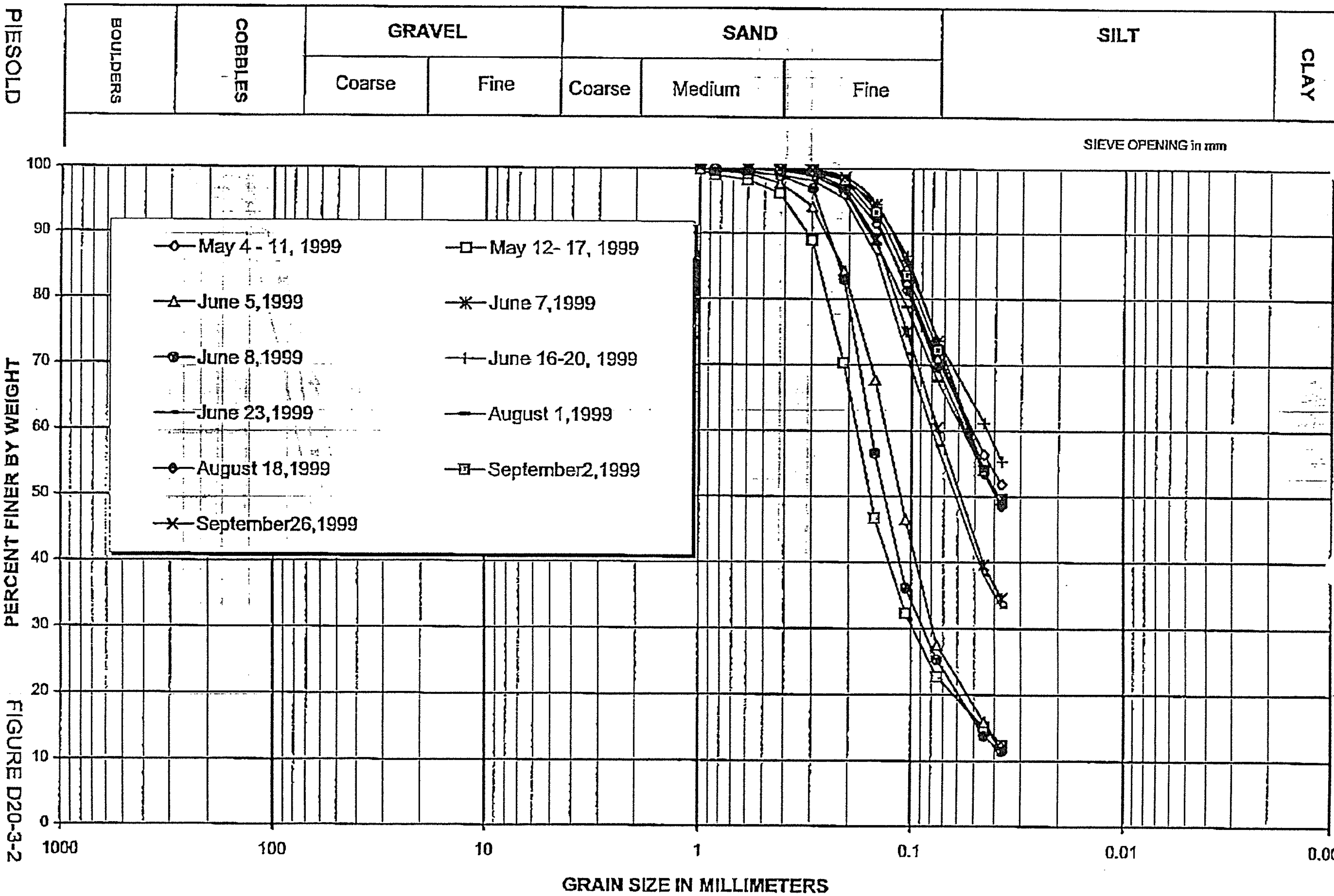

FIGURE D20-3-2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 4 OVERFLOW GRADATIONS

