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GOVERNMENT OF YUKON ENERGY, MINES AND RESOURCES - ASSESSMENT AND ABANDONED MINES

Mount Nansen Tailings Dam

Emergency Spillway Construction Report

307071-00856 -00-SS-REP-0002

23 December 2014

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DEC 23 - 2014

PROJECT 307071-00856 - MOUNT NANSEN TAILINGS DAM

REV	DESCRIPTION	ORIG	REVIEW	WORLEYPARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
0	Issued for Use	J. Gentles	A. Timmis	A. Timmis	19-Nov-14		
1	Re-issued for Use	J. Gentles	A. Timmis	A. Timmis	11-Dec-14		
2	Re-issued for Use	J. Gentles	A. Timmis	A. Timmis	17-Dec-14		
3	Re-issued for Use	J. Gentles	A. Timmis	A. Timmis	23-Dec-14		

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Any questions concerning the information or its interpretation should be directed to J. Gentles or A. Timmis.

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1. INTRODUCTION

A report prepared by WorleyParsons Canada Services Ltd. (WorleyParsons) titled “Mount Nansen Tailings Dam - Dam Safety Review”, Revision 1, dated November 13, 2013 (the DSR) recommended improvements to the Mount Nansen mine site tailings pond dam crest and emergency spillway (the improvements). The improvements were designed to increase the available tailings pond freeboard and improve the performance of the emergency spillway. WorleyParsons was retained by Government of Yukon Energy, Mines and Resources: Assessment and Abandoned Mines (AAM) to provide engineering services for the design and construction of the improvements (Engineering Agreement No. C00025483).

The following report documents the construction activities conducted at the Site from August 25, 2014 to October 20, 2014.

1.1 Background

Mount Nansen (the Site) is a former gold and silver mine located in the Yukon (YT), approximately 45 km west of Carmacks, YT and 180 km north of Whitehorse, YT. The property is located within the traditional territory of the Little Salmon Carmacks First Nation. The Mount Nansen Road, connecting the Site to the North Klondike Highway in Carmacks, is maintained by the Government of Yukon - Department of Highways and Public Works.

An aerial photo of the Mount Nansen mine is shown in Figure A. The Mount Nansen tailings pond includes a dam (located east of the pond) and an emergency spillway located at the northeast corner of the pond. The emergency spillway enables discharge from the pond during periods of elevated water levels to prevent overtopping of the dam crest and discharges downstream into the Dome Creek diversion channel.

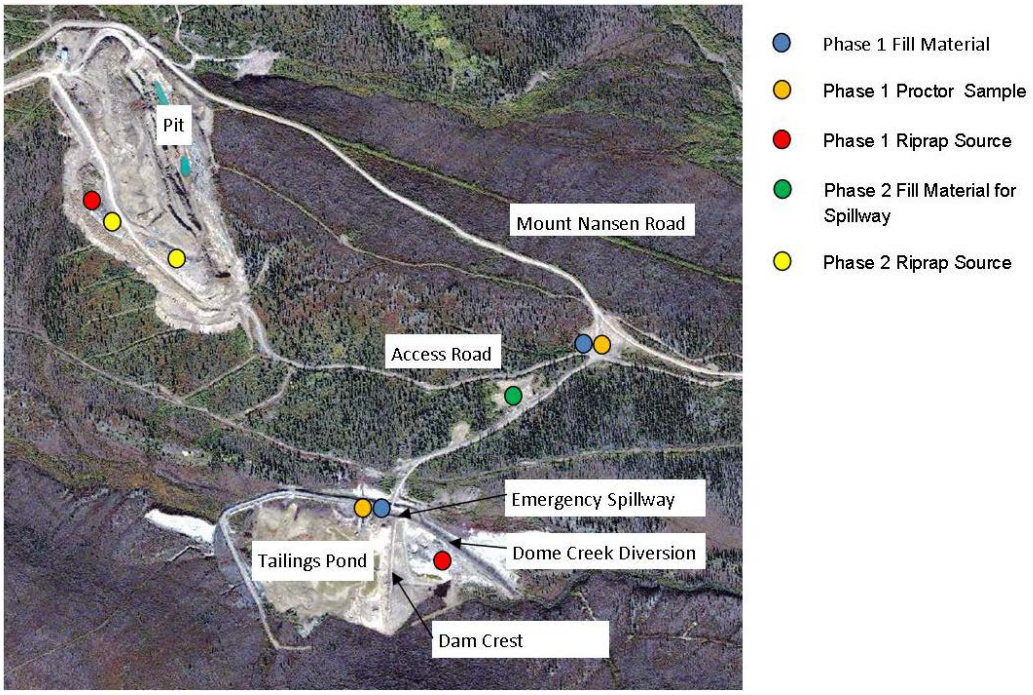


Figure A Mount Nansen Mine Site

1.2 Project Overview

In February, 2014, WorleyParsons completed a design of the improvements recommended in the DSR. Issued for Construction (IFC) drawings and design criteria can be found in the Design Summary report (WorleyParsons, 2014).

The improvements included the following components:

- Raising of the dam crest to an elevation of 1,099.6 m to provide sufficient freeboard in the tailings pond (1.0 m) during the inflow design flood (IDF) event with a return period of 200 years and an approximate flow rate of 1.3 m^3/s;
- Installation of four survey monuments to monitor dam crest movement;
- Lowering of the existing emergency spillway to provide sufficient freeboard (1.0 m) during conveyance of emergency discharge from the tailings pond during the IDF;
- Reconstruction of the emergency spillway to improve hydraulic performance;
- Reconstruction of the emergency spillway tie-in to the diversion channel / combined spillway;
- Placement of riprap armouring to protect the channel from scouring and erosion; and
- Reinstatement of the access road across the emergency spillway.

Record drawings of the improvements are included in Appendix 1.

2. CONSTRUCTION OVERVIEW

2.1 Phase 1

Construction of the improvements was undertaken by Norcope Construction Group (Norcope) from August 25 to 30, 2014. Staff from WorleyParsons (Daniel Paolone) and AAM (Jeff Moore) were on-site during construction; daily inspection reports summarizing the tasks completed by Norcope are included in Appendix 2.

2.2 Inspection

During an inspection by AAM staff (Josée Perron and Luca Poloni) on September 26, 2014 several deficiencies were identified, including the following:

- Large gaps in the riprap armouring through which the underlying geotextile was visible;
- Tears in the geotextile were visible;
- Insufficient overlapping of geotextile at joints;
- Geotextile installed along the top of bank, spillway inlet, and spillway outlet was exposed (i.e., geotextile was not properly anchored in a trench);
- Grades were incorrect (5.0% instead of 0.5% shown on the IFC drawings, resulting in the channel invert elevation of the emergency spillway being lower than the combined spillway overbank elevation causing ponding;
- Riprap coverage along the spillway channel was insufficient (i.e., did not meet the channel depth design criteria); and
- Riprap coverage at the tie-in to the combined spillway was insufficient.

These deficiencies could potentially impact the performance of the emergency spillway. Consequently, AAM determined that repairs to the emergency spillway were required prior to the 2015 freshet.

2.3 Phase 2

To address the deficiencies discussed above, AAM engaged Boreal Engineering Ltd. (Boreal) due to the fact that they were completing another project within the area. Boreal was also able to provide surveying services to expedite design revisions and field layout.

Boreal completed construction of the improvements and demobilized from site on October 19, 2014. Staff from WorleyParsons (Jake Gentles) and AAM (Josée Perron and Luca Poloni) were on-site during construction; daily inspection reports summarizing the tasks completed by Boreal staff (Erik Nyland, Gavin Nyland, and John Kooy) are included in Appendix 3.

3. IMPROVEMENTS - PHASE 1

3.1 Site Preparation

Norcope mobilized to site on August 25, 2014 and were lodged at the Mount Nansen bunkhouse. Norcope's on-site resources consisted of the following equipment:

- 1 x Excavator;
- 1 x Dump Truck;
- 1 x Compaction Roller; and
- 1 x Caterpillar Bulldozer.

3.2 Survey

Yukon Engineering Services established survey layout stakes to facilitate the construction of the improvements. Following construction, the extents of the improvements as well as the four markers were surveyed.

3.3 Regraded Dam Crest Geometry

The dam crest extends from the south to north ends of the tailings pond, sloping west to the tailings pond beach and to the east to the seepage collection pond and the valley floor (Photo A). The dam crest was regraded to achieve an elevation of 1,099.60 m with slight variations from the proposed geometry shown on the IFC drawings. The dam crest regrading is comprised of a layer of granular base fill topped with 50 mm minus crushed surfacing aggregate up to a depth of 150 mm.

Photo A Dam Crest – Looking Southwest

The IFC and as-constructed dimensions and parameters for the regraded dam crest are presented in Table A.

Table A Regraded Dam Crest Dimensions and Parameters

Dimension / Parameter	IFC	As-Constructed
Granular Base Elevation (m)	1,099.45	1,099.38 to 1,099.61 (estimated)[1]
Surfacing Aggregate Elevation (m)	1,099.60	1,099.53 to 1,099.76
Top Width (m)	5.0	5.0 to 6.3 (5.9 average)
Side Slopes	1.5H:1V	2.2H:1V to 4.5H:1V (3.0H:1V average)

Notes:

[1]As the granular base surface was not surveyed, the range of elevations was estimated by subtracting 150 mm (approximate depth of surfacing aggregate) from the surveyed surfacing aggregate range of elevations.

Although small segments of the regraded dam crest did not achieve an elevation of 1,099.60 m, there is sufficient freeboard (1.0 m during the IDF) to account for this variation. AAM, at its discretion, may choose to fill in the segments identified in Table B with compacted surfacing aggregate.

Table B Segments of Dam Crest Lower than Design Criteria

Approximate Stations	Lowest Elevation (m)	Maximum Infill Depth (m)
0+016 to 0+032	1,099.55	0.05
0+074 to 0+090	1,099.53	0.07
0+105 to 0+123	1,099.57	0.03

3.4 Soil and Compaction Testing

Soil samples were taken from the borrow pit north of the tailings facility and from the spillway (refer to Figure A). Sieve and proctor analyses of these samples were performed by Tetra Tech to determine soil gradations and dry density curves for each sample.

Fill material compaction in-situ dry density measurements were taken using a nuclear densometer at 20 m intervals.

Results of the analyses and compaction testing results are included in Appendix 4.

3.5 Survey Markers

Four survey markers were installed along the west edge of the dam crest to facilitate movement monitoring.

The as-constructed coordinates for the survey markers are presented in Table C.

Table C Survey Marker As-Constructed Coordinates

Survey Marker	Northing	Easting	Elevation (m)
Dam 1	6,880,674.88	389,458.29	1,099.69
Dam 2	6,880,625.23	389,457.11	1,099.59
Dam 3	6,880,575.26	389,455.94	1,099.54
Dam 4	6,880,524.96	389,455.36	1,099.66

3.6 Spillway Geometry

As the Phase 1 spillway was subsequently removed due to the deficiencies previously discussed, its geometry is not discussed in this report. The Phase 2 spillway geometry is discussed in Section 4.3.

