A TETRA TECH COMPANY

March 29, 2012

ISSUED FOR USE
EBA FILE: W14101589

Government of Yukon
Department of Energy Mines and Resources
P.O. Box 2703
Whitehorse, YT Y1A 2C6

Attention: Ms. Josée Perron. P.Eng.
Senior Project Manager, Assessment and Abandoned Mines

Subject: Effect of New Bridge Construction on Capacity of Diversion Ditch and Emergency Spillway
Mount Nansen Mine, YT.

1.0 INTRODUCTION

As requested, EBA Engineering Consultants Ltd., operating as EBA, A Tetra Tech Company (EBA) has completed an assessment of the effects of new bridge construction over the diversion ditch, on the capacity of both the diversion ditch and the emergency spillway. This letter presents a review of the original design geometry for the ditch and spillway, compared to the existing geometry, post-bridge construction.

2.0 ORIGINAL DESIGN OF DIVERSION AND SPILLWAY

The attached report by BK Hydrology Services contains the original design notes for the diversion and spillway. As a summary, the diversion was to be constructed with a trapezoidal channel shape, 2 m wide bottom and 3H:1V sideslopes. The spillway was also to be trapezoidal, constructed with a 5 m wide bottom and 3H:1V sideslopes. Both ditches were designed for a 1:200 year flow of 3.0 m/s, resulting in a 1.0 m water depth in the diversion ditch and 0.3 of water in the spillway.

3.0 EXISTING CONDITIONS

The attached Figure 1 shows the location of three cross sections across each of the diversion ditch and spillway. Figure 2 shows the existing cross sections of the diversion ditch, and Figure 3 shows the existing cross sections of the emergency spillway. All cross sections were generated from 2011 LIDAR data supplied by Yukon Government, Energy Mines and Resources.

4.0 CONCLUSIONS

As can be seen from the cross sections, the existing base width of the diversion and spillway, post bridge construction, exceed the original design base width in all cases measured. It is therefore concluded that the new bridge construction has had no effect on the design capacity of either the diversion ditch or the spillway.

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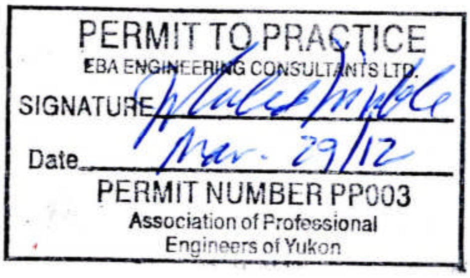
5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Government of Yukon, Energy Mines and Resources and their agents. EBA, A Tetra Tech Company, does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Government of Yukon, Energy Mines and Resources or for any Project other than the site described herein. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in the attached General Conditions.

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned.

Sincerely,
EBA, A Tetra Tech Company



J. Richard Trimble, P.Eng., FEC
Principal Consultant, Office Manager
Direct Line: 867.668.2071 x222
rtrimble@eba.ca

Attachments:
- EBA General Conditions
- BK Hydrology Report on Spillway Assessment, 2001
- Figure 1: Site Plan Showing Locations of Cross Sections
- Figure 2: Existing Diversion Ditch Cross Sections
- Figure 3: Existing Emergency Spillway Cross Sections

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

April 16, 2001

EBA Engineering Consultants Ltd.
Calcite Business Centre, Unit 6
151 Industrial Road
Whitehorse, Yukon
Y1A 2V3

Attention: Cord Hamilton, M.Eng., P.Eng.

Re: **Mount Nansen Gold Mine**
Spillway Assessment

This letter provides information on site observations, design calculations and proposed spillway modifications. This information is to be used to plan the modifications to the spillway channel to be constructed later this fall. The probable life of this proposed spillway channel is about five years. Within this five-year period, decisions will be made to either upgrade the spillway channel to handle the Probable Maximum Flood event or the tailings and tailings dam will be removed eliminating the need for the spillway channel. The information is provided in point form.

1. The diversion channel located upstream of the spillway has partially silted in with fine sands and silts. This material has washed off the exposed slopes draining to the diversion channel. The original design indicated that the diversion channel would be lined with a 300 mm layer of gravel consisting of 75 mm minus pitrun gravel. It is likely that this layer is still in place under the sand and silt.