#N/A

Knight Piesold
CONSULTING

1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

SHEET : 1 of 1
PERIOD : 31-Aug-99
PROJECT #: 11162/10
AREA : Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES
MATERIAL : D20-4 OVERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution																
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400	Hydrometer				
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
May 4 - 11, 1999	Cyclone #4			100.00	100.00	99.70	98.10	89.70	67.10	44.30	28.50	16.10	13.50	-	-	-	-	-
May 12- 17, 1999	Cyclone #4		100.0	98.60	97.80	95.50	88.40	70.20	49.30	34.00	25.20	14.40	12.30	-	-	-	-	-
May 27-30, 1999	Cyclone #4		100.0	99.7	99.2	97.8	94.0	77.0	52.6	34.2	23.0	15.1	12.4	-	-	-	-	-
May 31-June 2, 1999	Cyclone #4		100.0	99.5	99.1	97.6	94.0	84.4	70.8	61.1	55.0	50.5	48.7	-	-	-	-	-
June16-20, 1999	Cyclone #4				100.0	99.8	99.6	98.4	93.7	83.7	68.9	55.8	49.9	-	-	-	-	-
June 23,1999	Cyclone #4			100.0	99.8	99.6	99.3	98.1	93.2	82.5	70.5	52.1	46.9	-	-	-	-	-
July 3,1999	Cyclone #4				100.0	99.9	99.8	99.3	95.4	86.6	76.2	57.9	53.2	-	-	-	-	-
July 6,1999	Cyclone #4		100.0	99.7	98.6	93.3	80.6	60.6	44.4	33.1	25.5	16.7	15.2	-	-	-	-	-
July 25,1999	Cyclone #4		100.0	99.9	99.9	99.8	99.7	98.9	95.8	87.6	76.9	58.8	51.7	-	-	-	-	-
August 1,1999	Cyclone #4			100.0	99.9	99.8	99.2	97.0	89.7	80.5	69.3	56.5	50.7	-	-	-	-	-
August 16,1999	Cyclone #4		100.0	99.9	99.9	99.8	99.3	96.5	89.5	78.2	66.6	51.8	45.0	-	-	-	-	-
August 30,1999	Cyclone #4		100.0	99.9	99.7	97.0	88.4	65.9	45.4	32.3	24.3	16.1	13.2					
Sepember2,1999	Cyclone #4		100.0	99.8	99.7	99.3	98.1	93.5	84.3	72.5	61.7	46.2	42.4					
	MEDIAN	#NUM!	100.0	99.9	99.8	99.6	98.1	93.5	84.3	72.5	61.7	50.5	45.0	-	-	-	-	-
	MAXIMUM	0.0	100.0	100.0	100.0	99.9	99.8	99.3	95.8	87.6	76.9	58.8	53.2	-	-	-	-	-
	MINIMUM	0.0	100.0	98.6	97.8	93.3	80.6	60.6	44.4	32.3	23.0	14.4	12.3	-	-	-	-	

Notes: 1) These are 100% limits.

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MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-4 OVERFLOW TAILINGS SAMPLES

