DEH CHO FIRST NATIONS

BOX 89, FORT SIMPSON, N.W.T. X0E 0N0
TEL : (867) 695-2355 FAX : (867) 695-2038
EMAIL: dehchofn@cancom.net

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Date: Aug. 31, 2001

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DEH CHO FIRST NATIONS

BRANCH OFFICE - BOX 89, FORT SIMPSON, N.W.T. X0E 0N0
TEL: (867) 695-2355 FAX: (867) 695-2038
E-Mail: dehchofn@cancom.net

Luciano Azzolini
Environmental Assessment Officer
Mackenzie Valley Environmental Impact Review Board
Yellowknife, NT

Dear Mr. Azzolini:

RE: ENVIRONMENTAL ASSESSMENT METALLURGICAL PILOT PLANT AND UNDERGROUND DECLINE DEVELOPMENT AND EXPLORATION DRILLING (MVEIRB FILE 01-002)

The Deh Cho First Nations has reviewed the above file and has reached the following conclusions:

<u>Underground Decline</u>

In addition to the current land use permit application, the underground decline proposal requires an application for Class "B" Water License. Canadian Zinc has estimated that slightly more than 66,000 m^3 of minewater may be pumped, certainly resulting in the use of more than $100 m^3$ of water per day. (See BGC Engineering letter to Canadian Zinc Aug. 16, 2001). Further, dewatering involves the direct or indirect deposit of waste to surface waters.

<u>Tailings Pond</u>

There is significant public concern whether the tailings pond is sufficiently stable to safely accommodate possible combined discharge from the metallurgical pilot plant and minewater from the underground decline. In his letter of August 16, 2001 Canadian Zinc's geotechnical engineer states that: "...the stability of the tailings pond containment structures is adequate for the proposed use **provided levels do not rise more than about 1 m above the 1994 level under the proposed use**" [emphasis added]. Despite stating in its environmental assessment report that the volume of minewater discharge cannot be predicted, Canadian Zinc provided its geotechnical engineer with an estimate of slightly more than 70,000 m^3 combined pilot plant and minewater discharge. This is estimated to raise the water level as much as 70 cm, providing for only 30 cm of surplus safe capacity.

BGC Engineering has provided an extensive list of recommendations for rehabilitation of the tailings pond, which must be carried out before the mine is to go into production. No wastes have yet been deposited into the tailings pond. It will be much more difficult to safely rehabilitate the tailings pond, after the proposed waste is deposited, especially since Canadian Zinc has stated that it does not know the current water quality within tailings pond and that it cannot predict the water quality to be discharged from the pilot plant and the underground decline.

Fuel Storage

There is significant public concern whether the fuel facilities can safely continue to store fuel at the site. Motor oil and fuel leakage was observed into the containment berm during the site visit on August 30, 2001. Canadian Zinc stated that water from the containment berm is being pumped out of the fuel containment berm directly into Harrison Creek. Further, in its response to Parks Canada Information Request #1, Canadian Zinc has stated that its fuel storage facilities do not meet current standards. Fuel for the project will be used from these facilities, making the fuel facilities part of the project. Hence, the safety of the fuel facilities must be considered as part of this environmental assessment. || Scope issue.

Cumulative Effects

As referred to above, Canadian Zinc did not conduct a cumulative effects assessment of the combined discharge of waste from the pilot plant and the underground decline into the tailings pond.

There is significant public concern whether the cumulative effect of the Canadian Zinc project, the Tungsten project, and the Howard's Pass project will impair water quality in the watershed. Canadian Zinc has not provided estimates of total combined discharges of these project under exploration and/or production and its effects on water quality in the watershed. The sentence at the conclusion of Canadian Zinc's response to DIAND Information Request #7 is puzzling.

> In any event, given the state of environmental regulation, mining practices and environmental control technology, the cumulative effect on water quality of the South Nahanni River of all three operations being conducted simultaneously within the upper reaches of the expansive 37,000 km^2 South Nahanni watershed, each so as not to have significant adverse effects downstream water, would be expected to be negligible.

Does the writer mean that there is a negligible likelihood of the combined projects **not** having significant adverse environmental effects?

Finally, Canadian Zinc has not conducted a cumulative effects assessment of the total combined socio-economic impact of these projects.

Conclusion

The Mackenzie Valley Environmental Impact Review Board should make the following recommendations:

1) That the Mackenzie Valley Land and Water Board require Canadian Zinc to submit a Water License application for the Underground Decline in combination with the application for the Pilot Plant.

2) That approval of the Land Use Permit for the Underground Decline be subject to the approval of the above-referenced Water License.

3) That Canadian Zinc be required to conduct a cumulative effects assessment of the combined effects of water use and deposit of waste by the Pilot Plant and the Underground Decline.

4) That approval of a Water License for the Pilot Plant and Underground Decline be subject to the following terms and conditions:

    a) Successful rehabilitation of the tailings pond according to the recommendations of a professional geotechnical engineer (See letter from BCG Engineering December 18, 2000).

    b) Upgrading of the fuel storage facility to current standards.

    c) Cumulative effects assessment of combined discharges of all mineral exploration and development projects on water quality in the South Nahanni River watershed.

    d) Cumulative effects assessment of the combined socio-economic impacts of all mineral exploration and development projects in the South Nahanni River watershed.

Sincerely yours,

Michael Nadli
Grand Chief, Deh Cho First Nations

c.c. Deh Cho Leadership

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
#500 - 1045 Howe Street,
Vancouver, B.C.,
Canada, V6Z 2A9
Telephone (604) 684-5900
Facsimile (604) 684-5909

Project No. 0059-002-04

August 16, 2001

Canadian Zinc Corporation
Suite 1202, 700 West Pender Street
Vancouver, B.C.
V6C 1G8

Attention: Mr. J. Peter Campbell, Vice President – Project Affairs

Re: Prairie Creek Mine Tailings Impoundment Facility, NT
GNWT-RWED and DIAND Information Requests

Dear Sir:

From the information in your e-mail of August 14, 2001, I understand that Canadian Zinc Corp. (CZN) has applied for permits to conduct additional surface exploration, operate a metallurgical pilot plant, develop an underground decline and conduct underground exploration at the Prairie Creek Mine in western Northwest Territories. These activities, which are referred to here as "the proposed use", will be carried out over a 5 to 6 month period in 2002. CZN has received requests from the Government of Northwest Territories and the Department of Indian Affairs and Northern Development for additional information, some of which pertains to the tailings facility.

BGC Engineering Inc. (BGC) undertook geotechnical engineering studies on the tailings facility in 1994 and 1995 under contract to San Andreas Resources Ltd. Although constructed in 1982, the facility had not been operated and the purpose of our work was to assess possible rehabilitation needs arising from lack of use over the intervening 12 years. We undertook drilling, sampling and instrumentation at the site and follow-up geothermal and slope stability analyses leading to conceptual design modifications. A draft report was issued.

Last year CZN retained BGC to update and clarify details presented in our earlier draft report. The 2000 studies were documented in a BGC report dated 18 December 2000. As requested, I have had the text and figures of this report put on a compact disk, which is being sent to you under separate cover.

In your e-mail you indicated that the tailings facility would receive between 4,000m^3 and slightly more than 70,000m^3 of combined process and mine water under the proposed use. You further indicated that this would raise the current level of the tailings pond by between 4cm and slightly more than 70cm, respectively. You asked BGC to comment on whether the tailings facility in the form we last saw it is suited to the proposed use.

During a 1994 inspection I noted evidence of natural fluctuations in the tailings pond level of approximately 1m. Assuming that the level in the facility is still at the approximate 1994 level, then my response to your question is that the tailings pond has already experienced natural fluctuations greater than those contemplated under the proposed use. To be more specific, I am satisfied that the tailings facility is geotechnically stable in its present configuration and that the geotechnical stability of the tailings pond containment structures is adequate for the proposed use provided levels do not rise more than about 1m above the 1994 level under the proposed use. As a cautionary note, I point out that the facility should not be pumped down to create the planned storage without additional geotechnical assessment. This is because of potentially adverse uplift pressures on the basal clay liner.

As far as hydrotechnical stability is concerned, BGC found no field or anecdotal evidence of seepage loss from the containment structures during our previous studies. Damage to the hypalon liner along the cut backslope (i.e. northeastern side) of the facility may have some potential to create a seepage path. This will be of limited cross-sectional extent, however, given the height to which we determined the low permeability glacial lake clay rises beneath the cut backslope. The potential seepage path available is north and south at shallow depth in the cut backslope, however, the vast majority of such seepage would be expected to report to the south.

