

Government of Yukon, Water Resources Branch

Ketza Mine North Tailings Dam Toe Berm Assessment

Prepared by:

AECOM

AECOM

99 Commerce Drive
Winnipeg, MB, Canada R3P 0Y7
www.aecom.com

204 477 5381 tel
204 284 2040 fax

Project Number:

6029 014 00 (4.6.1.1)

Date:

December, 2009

Statement of Qualifications and Limitations

The attached Report (the “Report”) has been prepared by AECOM Canada Ltd. (“Consultant”) for the benefit of the client (“Client”) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the “Agreement”).

The information, data, recommendations and conclusions contained in the Report:

- are subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the “Limitations”)
- represent Consultant’s professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to Consultant which has not been independently verified
- have not been updated since the date of issuance of the Report and their accuracy is limited to the time period and circumstances in which they were collected, processed, made or issued
- must be read as a whole and sections thereof should not be read out of such context
- were prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

Unless expressly stated to the contrary in the Report or the Agreement, Consultant:

- shall not be responsible for any events or circumstances that may have occurred since the date on which the Report was prepared or for any inaccuracies contained in information that was provided to Consultant
- agrees that the Report represents its professional judgement as described above for the specific purpose described in the Report and the Agreement, but Consultant makes no other representations with respect to the Report or any part thereof
- in the case of subsurface, environmental or geotechnical conditions, is not responsible for variability in such conditions geographically or over time

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed by Consultant and Client
- as required by-law
- for use by governmental reviewing agencies

Any use of this Report is subject to this Statement of Qualifications and Limitations. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report.

December 7, 2009

AECOM Project: 6029 014 00 (4.6.1.1)

Mr. Glenn Ford
Geotechnical Technologist
Water Resources Branch
Environment
Government of Yukon
Box 2703, V-310
Whitehorse, YT
Y1A 2C6

Dear Mr. Ford:

Re: Ketza Mine – North Tailings Dam Toe Berm Assessment

AECOM Canada Ltd. (AECOM) is pleased to submit our Final Report for the above referenced project. If you require further information or clarification, please contact Ken Skafffeld, P.Eng. directly.

Sincerely,

AECOM Canada Ltd.


for Ron Typliski, P.Eng.
Vice-President, Manitoba District
Canada West Region

KS:dh
Encl.

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
4	Yes	Government of Yukon

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	K. Skafffeld	Nov. 23/09	Draft
2	K. Skafffeld	Dec. 7/09	Final

AECOM Signatures

Report Prepared By:


 Ken Skafffeld, P.Eng.
 Lead Geotechnical Engineer



Report Reviewed By:


 W. R. Wiesner, M.Sc., P.Eng. (Manitoba)
 Senior Geotechnical Engineer

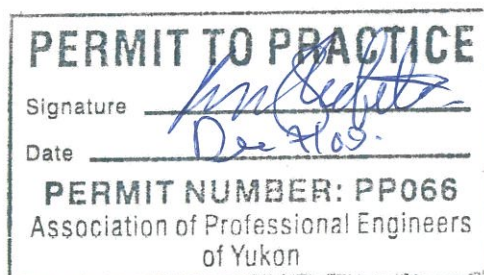


Table of Contents

Statement of Qualifications and Limitations
Letter of Transmittal
Distribution List

	page
1. Introduction	1
1.1 Scope of Work.....	1
1.2 Terms of Reference	1
1.3 Description	1
1.3.1 Location	1
1.3.2 Tailings Management Area.....	2
1.3.3 Background.....	4
2. Toe Berm Assessment	4
3. Conclusions and Recommendations.....	7

Appendices

Drawing 01 North Tailings Dam Toe Berm
Appendix A Site Photographs and Video
Appendix B As-Constructed Cross Sections

1. Introduction

1.1 Scope of Work

1.2 Terms of Reference

In response to a request from the Yukon Government, AECOM developed the following terms of reference to complete the identified project needs:

1. Review background information provided by the YTG Project Manager including past inspection reports, design drawings and construction records in order to familiarize ourselves with the north tailings dam toe berm constructed in 2008.
2. Visit the mine site and inspect the toe berm in the company of the Project Manager.
3. Prepare a site visit report detailing the condition of the berm, required repairs and/or maintenance and other observed issues. The need for and frequency for follow-up site inspections will also be identified.
4. Participate, as required, in teleconferences with the owners of the structures and/or their representatives and other government representatives to discuss observations, recommendations, and conclusions.
5. Review the issues noted against proposed mitigations, taken or to be taken, and submit to the Project Manager a follow-up report reviewing the adequacy of mitigations proposed and recommendations regarding any oversight or follow-up work that should be done.

This inspection report is based on a cursory visual inspection and data provided in previous reports by others. Detailed investigations were not carried out and as such, this investigation was not intended to be detailed assessment of their condition. There has been no attempt made to corroborate or further analyze information or conclusions presented in past reports.

1.3 Description

1.3.1 Location

The Ketza River Gold Mine is located within a valley bottom at about 1,400 m above sea level. Surrounding mountains are about 600 m higher than the valley bottom. The mine is located at the head of the Cache Creek drainage basin where Cache Creek was diverted around the tailings pond. Cache Creek drains to the northeast into the Ketza River. A portion of the mine site access road follows the Ketza River between the confluence of Cache Creek and the Robert Campbell Highway as shown on Figure 01.

