Materials Testing

Materials testing will be required to provide confirmation that specified grain size and durability criteria have been met. Grain size distribution can be determined on site but freeze-thaw durability testing requires more than a month to complete at a specialized laboratory off-site. Grain size analysis for each material should be completed at a regular frequency (e.g. one test for every 2,000 m^3 of material placed or a frequency determined by the supervising engineer). The frequency of testing will depend on the expected uniformity of the material. The selection of durable shale material for steeper areas of cover will require field judgement on the part of the on site engineering staff to minimize the risk of inadvertent use of non-durable material. A limited number of samples of the shale used in this part of the sideslope should be obtained and subsequently subjected to freeze-thaw durability testing to confirm its durability.

Construction Monitoring

Construction monitoring is required as part of the quality control program to verify that the work is completed in accordance with the design. Specifically, a trained geotechnician should monitor construction works in the field to ensure that material is placed in the prescribed lift thickness, conduct sampling and testing and arrange for or conduct survey control. This person should work under the direction of or be a qualified engineer.

Documentation

All test results, field inspections, and surveying at the site should be documented by the site geotechnician. The documentation should also include discussions with the operations foreman/contractor, deviations from acceptable laboratory results or specifications, reasons for accepting deviations, and any adjustments made to the design. Photographs should also be collected over the course of construction to generate a photographic record.

4.6 Performance Monitoring

4.6.1 Overview

The main objective of the performance monitoring program is to monitor the reclamation cover's performance in each location under three areas (seepage water quality, ground temperature, and physical stability) and to report the results, as described below. The program is to be conducted during the 2-year reclamation period and the 5-year closure period, as outlined in the Water Licence.

4.6.2 Seepage Water Quality

The water quality monitoring program described in the report "Nanisivik Mine Reclamation and Closure Monitoring Plan" (GLL 2004b) (the "Monitoring Plan") provides for water quality monitoring at a

number of locations that provide for monitoring the success reclamation in all of the areas described in this report. The specific stations are:

- West Adit Area: 159-9, 159-10, 159-11, 200-3 and 200-7;
- East Adit Area: 159-12, 159-12A, 159-12B, 159-13 and 159-16;
- Oceanview: 159-18 and 159-19;
- K-Baseline: 159-13 and 159-14; and
- Area 14: 15915 and 159-16.

The monitoring schedule for these stations through the Reclamation and Closure Periods, as presented in the Monitoring Plan, is provided in Appendix B.

The Monitoring Plan also provides for visual inspection for the presence of and sampling, as appropriate, of seepages directly from the reclaimed areas (i.e., a "seep survey").

In this way, any runoff or seepage water that is present at the reclaimed area will be monitored in addition to monitoring of Twin Lakes Creek, Chris Creek and the East Adit Treatment facility at strategic locations upstream and downstream of the reclaimed areas.

4.6.3 Geothermal Conditions

The temperatures experienced within the final covers will be measured by installing thermistors and frost gauges at various locations as illustrated on Figures 3, 8 and 15 as listed in the Monitoring Plan and summarized as follows:

- West Adit Area: one existing thermocouple, one new thermistor and two new frost gauges;
- East Open Pit: one existing thermocouple, one new thermistor and one new frost gauges; and
- Area 14: two existing thermocouples and one new frost gauge.

Geothermal monitoring instruments are not specifically required at each individual cover location as the proposed instruments are sufficient to verify the performance of the cover design for various slope grades and orientations.

The thermistor boreholes will be drilled through the waste materials to bedrock. Thermistor nodes will be regularly spaced through the boreholes at a 1 m interval or as determined by the responsible engineer after construction is complete.

During the 2-year reclamation period, the instruments will be read on a monthly basis. During the 5-year closure monitoring period and depending on results to date, the instruments will be read quarterly with emphasis on including early summer (June) and maximum thaw depth (August/September).

4.6.4 Physical Stability

Inspections are to be completed through the Reclamation and Closure Periods by a qualified geotechnical engineer in conjunction with inspections of other aspects of the mine site. A frequency of once per year during late summer (August/September) is recommended.

The inspection should include observations of signs of erosion, cracking, slumping, movement or other deformations of the cover. If there are any indications of erosion or slope instability, mitigative measures should be implemented as soon as possible.

4.6.5 Review and Reporting of Monitoring Results

The data collected from the monitoring program should be reviewed by qualified technical personnel on a regular basis and as soon as practical following receipt of data. The technical personnel should report any findings or recommendations directly to CanZinco on a timely basis.

A formal report on the monitoring data that includes recommendations for any amendments to the schedule or other aspects of the program should be prepared at the end of each year of the reclamation and closure periods.