3.7 Materials

Table D presents the approximate material quantities used to regrade the dam crest during Phase 1. Refer to Figure A for the locations of the site material sources.

Table D Approximate Phase 1 Dam Crest Quantities

Item	Approximate Quantity	Source
Granular Fill	760 m^3	Spillway
Dam Crest Surfacing	230 m^3	Borrow Pit – Phase 1

The results of the following geotechnical analyses of the dam crest granular base and surfacing aggregate are presented in Appendix 4:

- Soil gradation (sieve) analyses;
- Proctor and modified proctor analyses; and
- In-situ compaction testing.

3.7.1 Dam Crest Granular Base

Granular base material was placed above the existing dam crest material. The material is composed primarily of gravel with some sand / silt and was sourced primarily from material excavated from the emergency spillway with some material sourced from a borrow pit located north of the tailings facility. The material was spread using the bulldozer and compacted using the compaction roller. In-situ testing results indicate that compaction of the granular base generally exceeded the design criteria of 92% modified proctor maximum dry density (MPMDD).

3.7.2 Dam Crest Surfacing Aggregate

Surfacing aggregate was placed above the granular base. The material is composed of gravel and sand with some silt and was sourced from a stockpile located north of the site. The material was spread using the bulldozer and compacted using the compaction roller. In-situ testing results indicate that compaction of the granular base generally exceeded the design criteria of 95% MPMDD.

3.7.3 Survey Markers

Four survey markers were installed at approximately 50 m spacing along the west edge of the dam crest. The installation consisted of a steel rod embedded in concrete cast in place in a sono tube. Excavation for the sono tube was achieved using a backhoe to an approximate depth of 2 m. Following concrete placement, the excavation was backfilled with native material and compacted. Plastic markers were installed to identify the locations of the markers (Photo B).

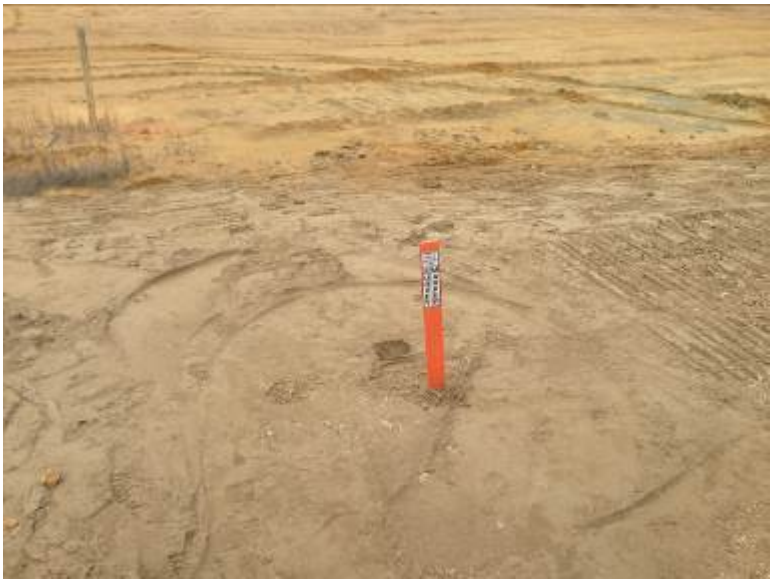


Photo B Survey Marker – Looking West

It is recommended that the markers are surveyed to monitor for horizontal and vertical movement based on the following criteria:

- On an annual basis following freshet;
- Following periods of heavy rains; or
- Following a period of increased water levels in the seepage pond.

4. IMPROVEMENTS - PHASE 2

Phase 2 construction consisted of the regrading of the spillway constructed in Phase 1 and removal of its materials.

4.1 Site Preparation

4.1.1 Mobilization

Boreal mobilized to site on October 9, 2014 and established a work camp east of the mine site on Mount Nansen Road. Boreal's on-site resources consisted of the following staff and equipment:

- 1 x Foreman;
- 1 x Equipment Operator;
- 1 x Grademan;
- 1 x 324D CAT Excavator;
- 1 x 225 Doosan Excavator;
- 1 x CAT Front End Loader;
- 1 x Dual Axle Dump Truck;
- 1 x 300 lb Plate Tampers; and
- 1 x 700 lb Plate Tamper (supplied by AAM).

4.1.2 Removal of Phase 1 Spillway Materials

Boreal began removing spillway materials (e.g., riprap and geotextile) soon after mobilizing to the site (Photo C). Riprap was retained on-site for reuse. The geotextile was disposed of at a designated area at the site.

Photo C Removal of Phase 1 Spillway Materials - Looking West (Upstream)

4.2 Survey

Boreal identified survey control points following mobilization, primarily using control monument Dam 1, established as part of Phase 1. Boreal completed its survey collection using real-time kinetic (RTK) survey equipment. They completed the following topographical surveys:

- Original ground – corresponding to the Phase 1 finished spillway surface;
- Subgrade – corresponding to the Phase 2 excavated spillway, prior to riprap placement; and
- Finished surface – corresponding to the Phase 2 finished spillway surface (used as the basis for the record drawings).

At the start of construction, Boreal used the original ground survey to generate an existing spillway profile (based on the Phase 1 works). A revised finished grade profile was developed with input from WorleyParsons and AAM staff to confirm that design criteria were met. A spillway design surface (discussed in Section 4.3) was generated from the revised profile and used to facilitate survey layout by Boreal.

During construction, Boreal used its RTK survey equipment to establish grade stakes and a laser level to confirm that the spillway was being constructed per the design.

4.3 Spillway Geometry

The spillway geometry was redesigned following the original ground topographic survey completed by Boreal and differs from the proposed geometry shown on the IFC drawings. These changes are discussed in the following sections.

4.3.1 Spillway Section 1

Spillway Section 1 extends from the upper portion of the tailings pond beach to a point in line with the dam crest (Photo D).

Photo D Construction of Spillway Section 1 – Looking Southeast (Downstream)

The IFC design did not require armouring of Section 1; however, it was determined in the field that riprap armouring should be installed to protect the north channel embankment. The embankment is located on the outside of a channel bend (where hydraulic stress is typically more severe) and is located directly below the primary access road to the dam crest. The IFC and as-constructed dimensions and parameters for Spillway Section 1 are presented in Table E.

To account for the addition of armouring, the Section 1 spillway subgrade was constructed at an elevation of 1,097.80 m - 490 mm lower than the IFC elevation of 1,098.29 m. The spillway should still function as designed (i.e., impounded water will begin to discharge via the spillway once the tailings pond water level reaches 1,098.30 m) as the tailings beach crest immediately upstream of the spillway is at an elevation of 1,098.30 m.

Prior to the reconstruction of the spillway the operating elevation of the tailings pond was 1,097.8 m. Above this level, water management measures are implemented by site staff to reduce the potential for untreated water to be discharged over the emergency spillway. As the result of lowering the spillway crest by approximately 0.3m, it is recommended that the pond operating level should be lowered to 1,097.5 m. It should be noted that WorleyParsons have not reviewed the basis for the previous operating level and that this recommendation is based solely on maintaining the 800 mm vertical offset between the channel spillway crest elevation and the operating pond water level.

Table E Spillway Section 1 Dimensions and Parameters

Dimension / Parameter	IFC	As-Constructed
Grade	0%	0%
Bottom Width (m)	5	5.7 to 6.6 (6.2 average)
Side Slopes	3H:1V	3.2H:1V (average)
Length of Channel (m)	40	40
Channel Depth[1] (m)	Undefined	1.3 to 1.5 (1.4 average)
Top of Subgrade Elevation – upstream (m)	1,098.29	±1,097.80
Spillway Invert Elevation[2] - upstream (m)	N/A	±1,098.38
Top of Subgrade Elevation – downstream (m)	1,098.29	±1,097.80
Spillway Invert Elevation[2] - downstream (m)	N/A	±1,098.38
Riprap Thickness (mm)	No riprap	510 to 640 (580 average)
Surface Area (m^2)	0	640

Notes:

[1] Channel depth refers to distance from top of riprap placed at the bottom of the spillway to the top of the riprap placed up the spillway slope.

[2] Spillway invert elevation refers to the top of the riprap at the bottom of the channel.

The Section 1 spillway footprint was limited due to the access road located north of the spillway. Consequently, the north spillway embankment was increased to approximately 2.2H:1V to avoid encroaching on the access road. The location of this change is indicated on drawing 307071-00856-00-CI-DGA-7003, Appendix 1.

4.3.2 Spillway Section 2

Spillway Section 2 extends from the end of Section 1 to the end of the spillway at the tie-in to the Dome Creek diversion channel (Photo E).

Photo E Construction of Spillway Section 2 - Looking Southeast (Downstream)

The IFC design included a Section 3; however, it proved to be more practical to maintain a consistent grade from the dam crest to the end of the spillway, effectively eliminating Section 3 from the as-constructed design.

The IFC and as-constructed dimensions and parameters for Spillway Section 2 are presented in Table F.

Table F Spillway Section 2 / 3 Dimensions and Parameters

Dimension / Parameter	IFC	As-Constructed
Grade	0.5% to 3.7%	2.7% at top of riprap
Bottom Width (m)	5	4.9 to 6.2 (5.4 average)
Side Slopes	3H:1V	4.0H:1V (average)
Length of Channel (m)	54	52
Channel Depth[1] (m)	1 to 1.3	0.9 to 1.3 (1.1 average)
Top of Subgrade Elevation - upstream (m)	1097.99	±1097.80
Spillway Invert Elevation[2] - upstream (m)	1,098.29	±1,098.38
Top of Subgrade Elevation - downstream (m)	1,096.34	±1,096.46
Spillway Invert Elevation[2] - downstream (m)	1,096.64	±1,096.96
Riprap Thickness (mm)	300	500 to 650 (560 average)

Dimension / Parameter	IFC	As-Constructed
Surface Area (m^2)	770	670

Notes:

[1] Channel depth refers to distance from top of riprap placed at the bottom of the spillway to the top of the riprap placed up the spillway slope.

[2] Spillway invert elevation refers to the top of the riprap at the bottom of the channel.

A portion of the Section 2 spillway footprint was limited due to the access road located north of the spillway. Consequently, the north spillway embankment was increased to approximately 2.2H:1V to avoid encroaching on the access road. The location of this change is indicated on drawing 307071-00856-00-CI-DGA-7003, Appendix 1.

4.3.3 Access Road

The access road was reinstated across the spillway to facilitate access to the tailings pond dam (Photo F).

Photo F Access Road - Looking Southeast (Across Channel)

The IFC and as-constructed dimensions and parameters for the access road are presented in Table G.

Table G Access Road Dimensions and Parameters

Dimension / Parameter	IFC	As-Constructed
Width (m)	4	3.9 to 4.9
Maximum Grade	12.5%	12.4%
Elevation at Spillway Centerline (m)	1,098.20	1,098.09

4.4 Materials

Table H presents the approximate material quantities used to construct the emergency spillway during Phase 2. Refer to Figure A for the locations of the site material sources.