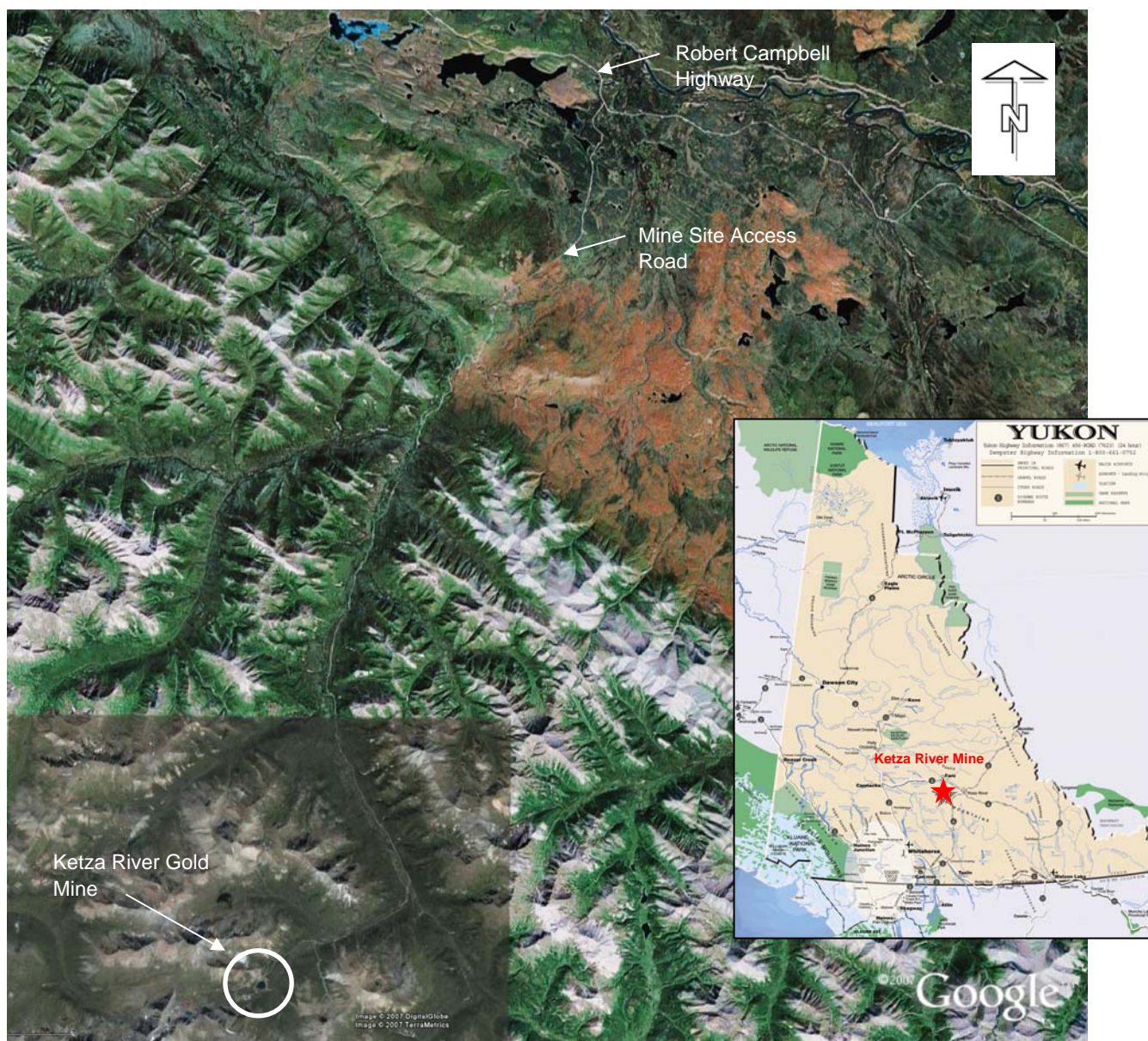


Fig 01 Location Plan

1.3.2 Tailings Management Area

The tailings management area (TMA) consists of the tailings impoundment created by the north and south tailings dams, and diversion ditches to route Cache Creek around the tailings pond as illustrated on Figure 02. The north and south dams are separated by a spillway. Seepage was previously observed at the toe of the north dam at several locations along a stretch of about 20 m (Figure 03). Water from these seeps collected into a common drainage channel that runs into the collection pond at Pumphouse N1 (Figure 04). The ground was observed to be very soft in the area of the seeps with quicking conditions evident. The soft zone extended up the face of the dam by approximately 1 m.