4.7 Contingency Plan

In the event that the covers do not perform as expected, then some or all items of the contingency plan should be implemented. Contingency actions are also described in the Covers Report. The components to the contingency plan that should be considered for implementation depending on the specific circumstances include:

- increased frequency of sampling/monitoring and data review by the technical professional;
- repair any erosion of the cover;
- place additional cover material to increase the cover thickness; and
- extend the period of performance monitoring.

5. References

BGC Engineering Inc. 2004a. Engineering Design of Surface Reclamation Covers. February 2004.

BGC Engineering Inc. 2004b. Quarry Development and Reclamation Plan. February 4, 2004.

CanZinco Ltd. 2003. Waste Disposal Plan. August 2003.

Craig, R.F. 1983, Soil Mechanics. Van Norstrand Reinhold (UK) Company Limited, Berkshire, England, 419 pages.

Gartner Lee Limited. 2002, Nanisivik Mine Closure and Reclamation Plan. February 2002.

Gartner Lee Limited. 2004a, Nanisivik Mine Landfill Closure Plan. February 2004.

Gartner Lee Limited. 2004b, Nanisivik Mine Reclamation and Closure Monitoring Plan. February 2004.

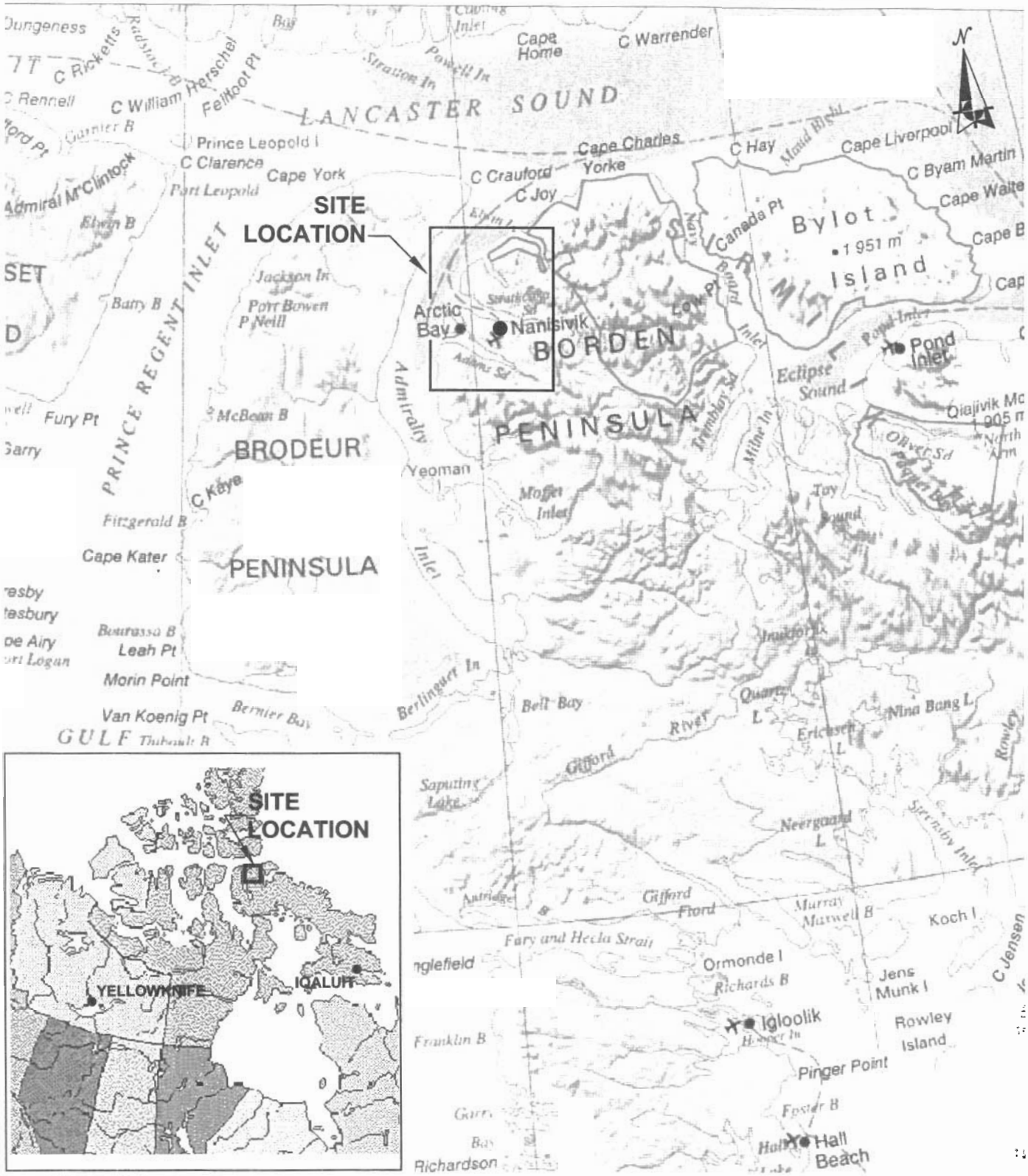
Golder Associates 1999. Geotechnical Assessment of Cover Materials for West Twin Disposal Area, Nanisivik Mine, Baffin Island, N.W.T. Report No. 982-2432.5200. Submitted to Nanisivik Mine, a division of CanZinco Ltd. February, 1999.

