

Government of Yukon
Former Clinton Creek Asbestos Mine
Long Term Performance Monitoring - 2007

Prepared by:

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UMA Project No.: 6029 009 00 (4.6.1.1)

July 2008

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UMA Project No. 6029 009 00 (4.6.1.1)

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Whitehorse, Yukon
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Dear Sir:

Re: Former Clinton Creek Asbestos Mine – Long Term Performance Monitoring - 2007

UMA Engineering Ltd. (UMA) is pleased to provide our report for the above referenced project.

If we can be of further assistance, please contact Gil Robinson, P.Eng. directly.

Sincerely,

UMA Engineering Ltd.



Ron Typliski, P.Eng.
Regional Manager
Earth and Environmental
GR/dh

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1.0 Introduction

This report provides a summary of the long term performance monitoring activities completed in 2007 at the former Clinton Creek Asbestos Mine. The work included a site inspection and surveying and is based on the recommendations for the long term performance monitoring program of the site (UMA 2006b) and the recommendations following the 2006 performance monitoring event (UMA 2007). The terms of reference for the work are outlined in our letter proposal to Mr. Hugh Copland, P.Eng. P.Geo. of the Government of Yukon (GY), Energy, Mines and Resources dated May 18, 2007. The recommendations for addressing erosion concerns on the Clinton Creek waste rock dump are based on communication with Mr. Hugh Copland in the fall of 2007.

The site inspection was completed by Gil Robinson, P.Eng. and Rolf Aslund of UMA Engineering with assistance from Hugh Copland P.Eng., P.Geo. of the Government of Yukon (GY) on July 4, 2007. Specific objectives of the inspection outlined in the Long Term Performance Monitoring Report for 2006 (UMA 2007) are as follows:

- Visually inspect the gabion drop structures at the Hudgeon Lake outlet for general performance and to confirm deformations observed in the baseline cross-section surveys,
- Measure the horizontal distances across each drop structure,
- Verify localized down-cutting of the Clinton Creek channel through the waste rock dump just downstream of Drop Structure #4,
- Assess Drop Structure #1 to determine the compartment of the weir that is to be opened (i.e. remove the gabion rock fill) to reduce the impact on lake levels which has occurred due to blockage of flow through the gabions (UMA 2006b) and evaluate repairs strategies to restore the 0.2 m of free board above the design flow depth.
- Visually inspect the rock lined channel and weirs on Wolverine Creek.

Based on our observations during the site inspection a list of maintenance work items was prepared and provided to GY (Appendix A). It is our understanding that this work was completed in 2007.

Underhill Geomatics Ltd. (UGL) from Whitehorse, YK completed the survey work for the performance monitoring program under Contract with the Government of Yukon. The survey was completed on July 4th 2007 by John Tom Tom and his assistant using Global Positioning Survey (GPS) referenced to the UTM NAD 83 (Zone 7) co-ordinate system. The horizontal accuracy of the GPS survey is within 2 to 3 cm, which is acceptable given the magnitude of movements expected and given the potential error in positioning the survey rod at the exact same location for each monitoring event. The monitoring requirements outlined above were discussed on-site with UGL. The survey information provided by UGL is provided in Appendix B. Specific objectives of the performance monitoring survey are as follows:

- Re-survey cross-sections Drop Structures #1 to #8 including the movement monitors (#1450 to #1465) established in 2006,
- Survey the top of channel elevations between Hudgeon lake outlet and Drop Structure #1 to confirm that a minimum 0.2 m of freeboard exists,

- Survey the Clinton Creek profile just downstream of Drop Structure #4 where channel degradation of about 0.3 m appears to have occurred over a short stretch of the channel,
- Survey waste rock movement monitors south of the stabilized Clinton Creek section (#0228, 1833, P2, 0226, 0229, 1831, 22A, 21A, 0224, 81-2, 20A and 1196), and
- Re-survey the Wolverine Creek profile and if possible, check the control points used for the 2003 survey should be checked.

The results of the performance monitoring work are provided in Sections 2 and 3 of this report. A discussion of the results is provided in Section 4 and any recommendations for maintenance and future work are provided in Section 5.

2.0 Clinton Creek Waste Rock Dump

2.1 Gabion Drop Structures

Starting in 2004, the monitoring program for the drop structures was limited to taking horizontal (closure) measurements across each gabion drop structure at two locations (Appendix C, Drawing C-1) to aid in determining if the gabions are deforming laterally. To provide a better understanding of the deformations of the gabion drop structures in relation to the waste rock movements, and the impact on functionality of the structures, additional surveys were recommended for long term performance monitoring (UMA 2006b). These recommendations included installing movement monitors near the four corners of each drop structure and surveying two cross sections of each drop structure.

The results from the first long term performance monitoring event in 2006 (UMA 2007) suggested that some deformation of the drop structures had taken place. The apparent deformations were further supported by the continued movement of some of the waste rock monitors in a northerly direction across the stabilized creek channel and the decreased horizontal measurements taken across each drop structure. In addition to the suggested deformations, the cross-section at the top end of Drop Structure 1 showed that the freeboard was less than 0.2 m. The 2007 site inspection work consisted of a visual condition assessment, photograph documentation and taking horizontal measurements at two locations across each drop structure. Digital photographs and video clips taken during the inspection are provided on the attached DVD. Recommendations for maintenance work are provided in Section 5.