Table H Phase 2 Quantities

Item	Approximate Quantity	Source
Subbase	150 m^3	Borrow source – Phase 2
Geotextile	2,300 m^2	Hurlburt Enterprises Inc.
Riprap[1]	670 m^3	McDade Open Pit and re-use from Phase 1 (originally sourced from piles near seepage pond)
Access Road Surface	80 m^3	Borrow source – Phase 2

Note:

[1] Riprap measurement based on volumetric difference between finished grade and subgrade and does not take into account void ratio or surface variability.

4.4.1 Subbase

Subbase material was placed, as required, to construct the spillway cross-section prior to armouring. The material is composed of a mixture of silty sand (available at the site) and friable rock (sourced from a stockpile north of the site). The subbase material was placed directly onto native material by the excavator. Voids in the subbase, a result of pockets of friable rock, were filled in manually with silty sand and compacted.

The subbase was graded and compacted by the excavator (i.e., track-packed). Compaction was also achieved using plate tampers (Photo G). Although in-situ testing was not completed using a nuclear densometer and water was not added to the material, sufficient compactive effort was applied to the subbase material to the satisfaction of WorleyParsons.

Photo G Subbase at Downstream End of Spillway - Looking Southeast (Downstream)

4.4.2 Geotextile

Non-woven geotextile (Layfield LP6) was installed along the length of the spillway channel to act as an interface between the subbase and riprap (i.e., providing erosion protection to limit scouring of fine, subbase material). The geotextile was installed from the downstream end of the channel to the upstream end of the channel such that the upstream piece overlapped onto the downstream piece a minimum of 600 mm. At its edges (top of embankment and upstream and downstream ends of the channel), a minimum of 500 mm of the geotextile was buried in an anchoring trench (Photo H).

Photo H Geotextile Anchor Trench - Looking Northeast (Across Channel)

At tie-in points, the geotextile was extended to wrap around existing embankments to prevent scouring (Photo I) and covered by riprap.

Photo I Geotextile Installed Along Existing Berms at Downstream End of Spillway - Looking Southeast (Downstream)

4.4.3 Riprap

Riprap material was composed of angular waste rock, free of signs of acid rock drainage (based on analysis by Tetra Tech), and available at a number of stockpiles located near the Mount Nansen pit. The riprap installed during Phase 1 was re-used to reconstruct the spillway.

The riprap used did not meet the design specification (D_{50} = 150 mm and no rock greater than 500 mm) due to a lack of acceptable material available on site; however, the protection provided by the larger rock will be more than sufficient to withstand the IDF (Photo K). The spillway cross-section was adjusted to accommodate the larger rock diameter with riprap thickness between 500 mm to 650 mm.

Photo J Riprap Placed Across Spillway - Looking East (Downstream)

Riprap was placed by an excavator equipped with a thumb operating from the top of the bank. The excavator first placed a thin layer of silty sand to protect the geotextile from damage. Large rocks were then manipulated to attain a suitable orientation and placed to “lock” in to other rocks. Smaller rocks were placed to fill in voids and create a cohesive, interlocked riprap blanket. Following placement, water was used to wash out the fine material and to identify voids which were then filled in manually using smaller rocks.

4.4.4 Access Road Surface

The existing access road across the spillway was reinstated by placing a layer of geotextile across the riprap (Photo K) and topping it with approximately 150 mm of friable rock. The rock was graded and compacted by the excavator (i.e., track packed).

Photo K **Access Road Surface - Looking Southeast (Across Channel)**

5. SUMMARY

The improvements to the Mount Nansen tailings facility were successfully completed by Norcope Construction Group (Phase 1 - Dam Crest) and Boreal Engineering (Phase 2 - Emergency Spillway) between August 25 and October 19, 2014. The improvements were required to address recommendations included in the most recent dam safety review (WorleyParsons, 2013).

The tailings pond dam was regraded to raise the crest elevation to 1,099.6 m. A 5 m-wide access road was reinstated along the dam crest, connecting to the existing mine site service road via a crossing of the emergency spillway. Four survey monuments were installed and established to facilitate monitoring of dam crest movement. Approximately 760 m^3 of granular base and 230 m^3 of surfacing aggregate were placed as part of the regrading.

The emergency spillway was reconstructed to convey the 200-year inflow design flood (1.3 m^3/s) while maintaining 1.0 m of freeboard at the dam. The spillway alignment extends east from northeast corner of the tailings beach to the Dome Creek diversion channel. The spillway was armoured with riprap and geotextile to limit erosion during periods of high flow. Approximately 670 m^3 of riprap, without accounting for voids, was placed in the spillway over an area of 1,310 m^2.

The completed emergency spillway was field fit to suit the conditions encountered on site (e.g., different topography, larger rock diameter). Although the geometry of the spillway differs from the geometry shown on the IFC drawings, calculations were completed in the field to confirm that the spillway could convey the IDF while maintaining the minimum freeboard.

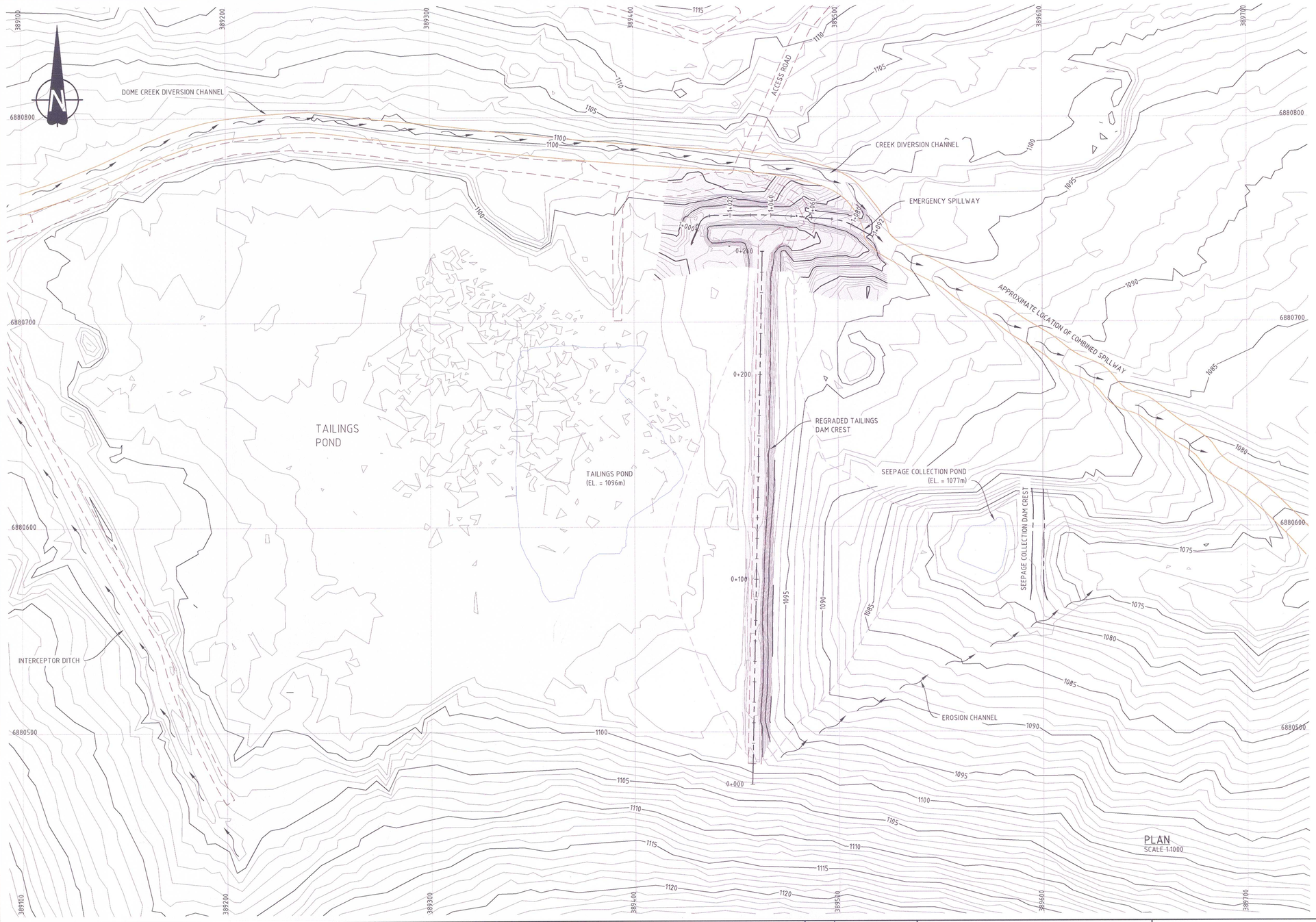
It is recommended that the markers installed along the dam crest are surveyed on an annual basis (following freshet) and/or following extreme precipitation events and periods of increased seepage to monitor the horizontal and vertical movement of the dam.

6. REFERENCES

WorleyParsons. 2014. Mount Nansen Tailings Dam - Design Summary.

WorleyParsons. 2013. Mount Nansen Tailings Dam - Dam Safety Review.

Appendix 1 Record Drawings



PLAN
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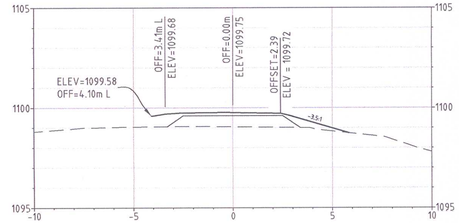

TAILINGS DAM – STATION: 0+200
SCALE 1:150

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. ALL COORDINATES REFERENCE THE NAD83 ZONE 7 COORDINATE SYSTEM AND THE CGVD28 VERTICAL DATUM.
3. POST CONSTRUCTION SURVEY DATA WAS OBTAINED FROM YUKON ENGINEERING SERVICES (DAM CREST) AND BOREAL ENGINEERING (SPILLWAY).
4. CONTOUR INFORMATION FOR THE SURROUNDING AREA IS BASED ON 2012 LIDAR DATA ASSEMBLED BY BGC ENGINEERING.
5. PRE-CONSTRUCTION GROUND SURFACE INFORMATION FOR THE DAM CREST IS BASED ON 2012 SURVEY DATA COLLECTED BY YUKON ENGINEERING SERVICES.
6. PRE-CONSTRUCTION GROUND SURFACE INFORMATION FOR THE SPILLWAY IS BASED ON OCTOBER 10, 2014 SURVEY DATA COLLECTED BY BOREAL ENGINEERING.
7. LAYFIELD LP6 NON-WOVEN GEOTEXTILE WAS USED.
8. RIPRAP CONSISTS OF CLEAN (I.E., FREE FROM SOIL AND/OR ORGANIC MATERIAL), DURABLE, SOUND, ANGULAR, AND ROUGHLY EQUIDIMENSIONAL ROCK.
9. FILL CONSISTS OF GRADED MATERIAL SELECTED FROM ON-SITE EXCAVATIONS AND SUBSTANTIALLY FREE OF ORGANICS, FROZEN OR WET SOIL, AND ROCKS LARGER THAN 150mm IN DIAMETER.
10. SURVEY MARKERS CONSIST OF READY ROD SET IN CONCRETE AT AN APPROXIMATE DEPTH OF 2m.