Koerner, M. Robert, 1990, Designing with Geosynthetics, Prentice Hall Inc., Englewood Cliffs, 652 pages.

Lambe, T. William, 1951. Soil Testing for Engineers, John Wiley and Sons, New York, 165 pages.

Lorax Environmental 2001. Acid Generation Potential of Soil, Waste Rock and Shale. April 2001.

Figures



0 15 30 60 90 120 150 Km

Scale 1:3,000,000

SOURCE OF FIGURE:
REFERENCE MAP BY NATURAL RESOURCES CANADA
"YUKON TERRITORIES, NORTHWEST TERRITORIES AND NUNAVUT"
DATE: 2000
(LAMBERT CONFORMAL CONIC PROJECTION)

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Project: ROCK PILES AND OPEN PITS CLOSURE PLAN
Location: NANISIVIK MINE, NUNAVUT
Client: CanZinco Ltd.

SITE LOCATION

Gartner Lee

Figure No. 1

LEGEND:

SITE LOCATION

SOURCE OF DRAWING:

LANDSAT ORTHOIMAGE
PRODUCT_ID – 036008_0100_000802_L7
PRODUCT_DATE – 2003/02/27
EDITION – 01
VERSION – 00
DATUM – NAD83 (CSRS)
PROJECTION – UTM
UTM_ZONE – 16
HORIZONTAL POSITIONAL ACCURACY VALUE – 20m
ORIGINATOR – GEOMATICS CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION

DRAWING INFORMATION:	
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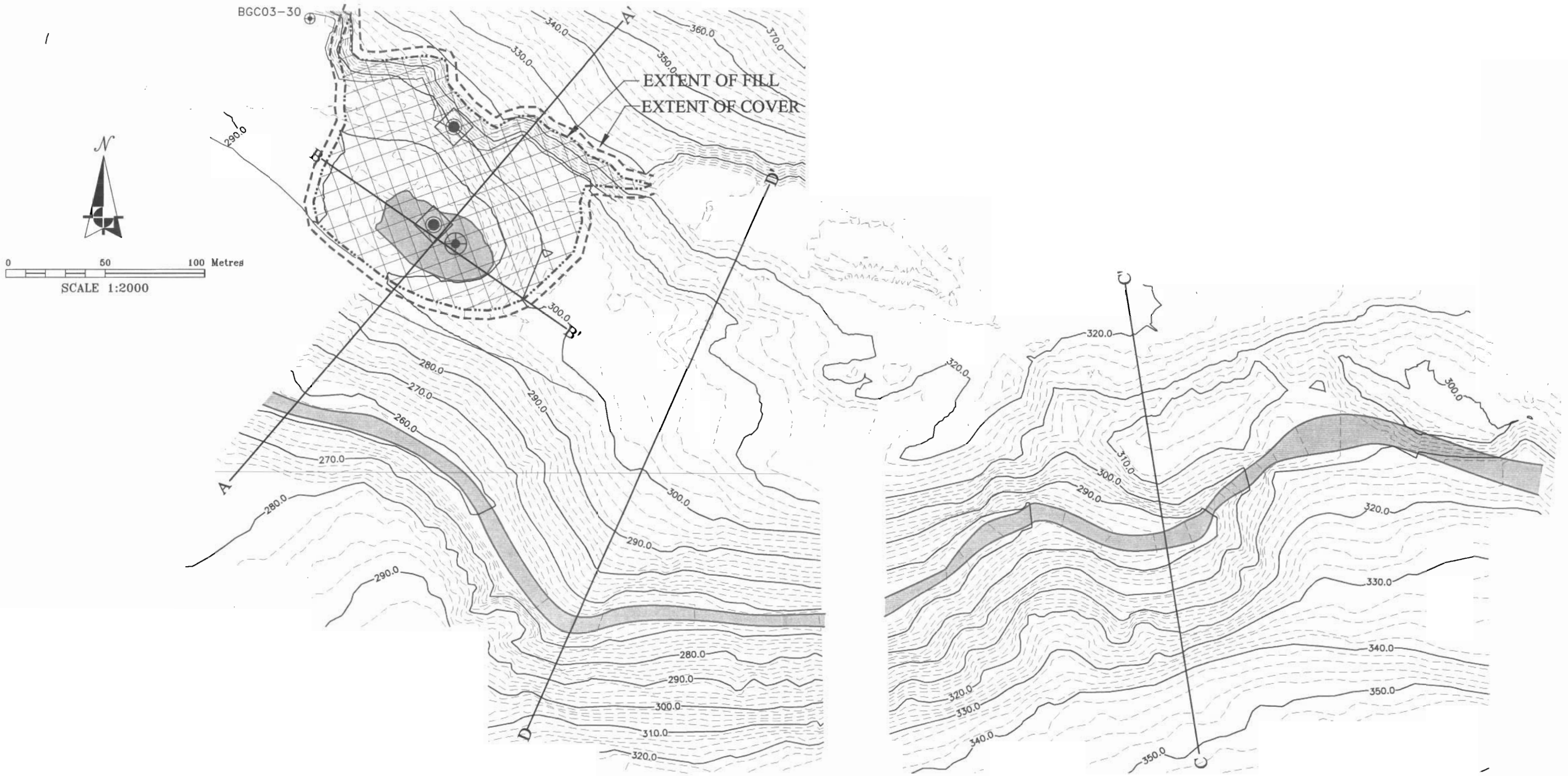
Location: NANISIVIK MINE, NUNAVUT
Client: CanZinco Ltd.

