APPENDIX 8

GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS TAILINGS POND AREA

PITEAU ENGINEERING LTD.

1996

PITEAU ENGINEERING LTD.
HYDROGEOLOGICAL AND GEOTECHNICAL CONSULTANTS

SUITE 100, 4500 - 16th AVENUE N.W.
CALGARY, ALBERTA
CANADA T3B 0M6
TELEPHONE (403) 286-2522
TELEX 03-821172
FAX (403) 247-4811

TADEUSZ L. DABROWSKI
FREDERIC B. CLARIDGE
DENNIS C. MARTIN

GEOTECHNICAL AND HYDROGEOLOGICAL ASSESSMENT PROPOSED TAILINGS POND AREA TELKWA COAL PROJECT

PREPARED FOR:

MANALTA COAL LTD.

KI97-3773-12

JANUARY, 1997

TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

APPENDIX V B.C. MINISTRY OF ENVIRONMENT LAND AND PARKS WATER NUMERICAL CRITERIA

EXECUTIVE SUMMARY

Introduction

Piteau Engineering Ltd. (PEL) was retained by Manalta Coal Ltd. (Manalta) to conduct a series of geotechnical and hydrogeological investigations in support of the proposed Telkwa Coal Project near Telkwa, B.C. The work program for this investigation was designed to address a number of engineering and environmental considerations required to evaluate the suitability of the proposed site for tailings pond construction.

Program Overview

Nine sites were drilled under the supervision of PEL personnel within the tailings pond area while another eleven sites were drilled under the supervision of Manalta personnel. Boreholes were typically advanced to 20 m depth or the bedrock surface. At key locations where the depth to bedrock exceeded 20 m, boreholes were continued to bedrock to improve understanding of subsurface conditions. These sites were well distributed throughout the tailings pond area and provide good lateral site coverage.

Soil samples for geotechnical tests were obtained from testholes at selected intervals using both split spoon and Shelby tube samplers. Where split spoon samples were obtained, a standard penetration test (recording of blow counts per unit length) was also conducted. The unconfined compressive strength of split spoon samples was measured in the field using a pocket penetrometer. Shelby tube samples were sealed with tape and were used for laboratory tests as required.

Double piezometer nests were installed at three locations. The upper piezometer was completed (screened) across the water table or inferred water table, while the lower piezometer was completed in the next potential groundwater bearing zone. The installation of double piezometer nests allows for the determination of vertical hydraulic gradients. After installation, all piezometers containing groundwater were developed using an air-lift technique. Where possible, single well response or "bail" tests were subsequently performed to determine hydraulic conductivity and samples were then collected for groundwater chemical analyses.

Surficial Geology

Surficial geological conditions were evaluated based on airphoto interpretations and borehole drilling. Within the tailings pond area, distinct upper and lower stratigraphic units were identified. The lower unit exhibits a high degree of lateral variability, ranging from coarse grained outwash sands and gravels to fine grained glacio-lacustrine silts and clays. Distribution of the lower unit is interpreted to be controlled by bedrock topography. The lower unit is encountered within the northern portion of the tailings pond area where the depth to bedrock exceeds approximately 20 m.

The upper unit is a lower permeability sand and silt till which is continuous beneath most of the tailings pond area. The upper surficial unit consists of 12 - 20 m of sand and silt till, overlain by up to 2.5 m of fine grained clayey silt deposits. The till is medium to dark brown and contains

some to little clay (~ 20%) and gravel. The overlying glacio-lacustrine sediments grade from pure silt in the south to clayey silt in the north.

A localized sand and gravel deposit, extending from surface to 9.5 m below ground surface was encountered within the west-central portion of the proposed tailings pond area. The sand and gravel unit occurs within a topographic low and is incised into the till and clay deposits which otherwise blanket the proposed tailings pond area. The deposit appears to follow the course of a northwest trending intermittent stream which drains into the local resident's dugout pond. Because of the inferred localized nature of the sand and gravel deposit, potential seepage through this unit can be easily mitigated as discussed below.

Bedrock Geology

The upper 10 m of bedrock comprises an interbedded sequence of dark gray mudstone, siltstone and sandstone. The bedrock surface dips to the north, at an estimated angle of approximately six degrees. At the south end of the tailings pond area, the depth to bedrock ranges from 12 m - 17.6 m below ground; near the north end of the tailings pond area, depth to bedrock is greater than 42.5 m below ground.

Hydrogeology

Groundwater Flow

Depth to groundwater in the surficial groundwater bearing zone ranges from 0.4 m to > 42.5 m below ground surface. Variations in groundwater surface elevations are interpreted to be controlled by the elevation of the bedrock surface, the occurrence of sand and gravel deposits in the lower surficial unit, and the elevation of adjacent valleys (which act as local drainage areas).

Groundwater flow within the surficial deposits is generally expected to follow topography in a north/northwest direction at a rate estimated to be less than 10 m/year. Groundwater flow patterns within bedrock are also expected to be in the same direction towards the Telkwa River. An upward vertical hydraulic gradient was measured at one of the piezometer nests. At this location, flowing artesian conditions occur; based on visual observations, the flow rate is estimated to be less than approximately 4 L/min. It was not possible to establish vertical hydraulic gradients at the other two piezometer nests as they were dry at the time of measurement.

Based on one single well response test, the in-situ hydraulic conductivity of the till was estimated to be approximately 6.5×10^{-9} m/s. The hydraulic conductivity of the underlying gravel/mudstone was estimated from one single well response test to be 8.2×10^{-7} m/s. Results of laboratory permeameter tests on till samples yielded a hydraulic conductivity of approximately 7.0×10^{-10} m/s (depth interval 0.50 - 0.95 m) and 4.0×10^{-11} m/s (depth interval 6.20 - 6.65 m).

Groundwater Quality

Groundwater temperatures were in the range of 6.5 to 7.3°C. Groundwater pH was in the range of 7.44 - 7.50, with electrical conductivities in the range of 734 to 1,090 µS/cm. Groundwater analyses from the two piezometers may be characterized as a sodium-bicarbonate hydrochemical type. The dominance of the sodium cation suggests groundwater with a relatively long subsurface residence time and/or natural softening by cation exchange. Concentrations of total dissolved solids (TDS) were in the range of 460 - 688 mg/L.

The B.C. Ministry of Environment Land and Parks water quality criteria for freshwater aquatic life were used to appraise results for select indicator parameters and metals. Concentrations of the indicator parameters sulphate, chloride, TDS, and nitrogen species in groundwater were below the freshwater aquatic life criteria.

Total metals measured at concentrations above the recommended criteria were cadmium (total and dissolved), chromium, copper, lead, zinc, aluminum, iron, and manganese. Chemical results from the first sampling event may not be representative of actual groundwater conditions due to the likelihood of high levels of suspended solids occurring within the sand pack following piezometer installation. Laboratory results from a second sampling event are expected to provide a better indication of metal concentrations in groundwater.

Preliminary Seepage Analysis

Neglecting the northwest portion of the proposed tailings pond area underlain by sand and gravel, the seepage rate through the remaining tailings pond area (~ 1.20 km^2) is estimated to be in the order of 6 L/sec. Using assumed distributions for the factors that control seepage *(i.e.,* hydraulic conductivity of the till and vertical hydraulic gradient between the tailings pond and underlying till), a statistical technique was also employed to estimate what the possible range of seepage values may be. From this analysis, seepage through the tailings pond is estimated to be in the range of approximately 0.1 - 22.5 L/sec.

Results from the preliminary seepage analysis suggest that the majority of the proposed tailings pond area, which is largely underlain by more than 10 m of low permeability till, would be suitable for tailings deposition. Potential high seepage rates through a limited sand and gravel deposit can be readily mitigated by constructing a low permeability subsurface cutoff wall.

Geotechnical Considerations

Soil Properties

The clayey silt layer, which was noted in most boreholes varies in thickness from 0.8 to 3.1 m and extends to a maximum depth of 3.5 m below grade. The clayey silt is medium brown coloured, low plastic, firm to stiff in consistency and contains a trace of sand. Moisture content values are in the range of 25 to 26 percent. Corresponding average SPT blow count and undrained shear strength values are 10 blows/0.3 m and 0.75 kg/cm^2 respectively.

The till deposit consists predominantly of silt and sand. The till is medium brown coloured, low plastic, stiff to hard in consistency, and contains a little to some clay and gravel. Moisture content values are in the range of 8 to 11 percent and laboratory measured coefficient of permeability for the clayey silt is $4x10^{-7}$ m/s. The tills are generally classified as CL-ML, CL or ML-OL. SPT blow counts throughout the deposit ranged from 16 to 44, which is indicative of a stiff to hard deposit. Similarly, compressive strength values varied between 1.25 and 4.5 kg/cm^2 (125-450 kPa). Corresponding undrained shear strength values are 63 to 225 kPa *(i.e.,* half the compressive strength values).

Perimeter Dyke

The proposed 2.6 km of perimeter dykes are feasible from a geotechnical design stand point. The till and sand and gravel foundations will provide adequate support for the structure. However, it will be necessary to provide a seepage cut off or impervious blanket across the sand and gravel zone as discussed below.

The dykes would be constructed from earth materials, the bulk of which would be excavated from within the reservoir area. The most economic and effective design would probably entail a homogeneous till section, with upstream rock riprap as erosion protection, placed on sand and gravel transition zone material. An internal drainage layer of sand or sand and gravel would also be required. The till can be readily placed and compacted to a dense condition with a minimal amount of moisture conditioning required. Riprap would be obtained from a suitable rock quarry, or from mine rock waste, depending on its properties, particularly the resistance to breakdown from physico-chemical weathering processes. Some or all of the granular transition and filter materials may be obtained from the dam and reservoir area, depending on the material specifications and design requirements.

Sand and Gravel Zone Cutoff

Although the sand and gravel deposit underlying a 200 m long section of the perimeter dyke will provide adequate foundation support, it will need to be sealed off to separate the reservoir water from groundwater. Based on the available drilling information, it should be feasible to excavate at relatively steep slopes (1.5 horizontal to vertical) down to the water table at a depth of approximately 4 m. For the remaining 5-6 m below the water table to the bottom of the deposit, a slurry cutoff wall is recommended.

An alternative to an excavated cutoff is to place a blanket of low permeability soil over the area of sand and gravel deposit which is exposed in the reservoir. The blanket would be constructed from till in compacted layers to a minimum thickness of 1 m. It would be covered with a 1 m thick layer of free dumped till to protect the blanket from desiccation and weathering effects.

1. INTRODUCTION

Piteau Engineering Ltd. (PEL) was retained by Manalta Coal Ltd. (Manalta) to conduct a series of geotechnical and hydrogeological investigations in support of the proposed Telkwa Coal Project near Telkwa, B.C. (Figure 1). This report presents results from the geotechnical and hydrogeological investigations within the proposed tailings pond area (Figure 2). It parallels additional studies by PEL involving: 1) an assessment of the engineering geology and geotechnical considerations at the Tenas Pit and waste dumps (PEL, 1997a), and 2) an investigation of baseline hydrogeological conditions at Tenas Pit, the waste dumps, and Pit 3 (PEL, 1997b).

The work program for this investigation was designed to address a number of engineering and environmental considerations required to evaluate the suitability of the proposed site for tailings pond construction. Field work was completed between July and September, 1996.

2. TAILINGS POND AREA

2.1 PROGRAM OVERVIEW

Geotechnical and hydrogeological investigations were conducted within the proposed tailings pond area (Figure 3). Nine sites (denoted TOB96 series) were drilled by Cora Lynn Drilling Ltd. under the supervision of PEL personnel within the tailings pond area. Boreholes were typically advanced to 20 m depth or the bedrock surface. At key locations where the depth to bedrock exceeded 20 m, boreholes were continued to bedrock to improve understanding of subsurface conditions. Eleven sites (one denoted T79R and ten denoted T96R series) were drilled as coal exploration holes in the vicinity of the pond under the supervision of PEL personnel. Overall, borehole locations were well distributed throughout the tailings pond area and provide good lateral site coverage.

Soil samples for geotechnical tests were obtained from testholes at selected intervals using both split spoon and Shelby tube samplers. Where split spoon samples were obtained, a standard penetration test (recording of blow counts per unit length) was also conducted. The unconfined compressive strength of split spoon samples was measured in the field using a pocket penetrometer. Shelby tube samples were sealed with tape and were used for laboratory tests as required.

Double piezometer nests were installed at the following three locations within the proposed tailings pond area: at TOB96-07 (upgradient position), TOB96-10 and TOB96-14 (downgradient positions). The upper piezometer was completed (screened) across the water table or inferred water table, while the lower piezometer was completed in the next potential groundwater bearing zone. The installation of double piezometer nests allows for the determination of vertical hydraulic gradients.

After installation, all piezometers containing groundwater were developed using an air-lift technique. Where possible, single well response or "bail" tests were subsequently performed to

determine hydraulic conductivity and samples were then collected for groundwater chemical analysis. Field protocols for these activities are discussed in Appendix I. Piezometer completion details are summarized in Table 1 and are illustrated on the logs in Appendix II. Summary information on the T79R and T96R series boreholes are presented in Table 2. Hydraulic conductivity test data and analyses are provided in Appendix III, while the laboratory reports are given in Appendix IV.

2.2 SURFICIAL GEOLOGY

The surficial geology is discussed below based on airphoto interpretations (PEL, 1996) and borehole drilling. The geotechnical properties of the surficial deposits are discussed separately in Section 2.6.1.

Within the tailings pond area, the surficial geology comprises distinct upper and lower stratigraphic units. The lower unit exhibits a high degree of lateral variability, ranging from coarse-grained outwash sands and gravels to fine grained glacio-lacustrine silts and clays. Distribution of the lower unit is interpreted to be controlled by bedrock topography. The upper unit is a lower permeability sand and silt till which is continuous beneath most of the tailings pond area. The surficial geology of the tailings pond area is illustrated in cross-sections A-A', B-B', and C-C' on Figures 4 - 6, respectively.

Lower Surficial Unit

The lower unit is encountered within the northern portion of the tailings pond area where the depth to bedrock exceeds approximately 20 m. It consists of predominantly fine grained silts and clays likely deposited in a glacio-lacustrine environment. Basal clays (TOB96-10, Figure 5) are overlain by silty clay, with thin sand and gravel layers. North of TOB96-10 at T96R-151 (Figure 5), and within the northeastern portion of the tailings pond area at TOB96-14 (Figure 6), the lower surficial unit predominately consists of sand and gravel outwash or valley fill deposits.

Within the central portion of the tailings pond area *(i.e.,* T96R-112, TOB96-10, and TOB96-14), a gravel deposit marks the contact between the lower and upper surficial units. The gravel

deposit is absent in the southern end of the tailings pond area, but increases gradually to the north where it attains a thickness of approximately 10 m at TOB96-10 (Figure 5).

Upper Surficial Unit

The upper surficial unit consists of 12 - 20 m of sand and silt till, overlain by up to 2.5 m of fine grained clayey silt deposits. The till is medium to dark brown and contains some to little clay (~ 20%) and gravel. The colour of the till becomes darker and clay percentage appears to increase with depth. The overlying glacio-lacustrine sediments grade from pure silt in the south to clayey silt in the north. The silt is medium brown, soft and varved (as observed in shelby tube samples).

A localized sand and gravel deposit, extending from surface to 9.5 m below ground surface was encountered at TOB96-06 (Figures 4 and 5). The sand and gravel unit occurs within a topographic low and is incised into the till and clay deposits which otherwise blanket the proposed tailings pond area. The deposit appears to follow the course of a northwest trending intermittent stream which drains into the local resident's dugout pond. Because of the inferred localized nature of the sand and gravel deposit, potential seepage through this unit can be easily mitigated. This is discussed further in Section 2.6.4.

2.3 BEDROCK GEOLOGY

The upper 10 m of bedrock comprises an interbedded sequence of dark gray mudstone, siltstone and sandstone. The bedrock surface dips to the north, at an estimated angle of approximately six degrees (Figure 5). At the south end of the tailings pond area, the depth to bedrock ranges from 12 m (TOB96-16) - 17.6 m (TOB96-07). Near the north end of the tailings pond area, depth to bedrock exceeds 81 m at TOB96-10.

2.4 HYDROGEOLOGICAL CONDITIONS

2.4.1 GROUNDWATER FLOW

Key features of the hydrogeology beneath the proposed tailings pond area are summarized below based on Figures 4- 6.

- the bedrock surface is interpreted to dip steeply to the north/northwest and consequently the thickness of surficial sediments overlying bedrock increases significantly in this direction;

- with the exception of the localized sand and gravel deposit in the northwest area (see below) the majority of the proposed tailings pond area is interpreted to be underlain by a low permeability till deposit which has a minimum thickness of 12 m;

- depth to groundwater in the surficial groundwater bearing zone ranges from 0.4 m (TOB96-07-10) to > 42.5 m below ground surface (TOB96-14-43). Variations in groundwater surface elevations are interpreted to be controlled by the elevation of the bedrock surface, the occurrence of sand and gravel deposits in the lower surficial unit, and the elevation of adjacent valleys which act as local drainage areas; and,

- at TOB96-07-20 (completed across the till/mudstone bedrock contact) flowing artesian conditions occur; based on visual observations, the flow rate is estimated to be less than approximately 4 L/min.

Although there is insufficient information to contour groundwater surface elevations (four of the six piezometers completed in the surficial sediments were dry at the time of measurement) and thus to determine horizontal hydraulic gradients and groundwater flow velocities, groundwater flow within the upper surficial deposits is generally expected to follow topography in a north/northwest direction at a rate estimated to be less than 10 m/year. Groundwater flow patterns within bedrock are also expected to be in the same direction towards the Telkwa River.

Upward vertical hydraulic gradients were measured at piezometer nest TOB96-07-10/20. It was not possible to establish vertical hydraulic gradients at the other piezometer nest sites (*i.e.*, TOB96-10-11/28 and TOB96-14-10/43) as they were dry at the time of measurement.

Based on one single well response test (TOB96-07-10), the in-situ hydraulic conductivity of the till was estimated to be approximately 6.5×10^{-9} m/s (Table 1). The hydraulic conductivity of the underlying gravel/mudstone was estimated from one single well response test (TOB96-07-20) to be 8.2×10^{-7} m/s.

Results of laboratory permeameter tests on till samples from TOB96-09 (Table 3) yielded a hydraulic conductivity of 7×10^{-10} m/s (depth interval 0.5 - 0.95 m) and 4×10^{-11} m/s (depth interval 6.2 - 6.65 m.

2.4.2 GROUNDWATER QUALITY

Field Measured Parameters

Measurements of sensitive water quality parameters *(i.e.,* temperature, pH, and electrical conductivity) were conducted during the field sampling program and are summarized on Table 4. Groundwater temperatures were in the range of 6.5 to 7.3°C. Groundwater pH was in the range of 7.44 - 7.50, with electrical conductivities in the range of 734 to 1,090 µS/cm.

Laboratory Analysis

Key results from the analyses are presented on Tables 5 and 6. The original laboratory and quality assurance/quality control (QA/QC) data sheets are provided in Appendix IV.

The hydrochemical nature of the groundwater samples was characterized on an expanded Durov diagram (Figure 7). This diagram allows a simple, concise graphical representation of the water analyses. Analytical data are plotted according to the relative proportions of the major cations *(i.e.,* calcium, magnesium, and sodium + potassium) and major anions *(i.e.,* bicarbonate, sulphate, and chloride), expressed as milliequivalents per litre (meq/L). Depending on the dominant cation(s) and anion(s), various hydrochemical water types can be identified.

Recently recharged groundwater is usually a calcium-bicarbonate type, plotting in the upper left-hand square of the Durov diagram. Natural softening by cation exchange *(i.e.,* sodium for calcium) can occur with increased residence time. This type of groundwater plots in the upper right-hand square of the diagram. Groundwater characterized by relatively long residence time is commonly of a sodium-chloride type, which plots in the lower right-hand square.

As shown on Figure 7, groundwater analyses from the two piezometers completed in the upper surficial units can be characterized as a sodium-bicarbonate hydrochemical type. The dominance of the sodium cation suggests groundwater with a relatively long subsurface residence time and/or natural softening by cation exchange. Concentrations of total dissolved solids (TDS) were in the range of 460 - 688 mg/L.

Indicator Parameters

Water quality standards as specified by the B.C. Ministry of Environment Land and Parks for freshwater aquatic life (Appendix V) were used to assess results for select indicator parameters and metals.

Concentrations of indicator parameters sulphate, chloride, TDS and nitrogen species, together with the applicable water quality criteria are presented in Table 5. Concentrations of the indicator parameters in groundwater were all below the freshwater aquatic life criteria.

Metals

Concentrations of metals, together with the B.C. freshwater aquatic life criteria are presented in Table 6. Metals measured at concentrations (total) above the recommended criteria were as follows:

Piezometer	Metals Above Freshwater Aquatic Life Criteria [1]
TOB96-07-10	cadmium (total and dissolved), copper, lead, zinc, aluminum, iron, and manganese
TOB96-07-20 (includes dup.)	cadmium, chromium, copper, zinc, aluminum, iron, and manganese

NOTES:

[1] Based on B.C. Ministry of Environment Land and Parks Water Numerical Criteria (see Appendix V).

Chemical results from the first sampling event may not be representative of actual groundwater conditions due to the likelihood of high levels of suspended solids occurring within the sand pack following piezometer installation. Laboratory results from a second sampling event are expected to provide a better indication of metal concentrations in groundwater.

In addition to the standard laboratory QA/QC procedures (see Appendix IV), a field blank and a duplicate sample from TOB96-07-20 were submitted for analysis. Concentrations of all indicator parameters and metals were below the laboratory detection limits for the field blank. With the exception of certain total metal concentrations, analytical results from TOB96-07-20 were within 20% of the duplicate sample. Overall, the QA/QC results are considered satisfactory.

2.5 PRELIMINARY SEEPAGE ANALYSIS

One of the key considerations in the assessment of the proposed tailings pond area is the amount of seepage *(i.e.,* volume per unit time) that may occur through the native soils. The seepage analysis was carried out using Darcy's Law as given by:

$$Q = K\,i\,A$$

where "Q" is the seepage rate [L^3/T], "i" is the vertical hydraulic gradient between the tailings pond and the underlying native soil [L/L], "K" is the hydraulic conductivity of the underlying native soil [L/T] and "A" is the surface area of the proposed tailings pond [L^2]. Results from the preliminary seepage analysis are summarized below based on an assumed vertical hydraulic gradient of 0.5. It is noted that no allowance is made for the potential sealing effect of the deposited tailings.

POND SECTOR	APPROXIMATE AREA (km^2)	HYDRAULIC CONDUCTIVITY (m/s)	ESTIMATED SEEPAGE RATE (L/sec)
Northwest portion (underlain by sand and gravel)	0.05	1×10^{-5}	250
Western, Eastern, and Northern portions *(i.e.,* remaining area)	1.20	1×10^{-8}	6

Notes:

1. Pond sector areas are approximate.
2. Hydraulic conductivity of the northwest portion (sand and gravel) assumed based on literature values (Freeze and Cherry, 1979).
3. Hydraulic conductivity of the till in the western, eastern, and northern portions of the tailings pond assumed to be ~ 0.5 order of magnitude greater than the value determined from the single well response test at TOB96-07-10.

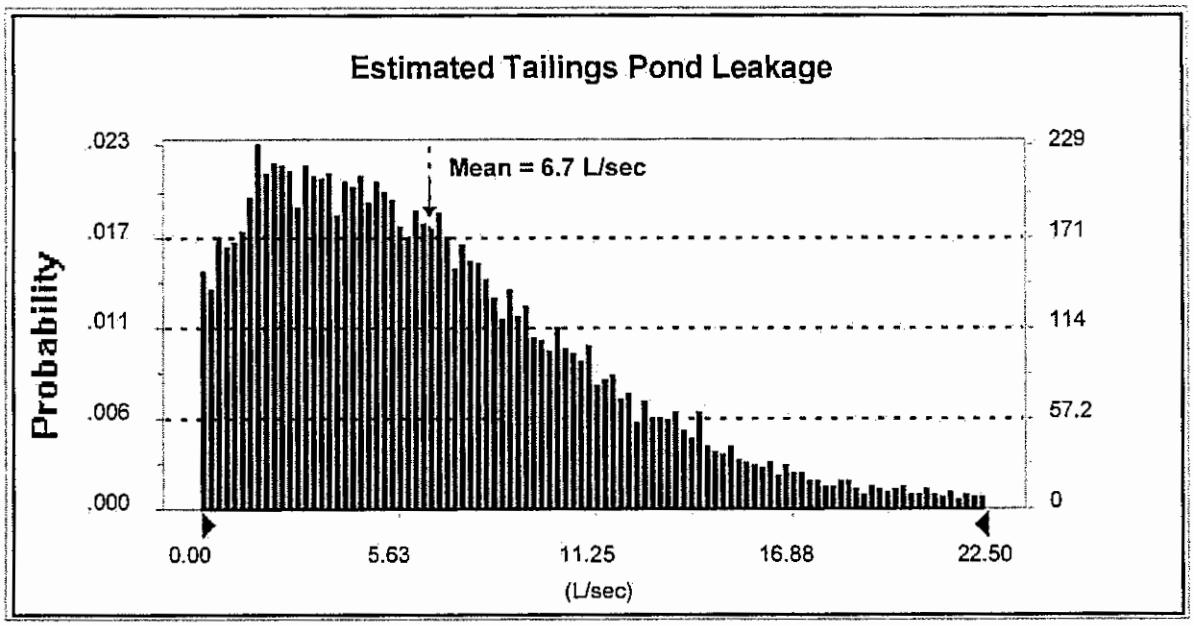
A very high seepage rate is estimated in the northwest portion of the tailings pond. The rate reflects the assumed high hydraulic conductivity of the sand and gravel sediments encountered at TOB96-06. Although the area extent of the sand and gravel deposits have not been determined, they are interpreted to be associated with the intermittent stream that traverses through the

northwest portion of the proposed tailings pond. Therefore, for calculation purposes, the deposits were assumed to occur within the area outlined by the 600 metres above sea level (masl) contour (~0.05 km^2 - see Figure 3).