Given the nature of the proposed developments and limited increase anticipated in pond water level, such seepage, if it were to occur at all, is expected to be minor. Given the shallow nature of the potential seepage path, the majority of such seepage, if it were to occur, would be expected to be picked up in the site catchment pond.

I trust the foregoing comments and the CD sent under separate cover are adequate for you at this time. If BGC can be of any further assistance in this matter, please do not hesitate to contact me.

Yours truly,
BGC ENGINEERING INC.

per: Dr. K. Wayne Savigny, P.Eng., P.Geol.
Principal

Enc: CD of December 18, 2001 BGC report under separate cover

KWS/ph

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
#500 - 1045 Howe Street,
Vancouver, B.C.,
Canada, V6Z 2A9
Telephone (604) 684-5900
Facsimile (604) 684-5909

Project No. 0059-002-04
December 18, 2000

Mr. Alan Taylor, Vice President – Exploration
Canadian Zinc Corporation
Suite 1202, 700 West Pender Street
Vancouver, B.C. V6C 1G8

Attention: Mr. J. Peter Campbell, Vice President – Project Affairs

Re: **Prairie Creek Mine Tailings Facility**
Summary of Past Work and Preliminary Recommendations for Rehabilitation

Dear Mr. Campbell:

Following your requests at our meetings of 29 August, 3 November and 5 December 2000, we are pleased to provide this overview of geotechnical issues pertaining to rehabilitation of the Prairie Creek Mine tailings facility.

1. INTRODUCTION

1.1 Background

The Prairie Creek Mine is located approximately 100km northwest of Nahanni Butte in Northwest Territories. At the brink of production in the early 1980's, it was placed on care and maintenance status. Although exploration has been ongoing, there has been no mining activity and neither the plant site nor the tailings facility has been operated.

The tailings facility was designed in 1980 and constructed in 1981. Localised geotechnical problems were assessed in 1983 and 1984 but no remedial work was initiated. At the request of Canadian Zinc Corporation (Canadian Zinc, formerly San Andreas Resources Corp.), BGC Engineering Inc. (BGC, formerly Bruce Geotechnical Consultants Inc.), undertook studies in 1994 and 1995 to improve understanding of the earlier problems and provide conceptual-level recommendations for rehabilitation. This work was not completed due to a lack of funding for the project at that time.

1.2 Scope-of-Work

In September 2000, Canadian Zinc requested that BGC carry out the following tasks related to the tailings facility:

- review the1994 and 1995 BGC work and prepare an executive summary; and,
- provide an estimate of the engineering effort to prepare a pre-feasibility-level rehabilitation design for the tailings facility.

In keeping with instructions from Canadian Zinc, no new design effort was undertaken within the present scope-of-work and all technical considerations were limited to geotechnical issues. Geo-chemistry, river engineering and operational aspects of the facility, for example, were not part of the current scope-of-work.

BGC understands that this letter report will be used by Canadian Zinc as part of a larger scoping study of possible production levels, capital requirements and operating costs for the Prairie Creek Mine Project.

2. EXECUTIVE SUMMARY OF BACKGROUND INFORMATION

2.1 Documents Reviewed

Key documents reviewed by BGC in compiling this executive summary are as follows:

- BGC. 1994. Reconnaissance Geotechnical Assessment, Tailings Facility and Winter Road, Prairie Creek Mine, NT., File No. 0059-001-01, dated June 22, 1994.
- BGC. 1995a. Memorandum to File: Background Summary, Prairie Creek Mine, Tailings Retention Pond Rehabilitation, File No. 0059-001-01, dated January 30, 1995.
- Nixon Geotech. Ltd. 1995. Geothermal/Stability Analysis for Prairie Creek Mine. February 7, 1995. Report prepared for BGC.
- BGC. 1995b. Prairie Creek Project, NT. Summary of Geotechnical Aspects, Tailings Facility and Access Road, File No. 0059-001-01, dated July 20, 1995.

2.2 Generalised Background to 1985

Initial geotechnical investigation and design for the tailings facility were carried out in the early 1980's. Two areas were selected for detailed investigation: T2 and T3. T2 is the present location. T3 is situated on the left side of Prairie Creek, approximately 1 km downstream.

T2 was chosen as the better location for a number of reasons. One of the most important was the apparent continuity of an impervious clay stratum at shallow depth over most of the pond area. It was extensive enough to provide a basal seal and also for utilization as an impervious component of containment structures.

Construction of the T2 tailings pond involved expanding existing river dykes to form the perimeter embankment. Material was excavated from the north valley wall (referred to as the backslope) for embankment construction. This also increased the pond volume. To mitigate possible seepage loss through materials comprising the backslope excavation, a synthetic liner and drainage system were installed in March 1982.

A performance summary for the embankment dam and engineered backslope is given in the following subsections. BGC has prepared a number of reference drawings to supplement the written summaries. Drawing 01 shows a plan view of the tailings facility. A typical cross-section of the embankment dam, Section A, is shown in Drawing 02. A surveyed cross-section of the backslope, Section B, is shown in Drawing 03. BGC has used available information in preparing these drawings, however, the as-built detail was limited and many assumptions have been made. BGC emphasizes that these drawings were prepared to facilitate discussion only and they should not be used for detailed design or construction purposes.

Embankment - Downstream Face

Localized erosion affected the downstream face of the embankment along the left bank of Prairie Creek. The most significant erosion occurred immediately downstream of the tailings pond embankment where little or no riprap protection had been placed to protect the embankment or original dyke (see Drawing 01).

Embankment - Upstream Face

Tension cracks were noted along the crest of the embankment during construction. Shallow movements affected the upstream face in June 1982 in association with a period of heavy rain. By 1985, gravel covering the impervious clay core had almost completely sloughed into the pond (Section A, Drawing 02).

Engineered Backslope

Movements ranging from shallow to moderately deep-seated and causing distortion and local tearing of the synthetic liner and underlying bedding and drain materials began during the late construction period and continued for several years. Permafrost degradation was believed to have been a contributing factor to these ground movements. Drawing 03 shows a profile along Section B derived from a field survey made at BGC's request in 1994.

Integrity of Tailings Facility

Despite the movements noted above, no breach of the embankment occurred. It is reported that no seepage from the pond was detected in observations made as late as 1985, however, no specific records describing the monitoring effort or the results are available[1].

1 Report "Geotechnical rehabilitation of the tailings pond, Prairie Creek Mine, NWT, Sept. 1985", p.2".

2.3 BGC Site Investigations

BGC undertook a site reconnaissance on 12 June 1994. Three possible movement mechanisms were identified:

1. shallow and affecting the upstream face of the perimeter embankment dyke;
2. shallow to moderately deep-seated and affecting the backslope; and
3. deep-seated translational and affecting the backslope.

Site investigations comprising drilling, sampling and instrumentation activities were carried out by BGC between 18 October and 4 November 1994. The program, which was planned on the basis of the June 1994 site reconnaissance, comprised eight drillholes in the backslope area. An additional one was drilled in an undisturbed region of the T3 area for the purpose of establishing base-line ground temperatures and permafrost conditions. Three piezometers, five slope inclinometer casings and four thermistor strings were installed. Four test pits were excavated into the upstream face of the perimeter embankment dyke. Site visits to obtain follow-up instrument readings were made on 15 December 1994 and 17 May 1995.

2.4 Laboratory Testing

Laboratory testing was conducted on samples obtained during the 1994 detailed site investigation, and the results were incorporated into the borehole and test pit logs.

2.5 Slope Indicator Monitoring over the period 1994-1995

Slope indicator monitoring indicated that movement in the backslope corresponded to locations where a grey, laminated, high plastic clay was encountered in the boreholes (typically 12m to 16m deep). By the time of the 17 May 1995 site visit, all slope indicator casings were rendered inoperable due to excessive movements.

2.6 Permafrost and Ground Ice

The main concern about the presence of permafrost is its common association with ground ice. Volumetric strains and excess pore pressures are generated as ground ice melts in fine-grained permafrost soils.