REGIONAL OVERVIEW

Gartner Lee

Figure No. 2



NOTE:
GAP IN TOPOGRAPHIC COVERAGE

LEGEND:

- SECTION LINE
- EXTENT OF FILL
- EXTENT OF COVER
- THERMOCOUPLE LOCATION
- PROPOSED THERMISTOR
- PROPOSED FROST GAUGE

SOURCE OF DRAWING:
DATA COMPILED FROM FILES RECIEVED FROM NANISIVIK MINE AND SURVEYS CONDUCTED BY SUB-ARCTIC SURVEYS LTD.

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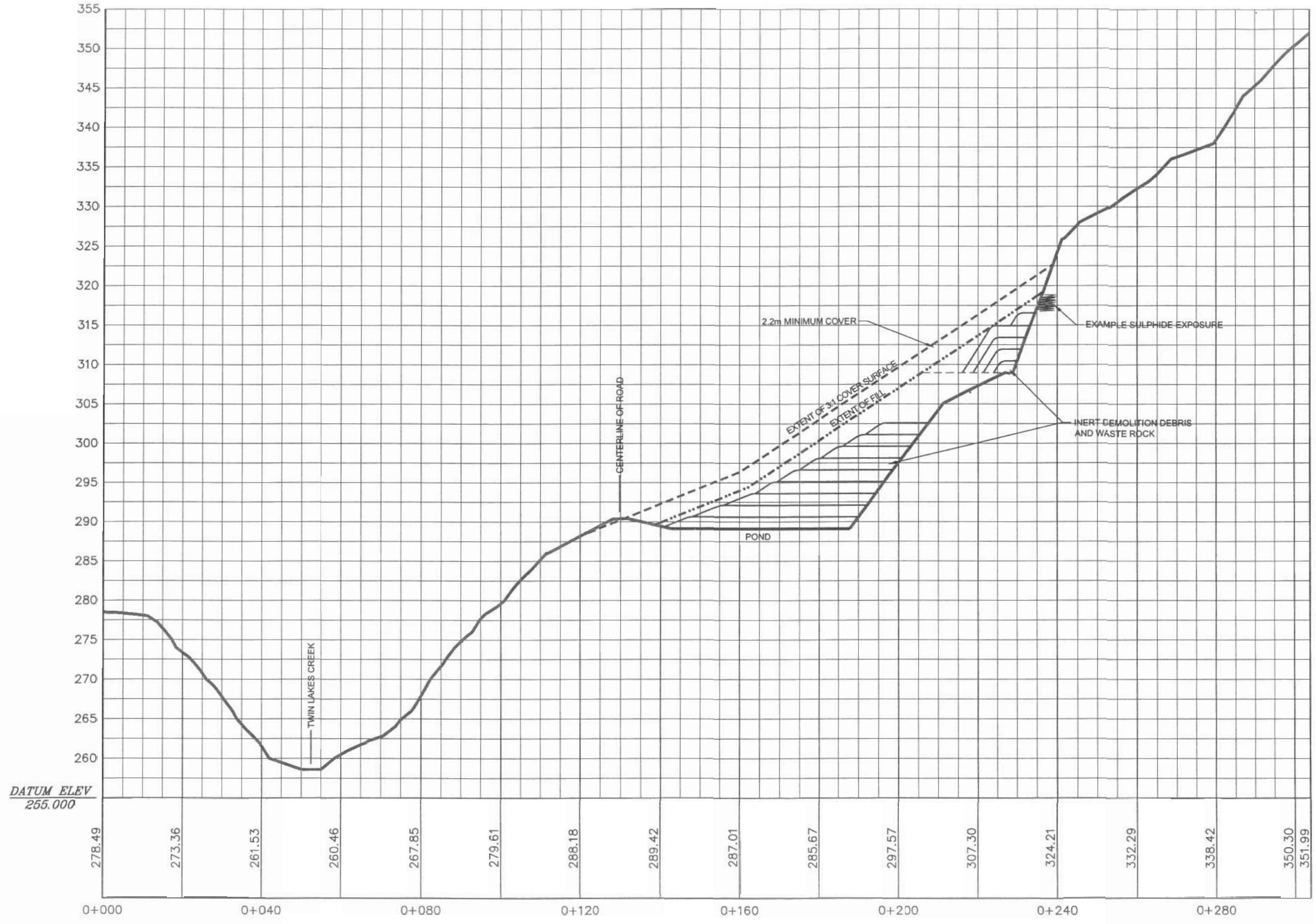
WEST ADIT AREA - SECTION LOCATION PLAN