2. Grass seeds should be broadcast on all exposed sand and silt material. The vegetation should help stabilize this material and reduce the wash-off of this material into the diversion channel. Seeding can be carried out till mid-September with a second seeding next spring.

3. The drainage area to the downstream end of the diversion channel is estimated at 3.07 km^2. The estimated 1:20 year maximum instantaneous peak flow in the diversion channel is 1.2 m^3/s. The estimated 1:200 year maximum instantaneous peak flow in the diversion channel is 3.0 m^3/s. Further details on the hydrology calculations and comparison to previous peak flow estimates are listed in the Appendix.

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4. Flow depths and velocities within the diversion channel were computed based on the following:

   a. Channel slope of between 0.1% and 0.2%
   b. Trapezoidal channel shape with a 2 metre bottom, 3H:1V side slopes and 1.5 metres deep
   c. Manning's n = 0.030

   For the 1:20 year peak flow of 1.2 m^3/s, flow depths are between 0.6 and 0.7 metres and velocities vary between 0.6 and 0.8 m/s. For the 1:200 year peak flow of 3.0 m^3/s, flow depths are between 0.8 and 1.0 metres and velocities vary between 0.8 and 1.0 m/s. The sand and silt within the channel will wash away when velocities are greater than about 0.3 to 0.5 m/s. The 75 mm minus pitrun gravel layer should withstand velocities of about 1.2 m/s. Therefore, the diversion channel should be able to handle the 1:200 year peak flow as long as the gravel layer as shown in the original design drawings is in place.

5. At present, the riprap material within the spillway varies from gravel to 500 mm rock. Along most of the spillway, the larger riprap material is near the top of the spillway side slope and located one or more metres above the bottom of the spillway channel. At the bottom of the spillway channel, almost all of the rock is less than 100 mm in size. At some locations, only gravel size material is located within the channel bottom.

6. An August 2000 survey of the spillway channel is attached. Information from this plan includes the following:

   a. The slope of the spillway channel varies between 7% and 15% with the majority of the channel length between 8% and 12%.
   b. The channel bottom width varies between 5 metres to 10 metres except near at the exit of the spillway. About 5 metres upstream of where the spillway channel enters the natural creek channel, the spillway channel narrows down from a width of 5 metres to a width of about 3 metres. This narrow section of channel is about 9 metres in length.
   c. At the top of the spillway, the channel bottom is around elevation 1150 metres and at the bottom around elevation 1122 metres.
   d. The spillway channel length is about 315 metres.
   e. The spillway channel side slopes are about 3H:1V.
   f. The depth of the channel varies from about 1.5 metres to 5.0 metres

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7. Normal flow depths and velocities with the spillway channel were computed based on the following:

   a. Channel slope of 7%, 10% and 15 %
   b. Trapezoidal shape with 5 metre bottom and 3H:1V side slopes. Flow depths and velocities would be less for a wider channel bottom.
   c. Manning's n = 0.060 (set high to account for high channel roughness in relation to channel flow depths)

Table 1 below lists flow depths and average velocities for a range of spillway flows. For a flow of less than 0.1 m^3/s, the sand and silt material within the spilllway channel would be washed away. Starting at a flow of about 0.6 m^3/s, the gravel within the channel bottom will start to move within the steeper sections of the spillway. At present, much of the spillway channel bottom is covered by gravel. Therefore, the present spillway could start to fail at a flow of about 0.6 m^3/s. For the 1:200 year maximum instantaneous peak flow of 3.0 m^3/s, the flow depth is about 0.24 metres and the flow velocity is about 2.2 m/s. Because of the shallow flow depth, localized velocities at small obstructions in the flow could be as high as 3.0 m/s or more.