Neglecting the northwest portion of the proposed tailings pond area, the estimated seepage rate over the remaining area of the tailings pond (~ 1.20 km^2) is in the order of 6 L/sec. (This value is less than the total maximum tailings pond seepage of 13.5 L/s estimated for the Telkwa north pond site, located north of the Telkwa River (PEL, 1994). Expressed another way, the leakage rate is equivalent to a water level decline of 0.16 m/year in the tailings pond.

It should be noted that the above analysis is based on a small number of hydraulic conductivity values determined either in the field *(i.e.,* single well response tests) or in the laboratory *(i.e.,* permeameter tests). While these values are considered to be realistic based on lithology, local variations in hydraulic conductivities may occur. Thus, to provide an estimate of what the potential range of seepage rates may be within the tailings pond (excluding the northwest sector underlain by sand and gravel), a risk analysis program (CRYSTAL BALL, V4.0a, Decisioneering Inc., 1996) was used.

Using assumed distributions for the factors that control seepage *(i.e.,* hydraulic conductivity of the till and vertical hydraulic gradient between the tailings pond and underlying till), a statistical technique was employed to estimate what the possible range of tailings pond seepage may be. Output from this analysis is presented below.



Given an assumed distribution for the hydraulic conductivity of the till *(i.e.,* log normal distribution with a mean of 1.0×10^{-8} m/s and a standard deviation of 1.0×10^{-8} m/s) and vertical hydraulic gradient *(i.e.,* varying between 0.3 and 0.8), seepage through the tailings pond is estimated to be in the range of approximately 0.1 - 22.5 L/sec. The maximum seepage rate is considered conservative as it is expected that, over time, the effect of fine tailings deposition in the pond would be to reduce seepage rates.

Results from the preliminary seepage analysis suggest that the majority of the proposed tailings pond area, which is largely underlain by more than 10 m of low permeability till, would be suitable for tailings deposition. Potential high seepage rates through a limited sand and gravel deposit can be readily mitigated by constructing a low permeability subsurface cutoff wall (see Section 2.6.4).

2.6 GEOTECHNICAL CONSIDERATIONS

2.6.1 SOIL PROPERTIES

Foundation conditions in the area of the proposed tailings pond are presented on borehole logs provided in Appendix II. These logs were prepared based on soil samples visually classified

according to the Unified Soil Classification (USC) system. Moisture content, Atterberg limits, grain size distribution, and permeability were determined in the laboratory on selected soil samples. These results are summarized in Table 3. Shear strength values were obtained from pocket penetrometer measurements to assess the stiffness of the deposit.

As noted in Section 2.2, the soil profile consists of a clayey silt layer underlain by a till, gravel or sand and gravel and mudstone/siltstone bedrock. The geotechnical characteristics of each unit are described below.

The clayey silt layer, which was noted in all boreholes with the exception of TOB96-05 and TOB96-16, varies in thickness from 0.8 to 3.1 m and extends to a maximum depth of 3.5 m below grade. The clayey silt is medium brown coloured, low plastic, firm to stiff in consistency and contains a trace to little sand. Coefficient of permeability of the clayey silt is in the order of $7x10^{-10}$ m/s. Encountered in the clayey silt deposit are areas of iron oxide straining, carbonaceous material in the form of coal fragments, calcareous deposits and occasional rootlets. Moisture contents values are in the range of 25 to 26 percent. Corresponding average SPT blow count and undrained shear strength values are 10 blows/0.3 m and 0.75 kg/cm^2 respectively.

The till deposit consists predominantly of silt and sand. The till is medium brown coloured, low plastic, stiff to hard in consistency, and contains a little to some clay and gravel. Noted in the till deposit are areas of iron oxide staining, calcareous deposits, carbonaceous materials in the form of coal fragments, siltstone fragments, and occasional sand stringers. Moisture content values are in the range of 8 to 11 percent and laboratory measured coefficient of permeability for the clayey silt is $4x10^{-7}$ m/s. The tills are generally classified as CL-ML, CL or ML-OL *(i.e.,* low plastic inorganic silts or clays), as shown in Figure 8.

Profiles of moisture content, SPT blow count and compressive strength (pocket penetrometer) against depth are provided in Figures 9 to 11 respectively. As indicated on Figure 10, SPT blow counts throughout the deposit ranged from 16 to 44, which is indicative of a stiff to hard deposit. Similarly, compressive strength values (Figure 11) varied between 1.25 and 4.5 kg/cm^2 (125-450

kPa). Corresponding undrained shear strength values are 63 to 225 kPa *(i.e.,* half the compressive strength values).

The geologic units encountered beneath the glacial till deposit varied between boreholes. Geotechnical information on these deposits is limited to visual description and overall thickness as detailed in the borehole logs (Appendix II).

2.6.2 PERIMETER DYKE

The proposed 2.6 km of perimeter dykes are feasible from a geotechnical design stand point. The till and sand and gravel foundations will provide adequate support for the structure. However, it will be necessary to provide a seepage cut off or impervious blanket across the sand and gravel zone as discussed below.

2.6.3 CONSTRUCTION MATERIALS

The dykes would be constructed from earth materials, the bulk of which would be excavated from within the reservoir area. The most economic and effective design would probably entail a homogeneous till section, with upstream rock riprap as erosion protection, placed on sand and gravel transition material. An internal drainage layer of sand or sand and gravel would also be required. The till could be readily placed and compacted to a dense condition with a minimal amount of moisture conditioning required.

Riprap would be obtained from a suitable rock quarry, or from mine rock waste, depending on its properties, particularly the resistance to breakdown from physico-chemical weathering processes. Some or all of the granular transition and filter materials may be obtained from the dyke and reservoir area, depending on the material specifications and design requirements.

2.6.4 SAND AND GRAVEL ZONE CUTOFF

Although the sand and gravel deposit underlying a 200 m long section of the perimeter dyke will provide adequate foundation support, it will need to be sealed off to separate the reservoir water from groundwater. Based on the available drilling information, it should be feasible to excavate

at relatively steep slopes (1.5 horizontal to vertical) down to the water table at a depth of approximately 4 m. For the remaining 5-6 m below the water table to the bottom of the deposit, a slurry cutoff wall is recommended.

The trench may be excavated through the sand and gravel with a backhoe. A soil-bentonite slurry would retain the trench walls at a near vertical angle. Following excavation, the slurry would be displaced by a well graded, low permeability soil, most likely till material from the adjacent area. Above the cutoff trench, the cutoff would be completed by placing layers of low permeability compacted till. The cutoff would be integral with the core of the overlying dyke, which would also be constructed in the same manner from till borrow material, as described above.

An alternative to an excavated cutoff is to place a blanket of low permeability soil over the area of sand and gravel deposit which is exposed in the reservoir. The blanket would be constructed from till in compacted layers to a minimum thickness of 1 m. It would be covered with a 1 m thick layer of free dumped till to protect the blanket from desiccation and weathering effects.

3. CONCLUSIONS

1. The site proposed for disposal of mine tailings appears to be satisfactory from both hydrogeological and geotechnical stability perspectives. The till deposit underlying the majority of the site offers a natural low permeability containment medium. The geotechnical properties of the till are also suitable both for foundation support and for use in dam construction.

2. The surficial geology of the tailings pond area comprises distinct upper and lower units. The upper surficial unit underlies the majority of the tailings pond area and consists of 12 m to 20 m of sand and silt till, overlain by up to 2.5 m of fine grained clayey silt deposits. The in-situ hydraulic conductivity of the till was estimated to be approximately 6.5×10^{-9} m/s. (TOB96-07-10). Results of permeameter tests yielded hydraulic conductivity values of approximately two orders of magnitude lower than determined from the in-situ test.

3. The depth to groundwater in the surficial groundwater bearing zone ranges from 0.4 m (TOB96-07-10) to > 42.5 m (TOB96-14-43). Variations in groundwater surface elevations are interpreted to be controlled by the elevation of the bedrock surface, the occurrence of sand and gravel deposits in the lower surficial unit, and the elevation of adjacent valleys (which act as local drainage areas). Groundwater flow within the upper surficial deposits is generally expected to follow topography in a north/northwest direction at a rate estimated to be less than 10 m/year. Groundwater flow patterns within bedrock are also expected to be in the same direction towards the Telkwa River.

4. An upward vertical hydraulic gradient was measured at piezometer nest TOB96-7-10/20. At this location, flowing artesian conditions occur; based on visual observations, the flow rate is estimated to be less than approximately 4l/min. It was not possible to establish vertical hydraulic gradients at the other piezometer nest sites (*i.e.,* TOB96-10-11/28 and TOB96-14-10/43) as they were dry at the time of measurement

5. Given an assumed distribution for the hydraulic conductivity of the till and vertical hydraulic gradient, the initial rate of seepage through the tailings pond is estimated to be in the range of approximately 0.1 - 22.5 L/sec. The maximum seepage rate is considered conservative as it is expected that, over time, the effect of fine tailings deposition in the pond would be to reduce seepage rates.

6. The localized sand and gravel deposit at TOB96-06, extending from surface to 9.5 m below ground surface could be hydraulically isolated from the tailings pond utilizing either a cutoff trench or a low permeability soil blanket.

7. Groundwater analyses from the two piezometers completed in the upper surficial units can be characterized as a sodium-bicarbonate hydrochemical type. Dominance of the sodium cation suggests groundwater with a relatively long residence time and/or natural softening by cation exchange. Concentrations of all indicator parameters were below the B.C. Ministry of Environment Land and Parks freshwater aquatic life criteria.

8. Total concentrations of cadmium (total and dissolved), chromium, copper, lead, zinc, aluminum, iron, and manganese were above the freshwater aquatic life criteria at TOB96-07-10 and TOB96-07-20. As results are based on the first sampling event, they may not be representative of actual groundwater conditions due to the high levels of total suspended solids occurring within the sand pack. Subsequent sampling programs will provide a better indication of groundwater chemistry.

4. RECOMMENDATIONS

1. The lateral extent and thickness of the sand and gravel deposit at TOB96-06 should be confirmed using a combination of geophysics surveys and borehole drilling. Based on these findings, the most cost effective approach to hydraulically isolate the deposits from the tailings pond should be identified.

2. Although the investigation program covered the general area of the proposed reservoir, additional delineation soil probing and/or geophysical investigation is warranted in the detailed engineering phase to confirm the continuity and thickness of the till and the limits of the sand and gravel deposit (s).

5. ACKNOWLEDGMENTS

The cooperation and assistance of project personnel from Manalta Coal Ltd. throughout the study is acknowledged and appreciated. Particular thanks are extended to Mr. A. Vanderputten and to Mr. A. Ledda.

Respectfully Submitted,

PITEAU ENGINEERING LTD.

Tadeusz L. Dabrowski, P.Eng. (Alta.)

Robert S. Clarkson, P.Geol. (Alta.)

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA F. B. CLARIDGE

Frederic B. Claridge, P.Eng.

Michael L. Brewster, P.Geol. (Alta.)

\\CENTRAL\DATA\PROJECTS\3773\3773-12\REPORTS\TAILPOND.DOC

6. REFERENCES

Decisioneering Inc., 1996. *CRYSTAL BALL* ®, Version 4.0a.

Freeze, R.A., and J.A. Cherry, 1979. *Groundwater*. Prentice-Hall. 604 pp.

Piteau Engineering Ltd., 1997a. *Engineering Geology and Geotechnical Assessment Tenas Pit and Waste Dumps.* Unpublished report prepared for Manalta Coal Ltd.. KI97-3773-12. January 1997.

Piteau Engineering Ltd., 1997b. *Baseline Hydrogeological Investigations in Tenas Pit and Pit #3.* Unpublished report prepared for Manalta Coal Ltd. KI97-3773-12. January 1997.

Piteau Engineering Ltd., 1996. *Preliminary Surficial Geology Map of the Telkwa Property. Unpublished Map prepared for Manalta Coal Limited.* KI93-3773-11. April 1996.

Piteau Engineering Ltd., 1994. *Telkwa Coal Project Water Management of Tailings Pond and Pits 7 and 8.* Unpublished report prepared for Manalta Coal Ltd. KI93-3773-3. June, 1994.

TABLE 1
PIEZOMETER INSTALLATION DETAILS, DATUM/ GROUNDWATER SURFACE ELEVATIONS AND HYDRAULIC CONDUCTIVITIES

PIEZO. NO.	NORTHING	EASTING	GROUND ELEVATION (masl)	STICK-UP PVC PIPE (above ground - approx.) (m)	DATUM ELEVATION (top of PVC casing) (masl)	TOTAL DEPTH OF PIEZO. (below ground) (m)	SCREEN INTERVAL (below ground) (m)	DATE (y/m/d)	DEPTH TO WATER BELOW DATUM (m)	GROUNDWATER SURFACE ELEVATION (masl)	HYDRAULIC CONDUCTIVITY (m/s)	LITHOLOGY
Tailings Pond												
TOB96-07-10	6057178	622256	613.28	0.65	613.93	10.4	7.4 - 10.4	96-Sep-18	1.08	612.85	6.5×10^{-9}	Silty clay till
TOB96-07-20	6057178	622256	613.28	0.65	613.93	19.7	16.6 - 19.6	96-Sep-18	flowing	>613.93	8.2×10^{-7}	Gravel / mudstor
TOB96-10-11	6057833	621877	605.02	0.65	605.67	10.5	7.5 - 10.5	96-Sep-18	dry	<605.67	N/A	Silty clay till
TOB96-10-28	6057833	621877	605.02	0.65	605.67	27.5	24.5 - 27.5	96-Sep-18	dry	<605.67	N/A	Sand & gravel
TOB96-14-10	6057804	622501	604.39	0.38	604.77	10.2	7.2 - 10.2	96-Sep-18	dry	<604.77	N/A	Silty clay till
TOB96-14-43	6057804	622501	604.39	0.38	604.77	42.5	41.0 - 42.5	96-Sep-18	dry	<604.77	N/A	Sand & gravel

NOTES:

1. masl - metres above sea level.
2. NA - not analyzed.
3. Borehole logs and piezometer completion details provided in Appendix II.

TABLE 2
BOREHOLE SUMMARY INFORMATION

DRILLHOLE	NORTHING	EASTING	TOTAL DEPTH OF BOREHOLE (below ground, m)	INTERVAL From (m)	INTERVAL To (m)	LITHOLOGY
Tailings Pond						
TOB96-05	6057406	621498	20.0	0.0	13.0	sand,silt,till
				13.0	20.0	silt (gravel)
TOB96-06	6057562	621644	10.0	0.0	9.5	sand,gravel
				9.5	10.0	till
TOB96-08	6057435	622515	19.0	0.0	1.0	silty clay
				1.0	8.0	sand,silt,till
				8.0	17.0	silt,gravel seams
				17.0	19.0	siltstone
TOB96-09	6057636	622296	20.0	0.0	1.9	clayey silt
				1.9	20.0	sand,silt,till
TOB96-15	6057406	622236	17.5	0.0	3.2	silty clay
				3.2	5.0	sand,gravel
				5.0	16.0	sand,silt,till
				16.0	16.5	gravel
				16.5	17.5	siltstone
TOB96-16	6057145	617700	13.5	0.0	2.0	silt
				2.0	2.5	sand
				2.5	10.0	sand,silt,till
				10.0	12.0	clay,silt,till
				12.0	13.5	siltstone
T79R-04	6057509	621492	71.3	N/A	N/A	N/A

TABLE 2
BOREHOLE SUMMARY INFORMATION

DRILLHOLE	NORTHING	EASTING	TOTAL DEPTH OF BOREHOLE (below ground, m)	INTERVAL From (m)	INTERVAL To (m)	LITHOLOGY
Tailings Pond						
T96R-104	6056245	622320	76.0	0.0	5.0	overburden
				5.0	19.8	mudstone
				19.8	27.0	siltstone
				27.0	28.5	sandstone
				28.5	31.0	mudstone
				31.0	38.0	siltstone
				38.0	44.0	mudstone
				44.0	47.8	siltstone
				47.8	61.7	mudstone
				61.7	61.8	coal
				61.8	62.1	mudstone
				62.1	62.3	coal
				62.3	62.6	mudstone
				62.6	64.2	coal
				64.2	64.4	mudstone
				64.4	65.6	coal
				65.6	69.0	conglomerate
				69.0	70.4	mudstone
				70.4	70.8	coal
				70.8	71.0	mudstone
				71.0	71.3	coal
				71.3	78.9	siltstone
				78.9	84.6	sandstone
				84.6	91.3	mudstone
				91.3	97.0	sandstone
				97.0	101.1	siltstone

TABLE 2
BOREHOLE SUMMARY INFORMATION

DRILLHOLE	NORTHING	EASTING	TOTAL DEPTH OF BOREHOLE (below ground, m)	INTERVAL From (m)	INTERVAL To (m)	LITHOLOGY
Tailings Pond						
T96R-104 (CON'T)				101.1	102.5	mudstone
				102.5	102.9	coal
				102.9	104.0	mudstone
				104.0	116.0	conglomerate
				116.0	122.0	sandstone
T96R-106	6056577	622290	135.1	0.0	5.0	overburden
				5.0	9.2	mudstone
				9.2	22.3	siltstone
				22.3	34.1	sandstone
				34.1	41.5	siltstone
				41.5	48.6	mudstone
				48.6	63.2	sandstone
				63.2	67.4	siltstone
				67.4	67.8	coal
				67.8	68.8	mudstone
				68.8	69.1	coal
				69.1	70.5	mudstone
				70.5	75.9	siltstone
				75.9	79.1	conglomerate
				79.1	86.2	mudstone
				86.2	86.8	coal
				86.8	87.0	mudstone
				87.0	87.2	coal
				87.2	88.2	mudstone
				88.2	88.7	coal
				88.7	91.0	mudstone
				91.0	91.3	coal

TABLE 2
BOREHOLE SUMMARY INFORMATION

DRILLHOLE	NORTHING	EASTING	TOTAL DEPTH OF BOREHOLE (below ground, m)	INTERVAL From (m)	INTERVAL To (m)	LITHOLOGY
Tailings Pond						
T96R-106 (CON'T)				91.3	91.7	mudstone
				91.7	91.9	coal
				91.9	92.4	mudstone
				92.4	92.7	coal
				92.7	92.9	mudstone
				92.9	94.0	coal
				94.0	94.3	mudstone
				94.3	95.4	coal
				95.4	98.0	sandstone
				98.0	99.6	mudstone
				99.6	99.8	coal
				99.8	100.1	mudstone
				100.1	101.1	coal
				101.1	101.3	mudstone
				101.3	101.6	coal
				101.6	105.0	mudstone
				105.0	105.3	coal
				105.3	105.7	mudstone
				105.7	107.1	coal
				107.1	107.4	mudstone
				107.4	107.7	coal
				107.7	108.6	mudstone
				108.6	109.2	coal
				109.2	116.9	siltstone
				116.9	123.0	conglomerate
				123.0	130.5	sandstone
				130.5	133.0	conglomerate
				133.0	140.0	mudstone

TABLE 2
BOREHOLE SUMMARY INFORMATION

DRILLHOLE	NORTHING	EASTING	TOTAL DEPTH OF BOREHOLE (below ground, m)	INTERVAL From (m)	INTERVAL To (m)	LITHOLOGY
Tailings Pond						
T96R-107	6056619	622141	86.0	0.0	4.0	overburden
				4.0	6.7	sandstone
				6.7	7.0	coal
				7.0	7.9	mudstone
				7.9	8.3	coal
				8.3	9.3	mudstone
				9.3	9.6	coal
				9.6	11.0	mudstone
				11.0	18.0	sandstone
				18.0	21.2	mudstone
				21.2	34.2	sandstone
				34.2	39.0	siltstone
				39.0	39.3	coal
				39.3	45.0	mudstone
				45.0	50.2	sandstone
				50.2	60.4	mudstone
				60.4	61.0	coal
				61.0	61.1	mudstone
				61.1	61.3	coal
				61.3	61.7	mudstone
				61.7	61.8	coal
				61.8	64.5	mudstone
				64.5	64.7	coal
				64.7	65.0	mudstone
				65.0	65.2	coal
				65.2	65.5	mudstone
				65.5	65.9	coal
				65.9	66.7	mudstone

TABLE 2
BOREHOLE SUMMARY INFORMATION

DRILLHOLE	NORTHING	EASTING	TOTAL DEPTH OF BOREHOLE (below ground, m)	INTERVAL From (m)	INTERVAL To (m)	LITHOLOGY
Tailings Pond						
T96R-107 (CON'T)				66.7	66.9	coal
				66.9	67.2	mudstone
				67.2	67.5	coal
				67.5	67.7	mudstone
				67.7	68.1	coal
				68.1	68.2	mudstone
				68.2	69.4	coal
				69.4	69.7	mudstone
				69.7	70.3	coal
				70.3	72.3	sandstone
				72.3	72.7	coal
				72.7	72.8	mudstone
				72.8	73.1	coal
				73.1	73.6	mudstone
				73.6	73.8	coal
				73.8	76.2	mudstone
				76.2	81.2	siltstone
				81.2	81.6	coal
				81.6	81.7	mudstone
				81.7	82.1	coal
				82.1	85.6	mudstone
				85.6	89.3	siltstone
				89.3	100.4	sandstone
				100.4	100.8	coal
				100.8	116.1	siltstone

TABLE 2
BOREHOLE SUMMARY INFORMATION

DRILLHOLE	NORTHING	EASTING	TOTAL DEPTH OF BOREHOLE (below ground, m)	INTERVAL From (m)	INTERVAL To (m)	LITHOLOGY
Tailings Pond						
T96R-108	6056569	621978	120.2	N/A	N/A	N/A
T96R-109	6056588	621653	65.0	N/A	N/A	N/A
T96R-112	6057637	621875	64.0	N/A	N/A	N/A
T96R-116	6057088	621362	25.0	N/A	N/A	N/A
T96R-145	6057117	622529	91.1	N/A	N/A	N/A
T96R-146	6056893	621621	94.0	N/A	N/A	N/A
T96R-151	6058251	621876	39.0	N/A	N/A	N/A

NOTES:

1. TOB96 series boreholes drilled under the supervision of Piteau Engineering Ltd.
2. T96R series boreholes drilled under the supervision of Manalta coal Ltd.
3. Borehole logs for TOB96 series boreholes provided in Appendix II.
4. N/A - Borehole log information not available.

TABLE 3
SUMMARY OF GEOTECHNICAL LABORATORY TEST DATA

Borehole	Depth (m)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Grain Size Distribution				Activity	*K value
						Gravel	Sand	Silt	Clay	P.I./% Clay	(m/sec)
Tailings Pond											
TOB96-09	0.5-0.95	25.5	28.5	23.5	5	0	0.9	83.4	15.7	0.32	7×10^{-10}
TOB96-09	0.9-1.3	25	30	24.9	5.1	0.4	3.5	73.4	22.7	0.23	N/A
TOB96-09	2.0-2.45	8.8	22	15.2	6.8	N/A	N/A	N/A	N/A	N/A	N/A
TOB96-09	4.0-4.45	12.6	28	15	13	16.4	34.7	30.7	18.2	0.71	N/A
TOB96-09	6.2-6.65	11	27	13.7	13.3	N/A	N/A	N/A	N/A	N/A	4×10^{-11}
TOB96-09	10.5-10.95	11	27.7	15.6	12.1	14.7	35	29.3	21	0.58	N/A

Notes:

1. * Permeability tests conducted on remoulded samples consolidated to present overburden stress.
2. N/A not analyzed.