In general, the structures within the reconstructed channel reach are performing well as evidenced by the photo in Figure 2.1. Grass and other vegetation are becoming established around the channel which will help to reduce surface erosion due to runoff into the channel.

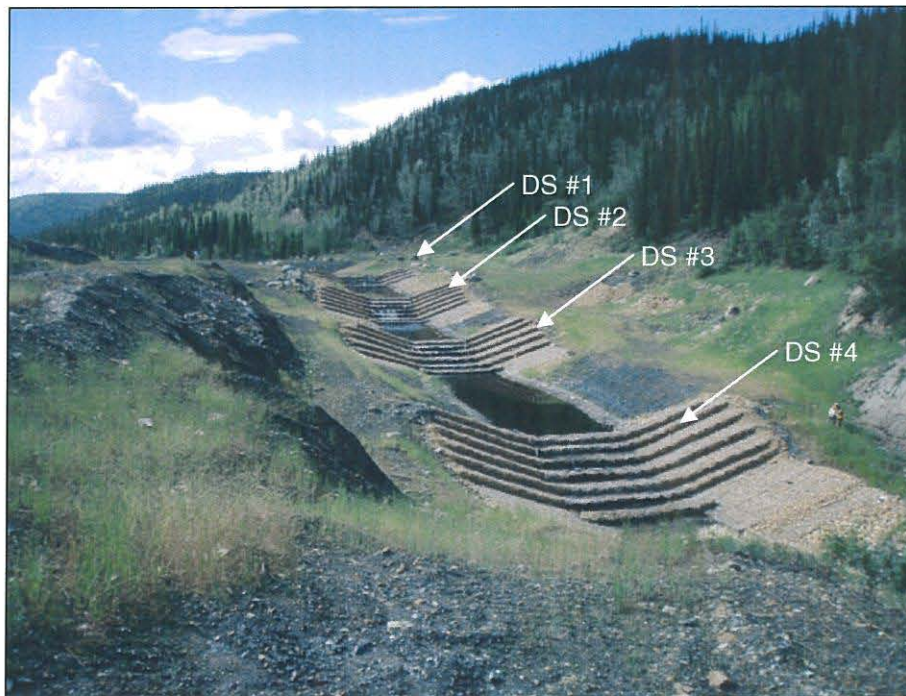


Figure 2.1 General Site Conditions

Drop Structure #1

Although some settlement of Drop Structure #1 (DS #1) was experienced in the first year following construction, its condition has not visibly changed since the May 2005 Site Inspection (UMA 2006). The gabion baskets are in good shape and do not require any infilling. Figure 2.2 illustrates the general condition of DS #1.



Figure 2.2 General Condition of Drop Structure #1

As noted in the previous performance monitoring report (UMA 2006b), the cross-section survey of DS #1 taken in 2006 (Drawing 01) shows that there is less than 0.2 m of free board at the design flow depth of 2.01 m. During the site inspection it was decided that some additional baskets should be added to the upper most row of baskets on either side of the channel.

A review of the levels in Hudgeon Lake, due to blockage of flow through the gabion baskets of DS#1, was provided in the last performance monitoring report (UMA 2006b). Based on this review and the 2007 site inspection, recommendations were made (Section 5) to make an opening in the structure by removing one compartment (0.5 m x 1.0 m x 1.0 m) in the draw-down reduction weir. Because of the rotation of the drop structure (i.e. channel bend), the compartment recommended for removal was located immediately to the right of the channel centreline (when facing downstream) so that the increased flow rate through this opening will occur on the inside of the channel bend. The opening may result in a small reduction in upstream water levels during periods of high runoff (e.g. spring freshet). During low flow periods, the flow will be centered in the structure at the first drop step and the lake levels are expected to range from 411.0 to 411.2 m.

Blockage of the opening in the drawdown weir may still occur if larger floating debris (e.g. drift wood) accumulates in front of the opening. The presence of debris should be checked for during every site visit and if necessary, blockages should be removed from the opening. If organic debris (e.g. leaves, pine needles, branches) is carried farther downstream creating a blockage of a drawdown weir of one of the lower drop structures, the increased water level between drop structures is not expected to be detrimental to the performance of the stabilized channel; Increased flow depths between structures as a result of such blockages will not create a breach condition.

Drop Structures #2, 3 and 4

The condition of Drop Structures #2, 3 and 4 has not visibly changed since the May 2005 Site Inspection (UMA 2006). The gabion baskets are in good condition although about 20 baskets have some voids in the fill that are about 150 mm deep. These baskets are typically located on the flat portion of the rows of baskets which are subjected to the most turbulence during high flows. The voids result from consolidation of the gabion fill and erosion of some smaller pieces of gabion fill. Figure 2.1 illustrates the general condition of Drop Structures #2, 3 and 4.

2.1.1 Horizontal Measurements

The locations where horizontal measurements are taken across the drop structures are illustrated on Drawing (Appendix C). The measurements are provided in Tables C-1 to C-5 (Appendix C). To date, the horizontal measurements have decreased by 0.01 to 0.27 m indicating that some lateral movements have occurred. The largest total change in the measurements (0.27 m) was measured at DS #3.