APPROXIMATE MATERIAL QUANTITIES

NON-WOVEN GEOTEXTILE (LAYFIELD LP6)	2300 m^2
20 mm MINUS CRUSHED SURFACING AGGREGATE	230 m^3
RIPRAP	670 m^3
SURVEY MARKERS	4

m 0 1 2 3 4 5 10 m
1:150

m 0 10 20 30 40 50 m
1:1000

REV	DATE (DD-MMM-YY)	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER
2	11-DEC-14	RE-ISSUED FOR RECORD (307071-01002)	JH	BM	JG	AT	AT	
1	19-NOV-14	ISSUED FOR RECORD (307071-01002)	JH	BM	JG	AT	AT	
0	20-FEB-14	ISSUED FOR CONSTRUCTION	JH		SC	AT	LM	

REF DRAWING No	REFERENCE DRAWING TITLE

D SHEET SCALE SHOWN

OneWay to zero harm

WORLEYPARSONS PROJECT No
307071-00856

ENGINEERING AND PERMIT STAMPS (As Required)

CUSTOMER
Yukon Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

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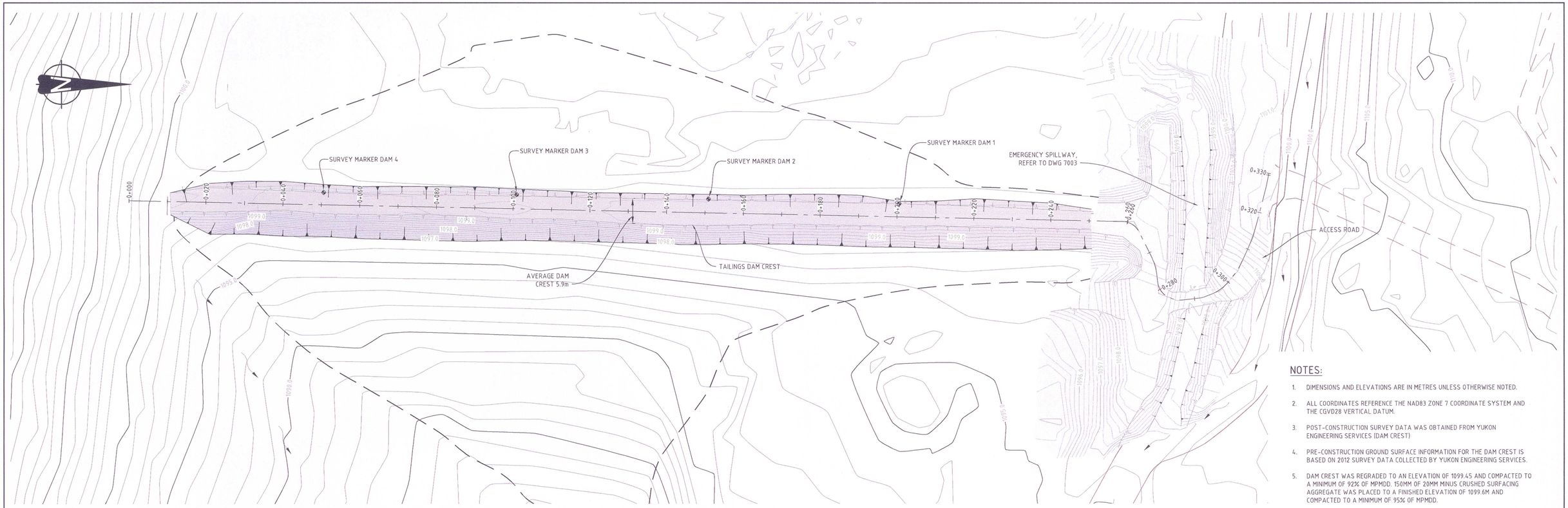
WorleyParsons resources & energy

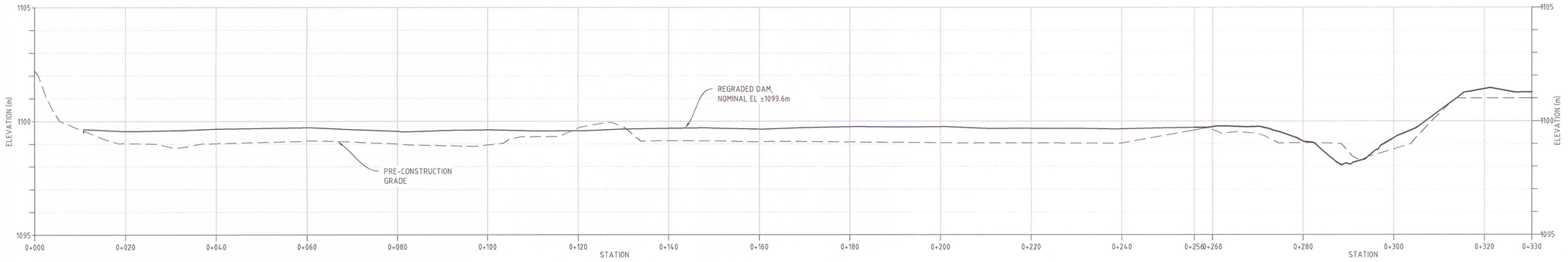
MOUNT NANSEN TAILINGS DAM
DAM CREST REGRADING AND
EMERGENCY SPILLWAY IMPROVEMENTS
PLAN

DRG No 307071-00856-00-CI-DGA-7001
REV 2

LOCATION: U:\YVR\307071\01002_YEM_CLNTNCRKT&\11_DRAWINGS\01_CIVIL\307071-00856-00-CI-DGA-7001.DWG
USER NAME: jiang.hu
PLOT DATE & TIME: 11/12/2014, 1:46:19 PM
SAVE DATE & TIME: 11/12/2014, 10:16:05 AM



TAILINGS DAM PLAN



TAILINGS DAM CREST PROFILE
HOR: 1:500
VERT 1:100

ACCESS ROAD PROFILE
HOR: 1:500
VERT 1:100

m 0 5 10 15 20 25 m
1:500

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. ALL COORDINATES REFERENCE THE NAD83 ZONE 7 COORDINATE SYSTEM AND THE CGVD28 VERTICAL DATUM.
3. POST-CONSTRUCTION SURVEY DATA WAS OBTAINED FROM YUKON ENGINEERING SERVICES (DAM CREST)
4. PRE-CONSTRUCTION GROUND SURFACE INFORMATION FOR THE DAM CREST IS BASED ON 2012 SURVEY DATA COLLECTED BY YUKON ENGINEERING SERVICES.
5. DAM CREST WAS REGRADED TO AN ELEVATION OF 1099.45 AND COMPACTED TO A MINIMUM OF 92% OF MPMDD. 150MM OF 20MM MINUS CRUSHED SURFACING AGGREGATE WAS PLACED TO A FINISHED ELEVATION OF 1099.6M AND COMPACTED TO A MINIMUM OF 95% OF MPMDD.

REV	DATE (dd-mmm-yy)	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
			AAL	RM	JG	AT	AT			
4	23-DEC-14	REVISED MARKER DAM LABELS	AAL	RM	JG	AT	AT			
3	11-DEC-14	RE-ISSUED FOR RECORD (307071-01002)	JH	BM	JG	AT	AT			
2	19-NOV-14	ISSUED FOR RECORD (307071-01002)	JH	BM	JG	AT	AT			
1	26-MAR-14	RE-ISSUED FOR CONSTRUCTION	JH		SC	AT	LM			
0	20-FEB-14	ISSUED FOR CONSTRUCTION	JH		SC	AT	LM			

D SHEET | SCALE | SHOWN

OneWay to zero harm

WORLEYPARSONS PROJECT No
307071-00856

ENGINEERING AND PERMIT STAMPS (As Required)

CUSTOMER

Yukon Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

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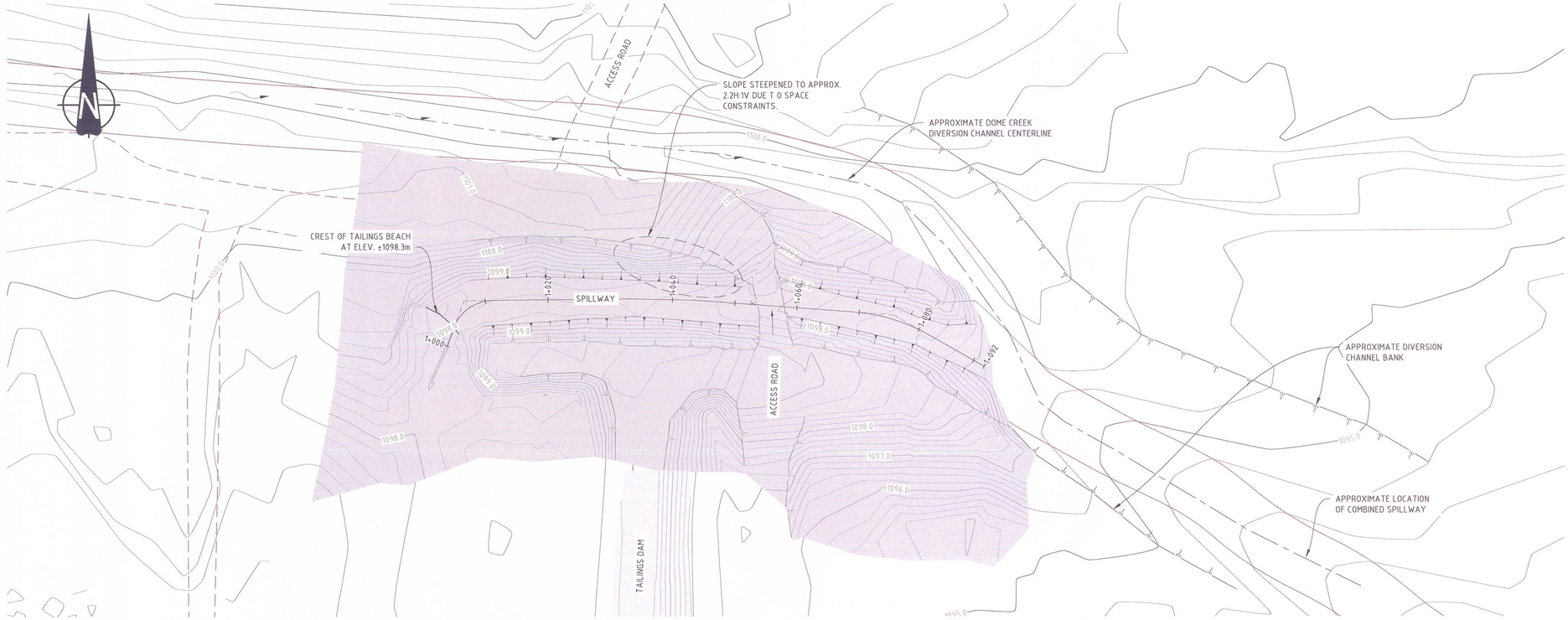
WorleyParsons resources & energy