Table 1
Spillway Flow Depths and Velocities

Flow (m^3/s)	7% Slope		10% slope		15% slope	
	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)	Depth (m)	Velocity (m/s)
0.1	0.04	0.5	0.04	0.6	0.03	0.6
0.6	0.11	1.0	0.10	1.1	0.09	1.2
1.2	0.17	1.3	0.15	1.4	0.14	1.6
3.0	0.29	1.8	0.27	2.0	0.24	2.3

8. Based on the above, the present spillway channel can probably handle a peak flow of about 0.6 m^3/s. The channel needs to be upgraded to handle the 1:200 year peak flow of 3.0 m^3/s. Two options were considered. The first option is to line the entire spillway channel with a 400 mm (7% to 9% slope) to 500 mm (greater than 9% slope) median size rock riprap. This rock riprap layer would be about 1.0 metre thick. The second option is to use drop structures along the spillway channel to reduce the flow velocities within the spillway. Considering

the various size ranges of available rock and the cost associated with each option, the second option was chosen.

The following modifications to the spillway channel based on the second option are recommended:

a. A gravel layer is present along most of the spillway channel but the thickness of this layer is not known. The gravel layer should be a minimum 300 mm in depth and is required as a filter layer between the rock riprap and the underlying sands and silts. The actual thickness of the gravel layer should be confirmed in the field using a small backhoe or power auger. Additional gravel should be brought in where the depth of gravel is less than 300 mm. Small erosion gullies (less than 200 mm in depth) in the bottom of the spillway channel should also be filled in with gravel.

b. There is a significant quantity of larger size rock (200 mm or greater in size) located along the upper slopes of the spillway channel. All rock located more than about 1.5 metres (equal to the computed design high water level plus a 0.5 metre freeboard) above the bottom of the spillway channel should be moved down. This rock should be placed on top of the gravel layer. The rock riprap layer should be about 0.6 metre thick.

c. If not enough rock is available on the upper channel slopes, additional rock should be brought from the rock stockpile. This rock should be durable and of good quality. The median size rock should be about 300 mm, 80% of the rock should be 200 mm in size or greater and all the rock should be less than 450 mm in size (Class I riprap specification).

d. 14 rock drop structures should be constructed along the spillway. The first drop structure would be placed at elevation 1148 metres and the last drop structure would be placed at elevation 1122 metres. Drop structures would be placed at each 2 metre drop in the bottom of the spillway channel (1148 m, 1146 m, 1144 m, ... 1124 m, and 1122 m). Spacing between the drop structure is between 15 and 25 metres depending on the local channel slope. Schematics of the drop structure layout are attached. These drop structures should minimize the extent of any localized failure within the spillway. For the 1:200 peak flow, maximum depths upstream of the drop structure will be about 1.0 metre.

e. The narrow 3.0 metre wide channel bottom near the spillway exit should be increased to a minimum 5.0 metre width. The channel section is about 9.0 metres in length. There is adequate space available to widen the channel to a 5 metre width.

9. If the diversion channel was breached (not expected to occur), the flows would enter the tailing dam reservoir. Routing the runoff through the reservoir would reduce the peak flows to about 20% of the peak flow in the diversion channel (1:20 year peak flow of about 0.24 m^3/s and 1:200 year peak flow of about 0.6 m^3/s). These relatively low flows can be handled by the existing spillway channel located upstream of the intesection of the diversion channel and the spillway.

If you have any questions about the above material, please give me a call.

Sincerely,

Bernie Kallenbach, M.Eng., P.Eng.
President

Appendix A

Hydrology Calculations

The August 10, 1995 report by Klohn Crippen estimated the peak flows in the diversion channel and the spillway channel. The report provides a table of intensity-duration rainfall values for the 1:20 year, 1:200 year and PMP event. This rainfall data was used to prepare 6 hour duration design storms (design storm values not listed). The report also indicates that the OTTHYMO program was used to determine peak flows using this rainfall information. However, the report does not list any of the runoff parameters used within the OTTHYMO program to compute the peak flows.

The Klohn Crippen report estimated the 1:20 year peak flow at 6.4 m^3/s for both the diversion channel and the spillway. The 1:200 year flood was expected to breach the diversion channel and divert flows through the tailing dam reservoir. Routing the flood peak through the tailing dam reservoir would significantly reduce the flood peak entering the spillway. The peak outflow from the reservoir during the 1:200 year event was estimated at 3.7 m^3/s. Since this was less than the 1:20 year peak flow, the spillway channel was designed to handle the 1:20 year peak flow of 6.4 m^3/s.