2.1.2 Movement Monitors

Sixteen movement monitors (#1450 to 1465) were installed near the corners of the four drop structures in July 2006 by Underhill Geomatics Ltd. (UGL) to provide additional data on horizontal deformations (closure). The locations of these monitors are illustrated on Drawings 01 to 04 and a summary of the distance between each pair of monitors is provided on Table C-6 (Appendix C). Between July 2006 (baseline survey) and July 2007, the horizontal distance between the pairs of movement monitors decreased from 0.02 m to 0.13 m with an average of 0.05 m. The largest decreases occurred at DS#3 with 0.07 m across the draw down weir and 0.13 m across the lower tier of the drop structure. The results indicated that the distance between the pair of monitors across the draw down weir at DS#4 increased by 0.02 m.

2.1.3 Surveyed Cross-Sections

Two cross-sections were surveyed across each drop structure in July 2006 by UGL as part of the long term performance monitoring program (UMA 2006b). The locations of these sections are illustrated on Drawings 01 to 04. The plan view and sections provided on the left hand side of these Drawings represent the as-constructed drop structure geometry. The sections on the right hand side of the drawings represent the surveyed geometry. The results of the baseline survey in June 2006 suggest that at that time (2006) some deformation had already occurred.

Drop Structure 1: Cross Sections 1 and 2 for Drop Structure #1 (Drawing 01) show that the design flow depth (2.01 m) at the top of the drop structure (Section 1) is just contained within the upper level of the gabion drop structure. This is most likely due to vertical settlement of the upper two or three gabion baskets on each side of the channel. On Cross Section 2, the dip in the side slope on the right hand side occurred during the first spring freshet after the structure was completed. No additional settlement has occurred since the baseline survey in 2006. A top of bank survey was completed to confirm that at least 0.2 m of freeboard is available above the maximum expected lake level of 411.21 m. The survey included a cross-section of the upstream side of DS#1 (Drawing 05). With the exception of one location on the south side of the outlet channel at elevation 413.34 m, there is at least 0.2 m of freeboard along both sides of the channel. Elevations less than 413.41 m at the ford crossing are due to the grade of the road at the edge of the channel; higher ground and sufficient freeboard exists just beyond the limit of the survey. The cross-section along the upstream edge of DS#1 reflects conditions before additional gabion baskets were added to provide additional freeboard. The elevation at the ends of DS#1 is now above the minimum freeboard elevation.

Drop Structures 2, 3 and 4: As noted in the previous performance monitoring report (UMA 2006b), the cross-section surveys of Drop Structures #2, 3 and 4 taken in 2006 (Drawings 02, 03 and 04) showed bulging in the toe of slope area. There were no visible signs that the gabion baskets had deformed, which was confirmed with the new cross-sections taken in 2007. It is now apparent that the bulging was a consequence of small piles of gabion fill on top of the baskets mistakenly included in the baseline cross-section survey. No significant deformation has occurred at these drop structures.

2.2 Clinton Creek Channel

The lake outlet channel upstream of DS #1 and the creek channel between the drop structures are in good condition with no evidence of active erosion. Between DS#3 and DS#4, a tension crack was visible at the top of the channel slope where an access ramp into the channel bottom was established to construct DS #4. The tension crack may be the result of settlement of fill placed to finish the channel construction, however, is of no consequence to the stability of the channel at this time.

A critical stretch of the channel with respect to the long term performance of the stabilization works is the transition between DS#4 and the bedrock outcropping at Station 0+225 m. The channel survey from 2006 (Drawing 06) showed that some erosion occurred between Stations 0+195 and 0+215 m since the previous survey which was completed in 2004. The 2007 survey of this channel stretch confirmed that about 0.2 to 0.3 m of channel erosion has occurred. The eroded channel section is characterized by deep pools of water as illustrated on Figure 2.3. The boulders lining the left hand (north) side of the channel directly downstream of DS #4 also showed signs of movement, possibly due to some erosion of the fine grained soil behind the boulders during high flow events (e.g. spring freshet). Minimal, if any, erosion occurred on the right hand side of the channel in this area.



Figure 2.3 Pool of Water Downstream of DS #4

2.3 Waste Rock Dump

2.3.1 Movement Monitors

Monitoring of the waste rock dump movement monitors was re-instated in 1999 with subsequent monitoring events in 2001, 2003, 2004 and 2006. The locations of the movement monitors surveyed in 2007 are shown on Drawing 07 and are categorized according to location on the waste rock dump that is, the lower slope monitors are located below elevation 420 m, the mid-slope monitors are located between elevation 420 m and 450 m and the upper slope monitors are located above elevation 450 m. The

monitoring results are provided on Table D-1 in Appendix D and are summarized on Drawing 07 and in Table 2.1. The vectors on Drawing 07 show the direction of total movement for each monitor since the baseline survey (either 2001 or 2003). The length of the vectors represents the total movement. The incremental movement measured from the last two surveys is indicated beside each vector.