Ground surface observations and thermistor monitoring indicated the presence of permafrost beneath the T3 site. Although virtually undetected at the time of design and construction, permafrost and excess ground ice were also present beneath the T2 site, particularly the backslope. Extensive clearing, the southwest aspect, the moderate to dark colour of the exposed synthetic liner, and the presence of a pond in the tailings facility likely contributed to deep permafrost degradation between the time of construction and the 1994 BGC site investigations. Limited permafrost and excess ground ice may remain at depth in the backslope but the rate of thaw front penetration, hence the excess pore pressures generated by thaw, can be expected to be small in comparison to the post construction period.

2.7 Interpretation of Movement Mechanisms

Information obtained to date for the embankment and engineered backslope suggests the following movement mechanisms.

Embankment - Downstream Face

The in situ clay was partially excavated for clay core fill but a laterally continuous section remains in the embankment foundation, according to the original design documents. We find no compelling reason to believe that clay comprising the embankment foundation experienced failure in the geological past. Moreover, there is no evidence that translational movements toward Prairie Creek affected the original dyke or embankment dam. For this reason, we believe peak rather than residual shear strengths are appropriate for design of the structure against translational sliding toward Prairie Creek.

Embankment - Upstream Face

Movements affecting the upstream face of the embankment involved shallow planar slippage along the pond-side contact between the upstream high plastic core and the sand and gravel cover separating it from the tailings pond (see Drawing 02). The tension cracks observed along the top of the embankment before slippage occurred are interpreted here as the precursor to these planar movements. Visual examination of the upstream clay core in the four test pits excavated in 1994 - 1995 indicated that the core was essentially intact. Hand measurement of shear strength by field vane and pocket penetrometer indicated that the main body of the clay core fill had high strength and it appeared stable. Seasonal freeze-thaw had caused slight overconsolidation and development of a faint fissure structure.

During construction, it is considered likely that the outside edge of the clay core (about 200 to 500mm wide) received little or no compaction during placement due to physical limitations of the compaction equipment. A steel drum or rubber tire soil roller compacting in lifts cannot compact fully to the edge of the lift. This loose edge zone of poorly compacted clay is believed to have had insufficient strength to support the thin sand and gravel cover and collapsed on wetting. Substantial slumping of the sand and gravel core cover took place following heavy rain in the period prior to 1985 and left the embankment structure in its assumed present configuration (Drawing 02).

Engineered Backslope

Information obtained to date for the pond backslope indicates a combination of thaw subsidence and deep-seated translational movements have occurred.

Thaw subsidence was significant and a major contributor to the very visible liner deformations; however, the high magnitude and rate of thaw-induced movements were short-lived for the reasons discussed below.

The depths of movements in BGC boreholes and the interpreted configuration of a contiguous failure surface are shown in Section B, Drawing 03. The surface is seated in a high plastic clay that may have been pre-sheared as a result of prior movements along the left valley slope of Prairie Creek. This mechanistic interpretation means that the mobilized strength of the clay beneath the backslope at the time movements began was somewhere below peak and approaching the residual value. A pervasive surface of sliding has developed, however, hence strengths used in re-design must be residual values.

The backslope movements were almost certainly exacerbated by development of excess pore pressures due to ground ice melting. Thaw-generated excess pore pressures can be expected to be significantly lower than when movements began because of deep permafrost degradation and significant attenuation in the rate of thaw in the intervening almost twenty years since backslope grading.

Poor performance of diversion ditches and water accumulation below the synthetic liner may have also been contributing factors to backslope instability. Pore pressures below the clay layer may also have been a contributing factor.

Further geotechnical investigations will be required to confirm the relative significance of the foregoing factors.

3. FACILITY REHABILITATION DESIGN CONCEPTS

3.1 Introduction

In order to bring the tailings facility into operation, one and possibly two steps will have to be followed: First, sufficient geotechnical investigation effort and follow-up analyses will be needed to confirm the factors of safety of the various movement mechanisms described in Section 2.7. Second, where the calculated factors of safety are lower than required, rehabilitation effort will be needed. Additional rehabilitation considerations, for example, seepage through microstructures in the impervious clay core and riprap armour on the downstream face of the embankment dam, will also be required. BGC recommends, however, that all further geotechnical considerations be deferred until rehabilitation efforts can be considered in conjunction with optimization of operational alternatives.

Three factors must be considered in the geotechnical optimization of rehabilitation designs: First, how to best accommodate the existing impervious, high plastic clay core in the embankment dam and its foundation; second, the presence of Prairie Creek limits rehabilitation design options to upstream construction unless authorization to re-direct the flow of Prairie Creek to the south side of the floodplain is pursued; and third, the current distribution of permafrost and ground ice in the backslope area and their influences on stability.

3.2 Embankment

Two rehabilitation scenarios for the embankment dam, "most likely" and "worst case", are discussed below.

Embankment - "Most Likely Scenario"

The "most likely" scenario for remediation of the embankment structure is to simply adopt its current configuration as shown in Drawings 05 and 02, plan and cross-section views, respectively.

The results of preliminary stability analyses support this configuration as shown in Drawing 04. This is reinforced by the fact that the embankment has remained essentially unchanged since the early post-construction period when the sand and gravel cover sloughed off and into the pond. Drawing 04 shows the factor of safety is calculated to be about 1.6, based on our best estimate of in situ soil properties, which are also listed on Drawing 04. Similar factors of safety can be expected for the downstream slope. As both embankment slopes are unchanged under the "most likely" scenario, there is no loss to the tailings pond volume due to the embankment dam rehabilitation.

A considerable amount of sand and gravel is present at the upstream toe of the embankment as illustrated schematically in Drawing 02. Whether this needs to be added to, in whole or in part, before operations commence will depend upon how initial waste disposal operations are planned. The sequencing of sand and gravel cover replacement above the current pond elevation of approximately 869.5m, if necessary, should be considered during the next phase of study in conjunction with optimization of operational alternatives. Additionally, the thickness uniformity and integrity of the impervious clay core will also have to be investigated further during the next phase of study. For the time being, we recommend that Canadian Zinc allow for a $150,000 up front cost to deal with these issues under the "most likely" scenario.

The next phase of geotechnical investigations should be planned to focus on the potential extent of the embankment and foundation movements and, if necessary, a means of managing the movements to achieve acceptable factors of safety over the long-term. Management should involve minimizing pre-development capital costs in favour of achieving the desired factors of safety using alternative operational means of placing materials.

Embankment - "Worst Case"

For the purpose of estimating a "worst-case" construction cost, a conceptual re-designed configuration of the embankment structure is shown in Drawings 06 and 07, plan and cross-section views, respectively.

The "worst case" scenario adopts the very conservative assumption that residual strengths are operative across the entire embankment foundation and must be used for both the upstream and downstream slope designs. The use of residual strength gives the unreasonably[2] low factor of safety shown in Drawing 04, indicating the upstream and downstream slopes must be re-configured to achieve an acceptable factor of safety. The slopes shown in Drawing 07 provide the following minimum factors of safety based on a preliminary analysis:

- Downstream slope - factor of safety about 1.2 for a slope of 3H:1V (see Drawing 07).
- Upstream slope - factor of safety about 1.1 for a slope of 3.6H:1V (See Drawing 07).

Re-construction of the embankment as shown in Drawings 06 and 07 results in an estimated loss in the tailings pond volume[3] in the amount of 210,000 m^3, which is approximately 35% of the available original volume. At an estimated cost of $ 3.00[4] per m^3, the construction cost of this worst-case scenario template for the embankments is estimated to be $630,000.

We emphasize that the foregoing estimate is what we believe to be a "worst-case" or upper bound scenario for the embankment. If subsequent geotechnical investigations and/or operational monitoring indicate less than peak strengths are mobilized in the foundation clay, Drawings 06 and 07 show that further re-design flexibility is available and could be implemented, as needed. This could apply on a local basis even after the "most likely" scenario has been adopted and operations are underway.

Embankment - Next Phases of Geotechnical Study

Pre-feasibility level geotechnical investigation and design will involve the following steps:

1. Site investigation, sampling and laboratory testing of in situ clay foundation soils.
2. Site investigation, sampling and laboratory testing of the impervious clay core properties and its thickness uniformity in the embankment.
3. Assess the implications of freeze-thaw cycles on the permeability of the upstream clay core.
4. Re-starting the slope stability analyses to confirm stable upstream and downstream slope designs.
5. Re-designing the upstream slope angle in response to 1. through 4., above, and, to the greatest extent possible, in a way that makes use of the existing upstream clay core as the main water retention element.
6. Assessing the need for cover replacement on the upstream slope; and, if necessary, alternative ways of doing so in whole or in part through operations.
7. Calculation of a new volume-elevation curve once the final design cross-section is

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[2] Factors of safety less than unity are an analytical reality only because a limit equilibrium analysis is only valid until a factor of safety of unity is reached. Thereafter the forces simulated are no longer in equilibrium.