TABLE 4
FIELD MEASURED PARAMETERS

WELL NUMBER	DATE (y-m-d)	TEMPERATURE (°C)	ELECTRICAL CONDUCTIVITY (µS/cm)	pH	REMARKS
Tailings Pond					
TOB96-07-10	96-Sep-18	6.5	734	7.44	
TOB96-07-20	96-Sep-18	7.3	1,090	7.50	
TOB96-10-11	96-Sep-18	N/A	N/A	N/A	*Dry*
TOB96-10-28	96-Sep-18	N/A	N/A	N/A	*Dry*
TOB96-14-10	96-Sep-18	N/A	N/A	N/A	*Dry*
TOB96-14-43	96-Sep-18	N/A	N/A	N/A	*Dry*

NOTES:

1. N/A - not analyzed.

TABLE 5
GROUNDWATER QUALITY INDICATOR PARAMETERS

Location	Sample Date	Sulphate (mg/L)	Chloride (mg/L)	TDS (mg/L)	TDS-calculated (mg/L)	Tot. Amm. (as N) (mg/L)	NO_2+NO_3 (as N) (mg/L)
Tailings Pond							
TOB96-07-10	96-Sep-18	52.1	13.1	460	427	0.17	0.902
TOB96-07-20	96-Sep-18	16.3	29.2	688	676	0.5	0.037
TOB96-07-20 (duplicate)	96-Sep-20	16.3	30.7	688	664	0.51	0.058
Distilled Water Blank #1	96-Sep-20	<0.1	<0.5	6.0	2.0	<0.01	0.035
B.C. freshwater aquatic life criteria:		***100***	***NC***	***NC***	***NC***	***1.84 ****	***40***

NOTES:
1.) NC - No Criteria.

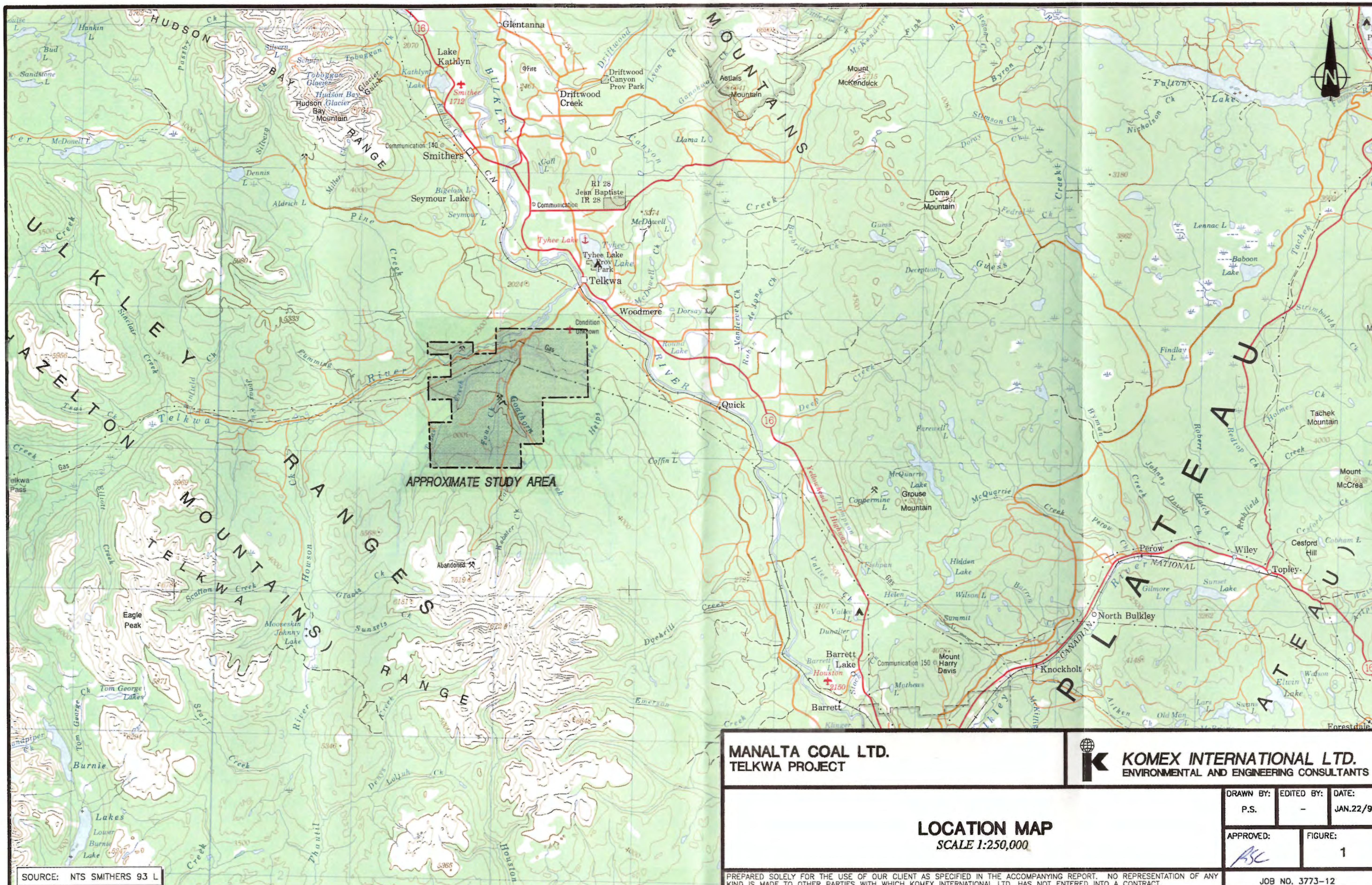
TABLE 6
LABORATORY ANALYSIS RESULTS FOR METALS

Location	Sample Date	Arsenic:T (mg/L)	Arsenic (mg/L)	Barium:T (mg/L)	Barium (mg/L)	Cadmium:T (mg/L)	Cadmium (mg/L)	Chromium:T (mg/L)	Chromium (mg/L)	Cobalt:T (mg/L)	Cobalt (mg/L)	Copper:T (mg/L)	Copper (mg/L)	Lead:T (mg/L)	Lead (mg/L)	Mercury:T (mg/L)	Mercury (mg/L)	Molybdenum:T (mg/L)	Molybdenum (mg/L)	Nickel:T (mg/L)	Nickel (mg/L)	Selenium:T (mg/L)	Selenium (mg/L)
Tailings Pond																							
TOB96-07-10	96-Sep-18	.0015	.0012	.115	.077	.0021	.0005	< .001	< .001	.0011	.0003	.0044	.004	.0042	< .0003	< .00005	< .00005	.0058	.0035	< .0005	< .0005	< .0002	< .0002
TOB96-07-20	96-Sep-18	.0007	.0002	.14	.032	.0007	< .0002	.039	< .001	.029	< .0003	.0040	< .0002	.0021	< .0003	< .00005	< .00005	< .0002	< .0002	< .0005	< .0005	< .0002	< .0002
TOB96-07-20 (Dup)	96-Sep-18	.0007	< .0002	.164	.146	.0032	< .0002	< .001	< .001	.0008	.0004	< .0002	< .0002	.0023	< .0003	< .00005	< .00005	.0023	.002	< .0005	< .0005	.0007	< .0002
Water Blanks																							
Distilled Water Blank #1	96-Sep-18	<0.0002	<0.0002	0.006	<0.0002	<0.0002	<0.0002	<0.001	<0.001	<0.0003	<0.0003	<0.0002	<0.0002	<0.0003	<0.0003	<0.00005	<0.00005	<0.0002	<0.0002	<0.0005	<0.0005	<0.0002	<0.0002
B.C. freshwater aquatic life criteria:		*0.05*		*1*		*0.0002 **		*0.002*		*0.05*		*0.002 **		*0.004*		*0.0001*		*1*		*0.025*		*0.001*	

Location	Sample Date	Silver:T (mg/L)	Silver (mg/L)	Zinc:T (mg/L)	Zinc (mg/L)	Aluminum:T (mg/L)	Aluminum (mg/L)	Beryllium:T (mg/L)	Beryllium (mg/L)	Boron:T (mg/L)	Boron (mg/L)	Iron:T (mg/L)	Iron (mg/L)	Manganese:T (mg/L)	Manganese (mg/L)	Phosphorus:T (mg/L)	Phosphorus (mg/L)	Ortho P (mg/L)	Total Diss. P (mg/L)	Uranium:T (mg/L)	Uranium (mg/L)	Vanadium:T (mg/L)	Vanadium (mg/L)
Tailings Pond																							
TOB96-07-10	96-Sep-18	<0.0001	<0.0001	0.0479	<0.0006	2.78	<0.001	<0.0002	<0.0002	0.1	<0.01	3.80	0.06	0.161	0.079	<0.1	<0.1	<0.003	0.008	0.0094	0.009	0.011	0.004
TOB96-07-20	96-Sep-18	<0.0001	<0.0001	0.0556	<0.0006	0.713	<0.001	<0.0002	<0.0002	0.24	0.1	1.26	0.03	0.752	0.019	<0.1	<0.1	<0.003	0.004	0.0074	0.0074	<0.001	<0.001
TOB96-07-20 (Dup)	96-Sep-18	<0.0001	<0.0001	0.0053	0.005	0.379	<0.001	0.0004	<0.0002	0.16	0.07	0.94	<0.01	0.04	0.025	<0.1	<0.1	0.011	0.015	0.0073	<0.0004	<0.001	<0.001
Water Blanks																							
Distilled Water Blank #1	96-Sep-18	<0.0001	<0.0001	<0.0006	<0.0006	<0.001	<0.001	<0.0002	<0.0002	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.1	<0.1	<0.003	<0.003	<0.0004	<0.0004	<0.001	<0.001
B.C. freshwater aquatic life criteria:		*0.0001*		*0.03*		*0.05***		*0.0053*		*NC*		*0.3*		*0.1*		*NC*		*NC*		*0.3*		*NC*	

Notes:

1.) Shaded area indicates concentrations which exceed B.C. Ministry of Environment Land and Parks freshwater aquatic life criteria (See Appendix V).
2.) * - Criteria increases with water hardness (see Appendix V).
3.) ** - Criteria increases with pH (see Appendix V).
4.) T indicates total metals analysis, otherwise analysis indicates dissolved concentration.
5) NC - no criteria.



SOURCE: NTS SMITHERS 93 L

MANALTA COAL LTD.
TELKWA PROJECT

KOMEX INTERNATIONAL LTD.
ENVIRONMENTAL AND ENGINEERING CONSULTANTS

LOCATION MAP
SCALE 1:250,000

DRAWN BY:	EDITED BY:	DATE:
P.S.	-	JAN.22/97

APPROVED:	FIGURE:
[signature]	1

JOB NO. 3773-12

PREPARED SOLELY FOR THE USE OF OUR CLIENT AS SPECIFIED IN THE ACCOMPANYING REPORT. NO REPRESENTATION OF ANY KIND IS MADE TO OTHER PARTIES WITH WHICH KOMEX INTERNATIONAL LTD. HAS NOT ENTERED INTO A CONTRACT.

6 058 000m N

6 058 000m N

TELKWA RIVER

PROPOSED PLANT

PROPOSED TAILINGS POND

Tenas Creek

Four Creek

Goathorn Creek

616 000m E

628 000m E

PIT 3

TENAS WEST PIT

TENAS PIT

6 050 000m N

SOURCE:
MANALTA COAL LTD. FILE TELKINF.DWG

LEGEND

- ROAD
- POWERLINE
- COAL LICENCE BOUNDARY
- POTENTIAL PIT LOCATION
- PROPOSED WASTE DUMP LOCATION
- PROPOSED PIT LOCATION

0 2000m

SCALE 1 : 35,000

MANALTA COAL LTD.
TELKWA PROJECT

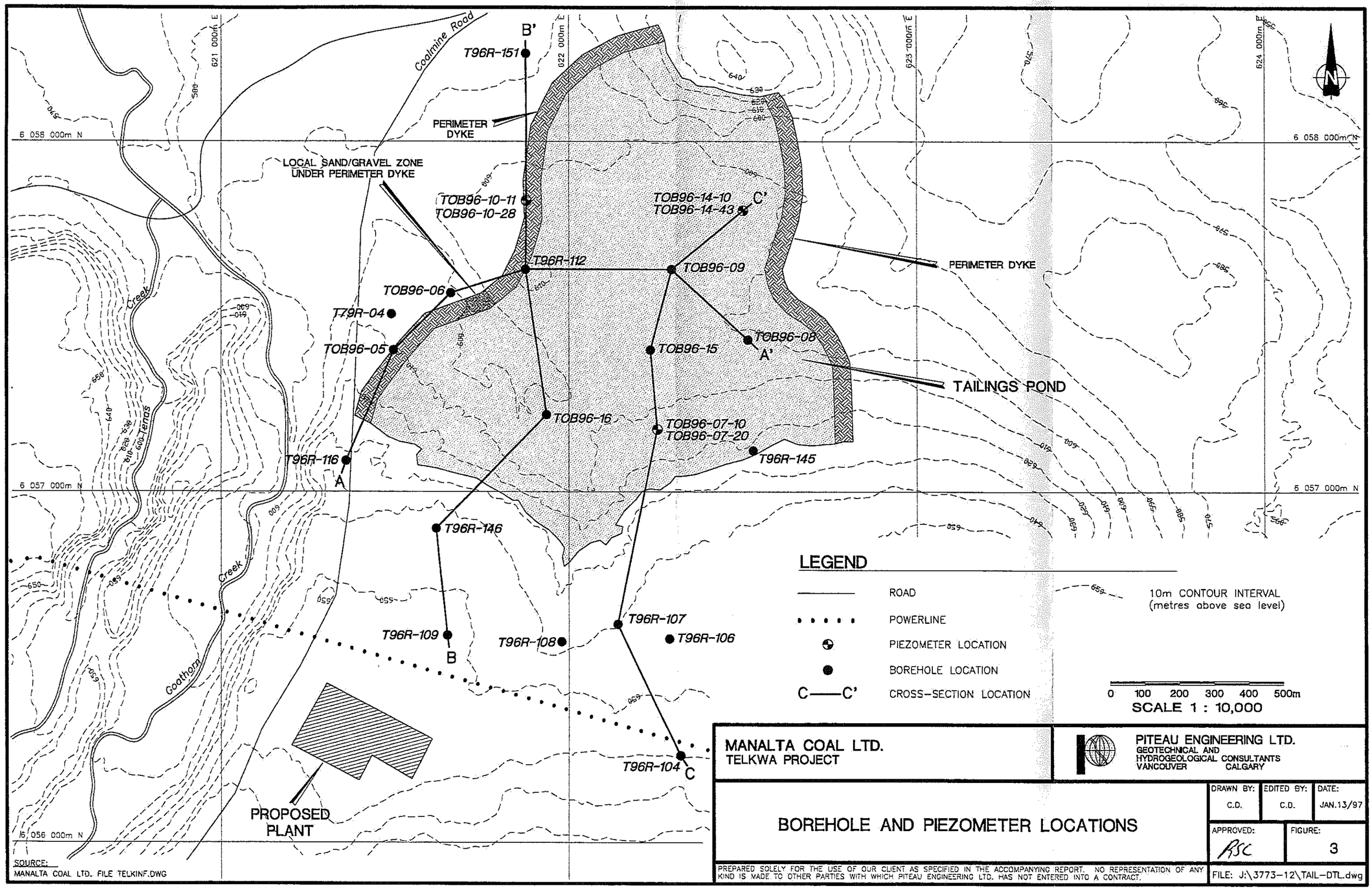
PITEAU ENGINEERING LTD.
GEOTECHNICAL AND
HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

SITE PLAN

DRAWN BY:	EDITED BY:	DATE:
J.P.	C.D.	JAN.24/97

APPROVED:	FIGURE:
RSC	2

J:\3773-12\TELK-DTL.DWG



MANALTA COAL LTD.
TELKWA PROJECT

PITEAU ENGINEERING LTD.
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

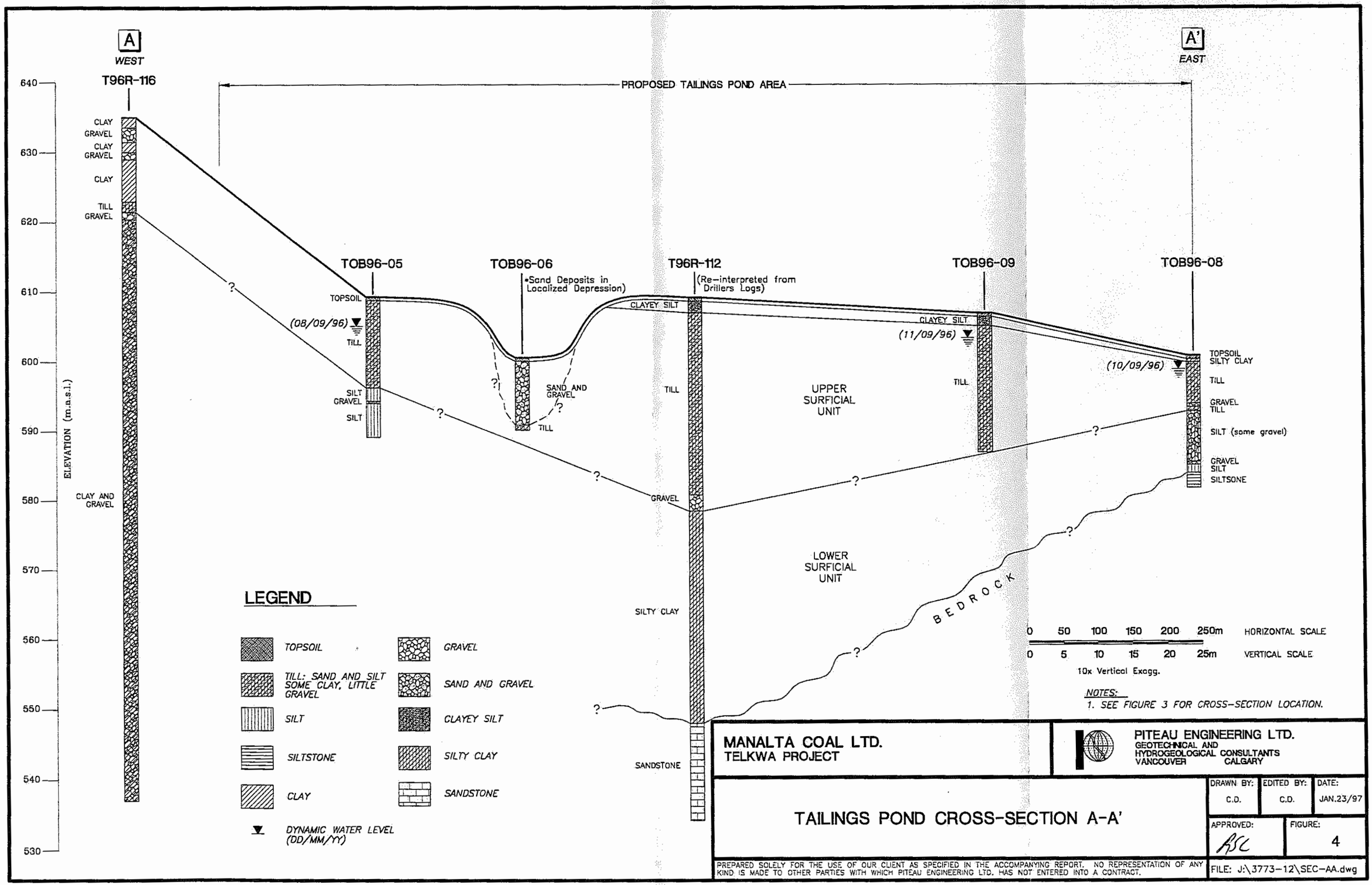
BOREHOLE AND PIEZOMETER LOCATIONS

DRAWN BY:	EDITED BY:	DATE:
C.D.	C.D.	JAN.13/97

APPROVED: RSC

FIGURE: 3

FILE: J:\3773-12\TAIL-DTL.dwg



NOTES:
1. SEE FIGURE 3 FOR CROSS-SECTION LOCATION.

MANALTA COAL LTD.
TELKWA PROJECT

PITEAU ENGINEERING LTD.
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

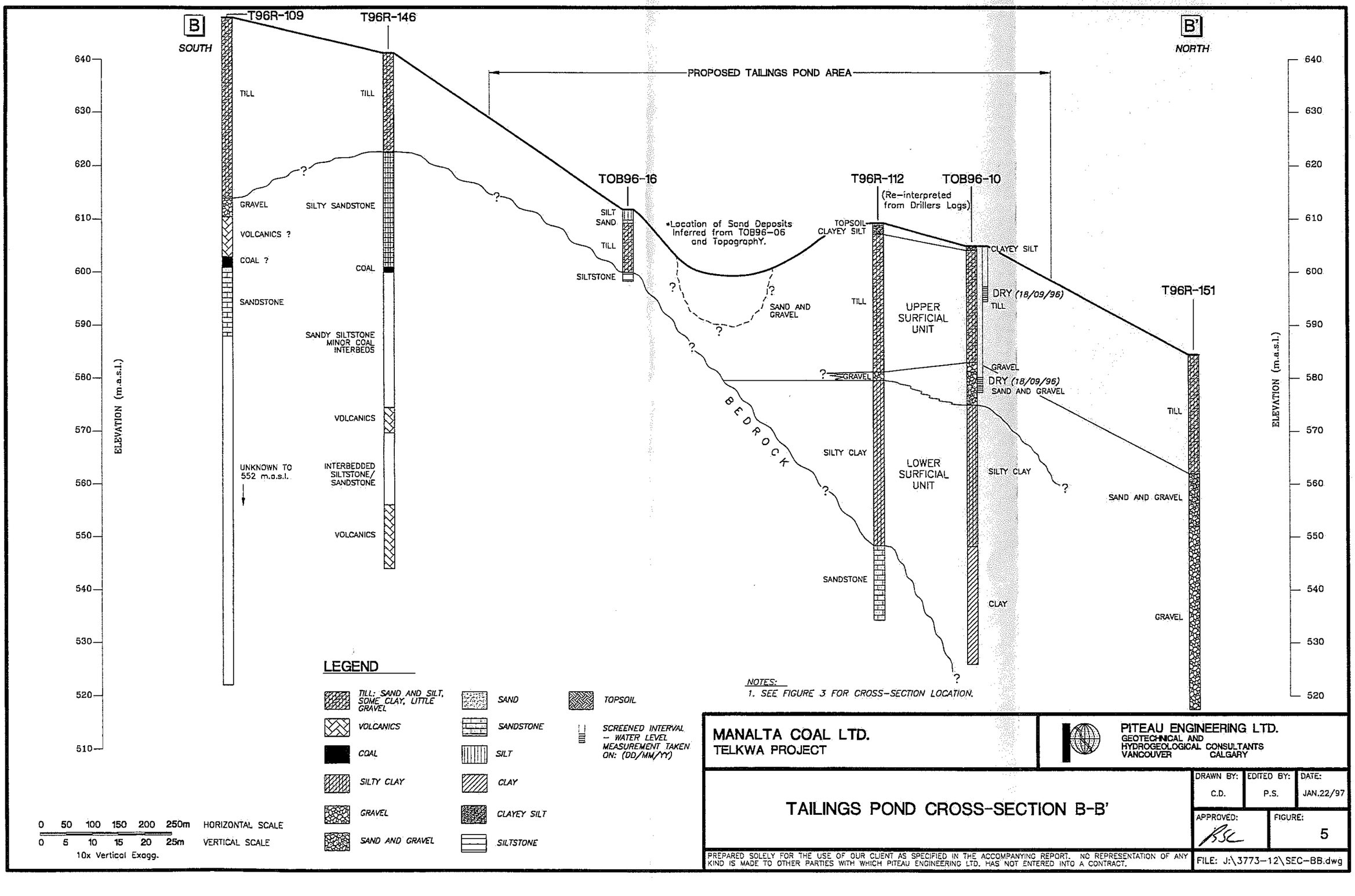
TAILINGS POND CROSS-SECTION A-A'

DRAWN BY:	EDITED BY:	DATE:
C.D.	C.D.	JAN.23/97

APPROVED: ASC

FIGURE: 4

FILE: J:\3773-12\SEC-AA.dwg



NOTES:
1. SEE FIGURE 3 FOR CROSS-SECTION LOCATION.