Table 2.1: Summary of Annual Movement Rates

CLINTON CREEK WASTE ROCK DUMP				
Dump Area	Annual Movement Rates (m/yr)			Rate Change
		Monitoring Period 2004-2006	Monitoring Period 2006-2007	
Upper (2 monitors)	Average	0.02	0.05	0.03
	Maximum	0.03	0.06	0.03
	Minimum	0.01	0.03	0.02
Mid (9 monitors)	Average	0.04	0.06	0.02
	Maximum	0.07	0.13	0.06
	Minimum	0.01	0.03	0.02
Lower (4 monitors)	Average	0.04	0.08	0.04
	Maximum	0.06	0.14	0.08
	Minimum	0.01	0.04	0.03

Upper Slope Monitors

Two of the five monitors located in the upper slope area were surveyed in 2007. The movement vectors and magnitudes shown on Drawing 07 suggest that this area of the waste rock dump moved in a northerly direction (i.e. down the underlying valley slope) at rates ranging from 0.03 to 0.06 m/yr with an average of 0.05 m/yr over the 2006 to 2007 monitoring period. The annual movement rates are on average about 0.03 m/yr higher than observed over the previous monitoring period from 2004 to 2006.

Mid Slope Monitors

There are 13 monitors located in the mid slope area of the waste rock pile, which covers the underlying south valley slope toe and the original valley bottom. Nine of the monitors were surveyed in 2007, those that are located south of the stabilized creek channel. The annual movement rates (2006 to 2007 monitoring period) for these monitors range from 0.03 to 0.13 m/yr with an average of 0.06 m/yr. These rates are on average 0.02 m/yr greater than observed over the previous monitoring period from 2004 to 2006. The three monitors located closest to Hudgeon Lake (#0229, #1831 and #22A) are moving in a west to north west direction towards the lake at rates of 0.05 to 0.08 m/yr. The central five monitors (#21A, 0224, 81-2, 20A and U1196) are located at the top of a high slope and are generally moving in a northerly direction at rates of 0.03 to 0.12 m/yr. Monitor #68 is moving in a northwest direction at a rate of 0.05 m/yr.

Lower Slope Monitors

There are 18 active monitors located in the lower slope area of the waste rock pile. This area of the waste rock pile is likely located along or above the toe of the original north valley slope. Four of the monitors were surveyed in 2007, those that are located south of the stabilized creek channel. The annual movement rates for the current monitoring period range from 0.04 to 0.014 m/yr with an average of 0.08 m/yr. These rates are on average 0.04 m/yr greater than observed over the previous monitoring period

from 2004 to 2006. Based on these results, it appears that the waste rock at the west side of the lower slope is moving towards Hudgeon Lake. Directly south of Drop Structures #1 and #2 (i.e. Monitor 1833) the waste rock is moving in a north westerly direction. Directly south of Drop Structures #3 and #4 (i.e. Monitor P2) the waste rock is moving in a northerly direction. Monitor #0226 is moving in a north easterly direction, which is the direction of the steepest slope at this location.

2.4 Access Road

During a site visit by GY in October 2007, a significant erosion gully was observed on the north side of the mine access road between Drop Structures 2 and 3 (Figure 2.4). The erosion gully extends down from the mine access road to the access road located on the south side of the stabilized creek channel. The gully is confined to the waste rock material and does not appear to have impacted the side slopes of the stabilized creek channel. This particular location along the mine access road is subject to ponding and the gully likely formed during a period of high run-off.



Figure 2.4 Erosion Gully

3.0 Wolverine Creek

The inspection consisted of a visual condition assessment of Wolverine Creek from Station 0+800 to 1+300m (Drawing 09). This area includes the rock-lined channel and the section of the creek that crosses the south lobe of the tailings pile. The intent of the condition assessment was to identify the requirement for any maintenance and/or upgrading work. Digital photographs and video clips taken during the inspection are provided on the attached DVD. Recommendations for maintenance work are provided in Section 5.

As illustrated on Drawing 09, the rock-lined portion of the creek is located on a mound of tailings that were deposited in the mid-1970's when the South Lobe of the tailings failed and blocked the creek valley (UMA 2003). The blockage was breached which resulted in the deposition of tailings in the valley bottom downstream of the South Lobe. The existing rock-lined channel was constructed on the tailings to provide a stable channel for creek flows to pass over the deposit of tailings, which are generally fine grained and readily eroded.

The rock-lined channel is generally stable and the bed is well armoured by boulders and vegetation (e.g. trees and brush). At a number of locations, the right bank (when facing downstream) of the channel appeared to be higher and better armoured than the left bank. Therefore, a channel bank breach is more likely to occur along the left bank during high flows. Some vegetation (e.g. trees and brush) is well established in and around the channel (Figure 3.1) and may be affecting the hydraulic capacity although there were no obvious signs that flow had overtopped the banks. No significant channel blockages were identified although there are some signs of sedimentation taking place and some shifting of boulders that form the rock weirs in the channel (Figure 3.2).



Figure 3.1 Vegetation Along Rock-Lined Channel



Figure 3.2 Sedimentation and Shifted Boulders In Rock-Lined Channel

The root systems of the well established vegetation in the channel bonds the channel surface and should not be disturbed. However, large brush and trees in the channel tend to accumulate floating debris and could direct flow jets toward the channel banks, which could cause bank erosion and possibly lead to a bank breach.

Up stream of the rock-lined channel, the channel across the South Lobe of the tailings (Station 1+050 to 1+300 m on Drawing 09) is in a similar state as observed during our 2005 site inspection. The main difference illustrated in Figures 3.3 and 3.4 is the amount of tailings that has sloughed into the channel.