My peak flow estimates are considerably less than those produced by Klohn Crippen. My 1:20 year peak flow is estimated at 1.2 m^3/s (about 19% of the Klohn Crippen peak). A direct comparison cannot be made of the 1:200 year event since Klohn Crippen did not list the peak flow that would enter the tailings dam reservoir.

I've computed the peak flow using the SWMM program. Parameters used for the modelling include:

1. I developed a Chicago Distribution storm using the Table 3 intensity-duration rainfall values listed in the Klohn Crippen report. The design storm is of two hour duration, 5 minute time steps, and the peak rainfall occurrs at 40 minutes from the start of the storm event. Total rainfall for the 2 hour design storm is 21.7 mm for the 1:20 year event and 30.0 mm for the 1:200 year event. I didn't use a six hour storm like Klohn Crippen since the difference in the 2 hour and 6 hour rainfall amounts was less than less than 6 mm for the 1:20 and 1:200 year event. This 6 mm of rainfall spread over a 4 hour period would not have a significant impact on peak flow estimates.

2. I divided the basin into three subbasins varying in size from 100 ha to 107 ha. Basin slopes varied between 20% and 25%. Maximum overland flow lengths were set at 500 metres. The percent imperviousness of each basin was set 0.5% (a 5 metre wide strip to account for the stream channel). The depression storage for pervious areas was set at 3.0 mm. The Horton infiltration values were set at 25 mm/hr for initial infiltration capacity, 2.5 mm/hr

for final infiltration capacity and 4 hr^{-1} for the decay coefficient. For overland flow routing a Manning's n was set at 0.90 to account for the rough terrain and vegetation cover.

3. The subbasin flows were routed through trapezoidal channels to model the flow within the creek. The channel slopes varied from 8% to 12%. The diversion channel was also modelled with a channel slope of 0.1%.

4. Model results indicate that the peak outflow from the subbasins occurs about 20 minutes after the peak rainfall. The outflow from the basin drops to about 10% of the peak flow about 4 hours after the start of the storm event.

As an independent check, I computed the 1:20 and 1:200 peak flows using the procedure listed in the report Design Flood Estimating Guidelines for the Yukon Territory by J.R. Janowicz, 1989. This report provides procedures for estimating the 1:2 to 1:100 year peak flows. I extrapolated the curve values on log-frequency paper to estimate the 1:200 year values. The 1:20 year peak flow estimate is 0.96 m^3/s and the 1:200 year peak flow estimate is 2.2 m^3/s. These values are between 20% and 27% lower than my estimates listed above. This would indicate that my flow estimates are slightly conservative.

As another independent check, I transferred the 1:200 year peak flow estimate from the Big Creek Water Survey of Canada station to our basin using the following formula:

$$Q = Q(Big) * (A(site)/A(Big))^{0.8}$$

$$Q = 350\ m^3/s * (3.07/1750)^{0.8}$$

$$Q = 2.2\ m^3/s$$

This again would indicate that my peak flow estimate of 3.0 m^3/s for the 1:200 year event is slightly conservative.