Gartner Lee

Figure No. 3



LEGEND:

- EXISTING GROUND (SURVEY)
- WATER LEVEL (APPROX.)
- EXTENT OF FILL
- EXTENT OF COVER

SOURCE OF DRAWING:

DATA COMPILED FROM FILES RECIEVED FROM NANISIVIK MINE AND SURVEYS CONDUCTED BY SUB-ARCTIC SURVEYS LTD.

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Client: CanZinco Ltd.

WEST ADIT AREA - SECTION 'A'

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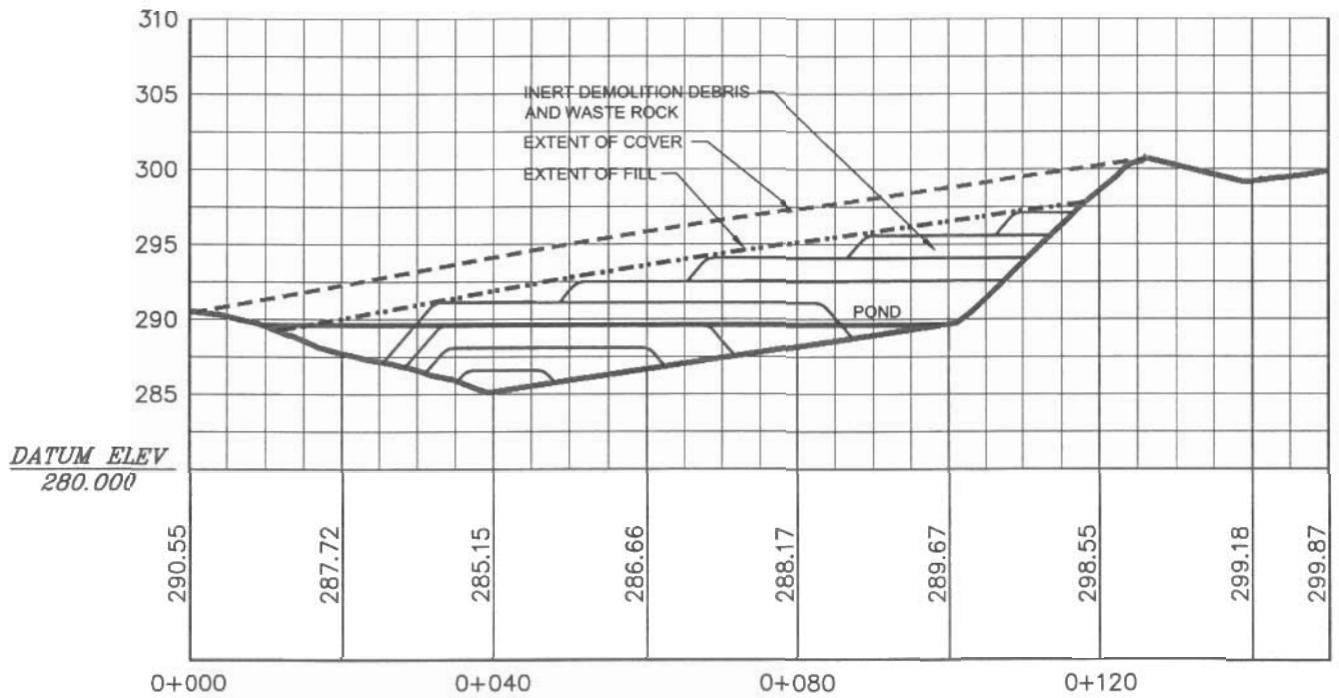
Figure No. 4