There does not appear to be any significant erosion on the valley side of the channel. The creek profile survey completed in 2007 (Drawing 09) suggests there has been little change in the profile of the creek in this area since 2003. Near Station 1+300 m the creek channel turns back into the tailings and has resulted in some localized erosion, as shown on Figure 3.5.



Figure 3.3 Wolverine Cr Along S Lobe in 2005



Figure 3.4 Wolverine Cr Along S Lobe in 2007



Figure 3.5 Wolverine Cr at U/S End of S Lobe

3.1 Creek Channel Profile Survey

The 2006 survey completed during the first long term performance monitoring event could not be reconciled with the 2003 survey (UMA 2007). Underhill Geomatics Ltd. concluded that the two surveys could not be reconciled without verification of the control points used for the 2003 survey. It was recommended that the survey be re-done in 2007 and if possible, the control points from 2003 should be checked (UMA 2007). It is our understanding that the survey completed by UGL in 2007 was terminated at Station 1+025 m due to the presence of bears in the valley.

Channel degradation along the rock-lined channel portion of Wolverine Creek can not be evaluated until a complete survey is available. The channel is scheduled to be surveyed again in 2008 as part of the long term performance monitoring program.

The survey completed in 2007 indicates that the creek profile across the South lobe of the tailings pile has not eroded significantly, when compared to the 2003 baseline survey.

4.0 Summary

4.1 Gabion Drop Structures and Waste Rock Dump

The gabion drop structures are performing well and do not show any signs of deformation due to movements of the waste rock pile.

The results from the horizontal measurements taken across each structure and the movement monitors located at the four corners of each drop structure confirm that the width of the gabion drop structures, at the top of the channel slope, is decreasing with time. However, visual observations and the surveyed cross-sections have not revealed any deformations to date that would compromise their functionality or ability to pass the expected design flow from Hudgeon Lake. The rate of change of the drop structure width is of the same order of magnitude as the waste rock movement monitors located directly south of the stabilized creek channel.

The movements of the waste rock monitors suggest that some radial spreading of the waste rock pile is occurring, which has been previously reported and is not unexpected. The movement of some of the monitors (e.g. #0226, #68, #0224) may be influenced by local movements of the waste rock pile due to their location at the top of a high slope that is creeping in the direction of the slope.

The largest change in the width of the drop structures were measured at Drop Structures #3 and #4 and the largest movement of the waste rock monitors was at Monitor P2, which is directly south of these two drop structures. The relatively high waste rock slopes above these two drop structures may explain the larger movements.

4.2 Clinton Creek Channel

Erosion of the creek channel has occurred just downstream of Drop Structure #4 between Stations 0+195 and 0+215 m. This area of the channel was re-surveyed in 2007 and confirmed that some erosion has occurred since 2004. This area of the channel will be re-surveyed in 2008 during the next performance monitoring event.

4.3 Wolverine Creek Channel

The rock-lined channel is generally stable and the bed is well armoured by boulders and vegetation and there are no obvious signs that flow had overtopped the banks. At a number of locations, the right bank (when facing downstream) of the channel appeared to be higher and better armoured than the left bank and some vegetation may be affecting the hydraulic capacity of the channel. The primary concern with respect to the long term performance of the rock-lined channel is the potential for a bank breach resulting in the rapid erosion and down-cutting of the tailings material. The breach potential and risk associated with a breach have not been quantified to date but would require hydraulic modelling of flow through the Wolverine Creek valley.

Erosion of the creek channel could not be assessed due to the lack of survey information as discussed in Section 3.

5.0 Recommendations

5.1 2007 Maintenance

Immediately following the 2007 site inspection, recommendations for maintenance work were provided in a letter to Hugh Copland dated July 17, 2007 (Appendix A). At the time of writing this report it was our understanding that the maintenance work has been completed. Some photographs, provided by GY, of the completed work are included. The recommended maintenance work and/or our understanding of the work completed in 2007 is summarized as follows:

5.1.1 Gabion Drop Structures

- Drop Structure #1:
 - During the site inspection it was confirmed that one cell (1 m x 1 m x 0.5 m) should be removed from the drawdown weir to reduce the impact of the organics which have partially plugged the draw down weir. The completed work is illustrated in Figures 5.1 and 5.2.
 - As illustrated on Figure 04 in Appendix A, three gabion baskets were added to the top row of the drop structure at the top of the channel slope on each side of the drop structure. This work was required to maintain a minimum of 0.2 m of free board during high flow events. One basket was installed beside the existing basket at the top of the channel slope and the extra basket placed on top straddling the two baskets at the top of the channel slope. A third basket was placed on top of the baskets at a 45 degree angle to re-direct water back into the channel in the event where the channel is running at or slightly above capacity. The completed work is illustrated in Figure 5.1.