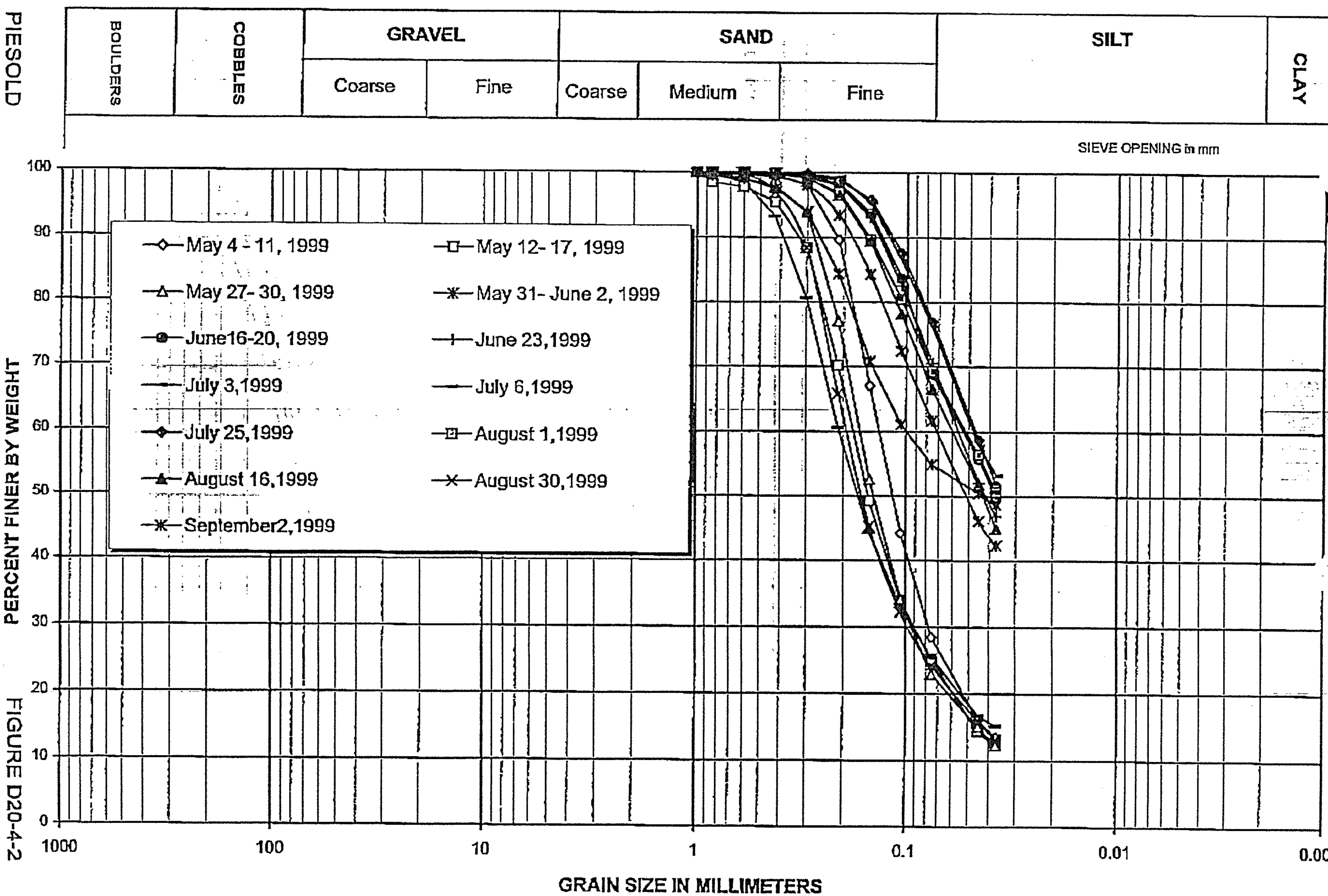

FIGURE D20-4-2

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 5 OVERFLOW GRADATIONS

#N/A

Knight Piesold CONSULTING

1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

SHEET : 1 of 1
PERIOD : 31-Aug-99
PROJECT #: 11162/10
AREA : Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES
MATERIAL : D20-5 OVERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution												Hydrometer				
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037	0.030	0.010	0.005	0.002	
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400					
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
June 16 - 20, 1999	Cyclone #5					100.00	99.88	98.68	93.30	82.75	65.63	51.65	46.00	-	-	-	-	-
June 23,1999	Cyclone #5			100.00	99.70	99.28	97.98	93.70	83.88	70.00	57.68	40.98	36.75	-	-	-	-	-
July 3,1999	Cyclone #5		100.0	99.98	99.95	99.90	99.65	98.48	93.63	83.90	73.08	56.03	51.35	-	-	-	-	-
July 6,1999	Cyclone #5		100.0	99.95	99.90	99.85	99.70	97.58	88.60	72.58	59.50	42.93	39.13	-	-	-	-	-
July 8-11, 1999	Cyclone #5		100.0	99.95	99.85	99.68	99.18	96.38	88.40	75.85	64.25	44.00	42.20	-	-	-	-	-
July 29,1999	Cyclone #5		100.0	99.78	99.76	99.59	98.64	94.94	86.93	76.50	63.75	47.50	43.25	-	-	-	-	-
August30,1999	Cyclone #5				100.00	99.95	99.43	95.63	86.38	73.90	62.60	45.10	41.05					
	MEDIAN	#NUM!	100.0	100.0	99.9	99.9	99.4	96.4	88.4	75.9	63.8	45.1	42.2	-	-	-	-	-
	MAXIMUM	0.0	100.0	100.0	100.0	100.0	99.9	98.7	93.6	83.9	73.1	56.0	51.6	-	-	-	-	-
	MINIMUM	0.0	100.0	99.8	99.7	99.3	98.0	93.7	83.9	70.0	57.7	41.0	36.8	-	-	-		

Notes: 1) These are 100% limits.