MANALTA COAL LTD.
TELKWA PROJECT

PITEAU ENGINEERING LTD.
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

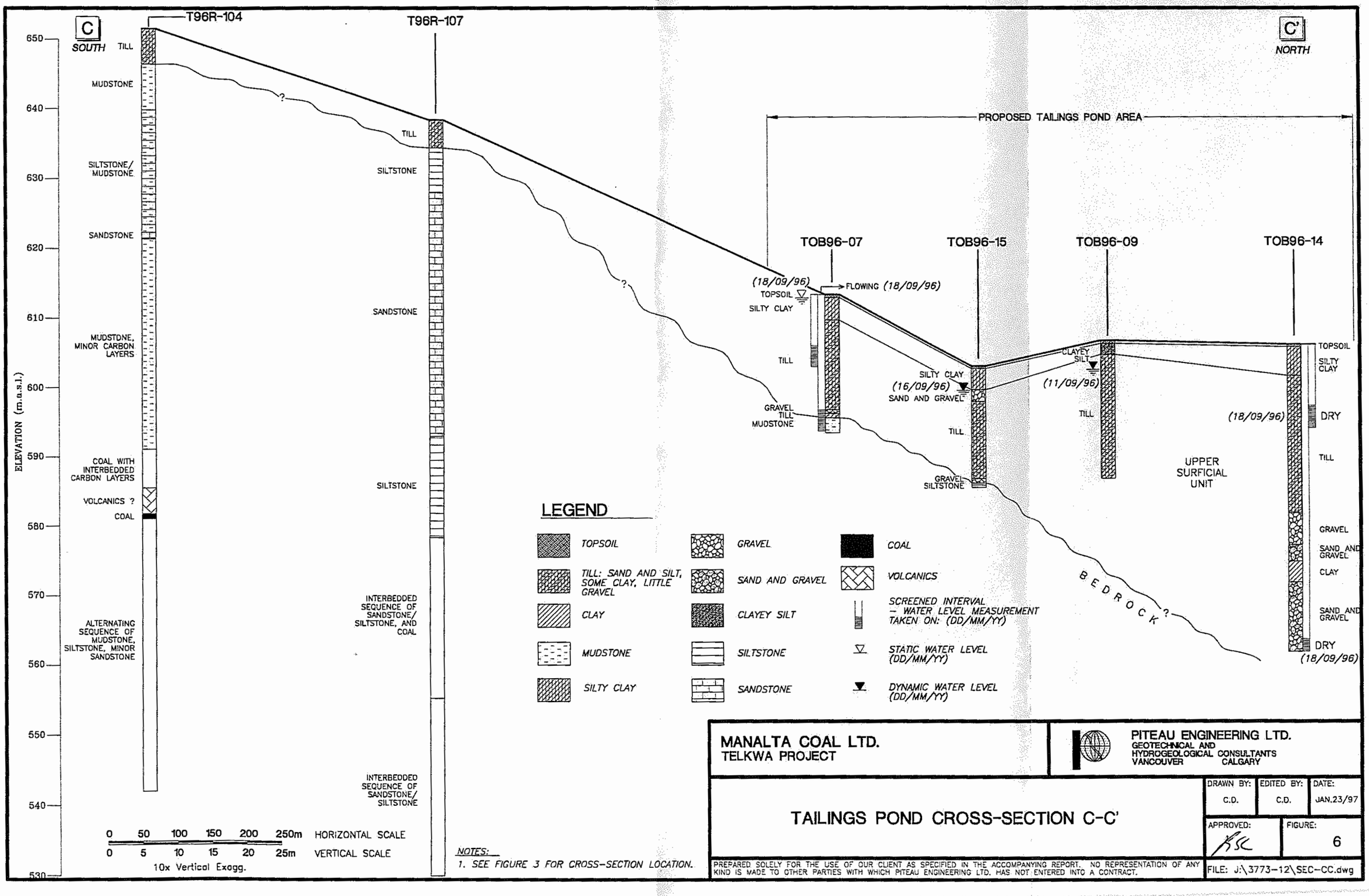
TAILINGS POND CROSS-SECTION B-B'

DRAWN BY:	EDITED BY:	DATE:
C.D.	P.S.	JAN.22/97

APPROVED: BSC

FIGURE: 5

FILE: J:\3773-12\SEC-BB.dwg



LEGEND

- TOPSOIL
- TILL: SAND AND SILT, SOME CLAY, LITTLE GRAVEL
- CLAY
- MUDSTONE
- SILTY CLAY
- GRAVEL
- SAND AND GRAVEL
- CLAYEY SILT
- SILTSTONE
- SANDSTONE
- COAL
- VOLCANICS
- SCREENED INTERVAL – WATER LEVEL MEASUREMENT TAKEN ON: (DD/MM/YY)
- STATIC WATER LEVEL (DD/MM/YY)
- DYNAMIC WATER LEVEL (DD/MM/YY)

NOTES:
1. SEE FIGURE 3 FOR CROSS-SECTION LOCATION.

MANALTA COAL LTD.
TELKWA PROJECT

PITEAU ENGINEERING LTD.
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS
VANCOUVER CALGARY

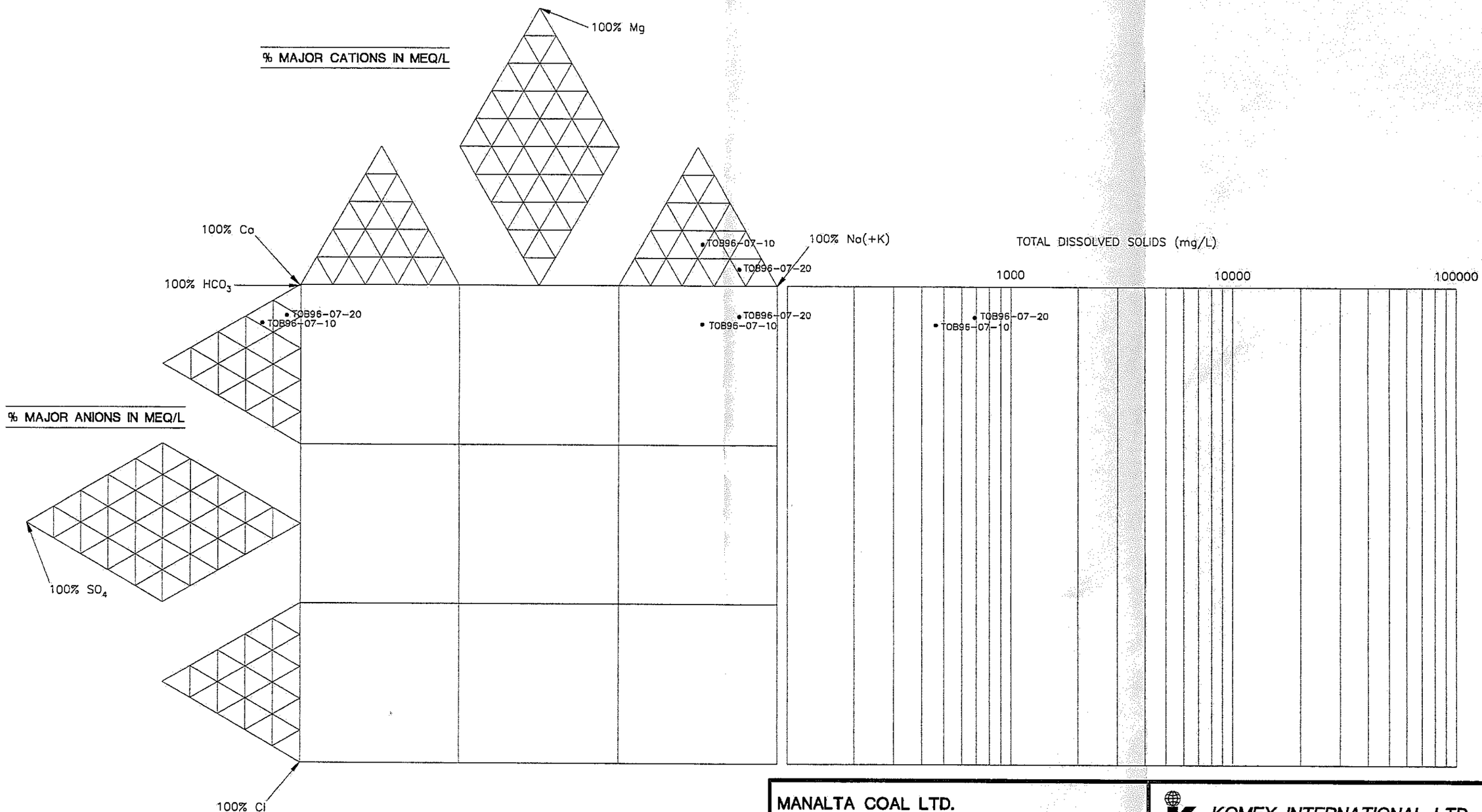
TAILINGS POND CROSS-SECTION C-C'

DRAWN BY:	EDITED BY:	DATE:
C.D.	C.D.	JAN.23/97

APPROVED: BSC

FIGURE: 6

FILE: J:\3773-12\SEC-CC.dwg



MANALTA COAL LTD.
TELKWA PROJECT

KOMEX INTERNATIONAL LTD.
ENVIRONMENTAL AND ENGINEERING CONSULTANTS

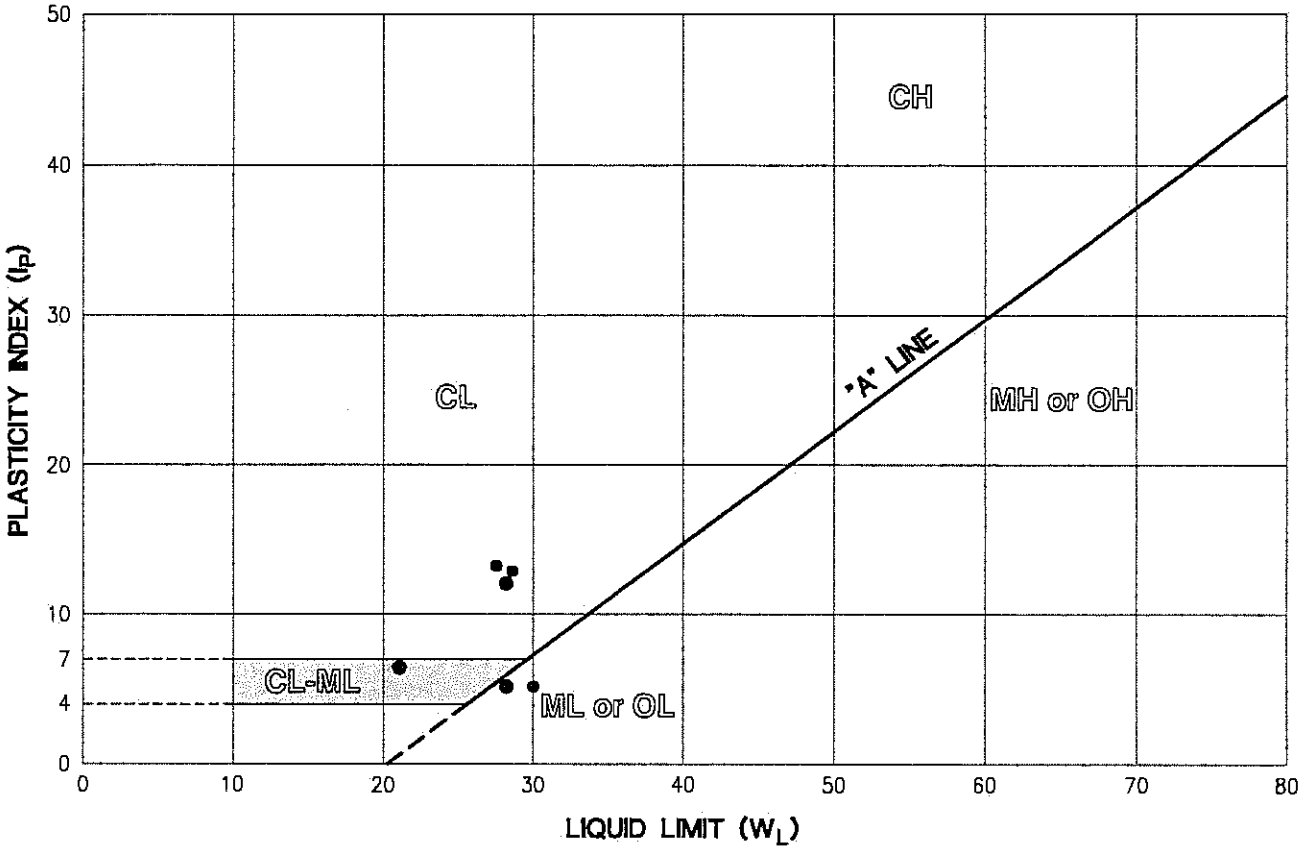
MAIN ION CHEMISTRY (SURFICIAL DEPOSITS)
: EXPANDED DUROV DIAGRAM

DRAWN BY:	EDITED BY:	DATE:
C.D.	C.D.	JAN.13/97

APPROVED:

FIGURE: 7

FILE: J:\3773-12\DUR-POND.dwg



MANALTA COAL LTD.
TELKWA PROJECT

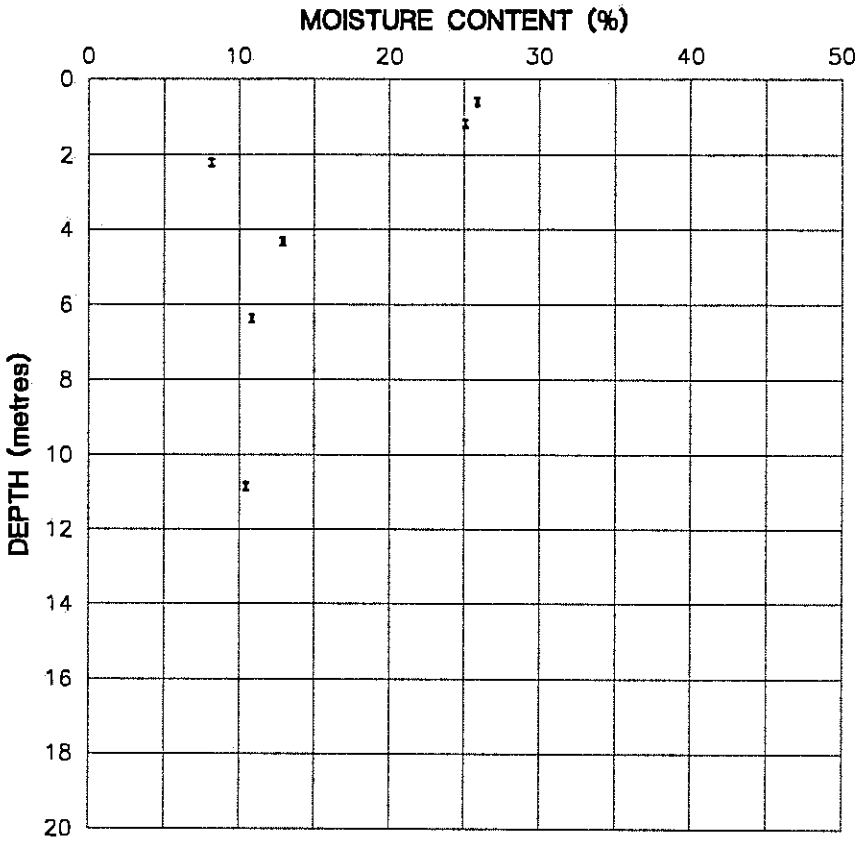
KOMEX INTERNATIONAL LTD.
ENVIRONMENTAL AND ENGINEERING CONSULTANTS

PLASTICITY INDEX vs LIQUID LIMIT

DRAWN BY:	EDITED BY:	DATE:
M.Z.	C.D.	JAN.13/97

APPROVED:	FIGURE:
RSC	8

FILE: J:\3773-12T2\PLAST-P.dwg



MANALTA COAL LTD.
TELKWA PROJECT

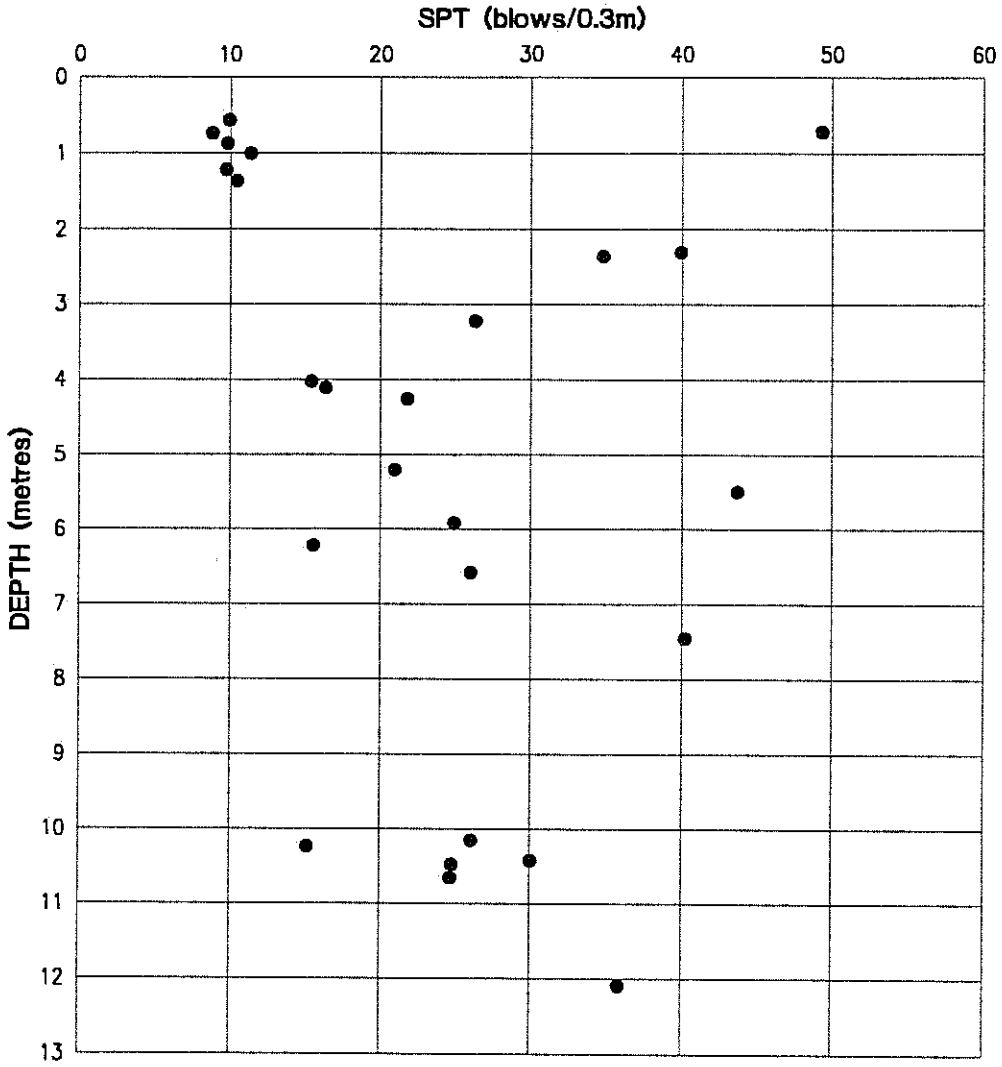
KOMEX INTERNATIONAL LTD.
ENVIRONMENTAL AND ENGINEERING CONSULTANTS

MOISTURE CONTENT vs DEPTH (TILL)

DRAWN BY:	EDITED BY:	DATE:
M.Z.	C.D.	JAN.13/97

APPROVED:	FIGURE:
RSC	9

FILE: J:\3773-12T2\MOIST-P.dwg



MANALTA COAL LTD.
TELKWA PROJECT

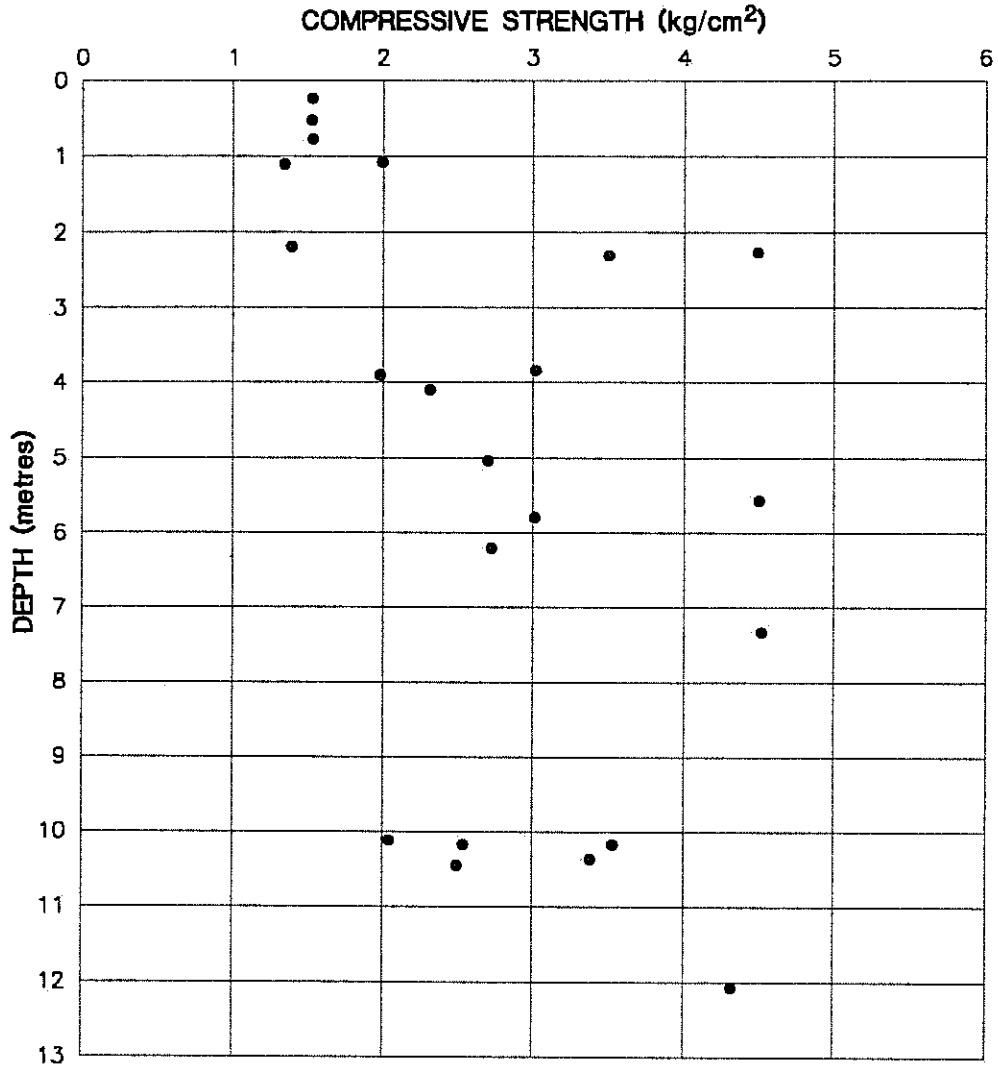
KOMEX INTERNATIONAL LTD.
ENVIRONMENTAL AND ENGINEERING CONSULTANTS

SPT vs DEPTH

DRAWN BY:	EDITED BY:	DATE:
M.Z.	C.D.	JAN.13/97

APPROVED:	FIGURE:
	10

FILE: J:\3773-12T2\SPT-P.dwg



MANALTA COAL LTD.
TELKWA PROJECT

KOMEX INTERNATIONAL LTD.
ENVIRONMENTAL AND ENGINEERING CONSULTANTS

PENETROMETER vs DEPTH

DRAWN BY:	EDITED BY:	DATE:
M.Z.	C.D.	JAN.13/97

APPROVED:

FIGURE: 11

FILE: J:\3773-12T2\PENETR-P.dwg

APPENDIX I

FIELD PROGRAM PROTOCOLS

APPENDIX I - FIELD PROGRAM PROTOCOLS

PIEZOMETER CONSTRUCTION

Piezometers were constructed using 51 mm (ID), schedule 40 PVC pipe supplied by Rice Engineering Ltd. of Edmonton. All sections were machined with threaded flush-joints (M/F 480) to avoid the use of PVC glue and primer for connections, since bonding materials can potentially introduce traces of organic contaminants. The screen sections of PVC pipe were constructed with three rows of No 20 slotting. The base of each screen section was closed with a heat-welded seal.

Following preparation, all piezometer pipe sections and screens were washed by the supplier using a non-phosphate detergent, and clean potable water. This procedure is in accordance with U.S. EPA recommended methods (Aller et al., 1989). After cleaning, each individual piece was sealed in a plastic bag to prevent contamination during transport.

All piezometers were constructed by placing a screen section of PVC pipe across a potential groundwater bearing interval. Shallow piezometers were constructed by placing a 3 m screen across the upper groundwater surface (water table). Deeper piezometers were constructed with a 1.5 m or 3.0 screen placed across the identified groundwater bearing zone.