Figure 5.1 DS #1 – Additional Baskets Added in 2007



Figure 5.2 DS#1 – Compartment Removed from Drawdown Weir in 2007

- Drop Structure #2: Place a patch over the hole on Tier #4 (middle step of the drop structure).
- Drop Structure #3: Remove the cobbles and boulders resting against the outside edges of the end sill. Water flowing over the drop structures, particularly at higher flows, may produce a 'rocking action' of the cobbles and boulders that could result in abrasion of the PVC coating on the gabions and expose the wire mesh leading to abrasion of the galvanized wire and premature corrosion.
- Drop Structures 2, 3 and 4: Remove the small piles of gabion fill located on the surface of the gabion baskets adjacent to the outside corners of the End Sill. These rock piles impact the cross-sections surveyed at these locations as part of the performance monitoring program.
- Top off gabion baskets (approximately 20 baskets) that have voids below the wire mesh that are about 150 to 200 mm deep. Fill with 100 to 150 mm diameter rocks from the remaining stock piles of gabion fill material.
- Remove all timber and logs trapped in the stabilized portion of the creek channel.
- Remove all trees (mainly willows) growing inside the stabilized channel.

5.1.2 Creek Channel Downstream of Drop Structure #4

A short stretch of the channel between the last drop structure and the point where bedrock is exposed in the channel needs to have some scour holes filled in with rock to prevent further deterioration. This section of the channel is critical to minimize channel degradation and the potential for undermining of the last drop structure.

Rocks and boulders were placed on the bottom of the channel to tie into the rocks lining the north side of the channel. The boulders on the north side of the channel were to be infilled with smaller rocks (100 to 200 mm diameter) to protect the underlying fine grained soil from erosion during high flow events. The maintenance work completed in 2007 is illustrated in Figure 5.3. Some voids still exist however, and these should be filled.



Figure 5.3 North Side of Channel d/s of DS #4

5.1.3 Wolverine Creek

Channel Across the South Lobe of the Tailings Pile

At the time of the site inspection an old beaver dam was located in Wolverine Creek at the upstream end of the South Lobe and was redirecting the creek flow directly back at the tailings pile resulting in some erosion of the tailings in this area. The beaver dam was removed to allow the creek flow to run parallel to the edge of the tailings. The maintenance work completed in 2007 is illustrated in Figure 5.4. The original conditions are illustrated in Figure 3.5.

Rock-Lined Channel

Debris (e.g. wood posts) and trees were removed from the middle area of the channel. The trees located within 2 m of the boulders forming the sides of the channel were left in place. The trees to be removed were to be cut-off about 200 mm above the creek channel base with the cut portion of the tree left in place along the outside edges the channel. The maintenance work completed in 2007 is illustrated in Figure 5.5.



Figure 5.4 Wolverine Creek Channel At Upstream End Of South Lobe After Maintenance Work Completed



Figure 5.5 Trees Removed From Rock-lined Channel

5.2 Future Work

Regular site visits, continued performance monitoring, maintenance and associated engineering are necessary components of the risk management plan for the mine site.

5.2.1 Performance Monitoring and Inspections

The second round of the long term performance monitoring should be conducted in 2008 as recommended in the Long Term Performance Monitoring Plan (UMA 2006b).

5.2.2 Maintenance

Mine Access Road Drainage

GY has suggested that some drainage improvements may be considered along the mine access road. It is our understanding that the intent of any drainage improvements would be to prevent erosion of the access road and the development of erosion gullies on the south bank of the Clinton Creek channel. As illustrated on Drawing 08, this can likely be achieved by grading the road surface where required so that it drains in a southward direction to the existing drainage ditch and excavate / clean up the existing drainage ditch as required to provide positive drainage along its entire length. The majority of the work is required at the general location where the erosion gully formed in 2007. The final details of the proposed drainage work would best be determined and laid out on site at the time of construction.

5.2.3 Engineering

Evaluate Feasibility of Regrading Waste Rock above Drop Structures #3 and #4

The results of the performance monitoring suggest that the largest movements of the waste rock pile and the drop structures is occurring in the area of Drop Structures #3 and #4. The waste rock above the drop structures at this location is oversteepened and likely contributing to the observed movements. The impact and feasibility of regrading the waste rock in this area should be considered. Representative cross-sections of the area would be required to do this work and should be surveyed in 2008 during the next performance monitoring event.

Hydraulic Modeling To Estimate Risk of a Bank Breach of Wolverine Creek

As discussed in Section 4.3, computer modeling could be used to estimate the risk of a bank breach along the rock-lined channel in Wolverine Creek. Input required for the computer model includes the topography of the tailings lobes and channel cross-sections. The tailings topography is required to generate flood water storage-elevation curves similar to what is done for storm-water retention ponds. The tailings topography can be obtained from the digital terrain mapping from 1999. The channel cross-sections must extend to the creek valley sides at close intervals (+/- 25 m) due to the steepness of the creek and the varying channel bank height between the downstream tailings lobe and Clinton Creek. The six channel cross-sections surveyed along the rock-lined channel in 2003 may not be useable as there is an unresolved discrepancy in the Wolverine Creek surveys from 2003 and 2006.

The scope of the survey to complete the hydraulic modelling includes the following:

- (1) Survey the water edge around the ponded area between the North and South Lobes and also upstream of the North Lobe,
- (2) Survey 3 typical cross-sections of the channel constrictions between the each tailings lobe and the creek valley sides. These cross-section surveys can be terminated 3 m above the stream

bed. (Survey sections at Stations 1+200, 1+250 and 1+300m along the South Lobe and at Stations 1+400, 1+450 and 1+500 m along the North Lobe)

- (3) Survey cross-sections at a 25 m spacing from Station 0+700 m to 1+200 m. Each channel cross-section should extend 10 m past the left and right top of banks plus one spot elevation at the toe of the left and right valley sides.