File: d20-5 Summary.xls Sheet: OVER.PLOT Date: 05/10/99 Time Plotted: 2:42 PM

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MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-5 OVERFLOW TAILINGS SAMPLES

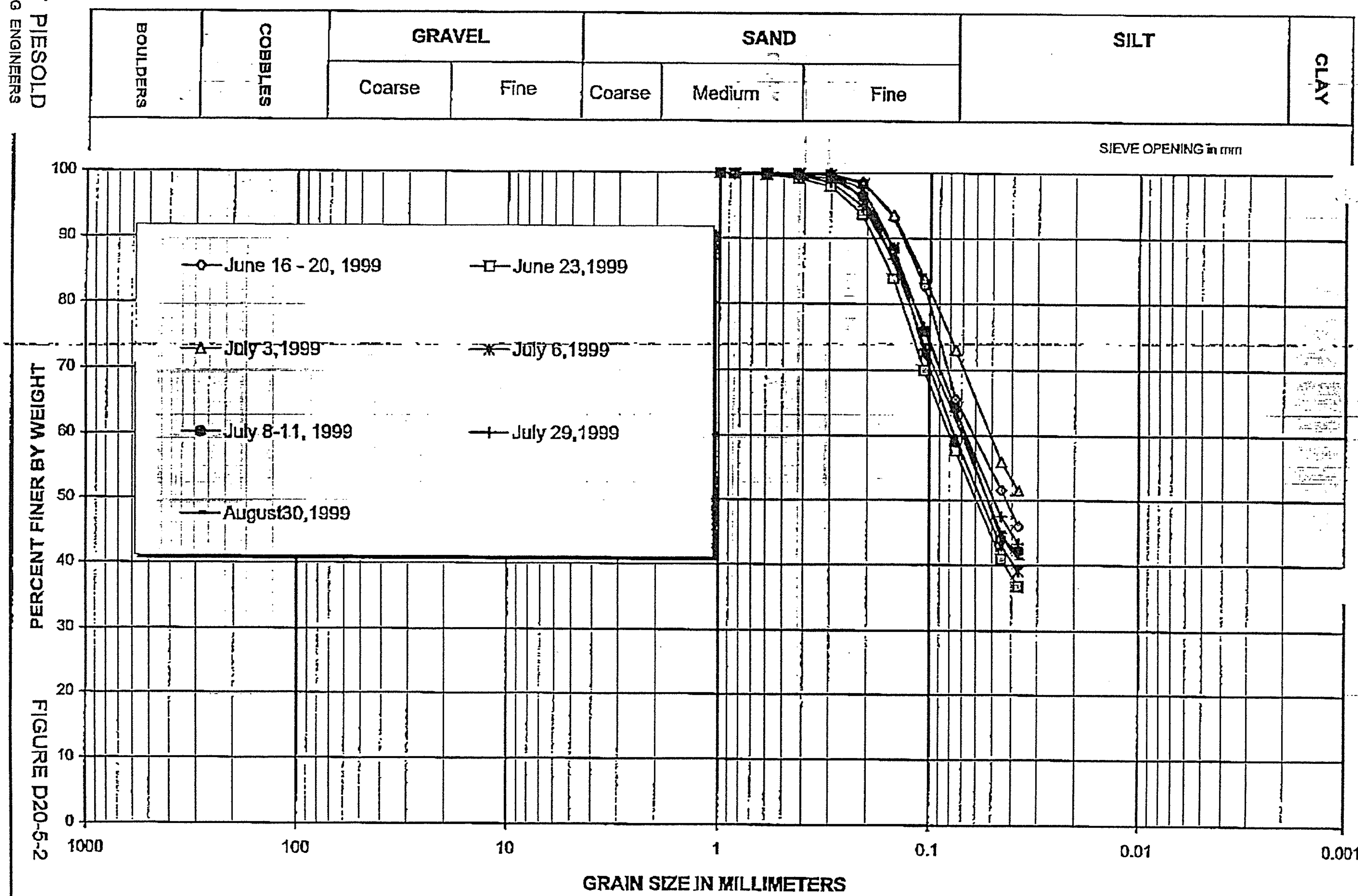

FIGURE D20-5-2

OCT. 7.1999 8:10AM MOUNT POLLY MINING NO.297 P.31/58

MOUNT POLLEY MINING CORPORATION
MOUNT POLLEY MINE

TAILINGS STORAGE FACILITY
STAGE 2C CONSTRUCTION

CYCLONE # 6 OVERFLOW GRADATIONS

#N/A

Knight Piesold
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1999 CONTROL SAMPLE TESTS - SUMMARY SHEET

SHEET : 1 of 1
PERIOD : 31-Aug-99
PROJECT #: 11162/10
AREA : Tailings Storage Facility

PROJECT : MOUNT POLLEY - CYCLONE TAILINGS ANALYSES
MATERIAL : D20-6 OVERFLOW TAILINGS SAMPLES

SAMPLE	LOCATION	Particle Size Distribution											
		2.36	1.00	0.85	0.60	0.43	0.30	0.212	0.150	0.106	0.075	0.045	0.037
		#8	#16	#20	#28	#35	#48	#65	#100	#150	#200	#325	#400
		%	%	%	%	%	%	%	%	%	%	%	%
June 16 - 20, 1999	Cyclone #6				100.00	99.93	99.35	97.00	90.00	78.33	61.95	47.98	42.35
June 23,1999	Cyclone #6		100.0	99.80	99.13	98.53	97.75	96.68	93.58	85.60	74.73	56.13	50.88
June 28,1999	Cyclone #6					100.00	99.98	99.10	93.30	80.55	66.73	44.10	38.15
July 6,1999	Cyclone #6					100.00	99.90	99.58	97.98	91.80	81.38	62.28	57.63