Solid sections of pipe were then threaded onto the screen sections, and the entire string lowered to the desired depth of completion. High silica content frac sand of 10/20 grade was added to the annulus to approximately 0.3 m above the screened interval. A primary water-tight seal, of 1.0 m average thickness, was placed above the sand pack using high quality 6 mm peltonite tablets. Any remaining annual space was then backfilled with bentonite chips.

At surface, a 102 mm diameter, 1.5 m long steel casing with a lockable cap was inserted approximately 0.75 m into the open borehole. This provides some physical protection and enhanced visibility for the piezometer. A hydrated bentonite cap was placed around the base of the protective steel casing. Cuttings were mounded around the base of the piezometer to direct surface water runoff away from the borehole. Piezometer depths and screen intervals are listed in Table 1. Full construction details are included on the borehole logs in Appendix II.

PIEZOMETER DEVELOPMENT AND HYDRAULIC CONDUCTIVITY TESTS

Shortly after installation, each piezometer was developed using the high volume, high pressure air compressor on the drill rig. Groundwater was air lifted from each piezometer until a sufficient volume was removed to purge any drilling fluids and remove fine materials from the sand pack. Where possible, air lifting was continued until the water was no longer turbid.

A hydraulic conductivity test was performed on each piezometer. The test was initiated by recording the static water level using a standard electric water level sounder. Standing water was then removed from the wellbore using a portable air compressor with a 46 m air line. Recovering water levels were measured at selected time intervals. Water level recovery versus time data are presented in Appendix III.

Hydraulic conductivity values obtained by this method are approximate due to the relatively small volume of water removed from the wellbore. As such, they only represent the zone within the immediate vicinity of the screened interval. Small variations such as fracture density in rock can greatly affect hydraulic conductivity values within zones of similar lithology. Nevertheless, this method of testing provides a useful indication of the order of magnitude of the local hydraulic conductivity.

For shallow piezometers completed in an unconfined groundwater bearing unit, the Bouwer and Rice method (1976) was used to interpret slug test results and estimate hydraulic conductivity values. For deeper piezometers completed in a confined groundwater bearing unit, the Cooper et al. (1967) method was used for interpretation of slug test results. Hydraulic conductivity data are summarized on Table 1 and presented in Appendix III.

GROUNDWATER SAMPLING

Groundwater sampling was performed between September 19 to 22, 1996. At least three volumes of standing water were removed from each piezometer prior to sampling to ensure samples collected were representative of formation water. All sample bottles were rinsed with formation water prior to sample collection.

At each piezometer the following sub-samples were collected:

- A 500 mL aliquots, unpreserved, stored in polyethylene bottle for analysis of major ions and routine portability parameters. These include: alkalinity, bicarbonate, carbonate, calcium, chloride, conductivity, hydroxide, dissolved iron, magnesium, dissolved manganese, nitrate plus nitrite nitrogen, pH, potassium, sodium, sulphate, total dissolved solids, total suspended solids, and total hardness.
- A 250 mL aliquot, unfiltered and preserved with 5 mL 12.5% H_2SO_4 for analyses of nutrients including total NH_3-N, dissolved phosphorus (lab filtered), total phosphorus, and orthophosphorus.
- A 250 mL aliquot, unfiltered and preserved with 1.25 mL 1:1 HNO_3 for analyses of total metals.
- A 250 mL aliquot field filtered to 0.45µm and preserved with 1.25 mL 1:1 HNO_3 for analyses of dissolved metals.
- A 125 mL aliquot, unfiltered and preserved with 1 mL $K_2C_4O_7$-HNO_3 for analyses of total mercury.
- A 125 mL aliquot field filtered to 0.45µm and preserved with 1 mL $K_2C_4O_7$-HNO_3 for analyses of dissolved mercury.

All samples were packed in ice (cooled to approximately 4°C) and delivered to Chemex Labs in Calgary within 48 hours of program completion.

SURVEY INFORMATION

All piezometers locations were surveyed by Manalta personnel using a portable differential global positioning system (GPS). Piezometer locations were surveyed in UTM. Elevations were surveyed as metres above mean sea level.

REFERENCES

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, D.M. Nielsen and J.E. Denne (1989). *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells.* Published by National Water Well Association, Dublin, Ohio, p. 398.

Bouwer, H. and R.C. Rice, 1976. *A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells.* Water Resources Research, Vol.12, No. 3, pp. 423-428.

Cooper, H.H., J.D. Bredehoeft, and S.S. Papadopulos, 1967. *Response of a finite-diameter well to an instantaneous charge of water.* Water Resources Research, Vol. 3, No.1, pp. 263-269.

APPENDIX II

BOREHOLE LOGS AND PIEZOMETER COMPLETION DETAILS

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 2

CONTRACT NO.: 3773-12-1
BORING NO.: TOB96-05
NORTHING: 6057405.62

COMPILED BY: M. Brewster
LOCATION: Tailings Pond
EASTING: 621497.84

BORING DATE: Sept. 8, 1996
CONTRACTOR: Cora Lynn Drilling
ELEVATION: 609.37 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1, 2, 3, 4)
SPT BLOWS/0.3m (10, 20, 30, 40, 50)
WATER CONTENT % (plastic limit 10, 30 ⊕ 50, liquid limit 70, 90)

DEPTH m	SYMBOL	DESCRIPTION (SOIL/ROCK)	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
0.0		TOPSOIL: silty clay, medium brown, wet, soft, plastic, weakly reactive with HCl.	S				
1.0		SAND AND SILT TILL: medium brown to red-brown, little to some clay, little gravel, trace coal, slightly calcareous, hard, dry, low plasticity.					
2.0			T				
			S				
3.0							
		3.6 Gravel.					
4.0							
						▼ 4.5	
5.0							
6.0			S				
7.0							
			S				
8.0							
9.0							
10.0							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 2 OF 2.

CONTRACT NO.: 3773-12-1
BORING NO.: TOB96-05
NORTHING: 6057405.62
COMPILED BY: M. Brewster
LOCATION: Tailings Pond
EASTING: 621497.84
BORING DATE: Sept. 8, 1996
CONTRACTOR: Cora Lynn Drilling
ELEVATION: 609.37 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORE BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit
liquid limit

DEPTH m	SYMBOL	DESCRIPTION	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
10.0		SOIL/ROCK					
		SAND AND SILT TILL: medium brown to red-brown, little to some clay, little gravel, trace coal, slighly calcareous, hard, dry, low plasticity.	S				
13.0		SILT: medium brown, little clay, sand, dry, infrequent coarser lenses (sand and gravel), strongly reactive.					
		end of hole 20 m water encountered at depth of 9.5 m					
20.0							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 1

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 9, 1996
BORING NO.:	T0896-06	LOCATION:	Tailings Pond	CONTRACTOR:	Cora Lynn Drilling
NORTHING:	6057562.22	EASTING:	621649.21	ELEVATION:	600.76 masl

SAMPLE TYPES

A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION: DISTURBED, FAIR, GOOD, LOST

TEST INFORMATION

● PENETROMETER kg/cm2 (1, 2, 3, 4)

△ SPT BLOWS/0.3m (10, 20, 30, 40, 50)

WATER CONTENT % (X plastic limit 10 30 ⊕ 50 70 liquid limit 90 X)

DEPTH m	SYMBOL	SOIL/ROCK DESCRIPTION	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
0.0		TOPSOIL: medium sand, dark brown, dirty (poorly sorted), slightly moist.					
0.7		SAND AND GRAVEL: dark brown, poorly sorted, trace silt, trace clay, gravels to 0.3 cm, loose, dry.	S				
9.5		TILL: harder drilling, no cuttings returns.					
10.0		Hole terminated at 10.0 m due to collapsing hole conditions.					

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 2

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 9, 1996
BORING NO.:	TD896-07 (-10, -20)	LOCATION:	Tailings Pond	CONTRACTOR:	Cora Lynn Drilling
NORTHING:	6057178.19	EASTING:	622255.67	ELEVATION:	613.28 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION: DISTURBED, FAIR, GOOD, LOST

TEST INFORMATION: PENETROMETER kg/cm2 (1, 2, 3, 4); SPT BLOWS/0.3m (10, 20, 30, 40, 50); WATER CONTENT % (plastic limit 10, 30; liquid limit 50, 70, 90)

DEPTH m	SYMBOL	DESCRIPTION (SOIL/ROCK)	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
0.0									
		TOPSOIL: sandy silt, dark brown, minor clay, organics, wood fragments, roots, moist, loose.			S				
0.4									
1.0		CLAYEY SILT: medium brown, trace coal, iron oxide staining along vertical partings, rootlets, slightly moist, soft to moderately stiff, non-reactive.							
2.0					T				
3.0									
3.5									
4.0		SAND AND SILT TILL: dark grey-brown, little to some clay, little gravel, non-calcareous, stiff, moist, low plasticity.			S				
5.0									
5.4									
6.0		As above, slightly calcareous, very stiff.			S				
7.0									
7.4									
8.0									
9.0									
9.2		Gravels.							
10.0									

STICK-UP A&B=0.65 m
BENTONITE
51 mm SCH 40 PVC PIPE
PELTONITE
159 mm DIA. HOLE
10/20 FRAC SAND
NO. 0.020 SLOT SCREEN

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 2 OF 2

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 9, 1996
BORING NO.:	TOB96-07 (-10, -20)	LOCATION:	Tailings Pond	CONTRACTOR:	Coro Lynn Drilling
NORTHING:	6057178.19	EASTING:	622255.67	ELEVATION:	613.28 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION: DISTURBED, FAIR, GOOD, LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1, 2, 3, 4)
SPT BLOWS/0.3m (10, 20, 30, 40, 50)
WATER CONTENT % (plastic limit 10, 30 — liquid limit 50, 70, 90)

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
10.0		SAND AND SILT TILL: dark grey brown, little to some clay, little gravel, non-calcareous, stiff, moist, low plasticity.			S				10.4 10/20 FRAC SAND; NO 0.020 SLOT SCREEN
11.0									BENTONITE
12.0									51 mm SCH 40 PVC PIPE
13.0									159 mm DIA. HOLE
14.0									14.6
15.0									PELTONITE
16.0									16.0
		16.5 Gravel.							16.6
17.0									10/20 FRAC SAND
		17.6							
18.0		SILTY MUDSTONE (BEDROCK): black, waxy, finely laminated, soft, brittle, carbonaceous.							NO. 0.020 SLOT SCREEN
19.0									19.6
20.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 2

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 10, 1996
BORING NO.:	TOB96-08	LOCATION:	Tailings Pond	CONTRACTOR:	Coro Lynn Drilling
NORTHING:	6057434.68	EASTING:	622514.65	ELEVATION:	600.90 mast

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1, 2, 3, 4)
SPT BLOWS/0.3m (10, 20, 30, 40, 50)
WATER CONTENT % (plastic limit 10, 30; liquid limit 50, 70, 90)

DEPTH m	SYMBOL	SOIL/ROCK	DESCRIPTION	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
0.0		0.2	TOPSOIL, PEAT: dark brown, woody, slightly moist, loose.	S				
1.0		1.0	SILTY CLAY: light brown, little iron oxidation, soft, slightly moist, low plasticity, slightly reactive.					
2.0		2.0	SAND AND SILT TILL: medium brown, little to some clay, little gravel (to 3 cm), trace coal, iron oxide staining, slightly calcareous, very stiff, loose, dry, low plasticity.	T S				
3.0								
4.0				S			▼	
5.0								
6.0				S				
7.0		7.1	Gravels.					
8.0		8.0	SILT: dark brown, little gravel, trace sand, hard, dry.					
9.0								
10.0								

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 2 OF 2

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept 10, 1996
BORING NO.: TDB96-08 LOCATION: Tailings Pond CONTRACTOR: Coro Lynn Drilling
NORTHING: 6057434.68 EASTING: 622514.65 ELEVATION: 600.90 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1, 2, 3, 4)
SPT BLOWS/0.3m (10, 20, 30, 40, 50)
WATER CONTENT % (plastic limit 10, 30 — liquid limit 50, 70, 90)

DEPTH m	SYMBOL	DESCRIPTION	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
		SOIL/ROCK					
10.0		SILT: as above.	S				
11.0							
12.0							
13.0							
14.0		14.2 Gravel, approximately 0.2 m.					
15.0							
16.0							
17.0		17.0 SILTSTONE (BEDROCK): dark grey, massive hard, dry.					
18.0							
19.0		TOTAL DEPTH = 19.0 m					
20.0							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 2

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 11, 1996
BORING NO.:	TDB96-09	LOCATION:	Tailings Pond	CONTRACTOR:	Cora Lynn Drilling
NORTHING:	6057636.23	EASTING:	622295.70	ELEVATION:	606.95 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1, 2, 3, 4)
SPT BLOWS/0.3m (10, 20, 30, 40, 50)
WATER CONTENT % (plastic limit 10, 30 ⊕ 50, liquid limit 70, 90)

DEPTH m	SYMBOL	SOIL/ROCK DESCRIPTION	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
0.0							
		0.3 SILT TOPSOIL: medium brown, slightly moist, soft, grass roots.					
		CLAYEY SILT: medium brown, thin fine sand laminations (<1 cm), iron oxide staining along vertical partings, stiff, slightly moist. Sand is highly calcareous, silt is slightly calcareous.	T				
1.0			S				
		1.9					
2.0		SAND AND SILT TILL: dark brown, little to some clay, little gravel (to 1 cm), stiff, dry, low plasticity.	S			▼ 2.5	
3.0							
4.0			S				
5.0							
6.0			S				
7.0							
8.0							
9.0							
10.0							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 2 OF 2

CONTRACT NO.: 3773-12-1
BORING NO.: TO896-09
NORTHING: 6057636.23
COMPILED BY: M. Brewster
LOCATION: Tailings Pond
EASTING: 622295.70
BORING DATE: Sept. 11, 1996
CONTRACTOR: Cora Lynn Drilling
ELEVATION: 606.95 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit
liquid limit

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
10.0		SAND AND SILT TILL: as above.					
		10.5	S				
11.0							
12.0							
13.0							
14.0							
15.0							
16.0							
17.0							
18.0							
19.0							
		TOTAL DEPTH = 20.0 m					
20.0							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 8

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 11, 1996
BORING NO.:	TDB96-10 (-11, -28)	LOCATION:	Tailings Pond	CONTRACTOR:	Cora Lynn Drilling
NORTHING:	6057832.72	EASTING:	621877.39	ELEVATION:	605.02 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION: DISTURBED, FAIR, GOOD, LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1, 2, 3, 4)
SPT BLOWS/0.3m (10, 20, 30, 40, 50)
WATER CONTENT % (plastic limit 10, 30 ⊕ liquid limit 50, 70, 90)

DEPTH m	SYMBOL	DESCRIPTION (SOIL/ROCK)	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
0.0		CLAYEY SILT: medium brown, trace sand, soft, slightly moist, low plasticity.							STICK-UP TDB96-10-11=0.65 m STICK-UP TDB96-10-28=0.65 m
1.5		SAND AND SILT TILL: dark brown, little to some clay, little gravel to 3 cm, very stiff, slightly moist, low plasticity.							BENTONITE 51 mm SCH 40 PVC 480 MF BUTTRESS THREAD PIPE 215 mm DIA. HOLE
6.8		As above, very stiff, dry.							6.5 PELTONITE 7.05 7.5 10/20 FRAC SAND ND 0.020 SLOT SCREEN
10.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 2 OF 8.

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 11, 1996
BORING NO.:	TOB96-10 (-1I, -2B)	LOCATION:	Tailings Pond	CONTRACTOR:	Cora Lynn Drilling
NORTHING:	6057832.72	EASTING:	621877.39	ELEVATION:	605.02 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON

T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1 2 3 4)
Δ SPT BLOWS/0.3m (10 20 30 40 50)
WATER CONTENT % (plastic limit 10 30 — liquid limit 50 70 90)

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
10.0		SAND AND SILT TILL: as above.							10/20 FRAC SAND
									NO 0.020 SLOT SCREEN
									10.5
11.0									
12.0									
13.0									BENTONITE
14.0									
15.0									
									51 mm SCH 40 PVC 480 MF BUTTRESS THREAD PIPE
16.0									
17.0									
									215 mm DIA. HOLE
18.0									
19.0									
20.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 3 OF 8.

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: TOB96-10 (-11, -2B) LOCATION: Tailings Pond CONTRACTOR: Cora Lynn Drilling
NORTHING: 6057832.72 EASTING: 621877.39 ELEVATION: 605.02 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit liquid limit

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
20.0		SAND AND SILT TILL: as above.							BENTONITE
		20.8							
21.0		GRAVEL: coarse (3 cm+), little sand, minor clay, dry.							51 mm SCH 40 PVC 480 MF BUTTRESS THREAD PIPE
22.0		22.0 Stopped drilling for 5 min, air lift, no groundwater.							215 mm DIA. HOLE
23.0									23.6 PELTONITE
		23.8							24.1
24.0		SAND AND GRAVEL: interbedded with clay, dark brown, soft.							24.5
25.0									10/20 FRAC SAND
26.0									NO 0.020 SLOT SCREEN
27.0									27.5
28.0									BENTONITE CHIPS
29.0									
30.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 4 OF 8.

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 11, 1996
BORING NO.:	TOB96-10 (-11, -2B)	LOCATION:	Tailings Pond	CONTRACTOR:	Cora Lynn Drilling
NORTHING:	6057832.72	EASTING:	621877.39	ELEVATION:	605.012 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1, 2, 3, 4)
SPT BLOWS/0.3m (10, 20, 30, 40, 50)
WATER CONTENT % (plastic limit 10, 30 ⊕ 50, liquid limit 70, 90)

DEPTH m	SYMBOL	DESCRIPTION (SOIL/ROCK)	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
30.0		SAND AND GRAVEL: as above. Stopped for 30 min, air lifted no groundwater.							
30.5		SILTY CLAY: medium grey, trace sand, trace gravel, very stiff, dry.							
31.0									
32.0									
33.0									BENTONITE CHIPS
34.0									
35.0									215 mm DIA. HOLE
36.0									
37.0									BACKFILL (PIT RUN)
38.0									
39.0									
40.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 5 OF 8

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: TO896-10 (-11, -2B) LOCATION: Tailings Pond CONTRACTOR: Cora Lynn Drilling
NORTHING: 6057832.72 EASTING: 621877.39 ELEVATION: 605.02 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit liquid limit

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
40.0		SILTY CLAY: as above.							
41.0									
42.0									
43.0									
44.0									
45.0									BACKFILL (PIT RUN)
46.0									
47.0									
48.0									215 mm DIA. HOLE
49.0									
50.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 6 OF 8

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: TO896-10 (-11, -28) LOCATION: Tailings Pond CONTRACTOR: Coro Lynn Drilling
NORTHING: 6057832.72 EASTING: 621877.39 ELEVATION: 605.02 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1 2 3 4)
Δ SPT BLOWS/0.3m (10 20 30 40 50)
WATER CONTENT % (plastic limit 10 30 — liquid limit 50 70 90)

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
50.0		SILTY CLAY: as above.							
51.0									
52.0									
53.0									
54.0									
55.0									BACKFILL (PIT RUN)
56.0									
57.0		57.0 CLAY: medium grey, trace gravel, slightly moist, low to medium plasticity.							
58.0									215 mm DIA. HOLE
59.0									
60.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 7 OF 8

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: TOB95-10 (-1I, -2B) LOCATION: Tailings Pond CONTRACTOR: Cora Lynn Drilling
NORTHING: 6057832.72 EASTING: 621877.39 ELEVATION: 605.02 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit liquid limit

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
60.0		CLAY: as above.							
61.0		Stopped for night, water level at 56 m next morning.							
62.0									
63.0									
64.0									
65.0									BACKFILL (PIT RUN)
66.0									
67.0									
68.0									215 mm DIA. HOLE
69.0									
70.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 8 OF 8

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: TOB96-10 (-1I, -2B) LOCATION: Tailings Pond CONTRACTOR: Cora Lynn Drilling
NORTHING: 6057832.72 EASTING: 621877.39 ELEVATION: 605.02 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1 2 3 4)
SPT BLOWS/0.3m (10 20 30 40 50)
WATER CONTENT % (plastic limit 10 30 liquid limit 50 70 90)

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
70.0		CLAY: as above, no gravel.							
71.0									
72.0									
73.0									
74.0									
75.0									BACKFILL (PIT RUN)
76.0									
77.0									
78.0									215 mm DIA. HOLE
79.0									
80.0		TOTAL DEPTH = 81.0 m.							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 5.

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: TOB96-14 (-10, -43) LOCATION: Tailings Pond CONTRACTOR: Cora Lynn Drilling
NORTHING: 6057804.07 EASTING: 622501.20 ELEVATION: 604.39 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit liquid limit

DEPTH m	SYMBOL	DESCRIPTION	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
0.0		SOIL/ROCK							
		SILTY CLAY: dark brown, little sand, little gravel, highly reactive, slightly moist, stiff, low plasticity.							
2.5		SAND AND SILT TILL: medium to dark brown, little clay, little gravel, very stiff, dry, low plasticity.							
5.8									
6.8									
7.2									
10.0									

STICK-UP TOB96-14-10 = 0.38 m
STICK-UP TOB96-14-43 = 0.38 m
BENTONITE
51 mm SCH 40 PVC 480 MF BUTTRESS THREAD PIPE
1.59 mm DIA. HOLE
PELTONITE
10/20 FRAC SAND
NO 0.020 SLOT SCREEN

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 2 OF 5.

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: T0896-14 (-10, -43) LOCATION: Tailings Pond CONTRACTOR: Cora Lynn Drilling
NORTHING: 6057804.07 EASTING: 622501.20 ELEVATION: 604.39 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit liquid limit

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
10.0		SAND AND SILT TILL: same as above.							10.2 10/20 FRAC SAND; NO 0.020 SLOT SCREEN
13.0									BENTONITE
15.5		Boulder, light grey, finely crystalline (0.5 m).							51 mm SCH 40 PVC 480 MF BUTTRESS THREAD PIPE
17.0									159 mm DIA. HOLE
20.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 3 OF 5.