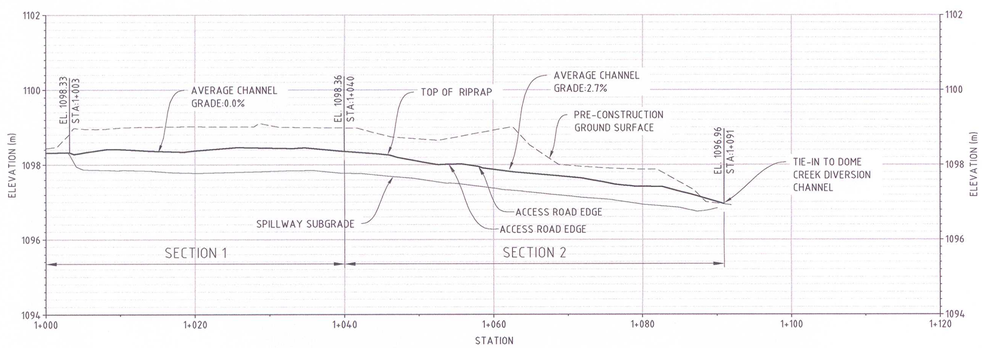
MOUNT NANSEN TAILINGS DAM DAM CREST REGRADING AND EMERGENCY SPILLWAY IMPROVEMENTS DAM AND ROAD - PLAN AND PROFILE

DRG No 307071-00856-00-CI-DGA-7002 | REV 4

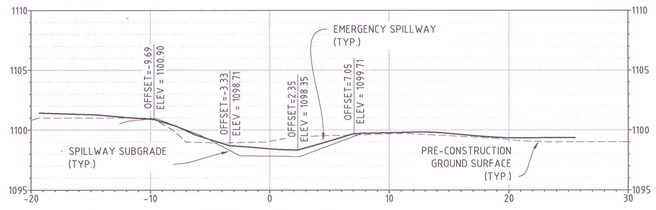
PLOT DATE & TIME: 23/12/2014 9:21:20 AM
SAVE DATE & TIME: 23/12/2014 8:51:25 AM
USER NAME: aaron.ledsham
LOCATION: U:\YVR\307071\01002_YEM_CLNTNCRA\11_DRAWINGS\01_CIVIL\307071-00856-00-CI-DGA-7002.DWG



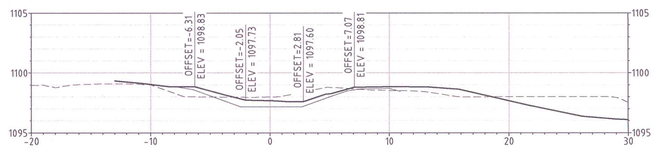
SPILLWAY PLAN
1:400



PROFILE - SPILLWAY
HOR:1:400 VERT 1:80



SECTION AT 1+030
1:250



SECTION AT 1+070
1:250

LEGEND:

- TOE OF SPILLWAY EMBANKMENT
- TOP OF SPILLWAY EMBANKMENT

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. ALL COORDINATES REFERENCE THE NAD83 ZONE 7 COORDINATE SYSTEM AND THE CGVD28 VERTICAL DATUM.
3. POST-CONSTRUCTION SURVEY DATA WAS OBTAINED FROM BOREAL ENGINEERING.
4. PRE-CONSTRUCTION GROUND SURFACE INFORMATION IS BASED ON 2012 SURVEY DATA COLLECTED BY BOREAL ENGINEERING.
5. EMERGENCY SPILLWAY SUBGRADE WAS REGRADED TO WITHIN +/- 500 mm BELOW THE FINISHED ELEVATIONS SHOWN (CORRESPONDING TO TOP OF RIPRAP).
6. NON-WOVEN GEOTEXTILE (LAYFIELD LP6) WAS PLACED UNDER AND AROUND THE RIPRAP, KEYED IN 500MM DEEP AT THE EDGES, AND OVERLAPPED A MINIMUM OF 600MM AT JOINTS, AS DESCRIBED IN SPECIFICATION 31 32 19.
7. THE ACCESS ROAD WAS RE-INSTATED OVER THE SPILLWAY WITH A ROAD SURFACE ELEVATION OF LESS THAN 1098.2m ACROSS THE BOTTOM OF THE SPILLWAY.
8. PRE-CONSTRUCTION GROUND SURFACE WAS BASED ON GROUND CONDITION PRIOR TO PHASE 1 CONSTRUCTION.

m 0 5 10 15 m
1:250

m 0 5 10 15 20 m
1:400

REV	DATE (DD-MMM-YY)	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
3	11-DEC-14	RE-ISSUED FOR RECORD (307071-01002)	JH	BM	JG	AT	AT			
2	19-NOV-14	ISSUED FOR RECORD (307071-01002)	JH	BM	JG	AT	AT			
1	26-MAR-14	RE-ISSUED FOR CONSTRUCTION	JH		SC	AT	LM			
0	20-FEB-14	ISSUED FOR CONSTRUCTION	JH		SC	AT	LM			

O SHEET | SCALE | SHOWN

OneWay to zero harm

WORLEYPARSONS PROJECT No
307071-00856

ENGINEERING AND PERMIT STAMPS (As Required)

CUSTOMER

Yukon Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

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WorleyParsons resources & energy

MOUNT NANSEN TAILINGS DAM
DAM CREST REGRADING AND EMERGENCY SPILLWAY IMPROVEMENTS
DETAILS

DRG No 307071-00856-00-CI-DGA-7003
REV 3

LOCATION: U:\YVR\307071\01002_YEM_CLNTNCRK14\11_DRAWINGS\01_CIVIL\307071-00856-00-CI-DGA-7003.DWG
USER NAME: jiangh
PLOT DATE & TIME: 11/12/2014 14:39 PM
SAVE DATE & TIME: 11/12/2014 11:00:11 AM

Appendix 2 Phase 1 (Norcope) Daily Inspection Reports

APPENDIX 2
PHASE 1 (NORCOPE) DAILY INSPECTION REPORTS

1. DAY 1 (AUGUST 25)

1.1 Summary of Activities and Work Completed

Crew visited construction site and reviewed work to be done.

Equipment was mobilized to site:

- Excavator / backhoe;
- Truck;
- Roller;
- Dozer; and
- Light vehicle trucks.

1.2 Photos

- None.

1.3 Issues

- None.

2. DAY 2 (AUGUST 26)

2.1 Summary of Activities

Construction began at 8:00 a.m. and work began cutting the high spot on the north end of the dam. Construction then shifted to excavating excess material along the spillway and placing it along the dam. Construction was completed at a brisk pace.

2.2 Work Completed

90 % of base layer was placed along the dam (150 mm thick). Majority of the material from the spillway was used for the base layer, with the remainder taken from a borrow pit north of the tailings facility. High point on north end of the dam was cut down.

2.3 Photos

Photo 1 Borrow Pit

Photo 2 Tailings dam looking south.

Photo 3 Tailings dam looking south with dozer.

Photo 4 Tailings dam looking north with roller.

Photo 5 Tailings dam looking north at end of day.

2.4 Issues

Waiting on Proctor Test results so percent compaction cannot be calculated until the following day. High moisture content due to rain. Some engineer field fits required along spillway due to intersection of slopes. Overlap of geotextile of 0.5 m used.

2.5 Work to be completed

Finish remaining base layer. Continue work along the spillway.

3. DAY 3 (AUGUST 27)

3.1 Summary of Activities

Construction began at 7:00 a.m. Work began cleaning up material placed material on north end of the dam, and placing and compacting it on the south end of the dam. Next, material was excavated in the spillway and used to re-establish alternative crossing for material to be supplied from the borrow source. By mid-day, work began placing riprap along the spillway and continued through the rest of the day. Construction was completed at a brisk pace.

3.2 Work Completed

Remainder of the base layer along the dam (150 mm thick) was completed. Densometer readings showed a couple of areas that required more compacting. 50 % of the spillway was placed with riprap and most of the required geotextile was placed along the spillway.

3.3 Photos

Photo 6 Riprap being placed along spillway.

Photo 7 Alternative crossing.

Photo 8 Geotextile being placed.

Photo 9 Geotextile being reviewed.

Photo 10 Riprap being placed.

Photo 11 Spillway excavation completed.

Photo 12 End-of-day riprap placement along spillway.

3.4 Issues

3.4.1 Previous Day's Issues

Waiting on Proctor Test results so percent compaction cannot be calculated until the following day (***Proctor Test results received***). High moisture content due to rain (***End of Day 3 moisture results were acceptable***).

3.4.2 Current Day's Issues

Some engineer field fits required along spillway due to intersection of slopes. Assumed minimum 5 m wide spillway with at least 3 m on either side.

End-of-day densometer results showed a few areas with low compaction results so Norcope was asked to re-compacted and then areas would be retested August 28.

3.5 Work to be completed

Finish remaining riprap, finish compacting base layer, and begin final 150 mm layer.

4. DAY 4 (AUGUST 28)

4.1 Summary of Activities

Construction began at 7:00 a.m. Work began re-compacting a few spots on the dam that the subgrade came in below compaction spec. Next, riprap placement continued as well as the re-establishment of the road over the spillway. The remainder of the day was spent placing the last 150 mm layer on the dam. Construction was completed at a brisk pace.

4.2 Work Completed

Base layer was compacted to spec and the road on top of the riprap and over the spillway was put in place.

4.3 Photos

Photo 13 Dozer pushing final lift on the dam.

Photo 14 Re-established crossing over the spillway.

Photo 15 Zoom in of re-established crossing over the spillway.

Photo 16 Dam after final compaction of base layer.

4.4 Issues

4.4.1 Previous Day's Issues

Waiting on Proctor Test results so percent compaction cannot be calculated until the following day (***Proctor Test results received***). High moisture content due to rain (***End of Day 3 moisture results were acceptable***). Densometer results showed a few areas with low compaction results for the base layer so Norcope was asked to re-compacted so areas could be retested (***the areas were re-compacted and retested and the results showed the areas meeting specification***).

4.4.2 Current Day's Issues

Haul truck got stuck at the crossing and had to be pulled out. No injuries or equipment damage.

4.5 Work to be completed

Finish remaining riprap, finish final 150 mm layer, and finish remainder of geotextile.

5. DAY 5 (AUGUST 29)

5.1 Summary of Activities

Work began at 7:00 a.m.; however, due to equipment issues, construction didn't begin until 7:30 a.m. Work began compacting the final lift along the dam. Only 100 m remained to be placed and compacted. Next, riprap placement continued and the final bit of geotextile was placed and covered. Construction was completed at a brisk pace.

At the end of the day, preparation work began on the monument construction work.

5.2 Work Completed

Riprap placed along the spillway and final lift along the dam was placed.

5.3 Photos

Photo 17 Oversize rock on dam.