July 25,1999	Cyclone #6		100.0	96.15	95.83	95.30	94.63	93.15	89.35	80.70	71.05	58.45	48.88
August 1,1999	Cyclone #6		100.0	99.98	99.97	99.90	99.38	97.17	89.93	80.23	67.80	53.15	45.00
August 5,1999	Cyclone #6		100.0	99.90	99.85	99.68	99.63	96.80	91.85	83.38	73.20	61.65	49.85
August 16,1999	Cyclone #6			100.00	99.98	99.95	99.73	98.08	93.13	82.33	69.70	53.63	44.98
August30,1999	Cyclone #6		100.0	99.98	99.95	99.90	99.53	96.45	87.28	73.40	60.15	39.53	34.78
September2,1999	Cyclone #6		100.0	99.63	99.23	96.45	87.58	66.13	46.98	32.75	23.85	14.35	12.70
	MEDIAN	#NUM!	100.0	99.9	99.9	99.9	99.5	96.9	90.9	80.6	68.8	53.4	45.0
	MAXIMUM	0.0	100.0	100.0	100.0	100.0	100.0	99.6	98.0	91.8	81.4	62.3	57.6
	MINIMUM	0.0	100.0	96.2	95.8	95.3	87.6	66.1	47.0	32.8	23.9	14.4	12.7

SAMPLE	LOCATION	0.030	0.010	0.005	0.002	1
		Hydrometer				
		%	%	%	%	%
June 16 - 20, 1999	Cyclone #6	-	-	-	-	-
June 23,1999	Cyclone #6	-	-	-	-	-
June 28,1999	Cyclone #6	-	-	-	-	-
July 6,1999	Cyclone #6	-	-	-	-	-
July 25,1999	Cyclone #6	-	-	-	-	-
August 1,1999	Cyclone #6	-	-	-	-	-
August 5,1999	Cyclone #6	-	-	-	-	-
August 16,1999	Cyclone #6	-	-	-	-	-
August30,1999	Cyclone #6					
September2,1999	Cyclone #6					
	MEDIAN	-	-	-	-	-
	MAXIMUM	-	-	-	-	-
	MINIMUM	-	-	-	-	-

Notes: 1) These are 100% limits.