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: TOB96-14 (-10, -43) LOCATION: Tailings Pond CONTRACTOR: Cora Lynn Drilling
NORTHING: 6057809.07 EASTING: 622501.20 ELEVATION: 609.39 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
1 2 3 4
SPT BLOWS/0.3m
10 20 30 40 50
WATER CONTENT %
plastic limit 10 30 liquid limit 50 70 90

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
20.0		SAND AND SILT TILL: as above.							
23.0		23.0							
		CLAYEY SILT: medium brown, some gravel, dry.							BENTONITE
24.9		24.9							
		GRAVEL: dark grey, little fine sand and silt.							51 mm SCH 40 PVC 480 MF BUTTRESS THREAD PIPE
26.9		26.9							
		FINE GRAVEL AND COARSE SAND: angular to well rounded, minor silt and clay. NOTE: shut down overnight, air-lifted, no water.							159 mm DIA. HOLE
30.0									

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 4 OF 5

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 11, 1996
BORING NO.:	TDB96-19 (-10, -43)	LOCATION:	Tailings Pond	CONTRACTOR:	Cora Lynn Drilling
NORTHING:	6057804.07	EASTING:	622501.20	ELEVATION:	604.39 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CORREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
STATIC WATER LEVEL
DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
1 2 3 4
SPT BLOWS/0.3m
10 20 30 40 50
WATER CONTENT %
plastic limit 10 30 liquid limit 50 70 90

DEPTH m	SYMBOL	DESCRIPTION	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
30.0		SOIL/ROCK							
		FINE GRAVEL AND COARSE SAND: as above.							
31.0		31.0							
		CLAY: dark brown, little gravel, trace sand and silt, moderately stiff, dry low plasticity.							
34.0		34.0							
		COARSE SAND AND GRAVEL: dark brown, little clay, dry.							
40.0									

BENTONITE
51 mm SCH 40 PVC 480 MF BUTTRESS THREAD PIPE
159 mm DIA. HOLE
38.0
PELTONITE
39.7
10/20 FRAC SAND

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 5 OF 5

CONTRACT NO.: 3773-12-1 COMPILED BY: M. Brewster BORING DATE: Sept. 11, 1996
BORING NO.: TOB96-14 (-1D, -43) LOCATION: Tailings Pond CONTRACTOR: Cora Lynn Drilling
NORTHING: 6057804.07 EASTING: 622501.20 ELEVATION: 604.39 masl

SAMPLE TYPES
B BULK SAMPLE
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1 2 3 4)
Δ SPT BLOWS/0.3m (10 20 30 40 50)
WATER CONTENT % (plastic limit 10 30 ⊕ 50 70 liquid limit 90)

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	USCS	BLOW COUNTS	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER INSTALLATION
0.0		COARSE SAND AND GRAVEL:							159 mm DIA. HOLE; 10/20 FRAC SAND
41.0		41.0 As above, little clay.							41.0; NO 0.020 SLOT SCREEN
42.5		TOTAL DEPTH = 42.5 m.							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 2

CONTRACT NO.: 3773-12-1
BORING NO.: TOB96-15
NORTHING: 6057406.00
COMPILED BY: M. Brewster
LOCATION: Tailings Pond
EASTING: 622236.0
BORING DATE: Sept. 16, 1996
CONTRACTOR: Cora Lynn Drilling
ELEVATION: 602.0 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit
liquid limit

DEPTH m	SYMBOL	DESCRIPTION	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
0.0	SOIL/ROCK						
0.1		TOPSOIL: silty, black, highly organic, loose, moist.	T				
1.0		SILTY CLAY: light to medium brown, fine sandy partings, moderately calcareous, medium stiff, moist, low plasticity.	S				
2.0			S				
3.0						▼ 3.2	
3.2		COARSE SAND AND GRAVEL: medium brown, little clay, poorly sorted.					
4.0							
5.0							
5.0		SAND AND SILT TILL: dark brown, little to some clay, little gravel, trace coal, stiff, moist, low plasticity.	S				
6.0							
7.0							
8.0							
9.0							
10.0							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 2 OF 2

CONTRACT NO.:	3773-12-1	COMPILED BY:	M. Brewster	BORING DATE:	Sept. 16, 1996
BORING NO.:	TOB96-15	LOCATION:	Tailings Pond	CONTRACTOR:	Cora Lynn Drilling
NORTHING:	6057406.00	EASTING:	622236.0	ELEVATION:	602.0 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2 (1, 2, 3, 4)
SPT BLOWS/0.3m (10, 20, 30, 40, 50)
WATER CONTENT % (plastic limit 10, 30; liquid limit 50, 70, 90)

DEPTH m	SYMBOL	DESCRIPTION	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
10.0		SOIL/ROCK					
		SAND AND SILT TILL: as above.	S				
11.0							
12.0							
13.0							
14.0							
15.0							
16.0		16.0					
		GRAVEL: coarse, loose.					
		16.5					
17.0		SILTSTONE BEDROCK: black, finely laminated.					
		TOTAL DEPTH = 17.5 m.					
18.0							
19.0							
20.0							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 1 OF 2

CONTRACT NO.: 3773-12-1
BORING NO.: TOB96-16
NORTHING: 6057145.00

COMPILED BY: M. Brewster
LOCATION: Tailings Pond
EASTING: 621787.00

BORING DATE: Sept. 16, 1996
CONTRACTOR: Cora Lynn Drilling
ELEVATION: 610 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit
liquid limit

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
0.0		SILT: light brown, little sand, little cobbles, loose, dry.	S				
2.0							
2.5		SAND: dark brown, fine to medium grained, poorly sorted, little gravel, loose, slightly moist.					
		SAND AND SILT TILL: dark brown, little to some clay, little gravel, moderately stiff, moist, very low plasticity.					
5.0		As above, trace coal, very stiff.	S				
10.0							

PITEAU ENGINEERING LTD. OFFICE REPORT ON SITE INVESTIGATION SHEET 2 OF 2

CONTRACT NO.: 3773-12-1
BORING NO.: TOB96-16
NORTHING: 6057195.00
COMPILED BY: M. Brewster
LOCATION: Tailings Pond
EASTING: 621787.00
BORING DATE: Sept. 16, 1996
CONTRACTOR: Cora Lynn Drilling
ELEVATION: 610 masl

SAMPLE TYPES
A AUGER SAMPLE
W WASH SAMPLE
R ROCK CORE
C CRREL BARREL
S SPLIT SPOON
T SHELBY TUBE
O THIN WALL OPEN
P THIN WALL PISTON
▽ STATIC WATER LEVEL
▼ DYNAMIC WATER LEVEL

SAMPLE CONDITION
DISTURBED
FAIR
GOOD
LOST

TEST INFORMATION
PENETROMETER kg/cm2
SPT BLOWS/0.3m
WATER CONTENT %
plastic limit
liquid limit

DEPTH m	SYMBOL	DESCRIPTION SOIL/ROCK	SAMPLES TYPE	SAMPLES CONDITION	SAMPLES NUMBER	WATER LEVEL	PIEZOMETER CONSTRUCTION DETAILS
10.0		CLAY AND SILT TILL: as above, hard.	S				
11.0							
12.0		12.0					
		SILTSTONE BEDROCK: dark grey, finely laminated.					
13.0							
		TOTAL DEPTH = 13.5 m					
14.0							
15.0							
16.0							
17.0							
18.0							
19.0							
20.0							

APPENDIX III

HYDRAULIC CONDUCTIVITY TEST DATA AND ANALYSES

Piezometer:	TOB96-07-10
Date:	96/09/18
Hydraulic Conductivity (m/s):	6.5×10^{-9}
Piezometer Stick-up (m):	0.65
Screened Interval (mbgs):	7.4 - 10.4
Static Water Level below top of PVC (mbtoc):	1.076

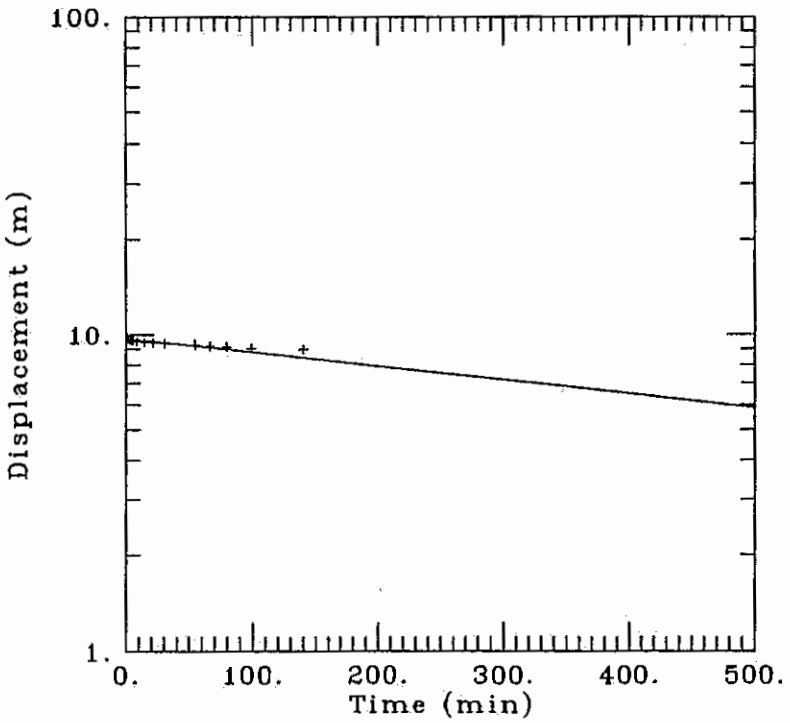
Elapsed Time (min:sec)	Drawdown (m)
0:54	9.77
1:30	9.74
1:58	9.73
2:48	9.73
3:36	9.64
3:55	9.61
5:30	9.57
8:25	9.52
14:30	9.47
21:30	9.42
30:45	9.37
55:00	9.27
66:30	9.18
79:34	9.12
99:00	9.05
140:00	8.94
1370:00	2.14

Notes:

1. mbgs = metres below ground surface
2. mbtoc = metres below top of casing

Piteau Engineering Ltd.	Client: Manalta Coal Ltd.
Project No.: 3773-12	Location: Tailings Pond

HYDRAULIC TEST PROGRAM - TELKWA PROJECT



DATA SET:
c:\3773-12\96-710.dat
09/27/96

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 18, 1996
TEST WELL:
TO896-7-10
OBS. WELL:
N/A

ESTIMATED PARAMETERS:
K = 3.8878E-07 m/min
y0 = 9.756 m

TEST DATA:
H0 = 10. m
rc = 0.0254 m
rw = 0.0762 m
L = 3. m
b = 10. m
H = 10. m

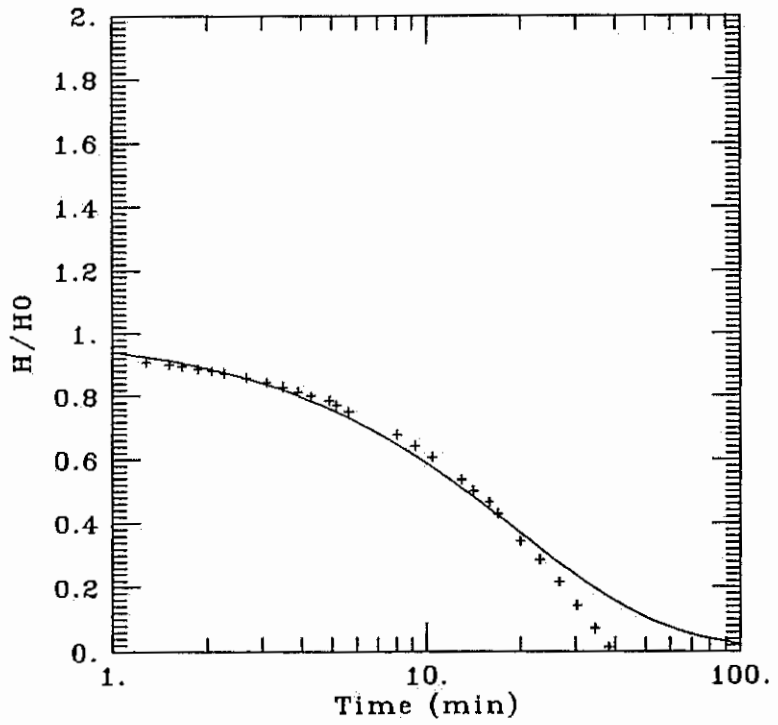
Piezometer:	TOB96-07-20
Date:	96/09/18
Hydraulic Conductivity (m/s):	8.2×10^{-7}
Piezometer Stick-up (m):	0.65
Screened Interval (mbgs):	16.6 - 19.6
Static Water Level below top of PVC (mbtoc):	flowing

Elapsed Time (min:sec)	Drawdown (m)
1:17	12.70
1:31	12.60
1:40	12.50
1:52	12.40
2:04	12.30
2:16	12.20
2:40	12.00
3:05	11.80
3:29	11.60
3:54	11.40
4:18	11.20
4:45	11.00
5:10	10.80
5:39	10.50
8:03	9.50
9:13	9.00
10:25	8.50
12:55	7.50
14:05	7.00
15:53	6.50
16:55	6.00
20:00	4.80
23:00	4.00
26:30	3.00
30:20	2.00
34:35	1.00
38:20	0.20

Notes:
1. mbgs = metres below ground surface
2. mbtoc = metres below top of casing

Piteau Engineering Ltd.	Client: Manalta Coal Ltd.
Project No.: 3773-12	Location: Tailings Pond

HYDRAULIC TEST PROGRAM - TELKWA PROJECT



DATA SET:
96-720.DAT
09/30/96

AQUIFER TYPE:
Confined
SOLUTION METHOD:
Cooper et al.
TEST DATE:
September 18, 1996
TEST WELL:
TO896-7-20
OBS. WELL:
N/A

ESTIMATED PARAMETERS:
T = 0.0001472 m^2/min
S = 1.E-08

TEST DATA:
H0 = 14. m
rc = 0.0254 m
rw = 0.0762 m

$$K = T/b = \frac{1.47 \times 10^{-4} m^2/min}{3m \times 60\ sec/min} = 8.2 \times 10^{-7} m/sec$$

APPENDIX IV

LABORATORY REPORTS

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
SUSAN LECLERC

DATE : October 9, 1996
CHEMEX PROJECT NO. : PITE192-0501-96-03529
CLIENT REFERENCE :
CLIENT JOB NO. : PROJ.#3773-12

Analytical Data Reviewed By : _____

QA/QC Reviewed By : _____

The above signatures indicate that the individuals identified have reviewed the enclosed documents.

NOTE : Soil samples and water samples (for stable parameters) will be retained for a period of 60 days after completion of analysis.
Retention beyond this period can be arranged for a fee.

CHEMEX Labs Alberta Inc. is accredited by both the Canadian Association for Environmental Analytical Laboratories and the Standards Council of Canada for specific parameters registered with the Association and the Council.

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-10
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 25, 1996
Sample Station Code :

Chemex Worksheet Number : 96-03529-3
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996
Analysis Date : October 2, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS		RESULTS	DETECTION LIMIT	MILLI EQUIVALENTS
Calcium - (ICP) Total	020005	mg/L		26.5	0.01	1.322
Calcium - (ICP) Dissolved	020111	mg/L		26.2	0.01	1.307
Magnesium - (ICP) Total	012005	mg/L		14.4	0.01	1.185
Magnesium - (ICP) Dissolved	012111	mg/L		14.2	0.01	1.169
Sodium - (ICP) Total	011005	mg/L		127.	0.01	5.525
Sodium - (ICP) Dissolved	011111	mg/L		127.	0.01	5.525
Potassium - (ICP) Total		mg/L		2.07	0.02	0.053
Potassium - (ICP) Dissolved	019111	mg/L		1.73	0.02	0.044
Chloride - Dissolved	017206	mg/L		13.1	0.5	0.369
Sulphate - (IC) Dissolved	016309	mg/L		52.1	0.1	1.084
PP Alkalinity (as CaCO3)	010151	mg/L	<	0.1	0.1	
Total Alkalinity (as CaCO3)	010111	mg/L		309.	0.5	
pH	010301	Units		7.55	0.01	
Carbonate	006301	mg/L	<	0.5	0.5	
Bicarbonate	006201	mg/L		377.	0.5	6.177
Total Hardness (as CaCO3)	010602	mg/L		124.	0.5	
Hydroxide	008501	mg/L	<	0.5	0.5	
Silicon - Total (ICP)		mg/L		10.3	0.02	
Silicon - Dissolved (ICP)		mg/L		6.34	0.02	
Specific Conductance	002041	uS/cm		713.	0.02	
Total Dissolved Solids	000201	mg/L		427.	1.	
Total Ammonia Nitrogen	007505	mg/L		0.17	0.01	0.012
Nitrite plus Nitrate Nitrogen as N	007110	mg/L		0.902	0.003	
Total Dissolved Phosphate as P	015423	mg/L		0.008	0.003	
Ortho Phosphate as P	015256	mg/L	<	0.003	0.003	
Total Phosphate as P	015406	mg/L		0.110	0.003	
Sulphur - (ICP) - Dissolved		mg/L		15.9	0.2	
Sulphur - (ICP) - Total		mg/L		15.9	0.2	
Total Filterable Residue (TDS)	010451	mg/L		460.0	1.	
Non-Filterable Residue (TSS)	010401	mg/L		101.	0.4	
Aluminum - Total (ICP-MS)	013016	mg/L		2.78	0.001	
Aluminum - Dissolved (ICP-MS)		mg/L	<	0.001	0.001	
Arsenic - Total (AA)	033005	mg/L		0.0015	0.0002	

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-10
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-3
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM	ANAL	DUP Rr	MATRIX SPIKES RECOV %	CONTROL LIMITS LOWER	UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS LOWER	UPPER
Calcium - (ICP) Total	02-10-96	10	SW	1.7	109.7	89.5	115.7	112.5	92.3	116.7
Calcium - (ICP) Dissolved	02-10-96	10	SW	1.7	109.7	89.5	115.7	112.5	92.3	116.7
Magnesium - (ICP) Total	02-10-96	10	SW	0.3	98.1	95.3	107.3	97.4	96.5	109.4
Magnesium - (ICP) Dissolved	02-10-96	10	SW	0.3	98.1	95.3	107.3	97.4	96.5	109.4
Sodium - (ICP) Total	02-10-96	10	SW	0.0	102.1	92.5	109.6	103.0	93.2	111.3
Sodium - (ICP) Dissolved	02-10-96	10	SW	0.0	102.1	92.5	109.6	103.0	93.2	111.3
Potassium -(ICP) Total	02-10-96	10	SW	0.2	101.3	88.2	112.4	100.8	90.2	112.6
Potassium -(ICP) Dissolved	02-10-96	10	SW	0.2	101.3	88.2	112.4	100.8	90.2	112.6
Chloride - Dissolved	30-09-96	10	LAD	1.2	102.2	90.8	108.8	102.8	94.3	105.6
Sulphate - (IC) Dissolved	30-09-96	10	LAD	0.0	103.2	91.3	108.3	104.7	90.7	104.7
PP Alkalinity (as CaCO3)	NOT APPLICABLE									
Total Alkalinity (as CaCO3)	26-09-96	3	AM	1.1	NOT APPLICABLE			NOT APPLICABLE		
pH	26-09-96	3	AM	1.8	NOT APPLICABLE			NOT APPLICABLE		
Carbonate	NOT APPLICABLE									
Bicarbonate	NOT APPLICABLE									
Total Hardness (as CaCO3)	NOT APPLICABLE									
Hydroxide	NOT APPLICABLE									
Silicon - Total (ICP)	02-10-96	10	SW	1.8	108.9	59.1	142.3	110.8	60.9	147.2
Silicon - Dissolved (ICP)	02-10-96	10	SW	1.8	108.9	59.1	142.3	110.8	60.9	147.2
Specific Conductance	27-09-96	1	LG	0.2	NOT APPLICABLE			NOT APPLICABLE		
Total Dissolved Solids	NOT APPLICABLE									
Total Ammonia Nitrogen	30-09-96	1	BF	0.0	104.0	80.8	117.3	100.0	90.0	107.5
Nitrite plus Nitrate Nitrogen as N	04-10-96	1	PK	0.4	100.6	93.1	105.1	102.0	87.8	107.9
Total Dissolved Phosphate as P	30-09-96	1	HO	0.0	96.4	80.9	118.0	94.5	82.2	116.0
Ortho Phosphate as P	02-10-96	1	HO	0.0	86.2	80.7	116.6	102.0	86.1	118.0
Total Phosphate as P	30-09-96	1	HO	0.0	96.4	80.9	118.0	94.5	74.8	121.5
Sulphur - (ICP) - Dissolved	02-10-96	10	SW	0.4	NOT APPLICABLE			NOT APPLICABLE		
Sulphur - (ICP) - Total	02-10-96	10	SW	0.4	104.0	.	.	0.0	.	.
Total Filterable Residue (TDS)	02-10-96	1	BF	0.6	NOT APPLICABLE			NOT APPLICABLE		
Non-Filterable Residue (TSS)	30-09-96	2	BF	2.0	NOT APPLICABLE			NOT APPLICABLE		
Aluminum - Total (ICP-MS)	01-10-96	20	WEM	0.0	120.4	84.0	117.8	107.1	82.8	123.2
Aluminum - Dissolved (ICP-MS)	01-10-96	20	WEM	0.0	120.4	84.0	117.8	107.1	91.9	109.6
Arsenic - Total (AA)	27-09-96	1	RJL	0.0	97.3	72.1	119.4	97.2	75.3	122.4

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2 Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-10
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 25, 1996
Sample Station Code :

Chemex Worksheet Number : 96-03529-3
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996
Analysis Date : September 27, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS	DETECTION LIMIT	MILLI EQUIVALENTS
Arsenic - Dissolved (AA)	033109	mg/L	0.0012	0.0002	
Barium - Total (ICP-MS)		mg/L	0.115	0.0002	
Barium - Dissolved (ICP-MS)		mg/L	0.0770	0.0002	
Beryllium - Total (ICP-MS)		mg/L	< 0.0002	0.0002	
Beryllium - Dissolved (ICP-MS)		mg/L	< 0.0002	0.0002	
Boron - Total (ICP-MS)		mg/L	0.10	0.01	
Boron - Dissolved (ICP-MS)		mg/L	< 0.01	0.01	
Cadmium - Total (ICP-MS)	048023	mg/L	0.0021	0.0002	
Cadmium - Dissolved (ICP-MS)		mg/L	0.0005	0.0002	
Chromium - Total (ICP-MS)		mg/L	< 0.001	0.001	
Chromium - Dissolved (ICP-MS)		mg/L	< 0.001	0.001	
Cobalt - Total (ICP-MS)	027016	mg/L	0.0011	0.0003	
Cobalt - Dissolved (ICP-MS)		mg/L	0.0003	0.0003	
Copper - Total (ICP-MS)	029016	mg/L	0.0044	0.0002	
Copper - Dissolved (ICP-MS)		mg/L	0.0040	0.0002	
Iron - Total (ICP-AES)	026009	mg/L	3.80	0.01	
Iron - Dissolved (ICP-AES)	026109	mg/L	0.06	0.01	
Lead - Total (ICP-MS)	082016	mg/L	0.0042	0.0003	
Lead - Dissolved (ICP-MS)		mg/L	< 0.0003	0.0003	
Lithium - Total (ICP-AES)	003009	mg/L	0.012	0.001	
Lithium - Dissolved (ICP-AES)	003109	mg/L	0.011	0.001	
Manganese - Total (ICP-MS)		mg/L	0.161	0.001	
Manganese - Dissolved (ICP-MS)		mg/L	0.079	0.001	
Mercury - Total (CVAA)	080011	ug/L	< 0.05	0.05	
Mercury - Dissolved (CVAA)	080101	ug/L	< 0.05	0.05	
Molybdenum - Total (ICP-MS)		mg/L	0.0058	0.0002	
Molybdenum - Dissolved (ICP-MS)		mg/L	0.0035	0.0002	
Nickel - Total (ICP-MS)	028016	mg/L	< 0.0005	0.0005	
Nickel - Dissolved (ICP-MS)		mg/L	< 0.0005	0.0005	
Phosphorus - Total (ICP-AES)		mg/L	< 0.1	0.1	
Phosphorus - Dissolved (ICP-AES)	015450	mg/L	< 0.1	0.1	
Selenium - Total (AA)	034005	mg/L	< 0.0002	0.0002	
Selenium - Dissolved (AA)	034105	mg/L	< 0.0002	0.0002	

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : T0896-7-10
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-3
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM	ANAL	MATRIX SPIKES DUP Rr	RECOV %	CONTROL LIMITS LOWER	UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS LOWER	UPPER
Arsenic - Dissolved (AA)	27-09-96	1	RJL	0.0	97.3	72.1	119.4	97.2	75.3	122.4
Barium - Total (ICP-MS)	01-10-96	20	WEM	0.0	106.1	75.8	123.5	98.0	87.1	113.2
Barium - Dissolved (ICP-MS)	01-10-96	20	WEM	0.0	106.1	75.8	123.5	98.0	87.1	113.2
Beryllium - Total (ICP-MS)	01-10-96	20	WEM	2.0	138.6	75.3	121.2	93.5	80.1	120.4
Beryllium - Dissolved (ICP-MS)	01-10-96	20	WEM	2.0	138.6	75.3	121.2	93.5	80.1	120.4
Boron - Total (ICP-MS)	01-10-96	20	WEM	0.0	85.4	71.5	136.2	98.2	76.3	127.8
Boron - Dissolved (ICP-MS)	01-10-96	20	WEM	0.0	85.4	71.5	136.2	98.2	76.3	127.8
Cadmium - Total (ICP-MS)	01-10-96	20	WEM	3.2	108.5	78.1	120.3	113.6	83.4	114.8
Cadmium - Dissolved (ICP-MS)	01-10-96	20	WEM	3.2	108.5	78.1	120.3	113.6	83.4	114.8
Chromium - Total (ICP-MS)	01-10-96	20	WEM	0.0	103.2	76.8	117.8	87.3	87.7	113.8
Chromium - Dissolved (ICP-MS)	01-10-96	20	WEM	0.0	103.2	76.8	117.8	87.3	87.7	113.8
Cobalt - Total (ICP-MS)	01-10-96	20	WEM	3.2	97.1	80.1	114.1	96.4	86.0	113.1
Cobalt - Dissolved (ICP-MS)	01-10-96	20	WEM	3.2	97.1	80.1	114.1	96.4	86.1	113.1
Copper - Total (ICP-MS)	01-10-96	20	WEM	0.0	114.2	79.0	115.4	80.6	83.5	115.1
Copper - Dissolved (ICP-MS)	01-10-96	20	WEM	0.0	114.2	79.0	115.4	80.6	83.7	115.1
Iron - Total (ICP-AES)	02-10-96	10	SW	0.0	110.5	88.8	114.6	110.0	92.2	112.0
Iron - Dissolved (ICP-AES)	02-10-96	10	SW	0.0	110.5	88.8	114.6	110.0	92.2	112.0
Lead - Total (ICP-MS)	01-10-96	20	WEM	3.2	100.2	80.5	116.9	103.2	77.8	129.8
Lead - Dissolved (ICP-MS)	01-10-96	20	WEM	3.2	100.2	80.5	116.9	103.2	85.3	113.9
Lithium - Total (ICP-AES)	02-10-96	10	SW	0.0	95.2	74.2	111.3	95.2	82.6	107.0
Lithium - Dissolved (ICP-AES)	02-10-96	10	SW	0.0	95.2	74.2	111.3	95.2	82.6	107.0
Manganese - Total (ICP-MS)	01-10-96	20	WEM	0.0	117.6	80.8	119.6	102.9	87.4	114.7
Manganese - Dissolved (ICP-MS)	01-10-96	20	WEM	0.0	117.6	80.8	119.6	102.9	87.4	114.7
Mercury - Total (CVAA)	02-10-96	1	CH	0.0	100.0	66.0	132.7	95.6	69.9	131.2
Mercury - Dissolved (CVAA)	02-10-96	1	CH	0.0	100.0	66.0	132.7	95.6	69.9	131.2
Molybdenum - Total (ICP-MS)	01-10-96	20	WEM	3.2	91.1	87.0	117.6	107.3	90.5	109.8
Molybdenum - Dissolved (ICP-MS)	01-10-96	20	WEM	3.2	91.1	87.0	117.6	107.3	90.5	109.8
Nickel - Total (ICP-MS)	01-10-96	20	WEM	0.0	101.4	78.4	116.6	105.9	83.3	118.4
Nickel - Dissolved (ICP-MS)	01-10-96	20	WEM	0.0	101.4	78.4	116.6	105.9	83.3	118.4
Phosphorus - Total (ICP-AES)	02-10-96	10	SW	0.8	99.5	84.0	113.4	101.6	85.1	110.0
Phosphorus - Dissolved (ICP-AES)	02-10-96	10	SW	0.8	99.5	84.0	113.4	101.6	85.1	110.0
Selenium - Total (AA)	27-09-96	1	RJL	0.0	88.0	79.2	120.7	97.2	76.6	122.4
Selenium - Dissolved (AA)	27-09-96	1	RJL	0.0	88.0	79.2	120.7	97.2	76.6	122.4