Photo 18 Final bit of riprap to be placed along spillway.

Photo 19 Dozer pushing one last load on the road over the riprap.

5.4 Issues

5.4.1 Previous Day's Issues

Waiting on Proctor Test results so percent compaction cannot be calculated until the following day (***Proctor Test results received***). High moisture content due to rain (***End of Day 3 moisture results were acceptable***). Densometer results showed a few areas with low compaction results for the base layer so Norcope was asked to re-compacted so areas could be retested (***the areas were re-compacted and retested and the results showed the areas meeting specification***).

5.4.2 Current Day's Issues

Large oversize rock on dam: asked Norcope to pulverize large oversize and issues with supplies for monuments.

5.5 Work to be completed

Monuments to be constructed.

6. DAY 6 (AUGUST 30)

6.1 Summary of Activities

Work began at 7:00 a.m.; however, due to equipment issues, construction didn't begin until 7:30 a.m. Work began putting in the final touches along the spillway and keying it in. Excavation and concrete pouring occurred throughout the day to complete monuments. Construction was completed at a brisk pace in order to complete all work by end of day.

6.2 Work Completed

Riprap placed along the spillway and monument construction.

6.3 Photos

Photo 20 Keying in spillway.

Photo 21 Spillway riprap with 6 in. notebook.

Photo 22 Tailings dam crest final lift fill with 6 in. notebook.

Photo 23 Oversize rock on dam after Norcope re-crushed.

Photo 24 Construction at beginning of day.

Photo 25 Spillway construction at beginning (first).

Photo 26 Spillway construction continued (second).

Photo 27 Spillway construction continued (third).

Photo 28 Spillway construction continued (fourth).

Photo 29 Spillway construction continued (fifth).

Photo 30 Monument construction.

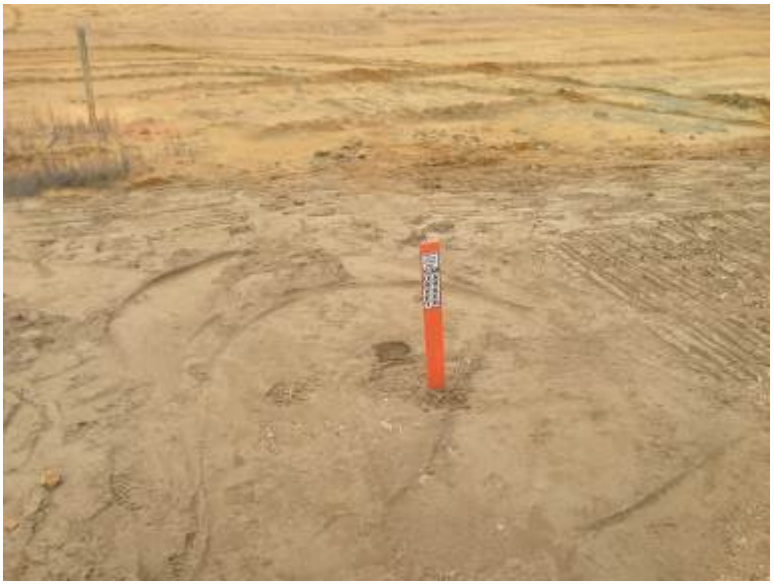

Photo 31 Monument construction zoomed-in.

6.4 Issues

6.4.1 Previous Day's Issues

Waiting on Proctor Test results so percent compaction cannot be calculated until the following day (***Proctor Test results received***). High moisture content due to rain (***End of Day 3 moisture results were acceptable***), densometer results showed a few areas with low compaction results for the base layer so Norcope was asked to re-compacted so areas could be retested (***the areas were re-compacted and retested and the results showed the areas meeting specification***). Large oversize rock on dam: asked Norcope to pulverize large oversize rock (***by end of day, Norcope had broken large rock into finer pieces***) and issues with supplies for monuments (enough supplies were found throughout site for monument construction).

6.4.2 Current Day's Issues

Survey points on monuments could not be completed because concrete would not settle fast enough for points to be placed so survey company will have to come another day to put in points.

6.5 Work to be completed

No work remaining.

Appendix 3 Phase 2 (Boreal) Daily Inspection Reports

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HYDROTECHNICAL QA/QC FIELD REPORT

Project #:	307071-00856	***Date:***	10-Oct-14
Proj. name:	Mt Nansen Emergency Spillway Construction support	***WorleyParsons Rep:***	Jake Gentles
Client:	Yukon Energy, Mines, and Resources - Abandoned Mines and Assessment	***Client Contact:***	Josée Perron
Contractor:	Boreal Engineering	***Contractor Contact:***	Erik Nyland
Task Name:	Construction of tailings pond emergency spillway		
Area Supervised	From Station 0+000 To Station 0+105 (Approx.)	***LSD:***	
Daily Task(s):	Monitoring of construction activities, adjusting design to suit field conditions		
Weather:	Temperature: Slightly overcast, 8C Precipitation: None		

Daily Field Summary

1. Drove from Carmacks to site. Arrived at bunkhouse at 11 am
2. Attended site safety orientation
3. Met with contractor to review survey data and adjust profile to suit field conditions
4. Drove to spillway at noon
5. Identified borrow pit for fill material (coarse, friable rock and cobbles)
6. Contractor had 3 staff (foreman, operator and grademan) and a 324D CAT excavator, Cat front end loader, and dump truck on site
7. Contractor removed majority of riprap and set aside for re-use except at access road crossing
8. Contractor removed filter fabric and set aside for disposal
9. Contractor placed grade stakes based on revised design
10. Contractor began grading of subgrade

Photo Caption:

1. Contractor removing riprap and filter fabric at top end of channel looking downstream

2. Upstream spillway section with existing riprap looking downstream

WorleyParsons
resources & energy

HYDROTECHNICAL QA/QC FIELD REPORT

Project #:	307071-00856	***Date:***	11-Oct-14
Proj. name:	Mt Nansen Emergency Spillway Construction support	***WorleyParsons Rep:***	Jake Gentles
Client:	Yukon Energy, Mines, and Resources - Abandoned Mines and Assessment	***Client Contact:***	Josée Perron and Luca Poloni
Contractor:	Boreal Engineering	***Contractor Contact:***	Erik Nyland
Task Name:	Construction of tailings pond emergency spillway		
Area Supervised	From Station 0+000 To Station 0+105 (Approx.)	***LSD:***	
Daily Task(s):	Monitoring of construction activities, adjusting design to suit field conditions		
Weather:	Temperature: Clear, 1C to 10C Precipitation: None		

Daily Field Summary

1. Added two plate tampers (1 x 300 lb and 1 x 700 lb) to the site
2. Attended tailgate safety meeting
3. Continued excavating/filling to subgrade. Large angular cobbles and roots were removed as much as possible
4. Voids were filled in by hand with sand as much as possilble
5. Fill lifts were limited to between 150mm-300mm thickness
6. Compacting was achieved through track packing by the excavator as well as the two plate tampers
7. Existing filter fabric was loaded into AAM truck for disposal at the site
8. Contractor removed access road

Photo Caption:

1. Contractor removing the access road

2. Downstream spillway section looking downstream

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HYDROTECHNICAL QA/QC FIELD REPORT

Project #:	307071-00856	***Date:***	12-Oct-14
Proj. name:	Mt Nansen Emergency Spillway Construction support	***WorleyParsons Rep:***	Jake Gentles
Client:	Yukon Energy, Mines, and Resources - Abandoned Mines and Assessment	***Client Contact:***	Josée Perron and Luca Poloni
Contractor:	Boreal Engineering	***Contractor Contact:***	Erik Nyland
Task Name:	Construction of tailings pond emergency spillway		
Area Supervised	From Station 0+000 To Station 0+105 (Approx.)	***LSD:***	
Daily Task(s):	Monitoring of construction activities, adjusting design to suit field conditions		
Weather:	Temperature: Overcast 2C-5C Precipitation: None		

Daily Field Summary

1. Added one Doosan 225 excavator to the site
2. Attended tailgate safety meeting
3. Contractor excavated the acces road and brough up to subgrade
4. Contractor added sand layer (<50mm) to act as cushion for filter fabric
5. Contractor began grading side slopes at 3H:1V
6. Contractor began laying filter fabric at downstream portion of spillway (with 500mm anchoring and 600 mm overlap)
7. Contractor began placing rip rap at downstream portion of spillway
8. Riprap was sourced from site and is significantly larger than design gradation (D50 of 150mm and D85 of 300mm)
9. Contractor placed sand cushion on top of filter fabric to prevent tearing during riprap placement
10. Contractor placed cobbles contained in fill material throughout riprap to infill voids
11. Contractor will wash out fines to identify additional voids
12. Tie-in to combined spillway partially constructed. Subgrade elevation matches existing grade, riprap will be tied into existing

Photo Caption:

1. Downstream tie-in to combined spillway

3. Spillway looking downtream

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HYDROTECHNICAL QA/QC FIELD REPORT

Project #:	307071-00856	***Date:***	13-Oct-14
Proj. name:	Mt Nansen Emergency Spillway Construction support	***WorleyParsons Rep:***	Jake Gentles
Client:	Yukon Energy, Mines, and Resources - Abandoned Mines and Assessment	***Client Contact:***	Josée Perron and Luca Poloni
Contractor:	Boreal Engineering	***Contractor Contact:***	Erik Nyland
Task Name:	Construction of tailings pond emergency spillway		
Area Supervised	From Station 0+000 To Station 0+105 (Approx.)	***LSD:***	
Daily Task(s):	Monitoring of construction activities, adjusting design to suit field conditions		
Weather:	Temperature: Cloudy 0C-5C Precipitation: Some snow		

Daily Field Summary

1. Continued placing riprap and geotextile
2. The redesigned channel requires additional riprap to armour.
3. The existing spillway was only armoured to a depth of 0.5 m
4. Due to items 2 and 3, there was insufficient riprap available at the spillway to complete armouring of the channel. A riprap source was identified and material was sorted and hauled to the site with a roundtrip time of 30 minutes.
5. Contractor excavated 6H:1V side slopes for access road crossing
6. Riprap size improved due to the sorting of the material from the new source.