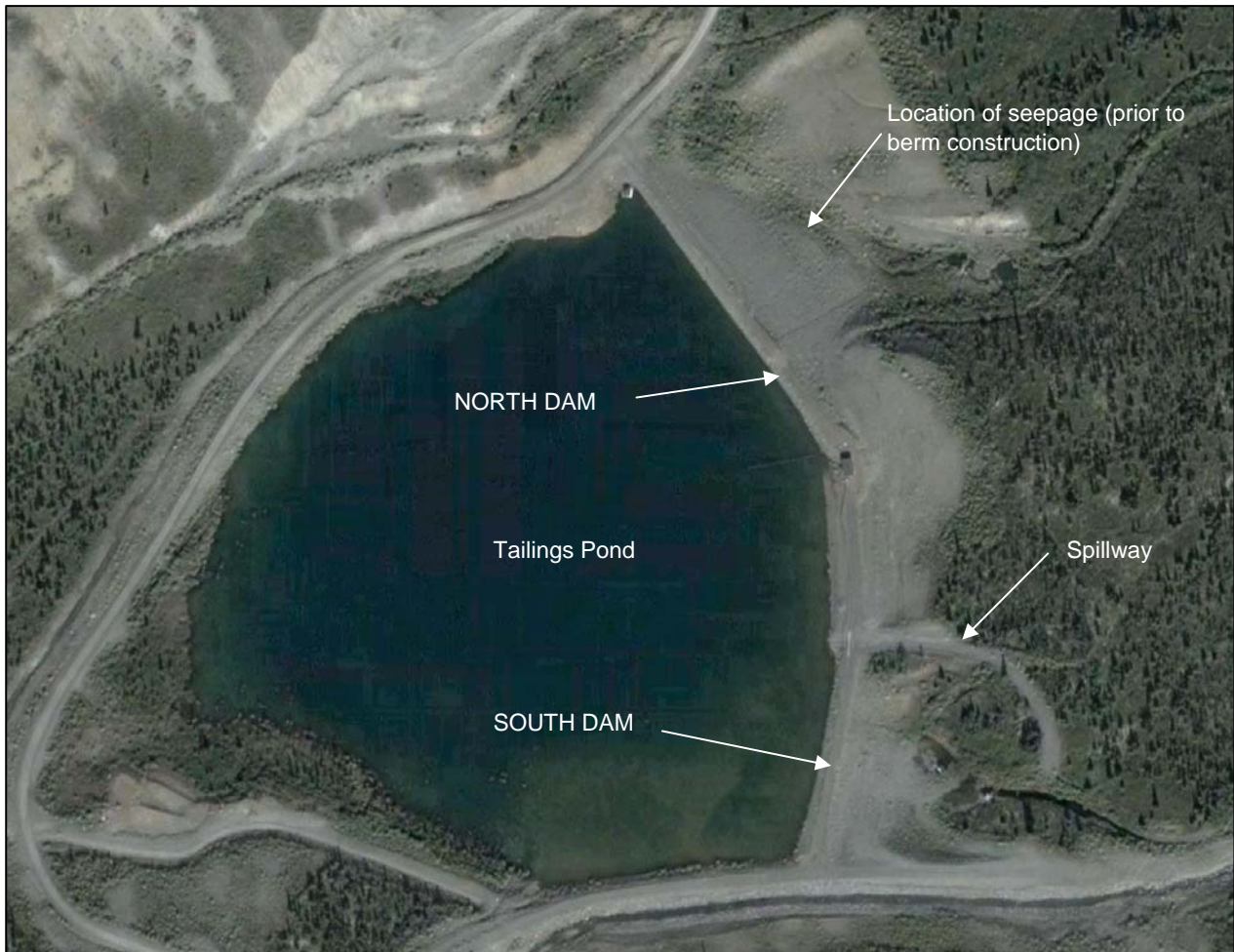


Fig 02 Tailings Impoundment and North Dam Prior to Toe Berm Construction



Fig 03 Seepage at Toe of North Dam (2007)



Fig 04 Drainage at Toe of N Dam (2007)

1.3.3 Background

Previous condition assessments recommended that a granular berm be constructed at the toe of the north dam to improve stability in the area where seepage was occurring. The design for the remedial works was provided to Ketza River Holdings Ltd. (KRH) by EBA Engineering Consultants Ltd. (EBA) on their Drawing ND-TB-02 dated April 7, 2008. It consisted of a berm constructed to elevation 1294.5 m with a 5 m wide top width and 2.5H:1V sideslopes. The berm was to be about 50 m long and tied into existing ground at the north and south ends. It is our understanding that KRH subsequently decided to retain the services of Victor Menkal, P.Eng. of Vista Tek Ltd. to supervise the construction of the toe berm which was carried out by KRH forces. It is our understanding that the rock was quarried and blended with finer grained material to achieve the design gradation (personal communication, Kyle Dziama). Construction was carried out in late October, 2008 and EBA was not retained to provide any inspection services during construction.

2. Toe Berm Assessment

The geotechnical inspection was carried out on July 13th 2009 by Mr. Ken Skafffeld of AECOM (formerly UMA Engineering) in the company of the Government of Yukon's Project Manager, Mr. Glenn Ford. Several photographs and a video were taken during the inspection. These have been included on the compact disc attached to this report as Appendix A. Select photographs have been used throughout the report. No detailed surveys were carried out, however, the edges of the berm were tied in using a hand-held GPS and the elevation of the top of the berm was established with a level survey using the elevation of the top of casing at Piezometer P11A as a benchmark (elev. 1315.160 m). Additional dimensions and slopes of the berm were measured approximately using a survey rod and inclinometer. None of these measurements were intended to be a detailed record of construction but were carried out with the intent of determining if the berm was in general agreement with the design drawings. As-constructed cross sections were provided by Mr. Kyle Dziama (Project Geologist) who also accompanied Mr. Skafffeld and Mr. Ford at the start of the assessment to provide a brief overview of the constructed works. The cross sections (based on NAD 27 UTM coordinates) are attached in Appendix B. The freeboard in the tailings pond was measured to be 1.2 m at the time of the inspection, compared with about 2 to 2.5 m estimated in 2007.