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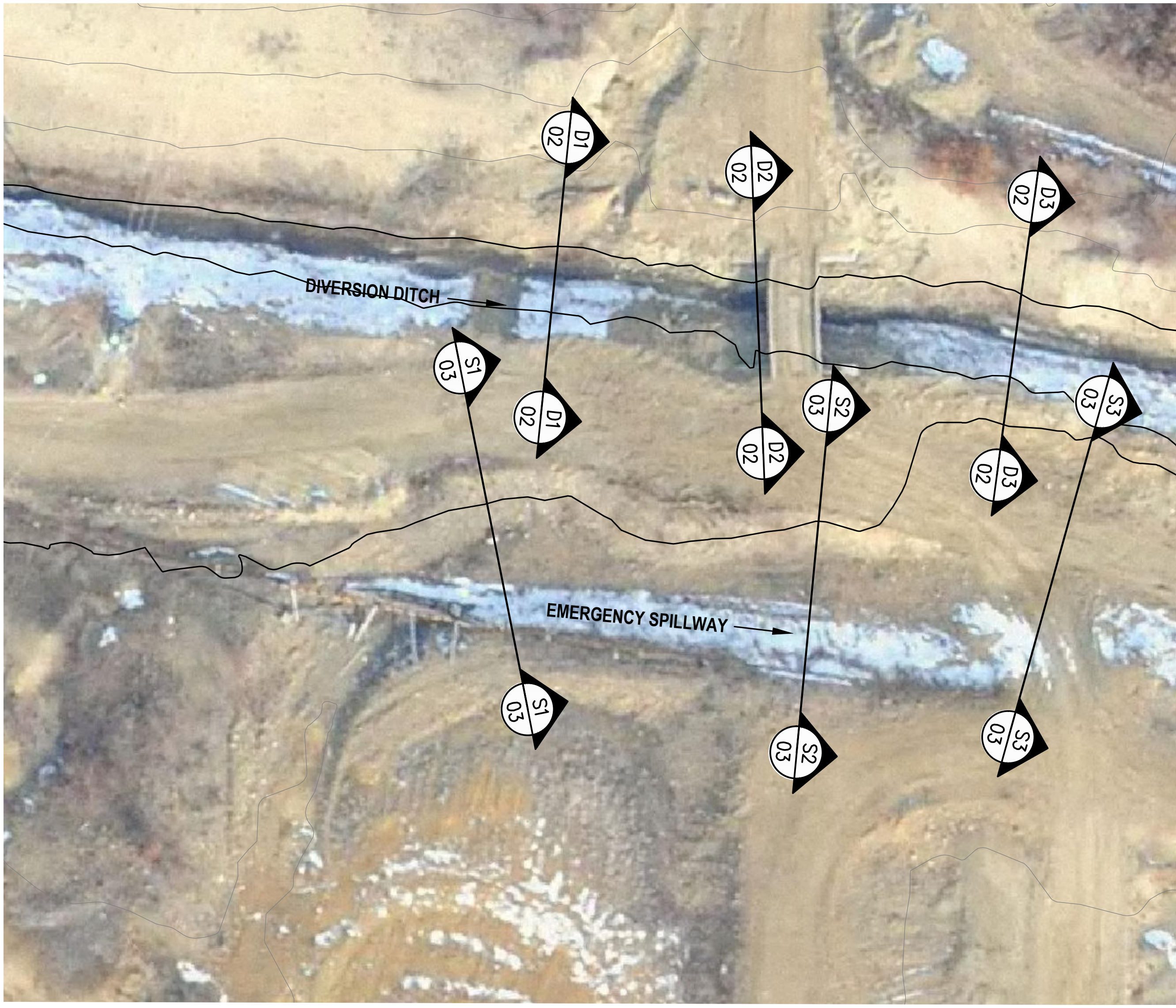
Q:\Whitehorse\Data\0201drawings\Mt Nansen\W14101589 2011 Geotechnical Inspections\W14101589 Channel Geometry Figs.1-3_R0.dwg [FIGURE 1] March 29, 2012 - 1:33:14 pm (BY: BUCHAN, CAMERON)



LOCATION PLAN

0 500

Scale: 1: 10 000 (metres)

0 25

Scale: 1: 500 (metres)

CLIENT

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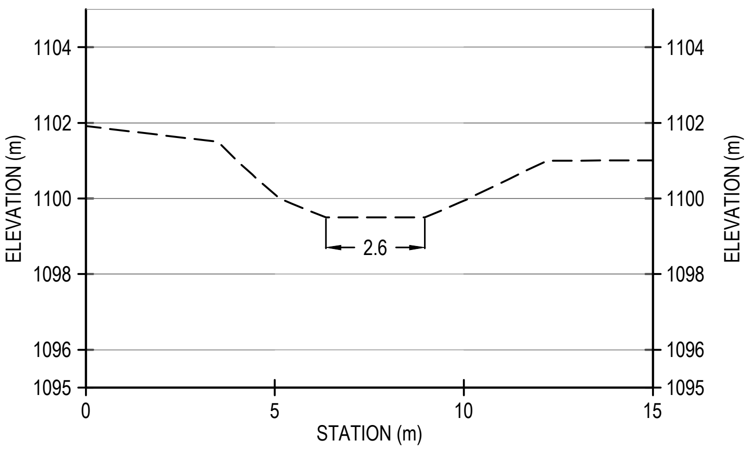
DIVERSION CHANNEL AND EMERGENCY SPILLWAY
MOUNT NANSEN MINE, YUKON