[3] BGC estimates the existing volume of the tailings facility is 600,000 m^3 between elevations 864m and 875m.

[4] The unit rate of $1.50 per tonne (or say$3.00 per m^3) to supply and place rockfill is based on the recommendation of Canadian Zinc Corporation.

determined and the extent to which tailings might be used as a stabilizing and/or cover material can be assessed, if needed.

8. Consideration of construction approach; in particular, the means of controlling possible uplift pressures during and after the existing pond is pumped down, if needed.
9. Preparation of a field drilling, sampling and instrumentation program, and laboratory testing requirements for feasibility-level design.
10. Re-assessment of armour requirements on the portion of the tailings embankment facing Prairie Creek.

3.3 Engineered Backslope

As stated in Section 2.6, we believe permafrost and ground ice were important factors contributing to engineered backslope instability. The 1994-95 geothermal analyses suggested extensive degradation of permafrost and ground ice had already occurred. Geothermal analyses completed in 1995 indicated that the rate of thaw penetration at depth had attenuated to levels that are unlikely to produce excess pore pressures. This means that some of the factors contributing to backslope instability (viz. ground ice, rapid rate of thaw and attendant excess pore pressures) may no longer be significant design impediments.

The backslope will require re-design, but we believe a more routine, "thawed soil mechanics" approach is appropriate. Of particular importance in the re-design is that available strengths on the deep-seated failure surface are limited to residual rather than peak values.

A variety of stabilization measures can be considered as part of re-building the backslope and/or initial placement of tailings at its toe. In our preliminary stability analyses and related cost estimation, we have limited our consideration to placement of a 40m wide stabilizing rock berm across the toe of the backslope where movements have occurred (see Drawings 06 and 08). This increased the factor of safety to about 1.1. The configuration shown involves an estimated 80,000 m^3 (13% of existing tailings pond capacity) and at a construction cost of \$3.00 per m^3, this amounts to a total cost of \$240,000.

A range of other rehabilitation designs is available. For example:

- Further detailed investigations may show that permafrost and ground ice have degraded to the extent that no stabilization effort is needed. In this case, rehabilitation might be limited to minor re-grading and repair / replacement of the synthetic liner.
- In the event that investigations show stabilization is needed, the toe buttress might be rejected in favour of unloading the top of the with no loss of capacity inside the existing facility.
- Pumped drawdown might be used to relieve groundwater pressures until the rockfill toe buttress discussed above can be replaced by tailings.

Based on our discovery of the impervious clay high beneath the backslope as shown in

Drawings 03 and 08, we believe the synthetic liner does not have to be replaced under the rock berm. It may, however, still be needed at the margins of the berm. This will be a key focus of the next phase of geotechnical studies. For the time being, we recommend that Canadian Zinc allow for a $150,000 cost related to the synthetic liner.

The requirement for and location of diversion ditches will also need to be assessed after the synthetic liner issue is clarified. For the time being, we recommend that Canadian Zinc allow for a $50,000 cost related to the diversion ditches.

Backslope - Next Phases of Geotechnical Study

Pre-feasibility level geotechnical investigation and re-design will involve the following steps:

1. Site investigation, sampling, installation of slope indicators and thermistors, and laboratory testing to confirm the extent of impervious clay and permafrost beneath the backslope.
2. Two-dimensional geothermal analyses of the backslope to simulate the thaw progression as a function of time. The period studied will span the time from original clearing and construction through to the anticipated re-construction timing and on through facility operation and abandonment.
3. Coupled geothermal and slope stability analyses to evaluate stable backslope configurations.
4. Re-assessment of the requirement for and, if necessary, the configuration of the synthetic liner (includes preliminary three-dimensional seepage analysis).
5. Optimization of the method of achieving a stable backslope configuration taking 1. through 4., above, into account.
6. Calculation of a new volume-elevation curve once the new design cross-section is determined (same as 7. in Sec. 3.2).
7. Preparation of a field drilling, sampling and instrumentation program, and laboratory testing requirements for feasibility-level design.

4. PRELIMINARY COST ESTIMATE FOR THE SECTION 3 ENGINEERING WORK SCOPE

ITEM	PERSON HOURS	COST
Meetings with client	100	8,500.
Site visit and instrument monitoring / data reduction	125	10,600.
Geotechnical drilling and test pitting on site	500	35,000.
Drill and test pit rigs supplied by Canadian Zinc	---	nil
Geotechnical instrumentation for installation at site	---	14,000.
Engineering supervision of field investigations	40	4,000.
Laboratory testing of soil samples from the field	---	4,000.
Terrestrial surveys completed by others after field work	---	7,000.
Slope stability analysis	140	11,200.
Geothermal analyses	100	9,000.
Coupled slope stability and geothermal analyses	90	8,100.
Hydrotechnical armour designs by others	50	4,400.
Volume-elevation curves	100	7,000.
Geothermal analyses (operation and abandonment)	120	10,800.
Drafting	80	5,200.
Report writing	130	10,400.
Report preparation	30	2,000.
Travel expenses	---	10,000.
Miscellaneous - Courier, telephone, printing, photos, etc.	---	1,500.
Estimated totals	**1,605**	**$ 162,700**

5. REHABILITATION SUMMARY

"Most likely" and "worst case" scenarios are outlined for rehabilitation of the embankment dam portion of the tailings facility. We estimate the costs are $150,000 and $630,000, respectively. Under the "most likely" scenario, we believe the structure can be used in its present configuration, however, the estimated cost of $150,000 is suggested because of the possible need for improvements to the cover and impervious clay core. We believe there is no justification for adopting the "worst case" scenario, which would reduce the available storage capacity by 210,000 m^3 or about 35%. It is highly conservative and can reasonably be replaced by monitoring as part of the "most likely" scenario. If local movements are detected as part of monitoring, the "worst case" re-designed template can be implemented over affected portions of the embankment structure, as required.

A variety of techniques can be considered for rehabilitation of the engineered backslope portion of the tailings facility. We have considered a stabilizing rock fill berm. This 40m wide structure would reduce the pond volume by 80,000 m^3 (13% of the existing tailings pond capacity) and cost about $240,000. An additional amount of $200,000 is estimated for the synthetic liner along the flanks of the berm and improvements to drainage ditches.

The next phase of geotechnical investigations and engineering design at the pre-feasibility level are estimated to cost in the order of $160,000.

For convenience, the foregoing costs are summarized in Table 1.

6. LIMITATIONS

This report was prepared by BGC for the account of Canadian Zinc. The material in it reflects the judgement of BGC staff in light of the information available to BGC at the time of report preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be based on it, are the responsibility of such Third Parties. BGC accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

As a mutual protection to our client, the public, and ourselves, all reports, tables and drawings are submitted for the confidential information of our client for a specific project. Authorization for use and/or publication of data, statements, conclusions or abstracts from or regarding our reports, tables and drawings is reserved pending our written approval.

7. CLOSURE

We trust the foregoing is adequate for your current overall scoping study. Please feel free to contact the undersigned if you have any questions or comments, or if we may be of further assistance.