If we can be of further assistance or should you wish to proceed with the recommended engineering work in 2008, please contact either of the undersigned.

Respectfully Submitted,

UMA Engineering Ltd.

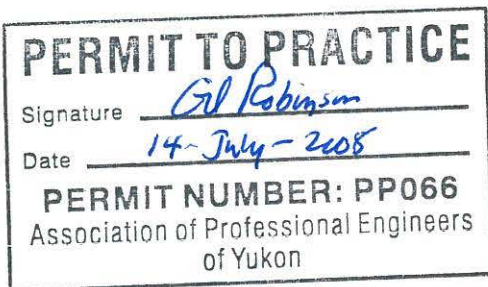
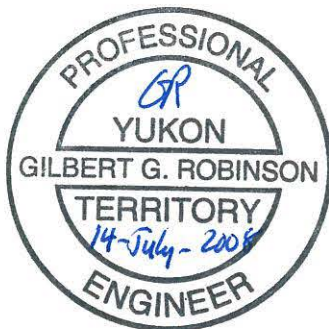
Reviewed By:



Gil Robinson, M.Sc., P.Eng.
Geotechnical Engineer
Earth and Environmental



Ken Skafffeld, P.Eng.
Senior Geotechnical Engineer
Earth and Environmental



References

UMA Engineering Ltd., 2003. Indian and Northern Affairs Canada, Abandoned Clinton Creek Asbestos Mine, Environmental Liability Report.

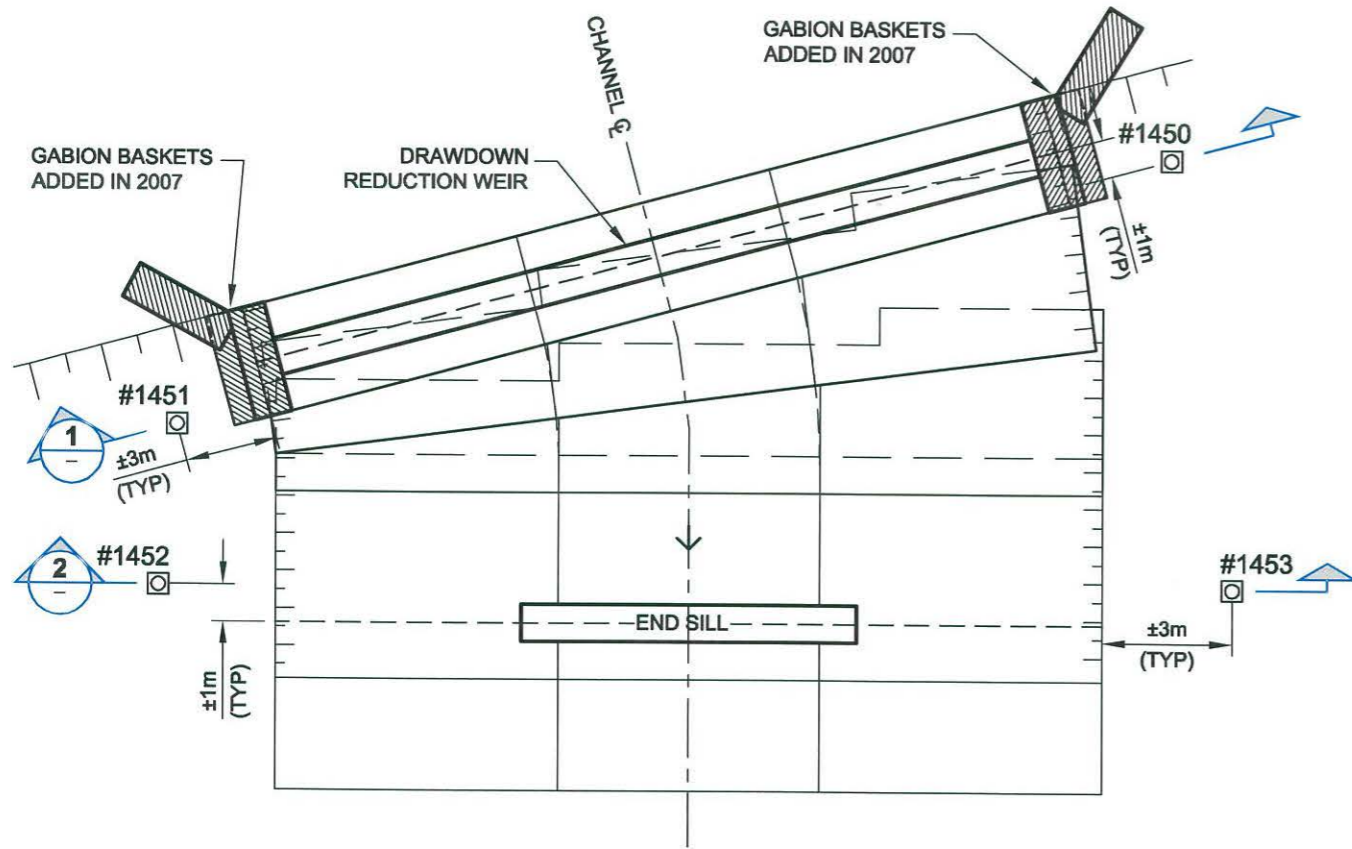
UMA Engineering Ltd., 2006. Government of Yukon, Former Clinton Creek Asbestos Mine – 2005 Engineering Services: Site Inspection and Monitoring Results, letter dated June 19, 2006.