In general, the berm appears to be in agreement with the design drawings although it was constructed with a series of 2 or 3 benches rather than a uniform slope (Figure 05). The berm material consists of rock fill placed on a non-woven geotextile. The saplings observed on the downstream face of the dam in 2007 have been removed. It is our understanding that the geotextile was originally placed to a higher elevation on the downstream face of the dam due to a misunderstanding as to the design elevation for the top of berm. A small amount of rock fill was also placed to a higher elevation as seen on Figure 06. Based on survey shots taken at approximately the section lines provided (Sections 2 and 3) and one intermediate shot, the top of the berm ranges in elevation from 1294.7 to 1295.2 compared to the design elevation of 1294.5 m. The north end of the berm at the access road to the seepage pond is at about elevation 1297.6 m. The top bench is in the order of 4 to 5 m wide. The benches below vary in width and height but the average slope was determined to be from 3H:1V to 3.2H:1V (compared with the design slope of 2.5H:1V). The berm surface is somewhat uneven, likely as a consequence of winter construction.



Fig 05 View S at Toe Berm From Access Rd



Fig 06 View S at Toe Berm From WP 162

Seepage is occurring at the toe of the berm at a location approximately coincident (in a north south perspective) to the seepage zone previously identified (Figure 07 and 08). The seepage water was clear with individual seeps estimated to be flowing at rates in the order of 0.2 l/sec. The seepage water meanders across the gravel at the toe of the berm where it is collected by a channel directed to the seepage pond. This is the same channel where seepage water previously was routed through a non-functional weir and broken steel pipe as noted in 2007. Flow at the pipe was estimated to be in the order of 0.6 l/sec. The seeps were generally along the edge of the fill where it terminates on gravel. There was no visible seepage farther up on the berm or beneath the geotextile where small inspection cuts were made. It appears that a small amount of fine grained soil from the toe area has eroded from surface runoff and accumulated in the drainage channel and seepage pond. The gravel is soft in the area of the seeps, a condition similar to observations made in 2007.



Fig 07 View S at Toe Seepage From WP 164



Fig 08 View N at Toe Seepage From WP 166



Fig 09 Seepage Channel and Weir Pipe



Fig 10 Pipe Outlet at Seepage Pond

The grading of the rock fill is somewhat variable, with some areas containing appreciable fines, most notably along the lower bench. The variability can be seen in Figures 11 and 12 taken along the toe of the berm at WPs 258 and 259 respectively. The variability can also be seen in the photos attached to this report in Appendix A. The areas with finer grained material are intermittent however and likely reflective of variability in the processing (blending) of material.



Fig 11 Rock Fill at Toe at WP 258



Fig 12 Rock Fill at Toe at WP 259

3. Conclusions and Recommendations

Overall, the north tailings dam toe berm appears to have been constructed in general agreement with the original (EBA) design, although some segregation has been observed in local areas. Seepage at the toe of the berm is not unexpected and provides an indication that the material overall is allowing seepage water to freely drain. However, the piezometer in the downstream face of the dam recommended in AECOM's 2007 prior to berm construction was not installed. The intent of the piezometer was to confirm the design assumptions with respect to groundwater (piezometric) levels across the dam used in previous slope stability analysis and assess any impact on groundwater levels from berm construction. Installation of at least one piezometer should still be considered to supplement the existing network of piezometers used to monitor the performance of the dam.

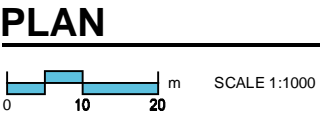
Construction of the toe berm was one of several recommendations provided in AECOM's 2007 report. Other remedial works recommended for consideration in this (2007) report included:

- An evaluation of the hydraulic capacity and erosion potential for the spillway with repairs and upgrades carried out as required,
- Repair weirs downstream of the north dam to allow flow measurements to be made,
- Construction of an emergency spillway to the Cache Creek diversion at the downstream end of the Lower Creek Subsidiary Diversion in the event that the culverts are blocked,
- Cut saplings on upstream dam slopes,
- Survey dam crest and fill low areas as required to restore design crest elevation,
- Repair riprap at the downstream segment of the Cache Creek diversion.
- Continue with recommended inspections and instrumentation monitoring.