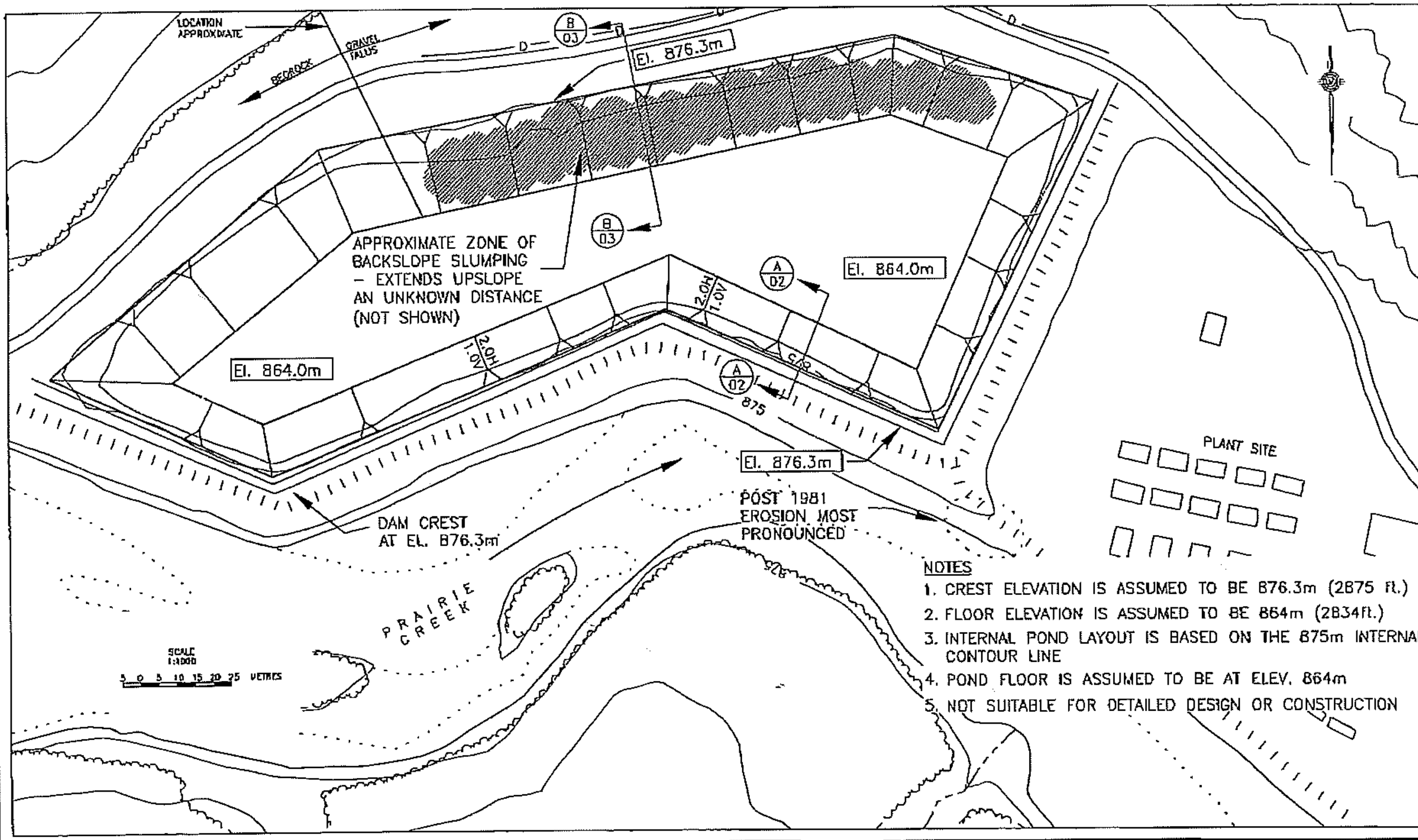
Sincerely,
BGC Engineering Inc.
per: Robert Toombs, P.Eng.
Geotechnical Engineer

Dr. K. Wayne Savigny, P.Eng., P.Geol.
Principal

KWS/rgt
Attachments

Table 1 Taillings Facility Rehabilitation Pre-Feasibility Level Cost Estimation

Cost Component	Most Like Scenario	Worst Case Scenario
Embankment	$150,000	$630,000
Engineered Backslope	$240,000	$240,000
Synthetic Liner	$150,000	$250,000
Diversion Ditch	$50,000	$50,000
Pre-Feasibility Engineering and Investigations	$160,000	$160,000
Totals	$750,000	$1,230,000



REV.	DATE	REVISION	DRAWN	CHECKED	APPROVED
		ISSUED FOR DISCUSSION			

SCALE:	AS SHOWN
DATE:	30NOV00
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DESIGNED:	RGT
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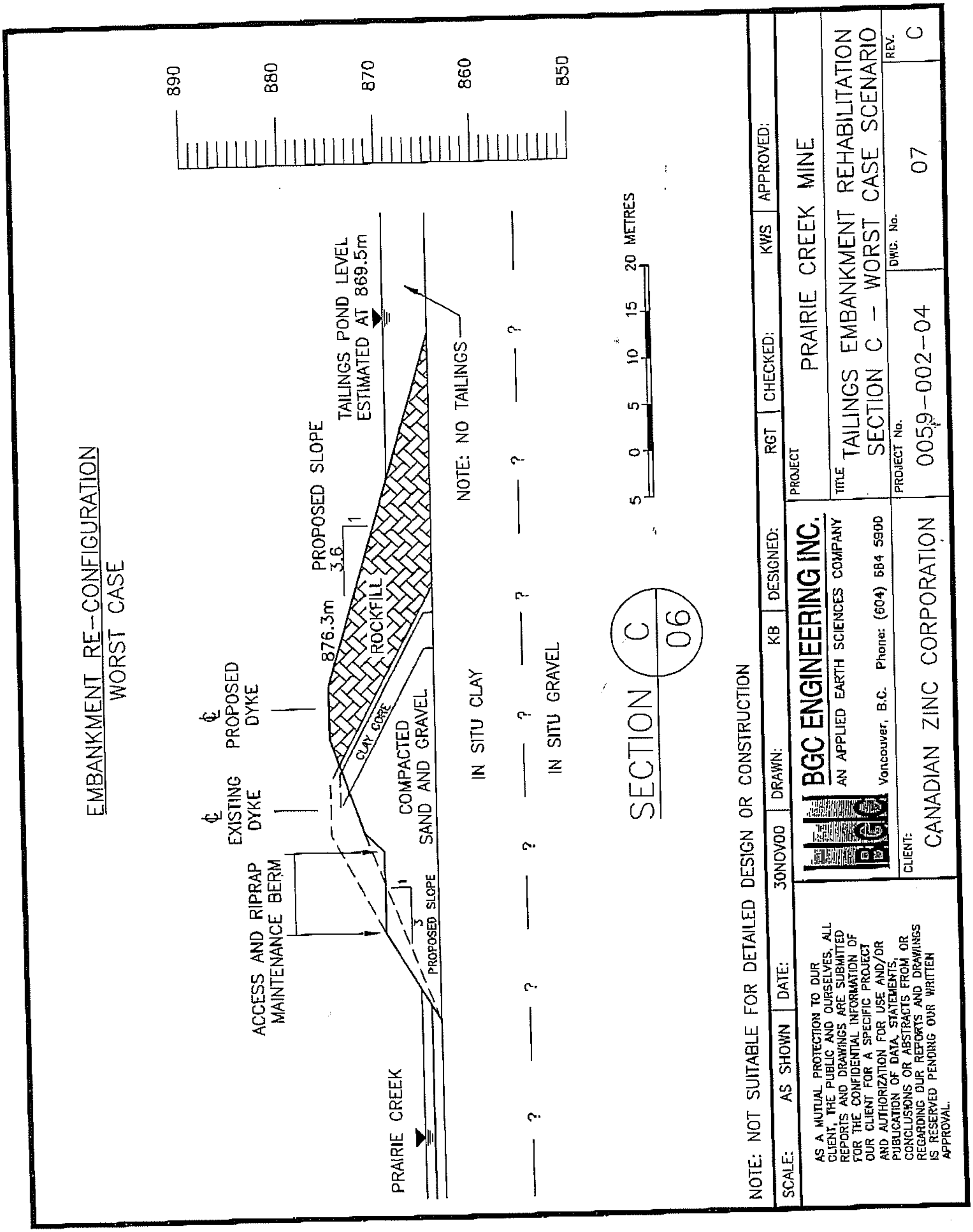
AN APPLIED EARTH SCIENCES COMPANY
Vancouver, B.C. Phone: (604) 684 5900