Photo Caption:

1. Downstream tie-in to combined spillway

3. Spillway looking downtream

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HYDROTECHNICAL QA/QC FIELD REPORT

Project #:	307071-00856	***Date:***	14-Oct-14
Proj. name:	Mt Nansen Emergency Spillway Construction support	***WorleyParsons Rep:***	Jake Gentles
Client:	Yukon Energy, Mines, and Resources - Abandoned Mines and Assessment	***Client Contact:***	Josée Perron and Luca Poloni
Contractor:	Boreal Engineering	***Contractor Contact:***	Erik Nyland
Task Name:	Construction of tailings pond emergency spillway		
Area Supervised	From Station 0+000 To Station 0+105 (Approx.)	***LSD:***	
Daily Task(s):	Monitoring of construction activities, adjusting design to suit field conditions		
Weather:	Temperature: Cloudy -5C to 2C Precipitation: Overcast in the morning, snow in the afternoon		

Daily Field Summary

1. Continued placing riprap and geotextile
2. Riprap placed at access road crossing was at a smaller diameter (300 to 500mm) to accommodate placement of geotextile and road surfacing material

Photo Caption:

1. Looking downstream at access road crossing

2. Riprap gradation (300-800mm)

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HYDROTECHNICAL QA/QC FIELD REPORT

Project #:	307071-00856	***Date:***	15-Oct-14
Proj. name:	Mt Nansen Emergency Spillway Construction support	***WorleyParsons Rep:***	Jake Gentles
Client:	Yukon Energy, Mines, and Resources - Abandoned Mines and Assessment	***Client Contact:***	Josée Perron and Luca Poloni
Contractor:	Boreal Engineering	***Contractor Contact:***	Erik Nyland
Task Name:	Construction of tailings pond emergency spillway		
Area Supervised	From Station 0+000 To Station 0+105 (Approx.)	***LSD:***	
Daily Task(s):	Monitoring of construction activities, adjusting design to suit field conditions		
Weather:	Temperature: Cloudy -5C to 0C Precipitation: Snow		

Daily Field Summary

1. Continued placing riprap and geotextile
2. Eryk Nyland departed site at end of day.
3. Upstream tie-in was excavated to smooth transition into spillway

Photo Caption:

1. Armouring of upstream end of spillway

2. At tie-in to combined spillway, looking upstream

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HYDROTECHNICAL QA/QC FIELD REPORT

Project #:	307071-00856	***Date:***	16-Oct-14
Proj. name:	Mt Nansen Emergency Spillway Construction support	***WorleyParsons Rep:***	Jake Gentles
Client:	Yukon Energy, Mines, and Resources - Abandoned Mines and Assessment	***Client Contact:***	Josée Perron and Luca Poloni
Contractor:	Boreal Engineering	***Contractor Contact:***	Gavin Nyland
Task Name:	Construction of tailings pond emergency spillway		
Area Supervised	From Station 0+000 To Station 0+105 (Approx.)	***LSD:***	
Daily Task(s):	Monitoring of construction activities, adjusting design to suit field conditions		
Weather:	Temperature: Clear -5C to 0C Precipitation: None		

Daily Field Summary

1. Continued placing riprap and geotextile
2. Installed access road geotextile and surfacing aggregate
3. Stockpile selected for surfacing aggregate consisted of friable rock, silty sand, and cobbles. Gradation did not meet specification; however, it was determined in the field that the material was suitable for surfacing of the access road (i.e., once compacted it will provide a consistent, drivable surface)
4. Upstream tie-in was armoured, but not transitioned to existing spillway cross-section
5. Josée Perron departed site in the afternoon

Photo Caption:

1. Upstream tie-in to existing spillway

2. Access road crossing

WorleyParsons
resources & energy

HYDROTECHNICAL QA/QC FIELD REPORT

Project #:	307071-00856	***Date:***	17-Oct-14
Proj. name:	Mt Nansen Emergency Spillway Construction support	***WorleyParsons Rep:***	Jake Gentles
Client:	Yukon Energy, Mines, and Resources - Abandoned Mines and Assessment	***Client Contact:***	Luca Poloni
Contractor:	Boreal Engineering	***Contractor Contact:***	Gavin Nyland
Task Name:	Construction of tailings pond emergency spillway		
Area Supervised	From Station 0+000 To Station 0+105 (Approx.)	***LSD:***	
Daily Task(s):	Monitoring of construction activities, adjusting design to suit field conditions		
Weather:	Temperature: Cloudy 0C Precipitation: Clear		

Daily Field Summary

1. Continued hauling riprap
2. Built up berm on the south side of the spillway tie-in to match elevation of berm on north side
3. Departed site at 11:00 AM
4. Luca Poloni and Gavin Nyland remained on site to complete construction (e.g., identifying and filling gaps in riprap armouring, washing granular soils out of riprap, etc.)

Photo Caption:

1. Access road crossing

2. Access Road crossing

Appendix 4 Geotechnical Analyses

Summary of Compaction Results

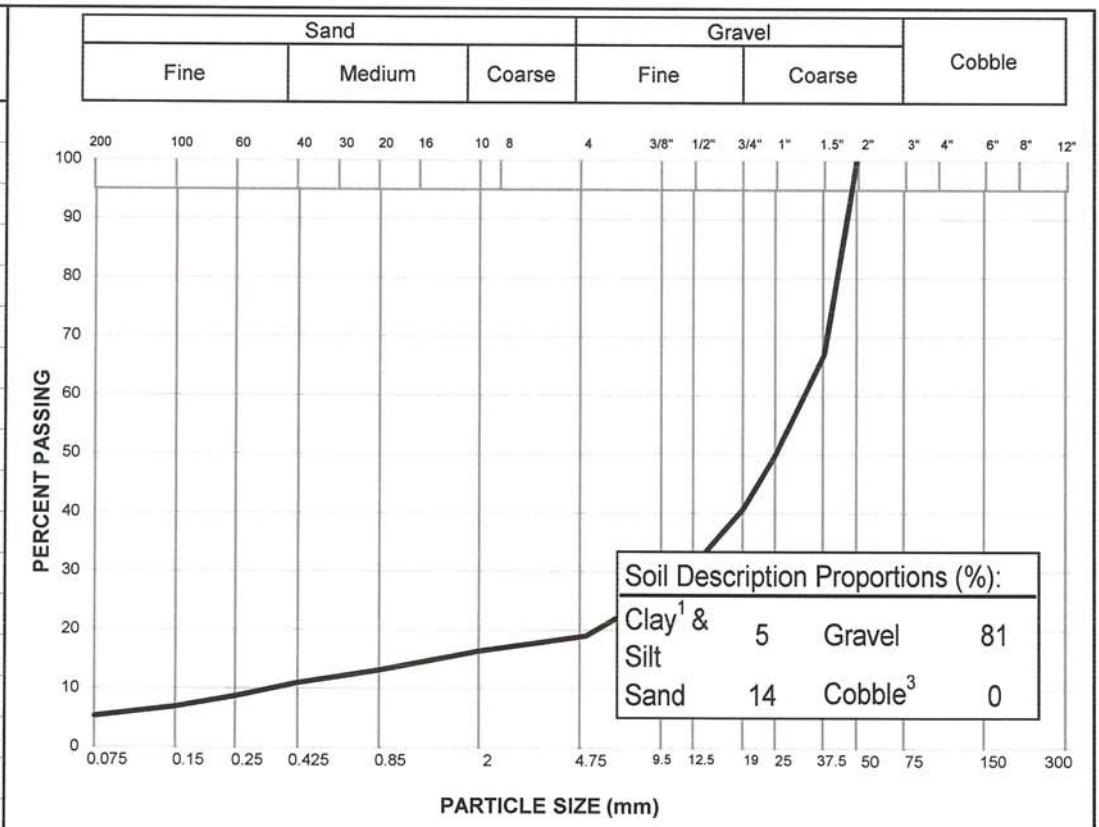
Location	Percent Compaction for Base Layer Aug 26	Percent Compaction for Base Layer Aug 27	Percent Compaction for Base Layer Aug 27	Percent Compaction for Base Layer Aug 28	Percent Compaction for Base Layer Aug 28	Percent Compaction for Final Layer Aug 28/29	Percent Compaction for Final Layer Aug 29	Percent Compaction for Final Layer Aug 29	Comments
0m	80%	92%	-	-	-	-	-	-	Original Ground, No Base Layer Placed
20m	86%	94%	92%	96%	-	94%	96%	97%	
40m	97%	89%	85%	91%	94%	100%	-	-	
60m	98%	95%	91%	94%	-	100%	-	-	
80m	98%	96%	94%	97%	-	98%	-	-	
100m	96%	93%	87%	94%	-	97%	-	-	
120m	94%	96%	94%	96%	-	100%	-	-	
140m	79%	91%	92%	94%	-	99%	-	-	
160m	94%	90%	92%	94%	-	98%	-	-	
180m	90%	97%	94%	98%	-	99%	-	-	
200m	83%	91%	93%	94%	-	97%	-	-	Original Ground, No Base Layer Placed
220m	-	94%	92%	91%	-	99%	-	-	Original Ground, No Base Layer Placed
240m	-	82%	86%	-	-	97%	-	-	Original Ground, No Base Layer Placed
260m	-	93%	92%	-	-	-	-	-	Original Ground, No Base Layer Placed
Minimum Compaction Spec	**>92%**	**>92%**	**>92%**	**>92%**	**>92%**	**>95%**	**>95%**	**>95%**	

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Mt Nansen Tailings Dam	Sample No.:	SA01
Project No.:	W14103465-01	Material Type:	Potential Borrow
Site:	Mt Nansen Tailings Dam	Sample Loc.:	Emergency Spillway Ditch S
Client:	Norcope Enterprises Ltd.	Sample Depth:	0.3 m
Client Rep.:	Malik Lasker	Sampling Method:	Grab
Date Tested:	August 25, 2014 By: TP	Date sampled:	August 24, 2014
Soil Description[2]:	GRAVEL, some sand, trace silt	Sampled By:	IM
		USC Classification:	Cu: 93.5
Moisture Content:	3.6%		Cc: 12.3

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	67
25	50
19	41
12.5	31
10	27
5	19
2	16
0.85	13
0.425	11
0.25	9
0.15	7
0.075	5.3



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to EBA description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: _____ P.Eng.