SITE PLAN SHOWING CROSS-SECTION LOCATIONS

PROJECT NO.	DWN	CKD	REV	
W14101589	CB	JRT	0	Figure 1
OFFICE	DATE			
EBA-WHSE	March 28, 2012			



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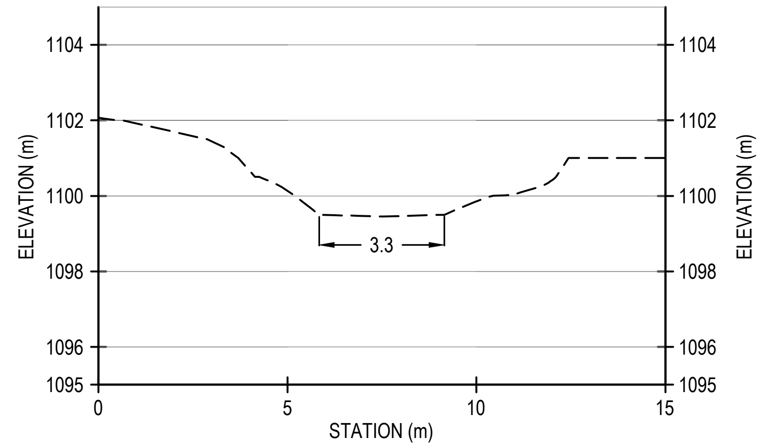

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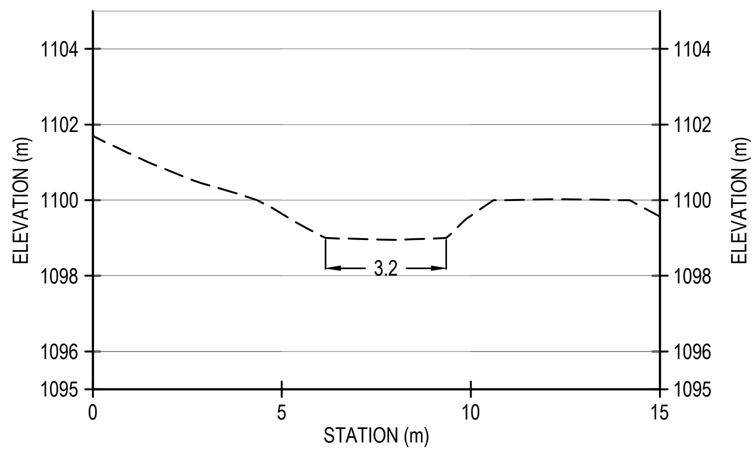

D3 / 01 SECTION D3
SCALE 1 : 200

NOTE : ORIGINAL DESIGN = 2.0 m BOTTOM WIDTH

0 — 10

Scale: 1: 200 (metres)

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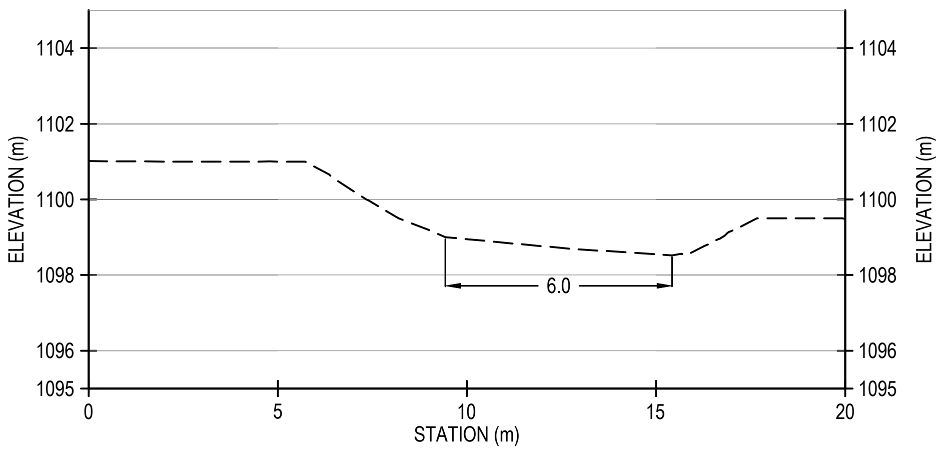
DIVERSION CHANNEL AND EMERGENCY SPILLWAY
MOUNT NANSEN MINE, YUKON