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-10
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 25, 1996
Sample Station Code :

Chemex Worksheet Number : 96-03529-3
Chemex Project Number : PITE92-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996
Analysis Date : October 1, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S	DETECTION LIMIT	MILLI EQUIVALENTS
Silver - Total (ICP-MS)	047016	mg/L	< 0.0001	0.0001	
Silver - Dissolved (ICP-MS)		mg/L	< 0.0001	0.0001	
Strontium - Total (ICP-MS)		mg/L	0.380	0.002	
Strontium - Dissolved (ICP-MS)		mg/L	0.361	0.002	
Titanium - Total (ICP-MS)		mg/L	0.079	0.001	
Titanium - Dissolved (ICP-MS)		mg/L	0.036	0.001	
Uranium - Total (ICP-MS)		mg/L	0.0094	0.0004	
Uranium - Dissolved (ICP-MS)		mg/L	0.0090	0.0004	
Vanadium - Total (ICP-MS)		mg/L	0.011	0.001	
Vanadium - Dissolved (ICP-MS)		mg/L	0.004	0.001	
Zinc - Total (ICP-MS)		mg/L	0.0479	0.0006	
Zinc - Dissolved (ICP-MS)		mg/L	< 0.0006	0.0006	
Ion Balance		Balance	1.05	0.01	

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-10
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-3
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM ANAL	MATRIX SPIKES DUP Rr	MATRIX SPIKES RECOV %	MATRIX SPIKES CONTROL LIMITS LOWER	MATRIX SPIKES CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CALIBRATION CHECK CONTROL LIMITS LOWER	CALIBRATION CHECK CONTROL LIMITS UPPER
Silver - Total (ICP-MS)	01-10-96	20 WEM	0.0	78.9	77.7	117.7	94.7	87.3	111.0
Silver - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	78.9	77.7	117.7	94.7	87.3	111.0
Strontium - Total (ICP-MS)	01-10-96	20 WEM	0.0	98.2	87.5	111.6	105.4	86.4	111.2
Strontium - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	98.2	87.5	111.6	105.4	86.4	111.2
Titanium - Total (ICP-MS)	01-10-96	20 WEM	0.0	73.8	68.1	123.7	109.1	82.2	114.9
Titanium - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	73.8	68.1	123.7	109.1	82.2	114.9
Uranium - Total (ICP-MS)	01-10-96	20 WEM	1.6	98.6	77.0	125.0	99.1	81.5	114.2
Uranium - Dissolved (ICP-MS)	01-10-96	20 WEM	1.6	98.6	77.0	125.0	99.1	81.5	114.2
Vanadium - Total (ICP-MS)	01-10-96	20 WEM	0.0	101.2	74.5	119.8	89.5	88.5	111.9
Vanadium - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	101.2	74.5	119.8	89.5	88.5	111.9
Zinc - Total (ICP-MS)	01-10-96	20 WEM	3.2	85.6	57.4	147.3	110.0	84.3	119.6
Zinc - Dissolved (ICP-MS)	01-10-96	20 WEM	3.2	85.6	57.4	147.3	110.0	84.3	119.6

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : T0896-7-20
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 24, 1996
Sample Station Code :

Chemex Worksheet Number : 96-03529-1
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : November 21, 1996
Analysis Date : October 2, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS	DETECTION LIMIT	MILLI EQUIVALENTS
Calcium - (ICP) Total	020005	mg/L	23.2	0.01	1.158
Calcium - (ICP) Dissolved	020111	mg/L	23.0	0.01	1.148
Magnesium - (ICP) Total	012005	mg/L	10.8	0.01	0.889
Magnesium - (ICP) Dissolved	012111	mg/L	9.84	0.01	0.810
Sodium - (ICP) Total	011005	mg/L	244.	0.01	10.614
Sodium - (ICP) Dissolved	011111	mg/L	244.	0.01	10.614
Potassium -(ICP) Total		mg/L	3.71	0.02	0.095
Potassium -(ICP) Dissolved	019111	mg/L	3.66	0.02	0.094
Chloride - Dissolved	017206	mg/L	29.2	0.5	0.823
Sulphate - (IC) Dissolved	016309	mg/L	16.3	0.1	0.339
PP Alkalinity (as CaCO3)	010151	mg/L	< 0.1	0.1	
Total Alkalinity (as CaCO3)	010111	mg/L	550.	0.5	
pH	010301	Units	7.99	0.01	
Carbonate	006301	mg/L	< 0.5	0.5	
Bicarbonate	006201	mg/L	670.	0.5	10.995
Total Hardness (as CaCO3)	010602	mg/L	98.0	0.5	
Hydroxide	008501	mg/L	< 0.5	0.5	
Silicon - Total (ICP)		mg/L	5.10	0.02	
Silicon - Dissolved (ICP)		mg/L	4.59	0.02	
Specific Conductance	002041	uS/cm	1084.	0.02	
Total Dissolved Solids	000201	mg/L	676.	1.	
Total Ammonia Nitrogen	007505	mg/L	0.50	0.01	0.036
Nitrite plus Nitrate Nitrogen as N	007110	mg/L	0.037	0.003	
Total Dissolved Phosphate as P	015423	mg/L	0.004	0.003	
Ortho Phosphate as P	015256	mg/L	< 0.003	0.003	
Total Phosphate as P	015406	mg/L	0.027	0.003	
Sulphur - (ICP) - Dissolved		mg/L	5.4	0.2	
Sulphur - (ICP) - Total		mg/L	9.0	0.2	
Total Filterable Residue (TDS)	010451	mg/L	688.	1.	
Non-Filterable Residue (TSS)	010401	mg/L	21.0	0.4	
Aluminum - Total (ICP-MS)	013016	mg/L	0.713	0.001	
Aluminum - Dissolved (ICP-MS)		mg/L	< 0.001	0.001	
Arsenic - Total (AA)	033005	mg/L	0.0007	0.0002	

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-20
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-1
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : November 21, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM ANAL	DUP Rr	MATRIX SPIKES RECOV %	CONTROL LIMITS LOWER	CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS LOWER	CONTROL LIMITS UPPER
Calcium - (ICP) Total	02-10-96	10 SW	1.7	109.7	89.5	115.7	112.5	92.3	116.7
Calcium - (ICP) Dissolved	02-10-96	10 SW	1.7	109.7	89.5	115.7	112.5	92.3	116.7
Magnesium - (ICP) Total	02-10-96	10 SW	0.3	98.1	95.3	107.3	97.4	96.5	109.4
Magnesium - (ICP) Dissolved	02-10-96	10 SW	0.3	98.1	95.3	107.3	97.4	96.5	109.4
Sodium - (ICP) Total	02-10-96	10 SW	0.0	102.1	92.5	109.6	103.0	93.2	111.3
Sodium - (ICP) Dissolved	02-10-96	10 SW	0.0	102.1	92.5	109.6	103.0	93.2	111.3
Potassium -(ICP) Total	02-10-96	10 SW	0.2	101.3	88.2	112.4	100.8	90.2	112.6
Potassium -(ICP) Dissolved	02-10-96	10 SW	0.2	101.3	88.2	112.4	100.8	90.2	112.6
Chloride - Dissolved	30-09-96	10 LAD	1.2	102.2	90.8	108.8	102.8	94.3	105.6
Sulphate - (IC) Dissolved	20-11-96	10 AM	0.0	100.8	91.3	108.3	98.4	90.7	104.7
PP Alkalinity (as CaCO3)	NOT APPLICABLE								
Total Alkalinity (as CaCO3)	26-09-96	3 AM	1.1	NOT APPLICABLE			NOT APPLICABLE		
pH	26-09-96	3 AM	1.8	NOT APPLICABLE			NOT APPLICABLE		
Carbonate	NOT APPLICABLE								
Bicarbonate	NOT APPLICABLE								
Total Hardness (as CaCO3)	NOT APPLICABLE								
Hydroxide	NOT APPLICABLE								
Silicon - Total (ICP)	02-10-96	10 SW	1.8	108.9	59.1	142.3	110.8	60.9	147.2
Silicon - Dissolved (ICP)	02-10-96	10 SW	1.8	108.9	59.1	142.3	110.8	60.9	147.2
Specific Conductance	27-09-96	1 LG	0.2	NOT APPLICABLE			NOT APPLICABLE		
Total Dissolved Solids	NOT APPLICABLE								
Total Ammonia Nitrogen	30-09-96	1 BF	0.0	104.0	80.8	117.3	100.0	90.0	107.5
Nitrite plus Nitrate Nitrogen as N	04-10-96	1 PK	0.4	100.6	93.1	105.1	102.0	87.8	107.9
Total Dissolved Phosphate as P	30-09-96	1 HO	0.0	96.4	80.9	118.0	94.5	82.2	116.0
Ortho Phosphate as P	02-10-96	1 HO	0.0	86.2	80.7	116.6	102.0	86.1	118.0
Total Phosphate as P	30-09-96	1 HO	0.0	96.4	80.9	118.0	94.5	74.8	121.5
Sulphur - (ICP) - Dissolved	02-10-96	10 SW	0.4	NOT APPLICABLE			NOT APPLICABLE		
Sulphur - (ICP) - Total	02-10-96	10 SW	0.4	104.0	.	.	0.0	.	.
Total Filterable Residue (TDS)	02-10-96	1 BF	0.6	NOT APPLICABLE			NOT APPLICABLE		
Non-Filterable Residue (TSS)	30-09-96	2 BF	2.0	NOT APPLICABLE			NOT APPLICABLE		
Aluminum - Total (ICP-MS)	01-10-96	20 WEM	0.0	120.4	84.0	117.8	107.1	82.8	123.2
Aluminum - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	120.4	84.0	117.8	107.1	91.9	109.6
Arsenic - Total (AA)	27-09-96	1 RJL	0.0	97.3	72.1	119.4	97.2	75.3	122.4

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-20
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 24, 1996
Sample Station Code :

Chemex Worksheet Number : 96-03529-1
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : November 21, 1996
Analysis Date : September 27, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS	DETECTION LIMIT	MILLI EQUIVALENTS
Arsenic - Dissolved (AA)	033109	mg/L	0.0002	0.0002	
Barium - Total (ICP-MS)		mg/L	0.140	0.0002	
Barium - Dissolved (ICP-MS)		mg/L	0.0320	0.0002	
Beryllium - Total (ICP-MS)		mg/L	< 0.0002	0.0002	
Beryllium - Dissolved (ICP-MS)		mg/L	< 0.0002	0.0002	
Boron - Total (ICP-MS)		mg/L	0.24	0.01	
Boron - Dissolved (ICP-MS)		mg/L	0.10	0.01	
Cadmium - Total (ICP-MS)	048023	mg/L	0.0007	0.0002	
Cadmium - Dissolved (ICP-MS)		mg/L	< 0.0002	0.0002	
Chromium - Total (ICP-MS)		mg/L	0.039	0.001	
Chromium - Dissolved (ICP-MS)		mg/L	< 0.001	0.001	
Cobalt - Total (ICP-MS)	027016	mg/L	0.0290	0.0003	
Cobalt - Dissolved (ICP-MS)		mg/L	< 0.0003	0.0003	
Copper - Total (ICP-MS)	029016	mg/L	0.0040	0.0002	
Copper - Dissolved (ICP-MS)		mg/L	< 0.0002	0.0002	
Iron - Total (ICP-AES)	026009	mg/L	1.26	0.01	
Iron - Dissolved (ICP-AES)	026109	mg/L	0.03	0.01	
Lead - Total (ICP-MS)	082016	mg/L	0.0021	0.0003	
Lead - Dissolved (ICP-MS)		mg/L	< 0.0003	0.0003	
Lithium - Total (ICP-AES)	003009	mg/L	0.013	0.001	
Lithium - Dissolved (ICP-AES)	003109	mg/L	0.011	0.001	
Manganese - Total (ICP-MS)		mg/L	0.752	0.001	
Manganese - Dissolved (ICP-MS)		mg/L	0.019	0.001	
Mercury - Total (CVAA)	080011	ug/L	< 0.05	0.05	
Mercury - Dissolved (CVAA)	080101	ug/L	< 0.05	0.05	
Molybdenum - Total (ICP-MS)		mg/L	< 0.0002	0.0002	
Molybdenum - Dissolved (ICP-MS)		mg/L	< 0.0002	0.0002	
Nickel - Total (ICP-MS)	028016	mg/L	< 0.0005	0.0005	
Nickel - Dissolved (ICP-MS)		mg/L	< 0.0005	0.0005	
Phosphorus - Total (ICP-AES)		mg/L	< 0.1	0.1	
Phosphorus - Dissolved (ICP-AES)	015450	mg/L	< 0.1	0.1	
Selenium - Total (AA)	034005	mg/L	< 0.0002	0.0002	
Selenium - Dissolved (AA)	034105	mg/L	< 0.0002	0.0002	

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-20
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-1
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : November 21, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM ANAL	MATRIX SPIKES DUP Rr	MATRIX SPIKES RECOV %	MATRIX SPIKES CONTROL LIMITS LOWER	MATRIX SPIKES CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CALIBRATION CHECK CONTROL LIMITS LOWER	CALIBRATION CHECK CONTROL LIMITS UPPER
Arsenic - Dissolved (AA)	27-09-96	1 RJL	0.0	97.3	72.1	119.4	97.2	75.3	122.4
Barium - Total (ICP-MS)	01-10-96	20 WEM	0.0	106.1	75.8	123.5	98.0	87.1	113.2
Barium - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	106.1	75.8	123.5	98.0	87.1	113.2
Beryllium - Total (ICP-MS)	01-10-96	20 WEM	2.0	138.6	75.3	121.2	93.5	80.1	120.4
Beryllium - Dissolved (ICP-MS)	01-10-96	20 WEM	2.0	138.6	75.3	121.2	93.5	80.1	120.4
Boron - Total (ICP-MS)	01-10-96	20 WEM	0.0	85.4	71.5	136.2	98.2	76.3	127.8
Boron - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	85.4	71.5	136.2	98.2	76.3	127.8
Cadmium - Total (ICP-MS)	01-10-96	20 WEM	3.2	108.5	78.1	120.3	113.6	83.4	114.8
Cadmium - Dissolved (ICP-MS)	01-10-96	20 WEM	3.2	108.5	78.1	120.3	113.6	83.4	114.8
Chromium - Total (ICP-MS)	01-10-96	20 WEM	0.0	103.2	76.8	117.8	87.3	87.7	113.8
Chromium - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	103.2	76.8	117.8	87.3	87.7	113.8
Cobalt - Total (ICP-MS)	01-10-96	20 WEM	3.2	97.1	80.1	114.1	96.4	86.0	113.1
Cobalt - Dissolved (ICP-MS)	01-10-96	20 WEM	3.2	97.1	80.1	114.1	96.4	86.1	113.1
Copper - Total (ICP-MS)	01-10-96	20 WEM	0.0	114.2	79.0	115.4	80.6	83.5	115.1
Copper - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	114.2	79.0	115.4	80.6	83.7	115.1
Iron - Total (ICP-AES)	02-10-96	10 SW	0.0	110.5	88.8	114.6	110.0	92.2	112.0
Iron - Dissolved (ICP-AES)	02-10-96	10 SW	0.0	110.5	88.8	114.6	110.0	92.2	112.0
Lead - Total (ICP-MS)	01-10-96	20 WEM	3.2	100.2	80.5	116.9	103.2	77.8	129.8
Lead - Dissolved (ICP-MS)	01-10-96	20 WEM	3.2	100.2	80.5	116.9	103.2	85.3	113.9
Lithium - Total (ICP-AES)	02-10-96	10 SW	0.0	95.2	74.2	111.3	95.2	82.6	107.0
Lithium - Dissolved (ICP-AES)	02-10-96	10 SW	0.0	95.2	74.2	111.3	95.2	82.6	107.0
Manganese - Total (ICP-MS)	01-10-96	20 WEM	0.0	117.6	80.8	119.6	102.9	87.4	114.7
Manganese - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	117.6	80.8	119.6	102.9	87.4	114.7
Mercury - Total (CVAA)	02-10-96	1 CH	0.0	100.0	66.0	132.7	95.6	69.9	131.2
Mercury - Dissolved (CVAA)	02-10-96	1 CH	0.0	100.0	66.0	132.7	95.6	69.9	131.2
Molybdenum - Total (ICP-MS)	01-10-96	20 WEM	3.2	91.1	87.0	117.6	107.3	90.5	109.8
Molybdenum - Dissolved (ICP-MS)	01-10-96	20 WEM	3.2	91.1	87.0	117.6	107.3	90.5	109.8
Nickel - Total (ICP-MS)	01-10-96	20 WEM	0.0	101.4	78.4	116.6	105.9	83.3	118.4
Nickel - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	101.4	78.4	116.6	105.9	83.3	118.4
Phosphorus - Total (ICP-AES)	02-10-96	10 SW	0.8	99.5	84.0	113.4	101.6	85.1	110.0
Phosphorus - Dissolved (ICP-AES)	02-10-96	10 SW	0.8	99.5	84.0	113.4	101.6	85.1	110.0
Selenium - Total (AA)	27-09-96	1 RJL	0.0	88.0	79.2	120.7	97.2	76.6	122.4
Selenium - Dissolved (AA)	27-09-96	1 RJL	0.0	88.0	79.2	120.7	97.2	76.6	122.4

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-20
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 24, 1996
Sample Station Code :

Chemex Worksheet Number : 96-03529-1
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : November 21, 1996
Analysis Date : October 1, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R E S U L T S	DETECTION LIMIT	MILLI EQUIVALENTS
Silver - Total (ICP-MS)	047016	mg/L	< 0.0001	0.0001	
Silver - Dissolved (ICP-MS)		mg/L	< 0.0001	0.0001	
Strontium - Total (ICP-MS)		mg/L	0.860	0.002	
Strontium - Dissolved (ICP-MS)		mg/L	0.719	0.002	
Titanium - Total (ICP-MS)		mg/L	0.024	0.001	
Titanium - Dissolved (ICP-MS)		mg/L	0.113	0.001	
Uranium - Total (ICP-MS)		mg/L	0.0074	0.0004	
Uranium - Dissolved (ICP-MS)		mg/L	0.0074	0.0004	
Vanadium - Total (ICP-MS)		mg/L	< 0.001	0.001	
Vanadium - Dissolved (ICP-MS)		mg/L	< 0.001	0.001	
Zinc - Total (ICP-MS)		mg/L	0.0556	0.0006	
Zinc - Dissolved (ICP-MS)		mg/L	< 0.0006	0.0006	
Ion Balance		Balance	1.02	0.01	

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4. Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-20
Sample Date & Time : 18-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-1
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : November 21, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM ANAL	MATRIX SPIKES DUP Rr	MATRIX SPIKES RECOV %	MATRIX SPIKES CONTROL LIMITS LOWER	MATRIX SPIKES CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CALIBRATION CHECK CONTROL LIMITS LOWER	CALIBRATION CHECK CONTROL LIMITS UPPER
Silver - Total (ICP-MS)	01-10-96	20 WEM	0.0	78.9	77.7	117.7	94.7	87.3	111.0
Silver - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	78.9	77.7	117.7	94.7	87.3	111.0
Strontium - Total (ICP-MS)	01-10-96	20 WEM	0.0	98.2	87.5	111.6	105.4	86.4	111.2
Strontium - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	98.2	87.5	111.6	105.4	86.4	111.2
Titanium - Total (ICP-MS)	01-10-96	20 WEM	0.0	73.8	68.1	123.7	109.1	82.2	114.9
Titanium - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	73.8	68.1	123.7	109.1	82.2	114.9
Uranium - Total (ICP-MS)	01-10-96	20 WEM	1.6	98.6	77.0	125.0	99.1	81.5	114.2
Uranium - Dissolved (ICP-MS)	01-10-96	20 WEM	1.6	98.6	77.0	125.0	99.1	81.5	114.2
Vanadium - Total (ICP-MS)	01-10-96	20 WEM	0.0	101.2	74.5	119.8	89.5	88.5	111.9
Vanadium - Dissolved (ICP-MS)	01-10-96	20 WEM	0.0	101.2	74.5	119.8	89.5	88.5	111.9
Zinc - Total (ICP-MS)	01-10-96	20 WEM	3.2	85.6	57.4	147.3	110.0	84.3	119.6
Zinc - Dissolved (ICP-MS)	01-10-96	20 WEM	3.2	85.6	57.4	147.3	110.0	84.3	119.6

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

Sample Description : TOB96-7-21 (Duplicate of TOBAb-7-20)
Sample Date & Time : 20-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 25, 1996
Sample Station Code :

PROJ.#3773-12
Chemex Worksheet Number : 96-03529-20
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996
Analysis Date : October 2, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS	DETECTION LIMIT	MILLI EQUIVALENTS
Calcium - (ICP) Total	020005	mg/L	22.7	0.01	1.133
Calcium - (ICP) Dissolved	020111	mg/L	22.7	0.01	1.133
Magnesium - (ICP) Total	012005	mg/L	10.9	0.01	0.897
Magnesium - (ICP) Dissolved	012111	mg/L	10.9	0.01	0.897
Sodium - (ICP) Total	011005	mg/L	241.	0.01	10.484
Sodium - (ICP) Dissolved	011111	mg/L	241.	0.01	10.484
Potassium - (ICP) Total		mg/L	3.59	0.02	0.092
Potassium - (ICP) Dissolved	019111	mg/L	3.59	0.02	0.092
Chloride - Dissolved	017206	mg/L	30.7	0.5	0.866
Sulphate - (IC) Dissolved	016309	mg/L	16.3	0.1	0.339
PP Alkalinity (as CaCO3)	010151	mg/L	< 0.1	0.1	
Total Alkalinity (as CaCO3)	010111	mg/L	556.	0.5	
pH	010301	Units	8.24	0.01	
Carbonate	006301	mg/L	< 0.5	0.5	
Bicarbonate	006201	mg/L	678.	0.5	11.115
Total Hardness (as CaCO3)	010602	mg/L	102.	0.5	
Hydroxide	008501	mg/L	< 0.5	0.5	
Silicon - Total (ICP)		mg/L	4.93	0.02	
Silicon - Dissolved (ICP)		mg/L	4.53	0.02	
Specific Conductance	002041	uS/cm	1064.	0.02	
Total Dissolved Solids	000201	mg/L	664.	1.	
Total Ammonia Nitrogen	007505	mg/L	0.51	0.01	0.036
Nitrite plus Nitrate Nitrogen as N	007110	mg/L	0.058	0.003	
Total Dissolved Phosphate as P	015423	mg/L	0.015	0.003	
Ortho Phosphate as P	015256	mg/L	0.011	0.003	
Total Phosphate as P	015406	mg/L	0.025	0.003	
Sulphur - (ICP) - Dissolved		mg/L	5.3	0.2	
Sulphur - (ICP) - Total		mg/L	5.3	0.2	
Total Filterable Residue (TDS)	010451	mg/L	688.0	1.	
Non-Filterable Residue (TSS)	010401	mg/L	21.0	0.4	
Aluminum - Total (ICP-MS)	013016	mg/L	0.379	0.001	
Aluminum - Dissolved (ICP-MS)		mg/L	< 0.001	0.001	
Arsenic - Total (AA)	033005	mg/L	0.0007	0.0002	