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MOUNT POLLEY MINING CORPORATION - MOUNT POLLEY MINE
GRADATION LIMITS
D20-6 OVERFLOW TAILINGS SAMPLES

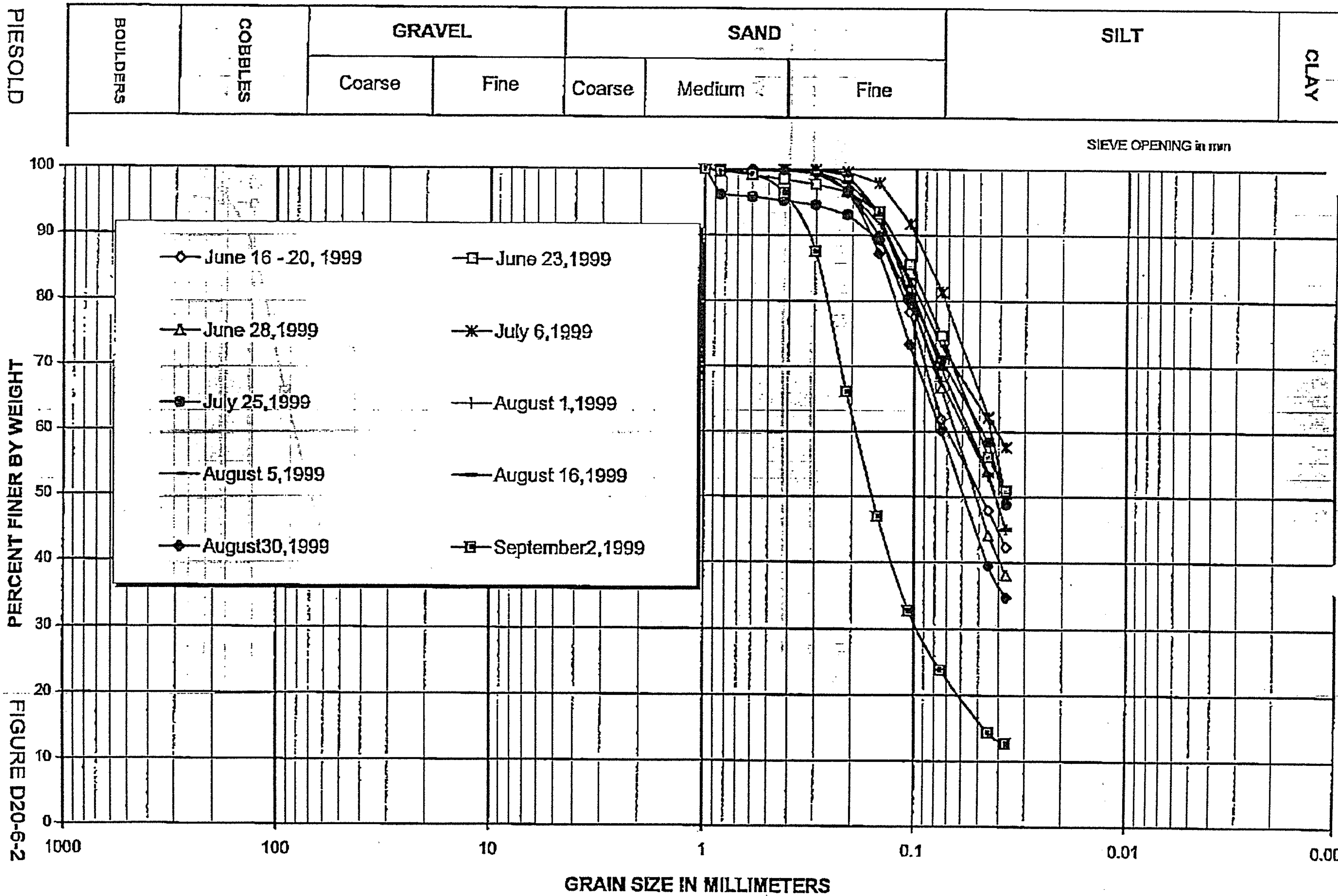

FIGURE D20-6-2

2-17