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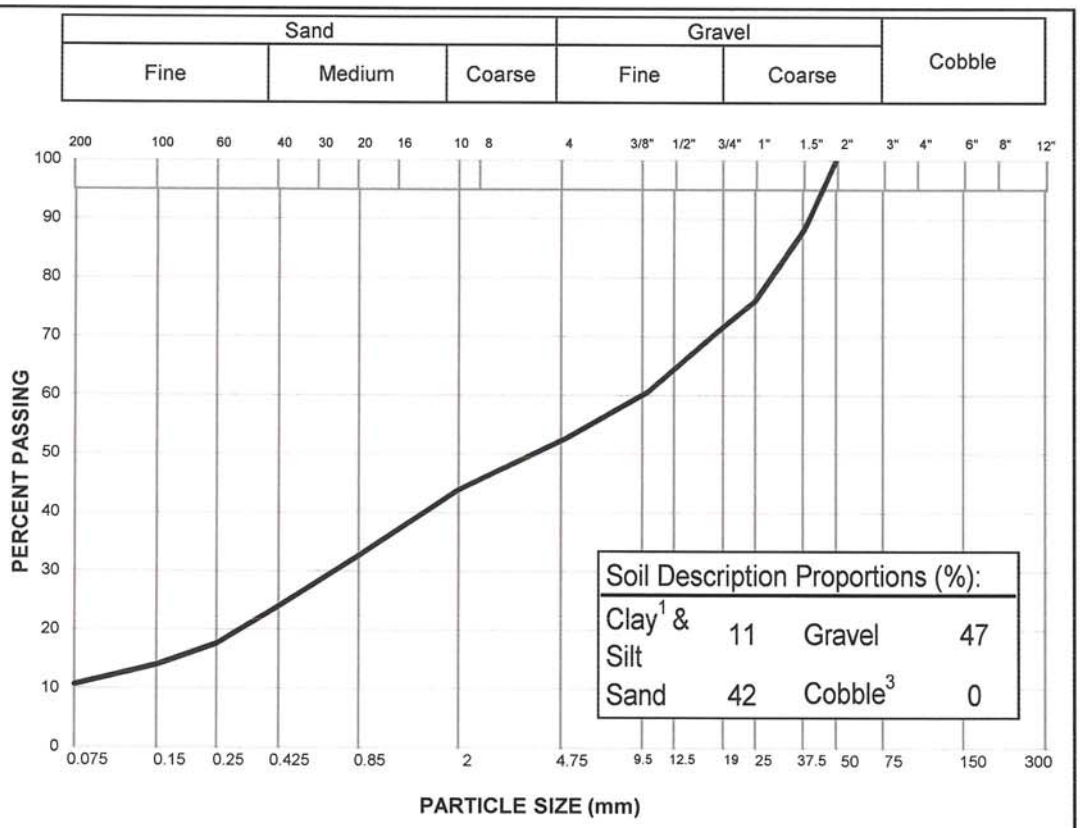
PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	Mt Nansen Tailings Dam	Sample No.:	SA02
Project No.:	W14103465-01	Material Type:	Potential Borrow
Site:	Mt Nanen	Sample Loc.:	Access Road Borrow Sourc
Client:	Norcope Enterprises Ltd.	Sample Depth:	0.6 m
Client Rep.:	Malik Lasker	Sampling Method:	Grab
Date Tested:	August 26, 2014 By: TP	Date sampled:	August 24, 2014
Soil Description[2]:	GRAVEL and SAND - some silt	Sampled By:	IM
		USC Classification:	Cu: #N/A
Moisture Content:	6.4%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	88
25	76
19	72
12.5	64
10	61
5	53
2	44
0.85	33
0.425	24
0.25	18
0.15	14
0.075	10.7



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to EBA description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: _____ P.Eng.

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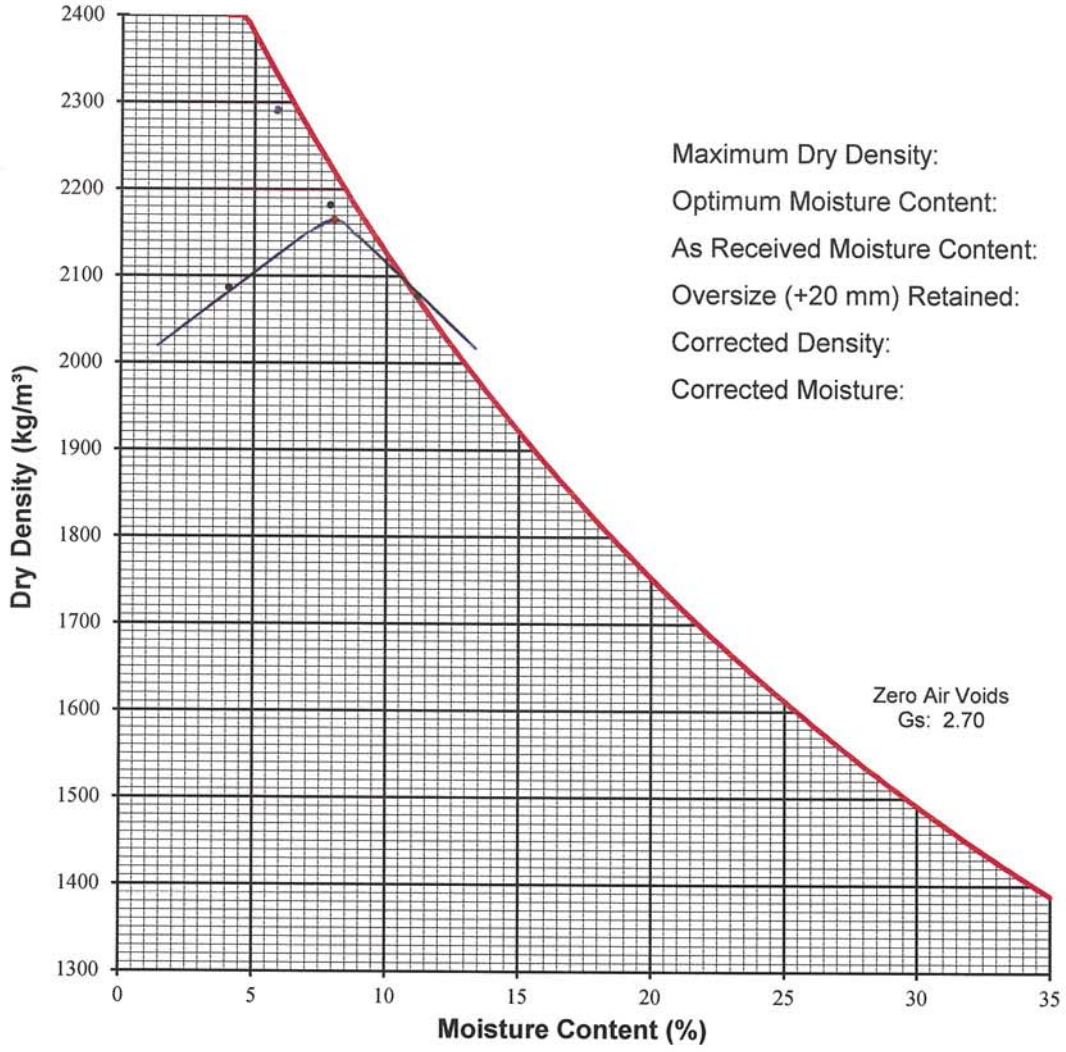
MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D1557 Modified

Project:	Mt Nansen Tailings Dam - Materials Testing	Sample No.:	SA01
Client:	Norcope Enterprises Ltd.	Sampled By:	IM
Attention:	Malik Lasker	Sample Date:	August 24, 2014
Project No.:	W14103465	Test Date:	August 25, 2014
Description:	SAND and GRAVEL, trace silt	Preparation:	Oven Dry
Source:	Emergency Spillway Ditch	Compaction:	Manual



Maximum Dry Density:	**2165**	kg/m³
Optimum Moisture Content:	**8.0**	%
As Received Moisture Content:	**3.6**	%
Oversize (+20 mm) Retained:	**30**	%
Corrected Density:	**2291**	%
Corrected Moisture:	**5.9**	%

Remarks:

Reviewed By: _____ P.Eng.

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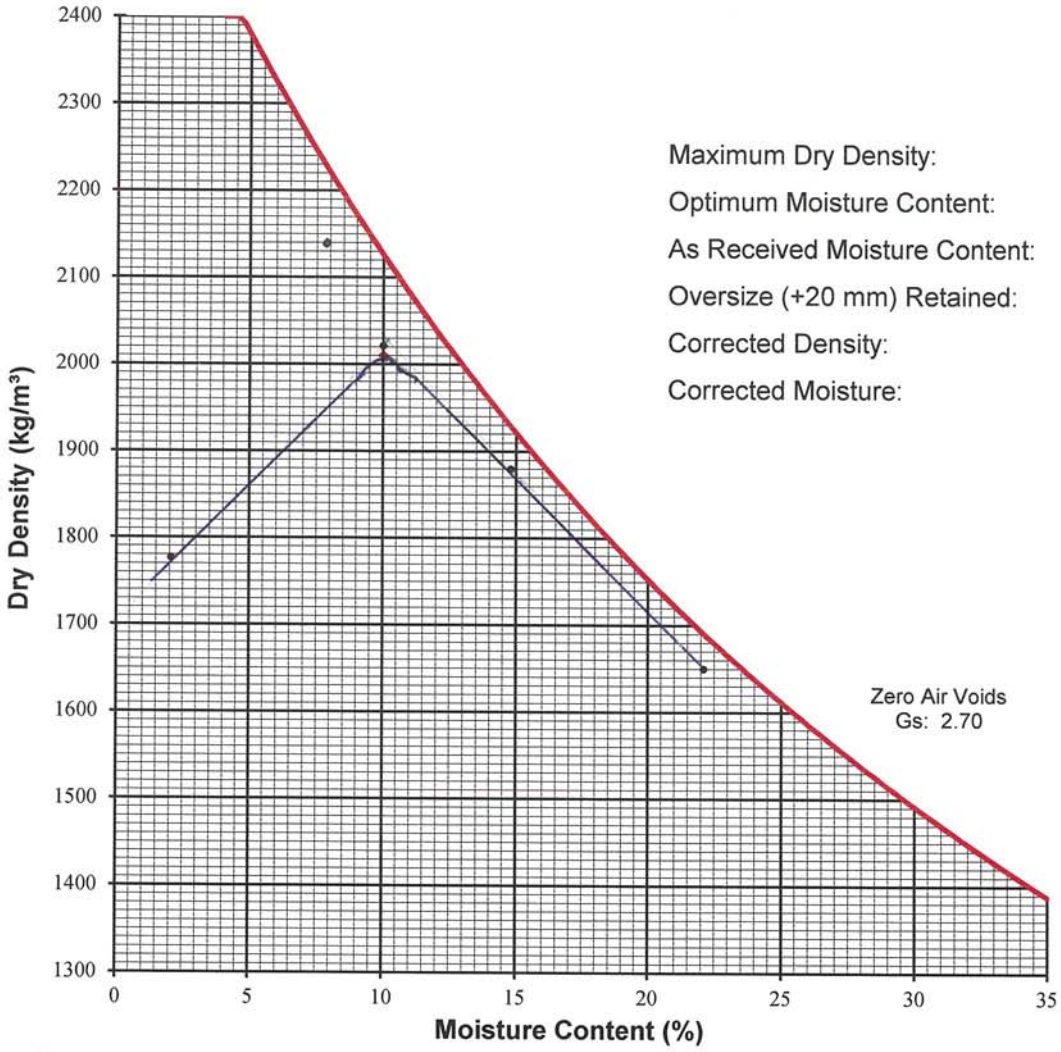
TETRA TECH

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D1557 Modified
Method A, B or C

Project:	Mt Nansen Tailings Dam - Materials Testing	Sample No.:	SA02
Client:	Norcope Enterprises Ltd.	Sampled By:	IM
Attention:	Malik Lasker	Sample Date:	August 24, 2014
Project No.:	W14103465	Test Date:	August 25, 2014
Description:	SAND, gravelly, trace to some silt	Preparation:	Oven Dry
Source:	Access Road Borrow Source	Compaction:	Manual



Maximum Dry Density:	**2010**	kg/m³
Optimum Moisture Content:	**10.0**	%
As Received Moisture Content:	**6.4**	%
Oversize (+20 mm) Retained:	**25**	%
Corrected Density:	**2140**	%
Corrected Moisture:	**7.8**	%

Remarks:

Reviewed By: _____ P.Eng.

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