CLIENT: CANADIAN ZINC CORPORATION

PROJECT: PRAIRIE CREEK MINE

TITLE: TAILINGS DAM REHABILITATION PLAN VIEW OF EXISTING POND

PROJECT No.	DWG. No.	REV.
0059-002-04	D1	C


EMBANKMENT RE-CONFIGURATION
WORST CASE
890
880
870
860
850
EXISTING DYKE
PROPOSED DYKE
ACCESS AND RIPRAP MAINTENANCE BERM
PROPOSED SLOPE
876.3m
PROPOSED SLOPE
3.6
1
3
1
TAILINGS POND LEVEL ESTIMATED AT 869.5m
ROCKFILL
CLAY CORE
COMPACTED SAND AND GRAVEL
NOTE: NO TAILINGS
PRAIRIE CREEK
IN SITU CLAY
IN SITU GRAVEL
5 0 5 10 15 20 METRES
SECTION C 06
NOTE: NOT SUITABLE FOR DETAILED DESIGN OR CONSTRUCTION
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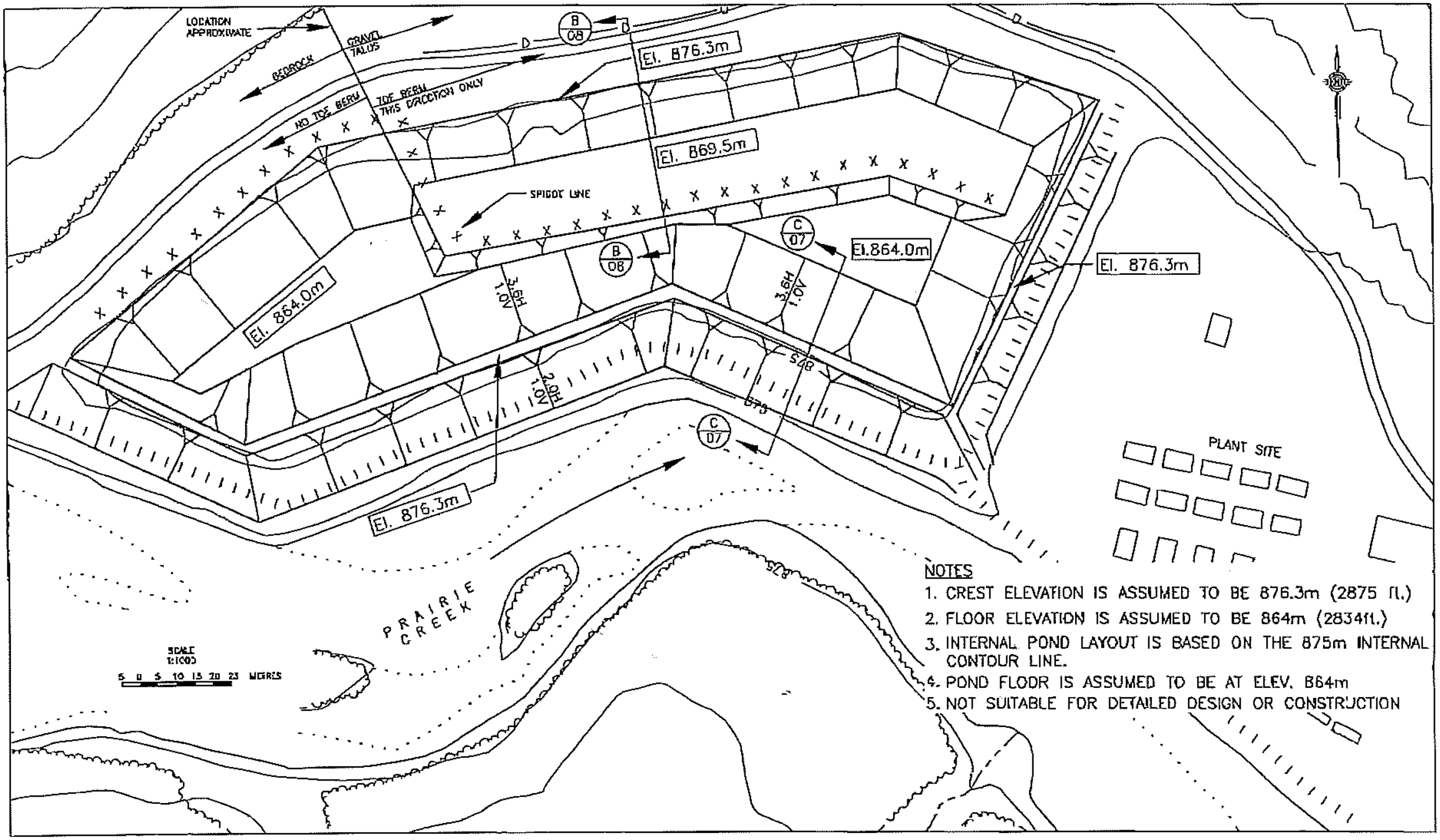
PROJECT PRAIRIE CREEK MINE
TITLE TAILINGS EMBANKMENT REHABILITATION SECTION C - WORST CASE SCENARIO
CLIENT: CANADIAN ZINC CORPORATION
PROJECT No. 0059-002-04
DWG. No. 07
REV. C



NOTES
1. CREST ELEVATION IS ASSUMED TO BE 876.3m (2875 ft.)
2. FLOOR ELEVATION IS ASSUMED TO BE 864m (2834ft.)
3. INTERNAL POND LAYOUT IS BASED ON THE 875m INTERNAL CONTOUR LINE.
4. POND FLOOR IS ASSUMED TO BE AT ELEV. 864m
5. NOT SUITABLE FOR DETAILED DESIGN OR CONSTRUCTION

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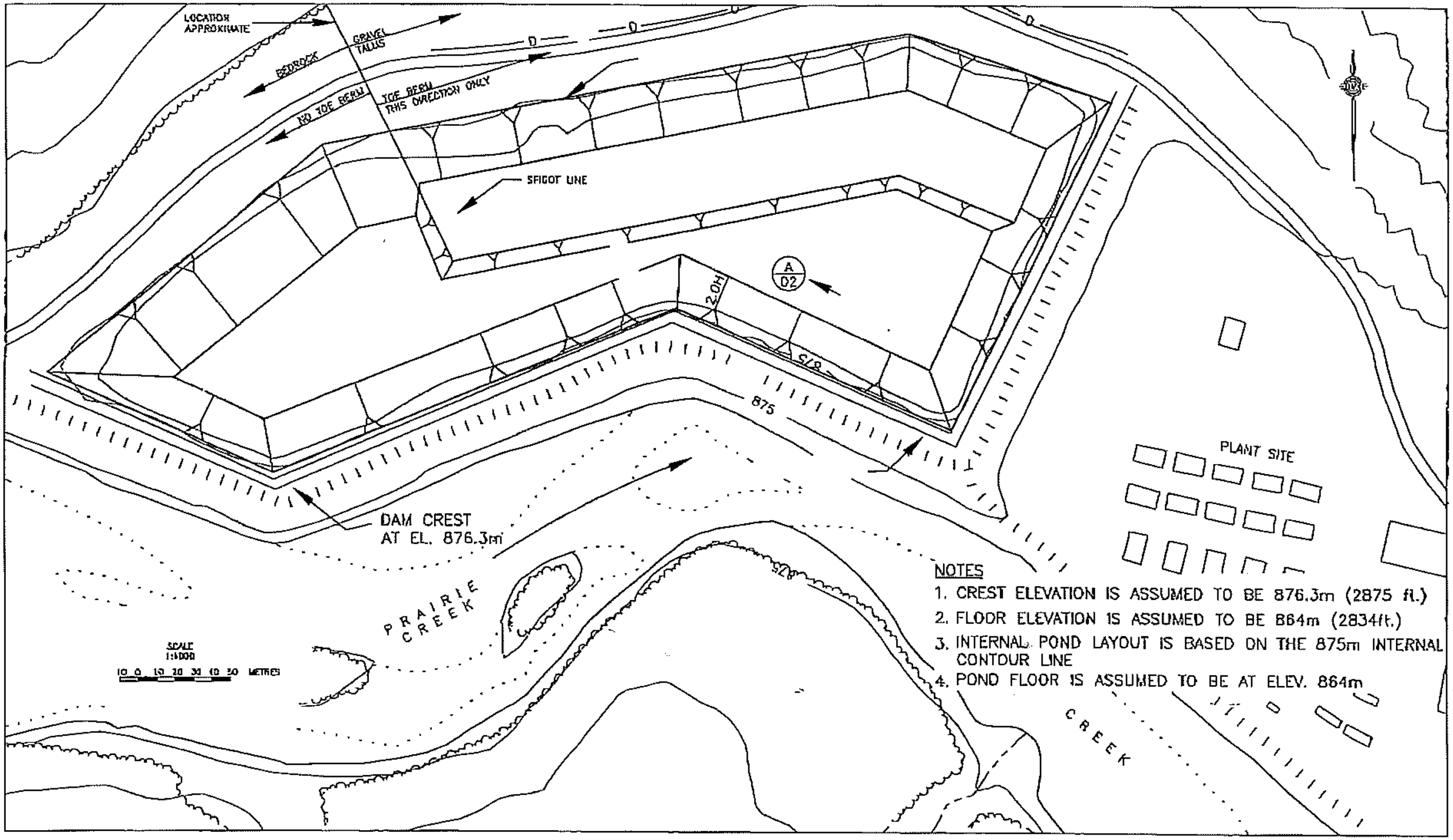
CLIENT: CANADIAN ZINC CORPORATION