DIVERSION CHANNEL CROSS-SECTIONS D1 - D3

PROJECT NO.	DWN	CKD	REV
W14101589	CB	JRT	0

OFFICE	DATE
EBA-WHSE	March 28, 2012

Figure 2



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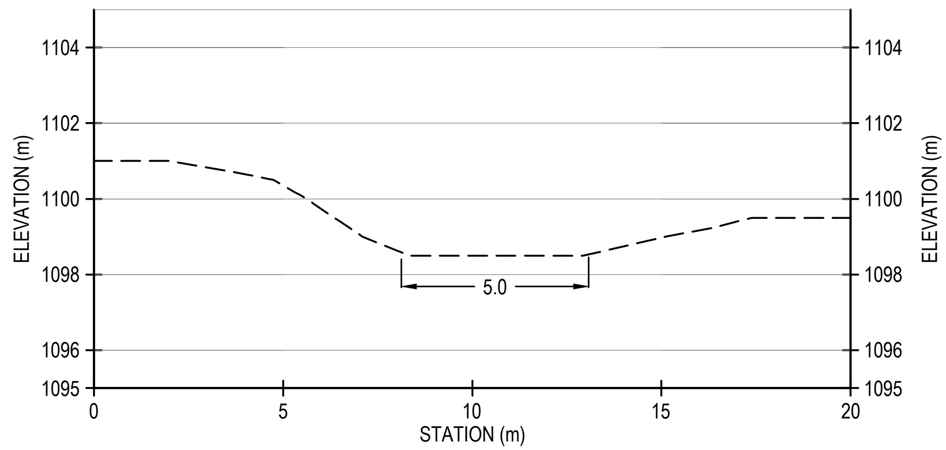

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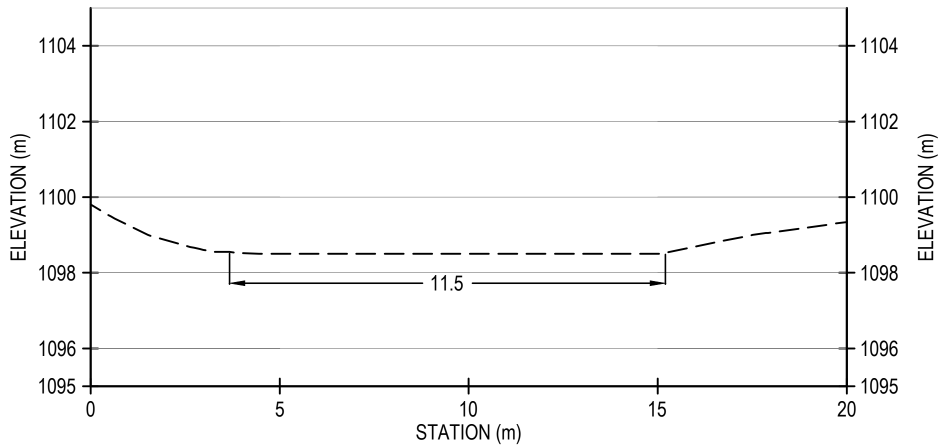

S3 / 01 SECTION S3
SCALE 1 : 200

NOTE : ORIGINAL DESIGN = 5.0 m BOTTOM WIDTH

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Scale: 1: 200 (metres)

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DIVERSION CHANNEL AND EMERGENCY SPILLWAY
MOUNT NANSEN MINE, YUKON

EMERGENCY SPILLWAY CROSS-SECTIONS S1 - S3

PROJECT NO.	DWN	CKD	REV
W14101589	CB	JRT	0

OFFICE	DATE
EBA-WHSE	March 28, 2012

Figure 3