0 5 10 20 30 Metres

SCALE 1:1000

2x Vertical Exaggeration

LEGEND:

- EXISTING GROUND (SURVEY)
- WATER LEVEL (APPROX.)
- EXTENT OF FILL
- EXTENT OF COVER

SOURCE OF DRAWING:

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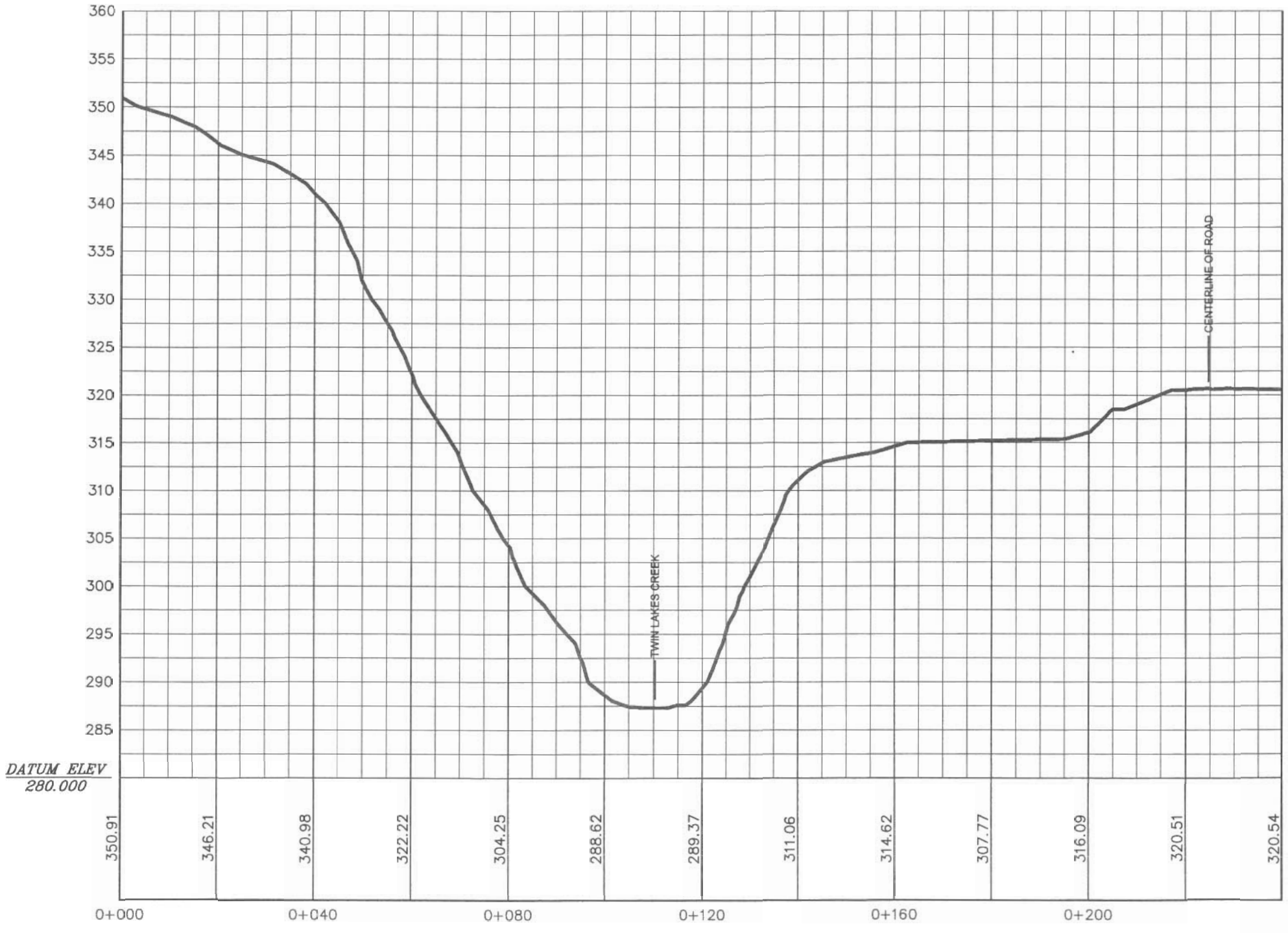
WEST ADIT AREA - SECTION 'B'

Gartner Lee

Figure No. 5



LEGEND:

EXISTING GROUND (SURVEY)
WATER LEVEL (APPROX.)