PROJECT: PRAIRIE CREEK MINE

TITLE: TAILINGS DAM REHABILITATION
PLAN VIEW – WORST CASE SCENARIO

PROJECT No.	DWG. No.	REV.
0059-002-04	06	C



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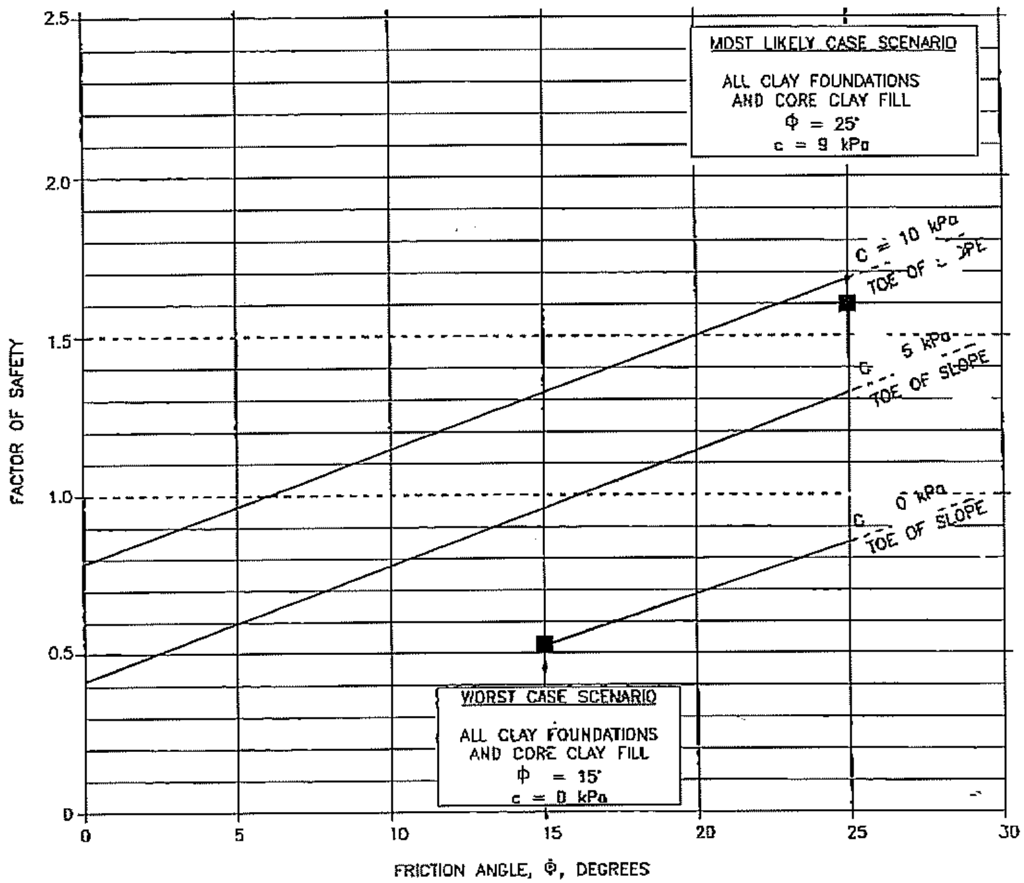
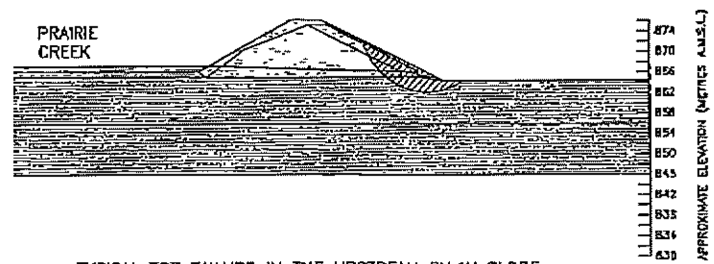
CLIENT: CANADIAN ZINC CORPORATION

PROJECT: PRAIRIE CREEK MINE

TITLE: TAILINGS DAM REHABILITATION
PLAN VIEW – MOST LIKELY SCENARIO

PROJECT No.	DWG. No.	REV.
0059-002-04	05	C





TYPICAL TOE FAILURE IN THE UPSTREAM 2H:1V SLOPE
OF THE EXISTING EMBANKMENT DAM

NOTE: NOT SUITABLE FOR DETAILED DESIGN
OR CONSTRUCTION

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DATE:	DEC14/00
DRAWN:	JYU
DESIGNED:	RGT
CHECKED:	KWS
APPROVED:	

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AN APPLIED EARTH SCIENCES COMPANY
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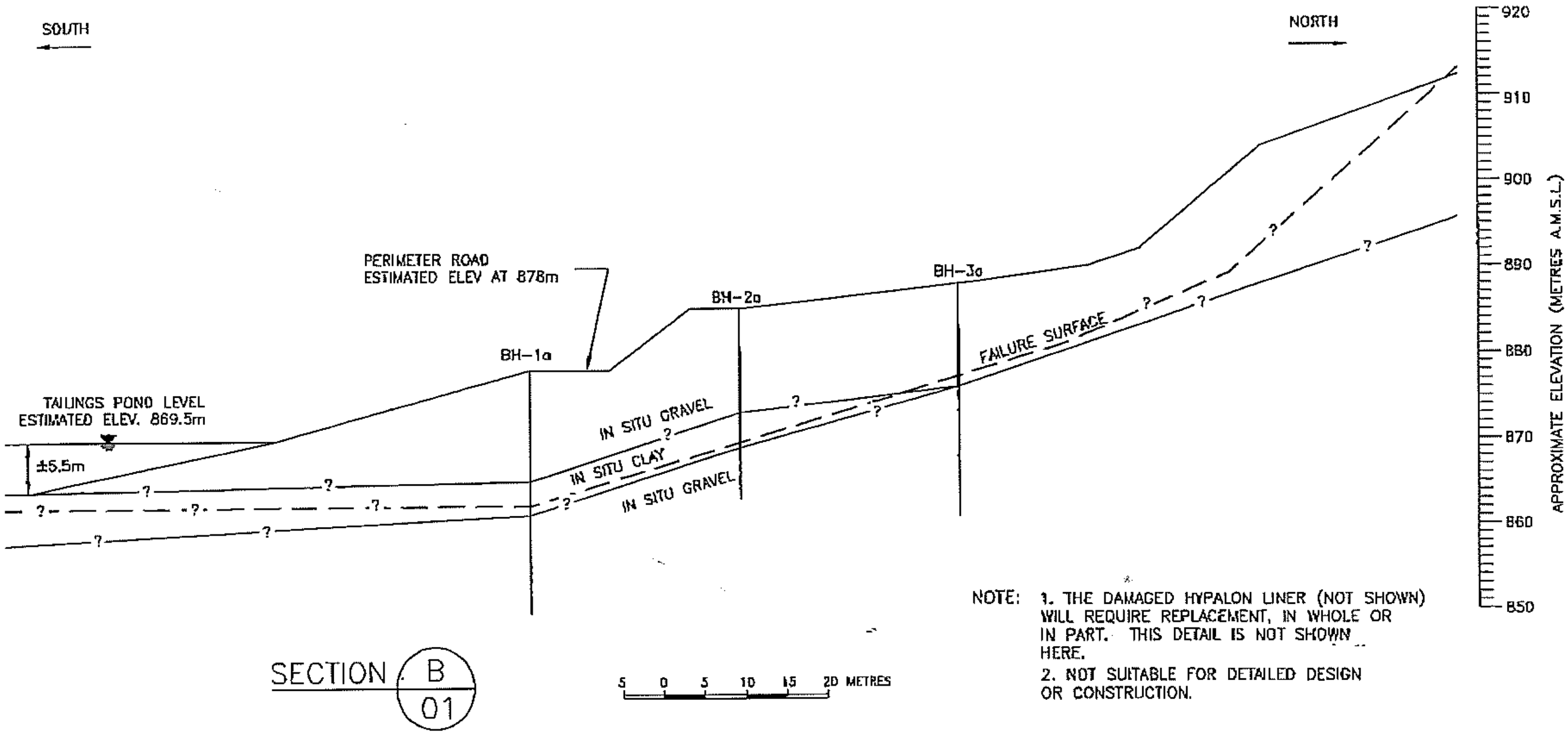
CLIENT: CANADIAN ZINC CORPORATION

PROJECT: PRAIRIE CREEK MINE

TITLE: TAILINGS EMBANKMENT REHABILITATION
PRELIMINARY STABILITY ANALYSIS, UPSTREAM SLOPE 2H:1V

PROJECT No.	DWG. No.	REV.
0059-002-04	04	C



SECTION B/01

NOTE:
1. THE DAMAGED HYPALON LINER (NOT SHOWN) WILL REQUIRE REPLACEMENT, IN WHOLE OR IN PART. THIS DETAIL IS NOT SHOWN HERE.
2. NOT SUITABLE FOR DETAILED DESIGN OR CONSTRUCTION.