It is not clear how many of the additional recommendations have been undertaken at this time and if there has therefore been any justification to reduce the risk scores assigned in 2007 sufficiently to reassign a reduced Risk Level.

Drawing 01

North Tailings Dam Toe Berm



Government of Yukon
2009 Geotechnical Inspections
Ketza Mine
Site Plan
North Tailings Dam Toe Berm
Drawing - 01



Appendix A

Site Photographs and Video

Ketza River Gold Mine - North Tailings Dam Toe Berm Assessment- July 2009
 PHOTO INDEX

Photo	Description
K. Skaftfeld Photos	
170500	View NE at access road to N Dam seepage pond (from N dam crest)
170504	View E at toe berm from N dam crest
170510	View E at toe berm from N dam crest
170516	View NW at tailings pond from P11 on N dam crest
170522	View S at tailings pond from P11 on N dam crest
170528	View NW at tailings pond from P11 on N dam crest
1557	View of toe berm from ramp at WP 162
1558	View of exposed geotextile above toe berm from ramp at WP 162
1559	View of road to seepage pond from ramp at WP 162
1560	View S along toe berm from WP 163
1561	View S along toe berm from WP 163
1562	View S along toe berm from WP 164
1563	View N along toe berm from WP 164
1564	Toe seepage at WP 165
1565	View N at seepage from WP 166
1566	View N at toe berm from S end at WP 167
1567	View upslope at berm and N dam from WP 167
1568	Seepage drainage ditch and weir pipe from WP 168
1569	Seepage pond from WP 168
1570	View N from S end of toe berm from WP 169
1571	View N from S end of toe berm from WP 255
1572	View N along top of berm from WP 256
1573	View S along top of berm from WP 256
1574	View SE along top of berm from WP 256
1575	Rock fill material at WP 257
1576	Rock fill material at WP 258
1577	Rock fill material at WP 259
1578	View S at seepage along toe from WP 260
1579	View N at seepage along toe from WP 260
1580	Rock fill material at WP 261
1581	Rock fill material at WP 262
1582	Rock fill material at WP 263
1583	View of toe berm from mine access road
1584	View of toe berm from mine access road
1585	View of toe berm from mine access road

Ketza River Gold Mine - North Tailings Dam Toe Berm Assessment- July 2009
VIDEO INDEX

Video Clip	Description
163033	View S at toe berm from ramp
163232	Middle of toe berm at downstream edge showing seeps
163709	View SW at toe berm from road to seepage pond
163819	Seeps and drainage channel to seepage pond
164101	S end of toe berm
170324	North tailings dam crest, tailings pond and view NE at toe berm