SOURCE OF DRAWING:

DATA COMPILED FROM FILES RECIEVED FROM NANISIVIK MINE AND SURVEYS CONDUCTED BY SUB-ARCTIC SURVEYS LTD.

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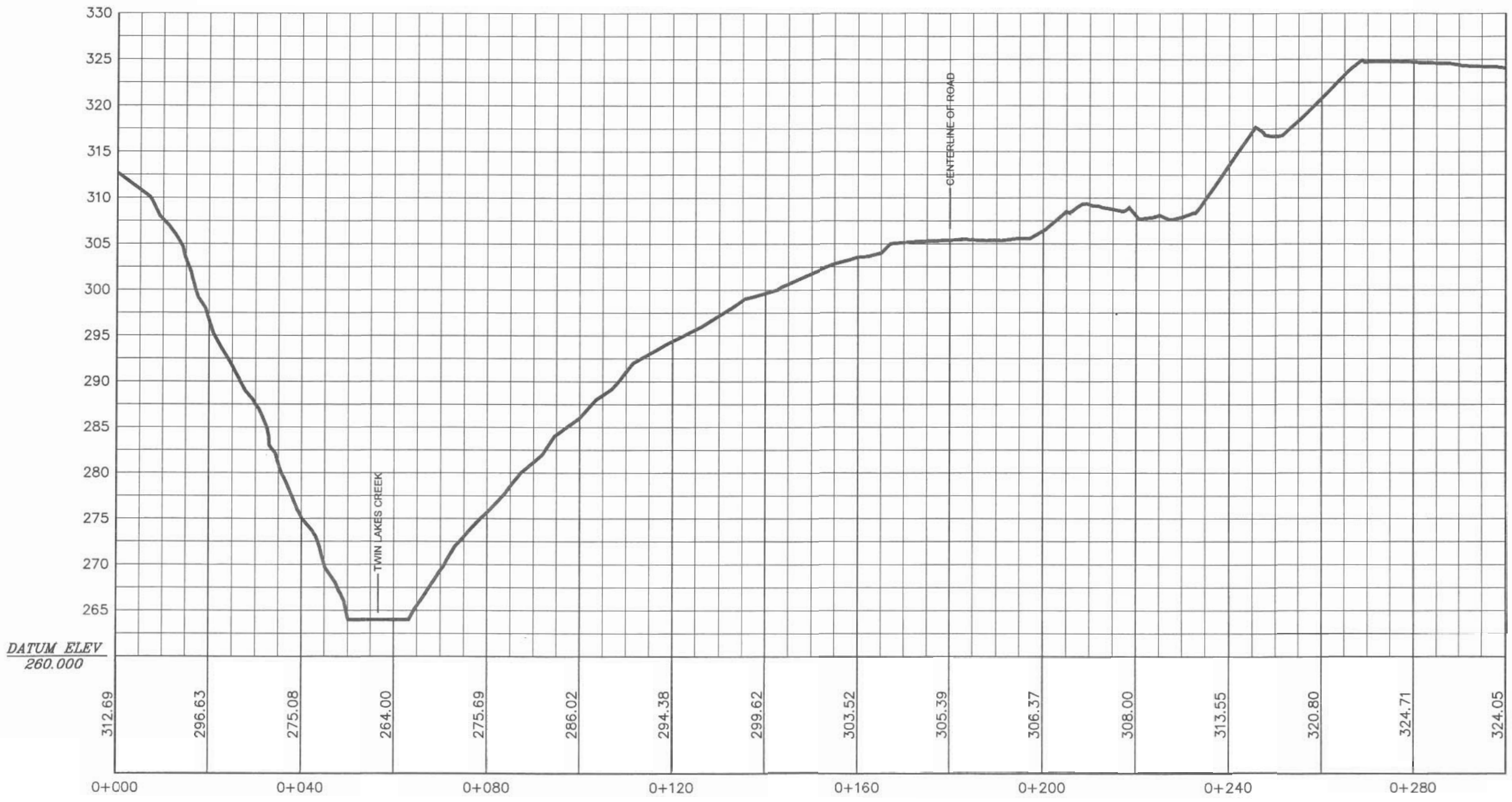
WEST ADIT AREA - SECTION 'C'

Gartner Lee

Figure No. 6



0 5 10 20 30 Metres

SCALE 1:1000

2x Vertical Exaggeration

LEGEND:

EXISTING GROUND (SURVEY)
WATER LEVEL (APPROX.)

SOURCE OF DRAWING:

DATA COMPILED FROM FILES RECIEVED FROM NANISIVIK MINE AND SURVEYS CONDUCTED BY SUB-ARCTIC SURVEYS LTD.