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		ISSUED FOR DISCUSSION			

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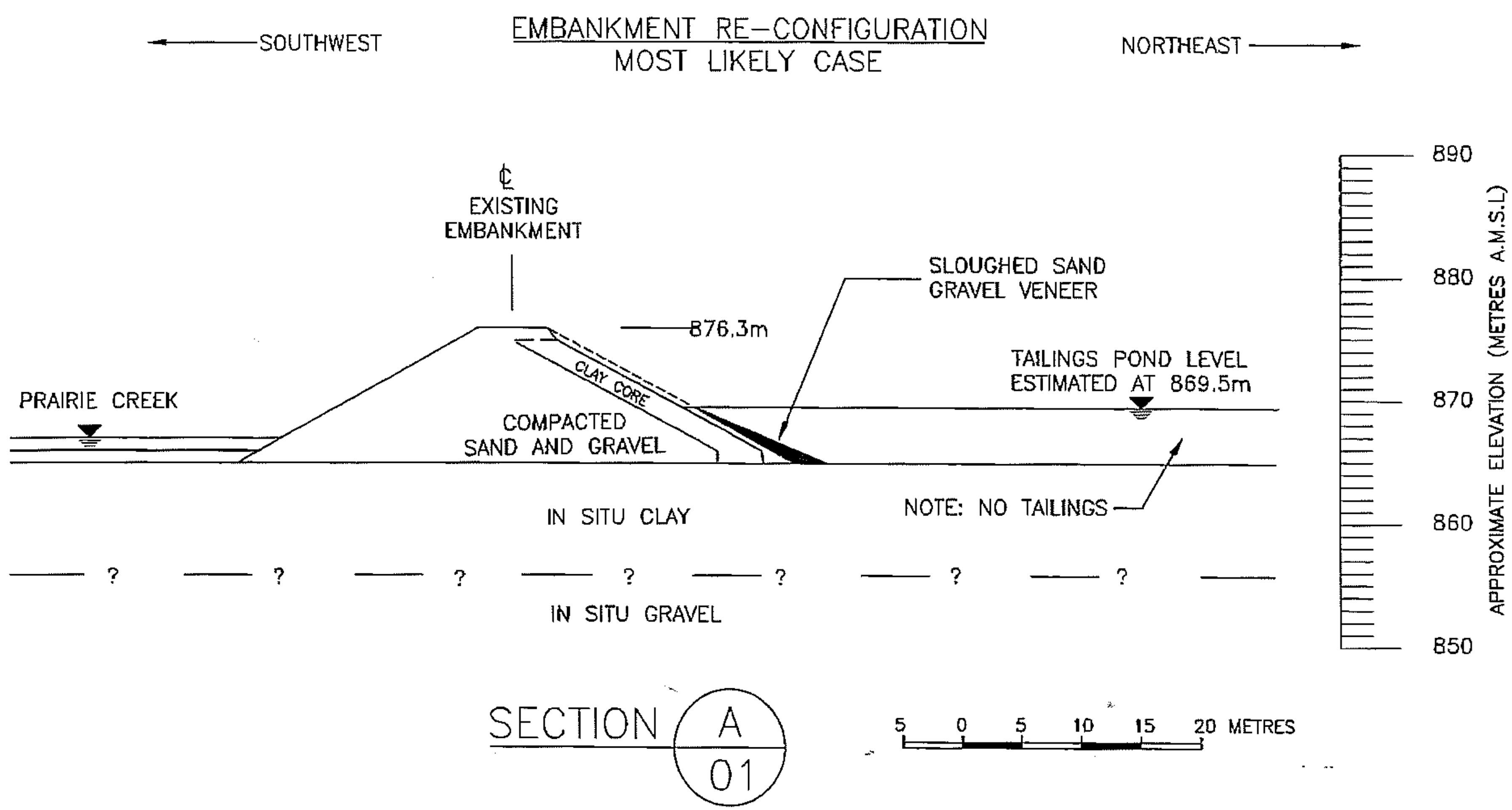
CLIENT: CANADIAN ZINC CORPORATION

PROJECT: PRAIRIE CREEK MINE

TITLE: TAILINGS DAM REHABILITATION SECTION B – SLOPE STABILITY

PROJECT No.	DWG. No.	REV.
0059-002-04	03	C



NOTE: NOT SUITABLE FOR DETAILED DESIGN AND CONSTRUCTION

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CLIENT: CANADIAN ZINC CORPORATION

PROJECT: PRAIRIE CREEK MINE

TITLE: TAILINGS EMBANKMENT REHABILITATION SECTION A – EXISTING EMBANKMENT

PROJECT No.	DWG. No.	REV.
0059-002-04	02	C

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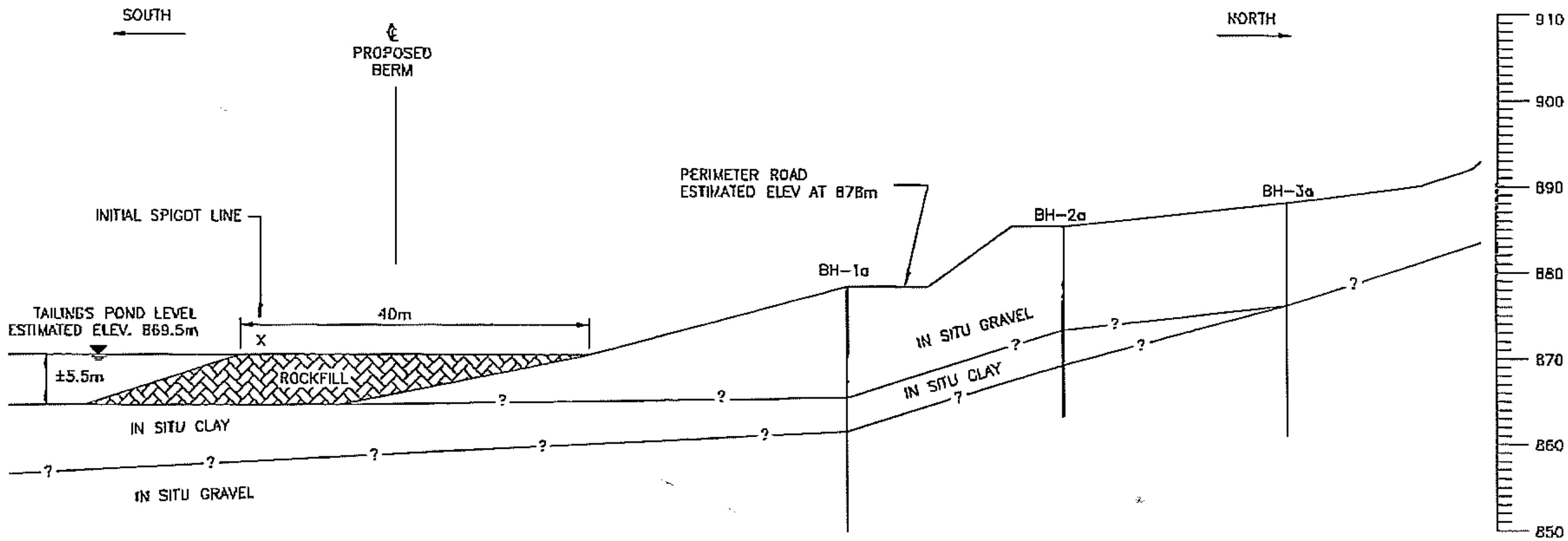

SECTION B 06 & 05

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TITLE: TAILINGS DAM REHABILITATION SECTION B – BERM ADDED

PROJECT No. 0059-002-04 | DWG. No. 08 | REV. C