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4. Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-21
Sample Date & Time : 20-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-20
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM	ANAL	DUP Rr	MATRIX SPIKES RECOV %	CONTROL LIMITS LOWER	CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS LOWER	CONTROL LIMITS UPPER
Calcium - (ICP) Total	02-10-96	10	SW	1.7	109.7	89.5	115.7	112.5	92.3	116.7
Calcium - (ICP) Dissolved	02-10-96	10	SW	1.7	109.7	89.5	115.7	112.5	92.3	116.7
Magnesium - (ICP) Total	02-10-96	10	SW	0.3	98.1	95.3	107.3	97.4	96.5	109.4
Magnesium - (ICP) Dissolved	02-10-96	10	SW	0.3	98.1	95.3	107.3	97.4	96.5	109.4
Sodium - (ICP) Total	02-10-96	10	SW	0.0	102.1	92.5	109.6	103.0	93.2	111.3
Sodium - (ICP) Dissolved	02-10-96	10	SW	0.0	102.1	92.5	109.6	103.0	93.2	111.3
Potassium -(ICP) Total	02-10-96	10	SW	0.2	101.3	88.2	112.4	100.8	90.2	112.6
Potassium -(ICP) Dissolved	02-10-96	10	SW	0.2	101.3	88.2	112.4	100.8	90.2	112.6
Chloride - Dissolved	30-09-96	10	LAD	1.2	102.2	90.8	108.8	102.8	94.3	105.6
Sulphate - (IC) Dissolved	30-09-96	10	LAD	0.0	103.2	91.3	108.3	104.7	90.7	104.7
PP Alkalinity (as CaCO3)	NOT APPLICABLE									
Total Alkalinity (as CaCO3)	26-09-96	3	AM	1.1	NOT APPLICABLE			NOT APPLICABLE		
pH	26-09-96	3	AM	1.8	NOT APPLICABLE			NOT APPLICABLE		
Carbonate	NOT APPLICABLE									
Bicarbonate	NOT APPLICABLE									
Total Hardness (as CaCO3)	NOT APPLICABLE									
Hydroxide	NOT APPLICABLE									
Silicon - Total (ICP)	02-10-96	10	SW	1.8	108.9	59.1	142.3	110.8	60.9	147.2
Silicon - Dissolved (ICP)	02-10-96	10	SW	1.8	108.9	59.1	142.3	110.8	60.9	147.2
Specific Conductance	27-09-96	1	LG	0.2	NOT APPLICABLE			NOT APPLICABLE		
Total Dissolved Solids	NOT APPLICABLE									
Total Ammonia Nitrogen	02-10-96	1	BF	0.4	101.0	80.8	117.3	102.0	90.0	107.5
Nitrite plus Nitrate Nitrogen as N	04-10-96	1	PK	0.4	100.6	93.1	105.1	102.0	87.8	107.9
Total Dissolved Phosphate as P	01-10-96	1	HO	0.0	95.6	80.9	118.0	98.5	82.2	116.0
Ortho Phosphate as P	02-10-96	1	HO	0.0	86.2	80.7	116.6	102.0	86.1	118.0
Total Phosphate as P	01-10-96	1	HO	0.0	95.6	80.9	118.0	98.5	74.8	121.5
Sulphur - (ICP) - Dissolved	02-10-96	10	SW	0.4	NOT APPLICABLE			NOT APPLICABLE		
Sulphur - (ICP) - Total	02-10-96	10	SW	0.4	104.0	,	,	0.0	.	.
Total Filterable Residue (TDS)	07-10-96	1	BF	1.1	NOT APPLICABLE			NOT APPLICABLE		
Non-Filterable Residue (TSS)	02-10-96	1	BF	0.0	NOT APPLICABLE			NOT APPLICABLE		
Aluminum - Total (ICP-MS)	01-10-96	20	WEM	0.0	120.4	84.0	117.8	107.1	82.8	123.2
Aluminum - Dissolved (ICP-MS)	04-10-96	20	WEM	0.0	94.4	84.0	117.8	89.3	91.9	109.6
Arsenic - Total (AA)	27-09-96	1	RJL	0.0	97.3	72.1	119.4	97.2	75.3	122.4

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-21
Sample Date & Time : 20-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 25, 1996
Sample Station Code :

Chemex Worksheet Number : 96-03529-20
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996
Analysis Date : September 27, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS		DETECTION LIMIT	MILLI EQUIVALENTS
Arsenic - Dissolved (AA)	033109	mg/L	<	0.0002	0.0002	
Barium - Total (ICP-MS)		mg/L		0.164	0.0002	
Barium - Dissolved (ICP-MS)		mg/L		0.146	0.0002	
Beryllium - Total (ICP-MS)		mg/L		0.0004	0.0002	
Beryllium - Dissolved (ICP-MS)		mg/L	<	0.0002	0.0002	
Boron - Total (ICP-MS)		mg/L		0.16	0.01	
Boron - Dissolved (ICP-MS)		mg/L		0.07	0.01	
Cadmium - Total (ICP-MS)	048023	mg/L		0.0032	0.0002	
Cadmium - Dissolved (ICP-MS)		mg/L	<	0.0002	0.0002	
Chromium - Total (ICP-MS)		mg/L	<	0.001	0.001	
Chromium - Dissolved (ICP-MS)		mg/L	<	0.001	0.001	
Cobalt - Total (ICP-MS)	027016	mg/L		0.0008	0.0003	
Cobalt - Dissolved (ICP-MS)		mg/L		0.0004	0.0003	
Copper - Total (ICP-MS)	029016	mg/L	<	0.0002	0.0002	
Copper - Dissolved (ICP-MS)		mg/L	<	0.0002	0.0002	
Iron - Total (ICP-AES)	026009	mg/L		0.94	0.01	
Iron - Dissolved (ICP-AES)	026109	mg/L	<	0.01	0.01	
Lead - Total (ICP-MS)	082016	mg/L		0.0023	0.0003	
Lead - Dissolved (ICP-MS)		mg/L	<	0.0003	0.0003	
Lithium - Total (ICP-AES)	003009	mg/L		0.012	0.001	
Lithium - Dissolved (ICP-AES)	003109	mg/L		0.012	0.001	
Manganese - Total (ICP-MS)		mg/L		0.040	0.001	
Manganese - Dissolved (ICP-MS)		mg/L		0.025	0.001	
Mercury - Total (CVAA)	080011	ug/L	<	0.05	0.05	
Mercury - Dissolved (CVAA)	080101	ug/L	<	0.05	0.05	
Molybdenum - Total (ICP-MS)		mg/L		0.0023	0.0002	
Molybdenum - Dissolved (ICP-MS)		mg/L		0.0020	0.0002	
Nickel - Total (ICP-MS)	028016	mg/L	<	0.0005	0.0005	
Nickel - Dissolved (ICP-MS)		mg/L	<	0.0005	0.0005	
Phosphorus - Total (ICP-AES)		mg/L	<	0.1	0.1	
Phosphorus - Dissolved (ICP-AES)	015450	mg/L	<	0.1	0.1	
Selenium - Total (AA)	034005	mg/L		0.0007	0.0002	
Selenium - Dissolved (AA)	034105	mg/L	<	0.0002	0.0002	

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2, Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 8331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-21
Sample Date & Time : 20-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-20
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM	ANAL	MATRIX SPIKES DUP Rr	RECOV %	CONTROL LIMITS LOWER	UPPER	CALIBRATION CHECK RECOV %	CONTROL LIMITS LOWER	UPPER
Arsenic - Dissolved (AA)	27-09-96	1	RJL	0.0	97.3	72.1	119.4	97.2	75.3	122.4
Barium - Total (ICP-MS)	01-10-96	20	WEM	0.0	106.1	75.8	123.5	98.0	87.1	113.2
Barium - Dissolved (ICP-MS)	01-10-96	20	WEM	0.0	106.1	75.8	123.5	98.0	87.1	113.2
Beryllium - Total (ICP-MS)	01-10-96	20	WEM	2.0	138.6	75.3	121.2	93.5	80.1	120.4
Beryllium - Dissolved (ICP-MS)	04-10-96	20	WEM	0.0	93.5	75.3	121.2	84.5	80.1	120.4
Boron - Total (ICP-MS)	01-10-96	20	WEM	0.0	85.4	71.5	136.2	98.2	76.3	127.8
Boron - Dissolved (ICP-MS)	04-10-96	20	WEM	3.2	97.8	71.5	136.2	103.8	76.3	127.8
Cadmium - Total (ICP-MS)	01-10-96	20	WEM	3.2	108.5	78.1	120.3	113.6	83.4	114.8
Cadmium - Dissolved (ICP-MS)	04-10-96	20	WEM	3.2	86.2	78.1	120.3	91.6	83.4	114.8
Chromium - Total (ICP-MS)	01-10-96	20	WEM	0.0	103.2	76.8	117.8	87.3	87.7	113.8
Chromium - Dissolved (ICP-MS)	04-10-96	20	WEM	0.0	85.1	76.8	117.8	95.1	87.7	113.8
Cobalt - Total (ICP-MS)	01-10-96	20	WEM	3.2	97.1	80.1	114.1	96.4	86.0	113.1
Cobalt - Dissolved (ICP-MS)	04-10-96	20	WEM	2.6	84.9	80.1	114.1	95.5	86.1	113.1
Copper - Total (ICP-MS)	01-10-96	20	WEM	0.0	114.2	79.0	115.4	80.6	83.5	115.1
Copper - Dissolved (ICP-MS)	04-10-96	20	WEM	0.4	89.0	79.0	115.4	94.5	83.7	115.1
Iron - Total (ICP-AES)	02-10-96	10	SW	0.0	110.5	88.8	114.6	110.0	92.2	112.0
Iron - Dissolved (ICP-AES)	02-10-96	10	SW	0.0	110.5	88.8	114.6	110.0	92.2	112.0
Lead - Total (ICP-MS)	01-10-96	20	WEM	3.2	100.2	80.5	116.9	103.2	77.8	129.8
Lead - Dissolved (ICP-MS)	04-10-96	20	WEM	0.0	93.4	80.5	116.9	95.0	85.3	113.9
Lithium - Total (ICP-AES)	02-10-96	10	SW	0.0	95.2	74.2	111.3	95.2	82.6	107.0
Lithium - Dissolved (ICP-AES)	02-10-96	10	SW	0.0	95.2	74.2	111.3	95.2	82.6	107.0
Manganese - Total (ICP-MS)	01-10-96	20	WEM	0.0	117.6	80.8	119.6	102.9	87.4	114.7
Manganese - Dissolved (ICP-MS)	04-10-96	20	WEM	0.0	90.4	80.8	119.6	93.5	87.4	114.7
Mercury - Total (CVAA)	03-10-96	1	CH	0.0	100.0	66.0	132.7	88.5	69.9	131.2
Mercury - Dissolved (CVAA)	03-10-96	1	CH	0.0	100.0	66.0	132.7	88.5	69.9	131.2
Molybdenum - Total (ICP-MS)	01-10-96	20	WEM	3.2	91.1	87.0	117.6	107.3	90.5	109.8
Molybdenum - Dissolved (ICP-MS)	04-10-96	20	WEM	3.2	89.9	87.0	117.6	96.6	90.5	109.8
Nickel - Total (ICP-MS)	01-10-96	20	WEM	0.0	101.4	78.4	116.6	105.9	83.3	118.4
Nickel - Dissolved (ICP-MS)	04-10-96	20	WEM	0.0	95.5	78.4	116.6	91.6	83.3	118.4
Phosphorus - Total (ICP-AES)	02-10-96	10	SW	0.8	99.5	84.0	113.4	101.6	85.1	110.0
Phosphorus - Dissolved (ICP-AES)	02-10-96	10	SW	0.8	99.5	84.0	113.4	101.6	85.1	110.0
Selenium - Total (AA)	27-09-96	1	RJL	0.0	88.0	79.2	120.7	97.2	76.6	122.4
Selenium - Dissolved (AA)	27-09-96	1	RJL	0.0	88.0	79.2	120.7	97.2	76.6	122.4

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-21
Sample Date & Time : 20-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Station Code :

Chemex Worksheet Number : 96-03529-20
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996

BATCH SPECIFIC QUALITY ASSURANCE REPORT

PARAMETER	DATE ANALYZED (DD-MM-YY)	QA/QC BATCH NUM ANAL	DUP Rr	MATRIX SPIKES RECOV %	MATRIX SPIKES CONTROL LIMITS LOWER	MATRIX SPIKES CONTROL LIMITS UPPER	CALIBRATION CHECK RECOV %	CALIBRATION CHECK CONTROL LIMITS LOWER	CALIBRATION CHECK CONTROL LIMITS UPPER
Silver - Total (ICP-MS)	01-10-96	20 WEM	0.0	78.9	77.7	117.7	94.7	87.3	111.0
Silver - Dissolved (ICP-MS)	04-10-96	20 WEM	3.2	83.6	77.7	117.7	92.1	87.3	111.0
Strontium - Total (ICP-MS)	01-10-96	20 WEM	0.0	98.2	87.5	111.6	105.4	86.4	111.2
Strontium - Dissolved (ICP-MS)	04-10-96	20 WEM	0.0	100.5	87.5	111.6	97.3	86.4	111.2
Titanium - Total (ICP-MS)	01-10-96	20 WEM	0.0	73.8	68.1	123.7	109.1	82.2	114.9
Titanium - Dissolved (ICP-MS)	04-10-96	20 WEM	3.2	71.1	68.1	123.7	84.8	82.2	114.9
Uranium - Total (ICP-MS)	01-10-96	20 WEM	1.6	98.6	77.0	125.0	99.1	81.5	114.2
Uranium - Dissolved (ICP-MS)	04-10-96	20 WEM	0.6	95.0	77.0	125.0	95.7	81.5	114.2
Vanadium - Total (ICP-MS)	01-10-96	20 WEM	0.0	101.2	74.5	119.8	89.5	88.5	111.9
Vanadium - Dissolved (ICP-MS)	04-10-96	20 WEM	3.2	82.2	74.5	119.8	89.5	88.5	111.9
Zinc - Total (ICP-MS)	04-10-96	20 WEM	3.2	113.7	57.4	147.3	94.8	84.3	119.6
Zinc - Dissolved (ICP-MS)	04-10-96	20 WEM	3.2	113.7	57.4	147.3	94.8	84.3	119.6

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077, FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-3332

PITEAU ENGINEERING LIMITED
ATTENTION : SUSAN LECLERC

PROJ.#3773-12

Sample Description : TOB96-7-21
Sample Date & Time : 20-09-96
Sampled By : RSC
Sample Type : GRAB
Sample Received Date: September 25, 1996
Sample Station Code :

Chemex Worksheet Number : 96-03529-20
Chemex Project Number : PITE192-0501
Sample Access :
Sample Matrix : WATER
Report Date : October 9, 1996
Analysis Date : October 1, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS	DETECTION LIMIT	MILLI EQUIVALENTS
Silver - Total (ICP-MS)	047016	mg/L	< 0.0001	0.0001	
Silver - Dissolved (ICP-MS)		mg/L	< 0.0001	0.0001	
Strontium - Total (ICP-MS)		mg/L	0.754	0.002	
Strontium - Dissolved (ICP-MS)		mg/L	0.700	0.002	
Titanium - Total (ICP-MS)		mg/L	0.062	0.001	
Titanium - Dissolved (ICP-MS)		mg/L	0.007	0.001	
Uranium - Total (ICP-MS)		mg/L	0.0073	0.0004	
Uranium - Dissolved (ICP-MS)		mg/L	< 0.0004	0.0004	
Vanadium - Total (ICP-MS)		mg/L	< 0.001	0.001	
Vanadium - Dissolved (ICP-MS)		mg/L	< 0.001	0.001	
Zinc - Total (ICP-MS)		mg/L	0.0053	0.0006	
Zinc - Dissolved (ICP-MS)		mg/L	0.0050	0.0006	
Ion Balance		Balance	1.03	0.01	

APPENDIX V

B.C. MINISTRY OF ENVIRONMENT LAND AND PARKS WATER NUMERICAL CRITERIA

Water Numerical Criteria[1]

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Substance	Aquatic Life[2] (AW)	Irrigation[2,3] (IW)	Livestock[2] (LW)	Drinking Water[4] (DW)
Inorganic Substances				
aluminum	5 @ pH≤4.5 7 @ pH=5.0 11 @ pH=5.5 20 @ pH=6.0 50 @ pH≥6.0	5000	5000	200
ammonia	131 @ pH=9.0[7] 370 @ pH=8.5[7] 1130@pH=8.0[7] 1840@pH≤7.7[7]			
arsenic	50	100	500[5]	25
barium	1000			1000
beryllium	5.3	100	100	
boron		500 - 6000[6]	5000	5000
cadmium	0.2 @ H[23]=0-60 (0.01 @ H=30) 0.8 @ H=60-120 (0.03 @ H=90) 1.3 @ H=120-180 (0.05 @H=150) 1.8 @ H>180 (0.06 @ H=210)	10	20	5
calcium			1000 mg/l	
chloride		100 - 700mg/l[6]		250 mg/l
chlorine	2	1000		
chromium	2	100	1000	50
cobalt	50	50	1000	
copper	2 @ H≤50mg/l $CaCO_3$ 4 @ H=100mg/l $CaCO_3$ 6 @ H=150mg/l $CaCO_3$ 8 @ H=200 mg/l	200[6]	300	1000
cyanide (WAD)[9]	5			
cyanide (SAD)[15]				200
fluoride	200 @ H<50mg/l 300 @ H≥50mg/l	1000	1000[5,8]	1500
iron	300	5000		300
lead	3 @ H≤40 mg/l $CaCO_3$ 5 @ H=50mg/l $CaCO_3$ 6 @ H=100mg/l $CaCO_3$ 11 @ H=180 mg/l	200	100	10
lithium		2500	5000	
manganese	100	200		50
mercury	0.1	1	2	1
molybdenum	1000	10 - 30[10]	50	
nickel	25 @ H-0.60mg/l $CaCO_3$ 65 @ H=60-120mg/l $CaCO_3$ 110@H=120-180mg/l $CaCO_3$ 150 @ H≥180mg/l $CaCO_3$	200	1000	
nitrate - N (or as N)	40mg/l		10000[11]	10000[11]
nitrate and nitrite (as N)	40mg/l		10000[11]	10000[11]
nitrite - N (or as N)	20 (chloride ≤ 2mg/l) - 60[12]		10000	3200
selenium	1	20[13], 50[14]	50	10
silver	0.1			
sodium				200 mg/l
sulphate	100 mg/l		1000000	500 mg/l
sulphide as H_2S	2			50
uranium	300	10	200	100
vanadium		100	100	
zinc	30	1000-5000[14,16]	50000	5000

Water Numerical Criteria[1]

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Substance	Aquatic Life[2] (AW)	Irrigation[2,3] (IW)	Livestock[2] (LW)	Drinking Water[4] (DW)
Monocyclic Aromatic Hydrocarbons (MAHs)				
benzene	300			5
ethylbenzene	700			2.4
toluene	300			24
xylenes				300
Polycyclic Aromatic Hydrocarbons (PAHs)				
naphthalene	1			
acenaphthene	6			
fluorene	12			
anthracene	0.1			
phenanthrene	0.3			
acridine	0.05			
fluoranthene	0.2			
pyrene	0.02			
benzo[a]anthracene	0.1			
benzo[a]pyrene	0.01			0.01
Phenolic Substances				
phenols (total)	1			
chlorinated phenols				
monochlorophenol	0.5 - 0.9[17]		0.1[9]	
dichlorophenols	0.12 - 0.35[17]		0.3[9]	0.3
trichlorophenols	0.06 - 0.5[17]		2[9]	2
tetrachlorophenols	0.02 - 0.3[17]		1[9]	1
pentachlorophenol	0.02 - 0.3[17]		30[9]	30
Chlorinated Hydrocarbons				
chlorinated aliphatics				
dichloroethane, 1,2-	100			5
dichloromethane				50
hexachlorobutadiene	0.1			
hexachlorocyclohexane isomers	0.01			
tetrachloroethylene	260			
trichloroethylene	20			50
vinyl chloride				2
chlorinated benzenes				
monochlorobenzene	15			30
dichlorobenzene, 1,2-	2.5			3
dichlorobenzene 1,3-	2.5			
dichlorobenzene, 1,4-	4			1
trichlorobenzene, 1,2,3-	0.9			
trichlorobenzene, 1,2,4-	0.5			
trichlorobenzene, 1,3,5-	0.65			
tetrachlorobenzene, 1,2,3,4-	0.1			
tetrachlorobenzene, 1,2,3,5-	0.1			
tetrachlorobenzene, 1,2,4,5-	0.15			
pentachlorobenzene	0.03			
hexachlorobenzene	0.0065			
PCBs	0.0001	0.5		
Halogenated Methanes				
carbon tetrachloride				5
trihalomethanes				100
Phthalate Esters				
DBP	4			
DEHP	0.6			
other phthalate esters	0.2			

Water Numerical Criteria[1]

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Substance	Aquatic Life[2] (AW)	Irrigation[2,3] (IW)	Livestock[2] (LW)	Drinking Water[4] (DW)
Pesticides				
aldicarb	0.15[18,19]	54.9[20], 67.5[21]	11	9
aldrin and dieldrin	0.004		0.7	0.7
atrazine	2[19], 10[18]	10	60	5
azinphos-methyl				20
bendiocarb				40
bromoxynil				5
carbaryl				90
carbofuran	1.75		45	90
chlordane	0.006			7
chlorpyrifos				90
cyanazine	2	0.5	10	10
2,4-D	4			100
DDT	0.001			30[22]
diazinon	0.01		14	20
dicamba				120
diclofop-methyl				9
dimethoate	6.2		3	20
dinoseb				10
diquat				70
diuron				150
endosulfan	0.02			
endrin	0.0023			
glyphosate	65		280	280
heptachlor & heptachlor epoxide	0.01			3
lindane				4
malathion				190
methoxychlor				900
metolachlor	8	28	50	50
metribuzin	1	0.5	80	80
paraquat				10
parathion				50
phorate				2
picloram	29	0.5	190	190
simazine	10	0.5	10	10
2,4,5-T				20
temephos				280
terbufos				1
toxaphene	0.008			
triallate	0.24		230	230
trifluralin	0.1		45	45
Radioactive Substances				
^{137}cesium				50 Bq/l
^{131}iodine				10 Bq/l
^{226}radium				1 Bq/l
^{90}strontium				10 Bq/l
^{3}tritium				40000 Bq/l

Water Numerical Criteria[1]

Footnotes

[1]All values are in ug/l unless otherwise stated.

[2]For surface water samples, samples must be tested to determine total combined particulate and dissolved substance concentrations. For groundwater samples, samples must be tested to determine dissolved substance concentrations.

[3]Applies to irrigation of all soil types.

[4]Drinking water criteria are for unfiltered samples obtained at the point of consumption. Heavy metals, metalloids and inorganic ions are expressed as total concentrations (particulate and dissolved) unless otherwise indicated.

[5]Criterion applies where dietary intakes or natural levels are high. Consult Director for further advice.

[6]Criterion varies depending on crop. Consult Director for further advice.

[7]Criterion varies with pH and temperature. 10°C is assumed. Consult Director for further advice.

[8]Criterion varies with type of livestock. Consult Director for further advice.

[9]WAD means weak acid dissociable.

[10]Criterion varies with crop, soil drainage and Mo:Cu ratio. Consult Director for further advice.

[11]Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

[12]Criterion varies with chloride concentration. Consult Director for further advice.

[13]Criterion for intermittent applications on crops.

[14]Criterion for continuous application on crops.

[15]SAD means strong acid dissociable.

[16]Criterion varies with soil pH. Consult Director for further advice.

[17]Criterion varies with pH and substance isomer. Consult Director for further advice.

[18]Criterion to protect marine aquatic life.

[19]Criterion to protect freshwater aquatic life.

[20]Criterion to protect crops other than legumes.

[21]Criterion to protect legumes.

[22]Includes DDT metabolites.

[23]H means water hardness in mg/l $CaCO_3$.

ERRATUM

The reference to footnote 9 for chlorinated phenols - livestock watering criteria (column IV) is incorrect. Footnote reference should be to footnote 24 below:

[24] Criterion to protect against taste and odor concerns.