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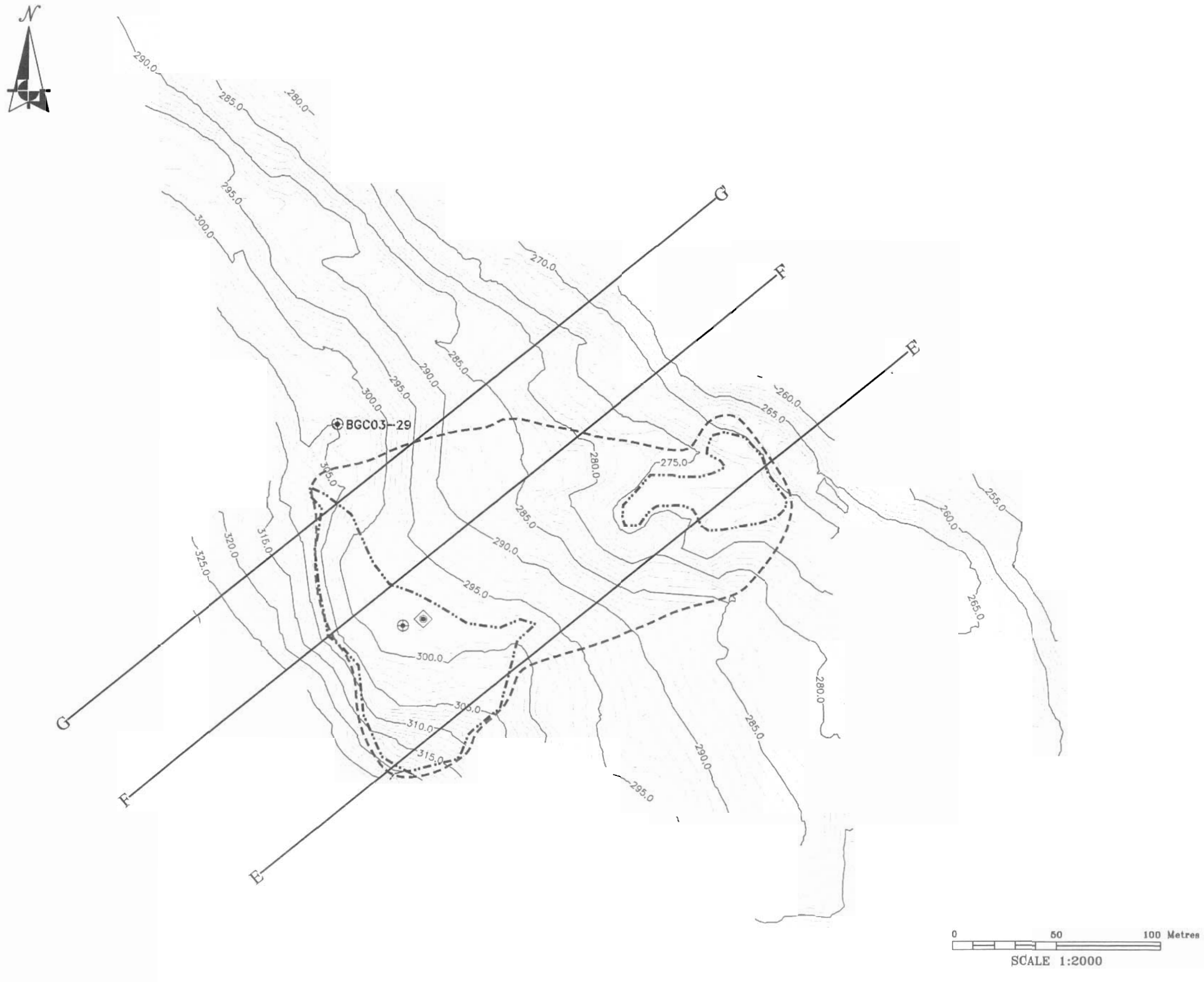
Client: CanZinco Ltd.

WEST ADIT AREA - SECTION 'D'

Gartner Lee

Figure No. 7



LEGEND:

- EXTENT OF COVER
- EXTENT OF FILL
- SECTION LINE
- THERMOCOUPLE LOCATION
- PROPOSED THERMISTOR
- PROPOSED FROST GAUGE

SOURCE OF DRAWING:

DATA COMPILED FROM FILES RECIEVED FROM NANISIVIK MINE AND SURVEYS CONDUCTED BY SUB-ARCTIC SURVEYS LTD.

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Project: ROCK PILES AND OPEN PITS CLOSURE PLAN
Location: NANISIVIK MINE, NUNAVUT
Client: CanZinco Ltd.

EAST OPEN PIT SECTION LOCATION PLAN

Gartner Lee

Figure No. 8