20090713-170500



20090713-170504



20090713-170510



20090713-170516



20090713-170522



20090713-170528



IMG_1557



IMG_1558



IMG_1559



IMG_1560



IMG_1561



IMG_1562



IMG_1563



IMG_1564



IMG_1565



IMG_1566



IMG_1567



IMG_1568



IMG_1569



IMG_1570



IMG_1571



IMG_1572



IMG_1573



IMG_1574



IMG_1575



IMG_1576



IMG_1577



IMG_1578



IMG_1579



IMG_1580



IMG_1581



IMG_1582



IMG_1583



IMG_1584



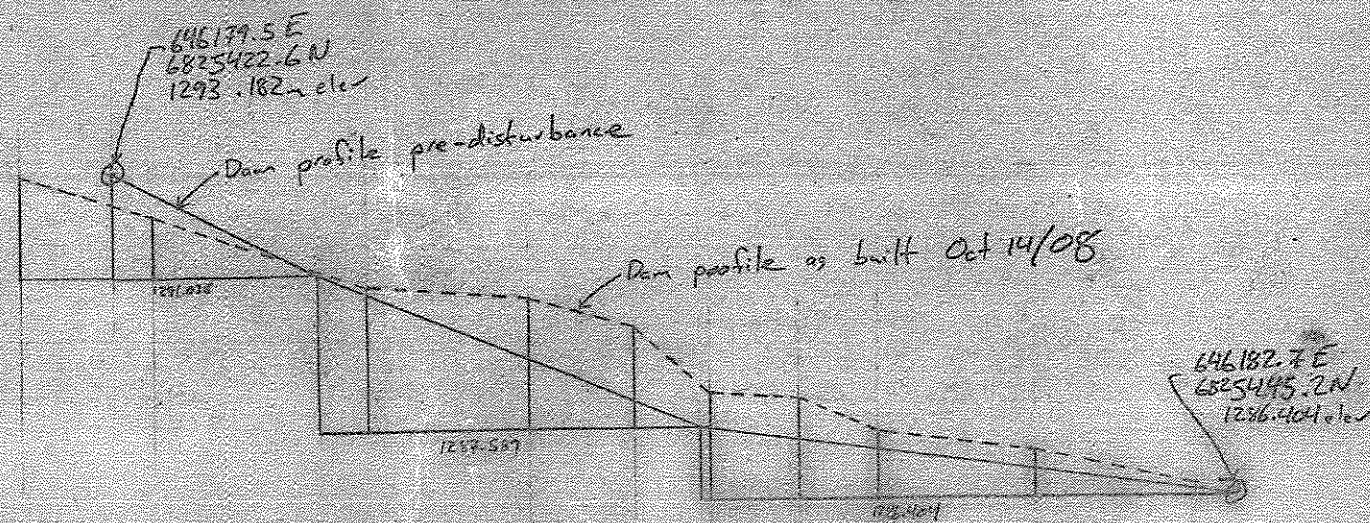
IMG_1585



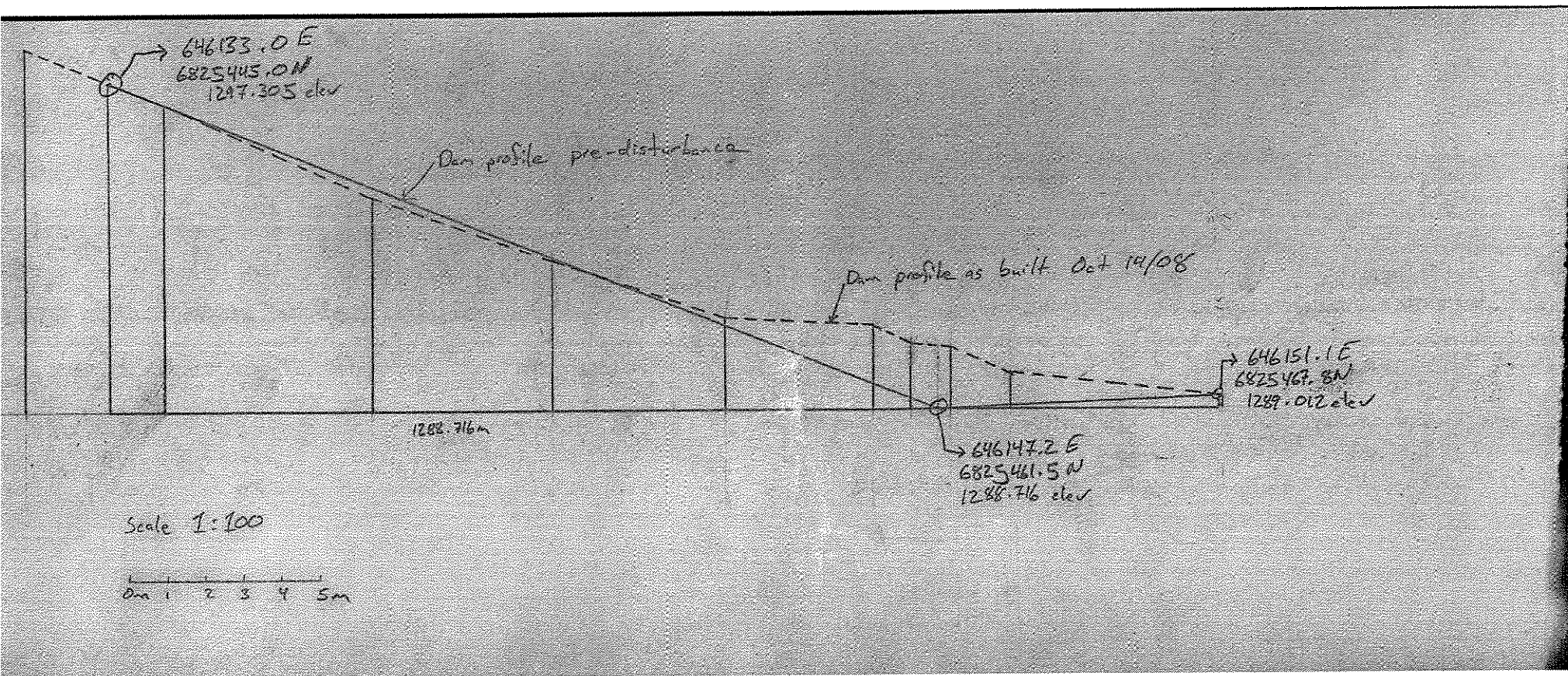
Appendix B

As-Constructed Cross Sections

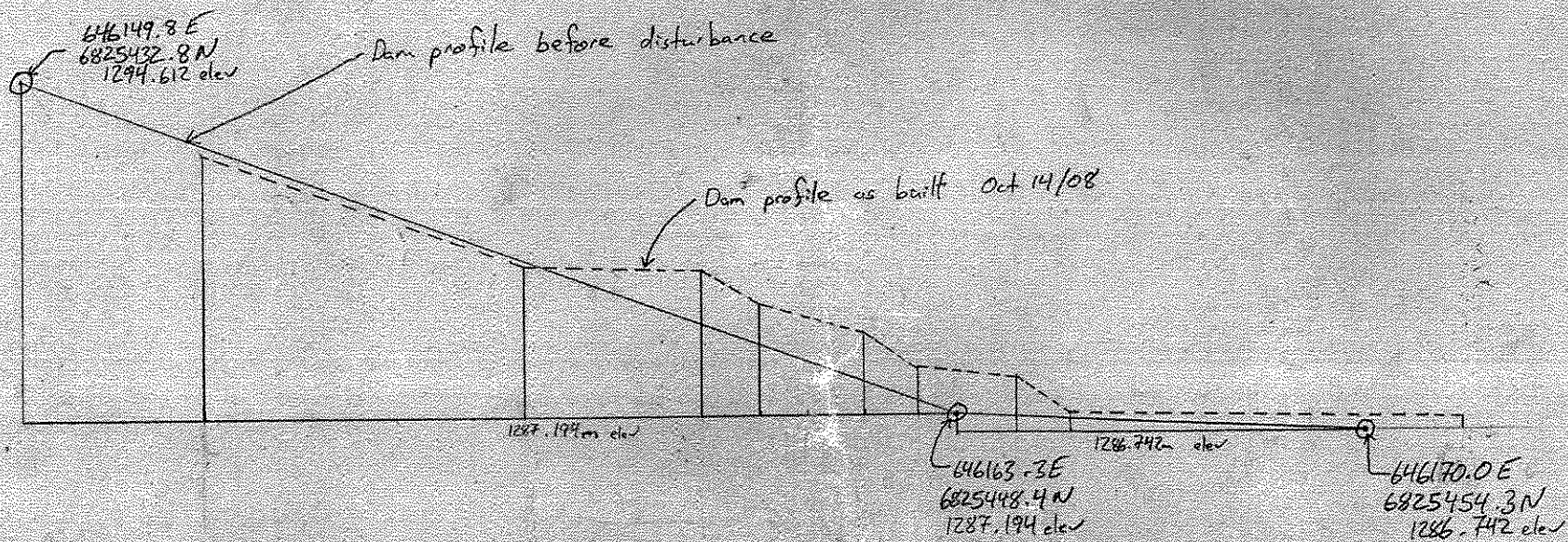
Scale 1:100



SECTION 1



SECTION 2



SECTION 3