UMA Engineering Ltd., 2006b. Government of Yukon, Former Clinton Creek Asbestos Mine – Long Term Performance Monitoring Program – August 2006.

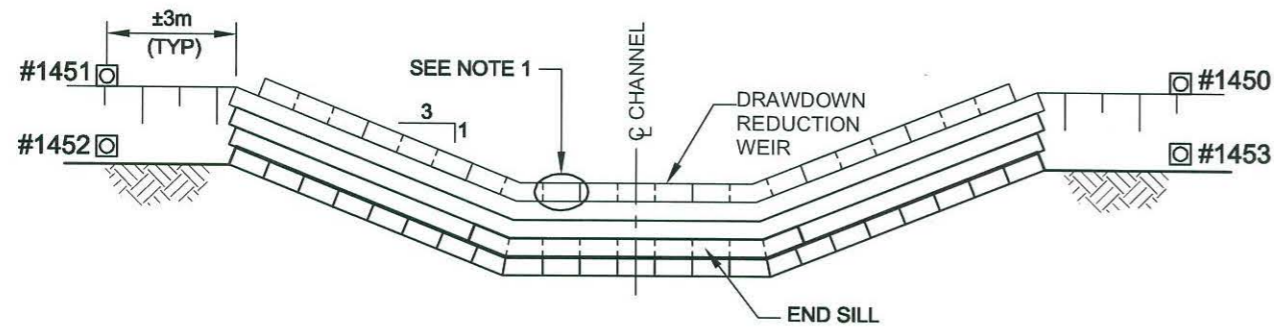
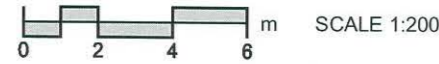
UMA Engineering Ltd., 2007. Government of Yukon, Former Clinton Creek Asbestos Mine – Long Term Performance Monitoring - 2006 – April 2007.

**2007 Site Inspection
Photographs and Video**

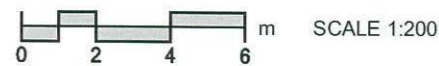
Drawings



DROP STRUCTURE PLAN VIEW (AS CONSTRUCTED)

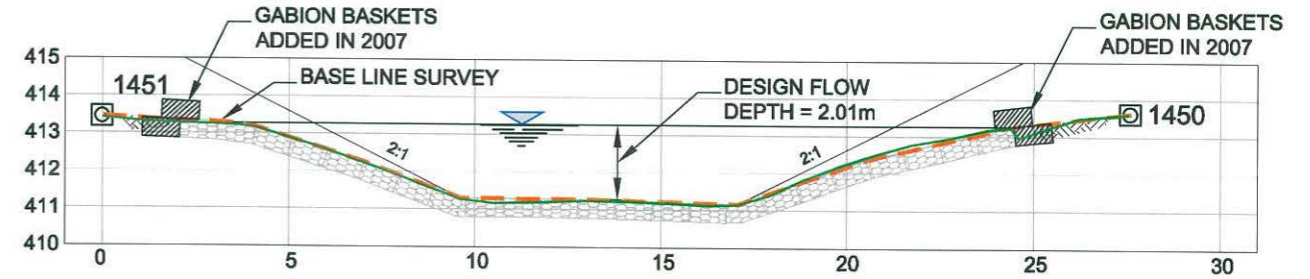


DROP STRUCTURE END VIEW (AS CONSTRUCTED)

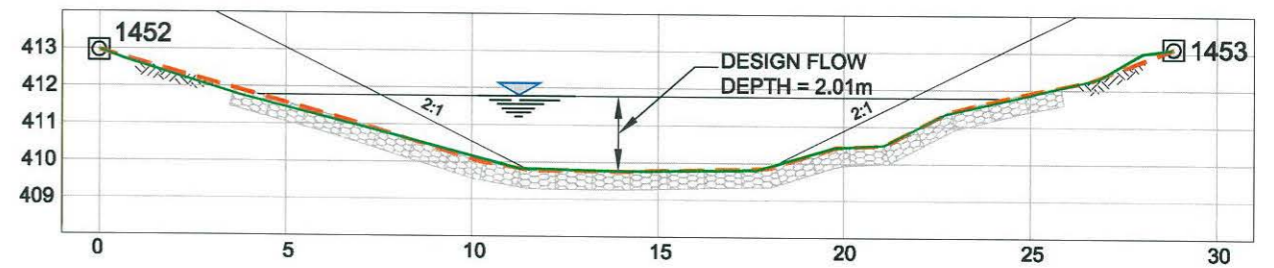


☐ CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN) INSTALLED DURING 2006 SURVEY.

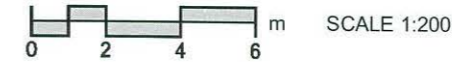
NOTE 1: GABION FILL REMOVED FROM THIS CELL OF THE DRAWDOWN WEIR IN 2007 TO AID IN DRAWING DOWN THE LEVEL IN HUDGEON LAKE DURING LOW FLOW PERIODS.



SECTION 1



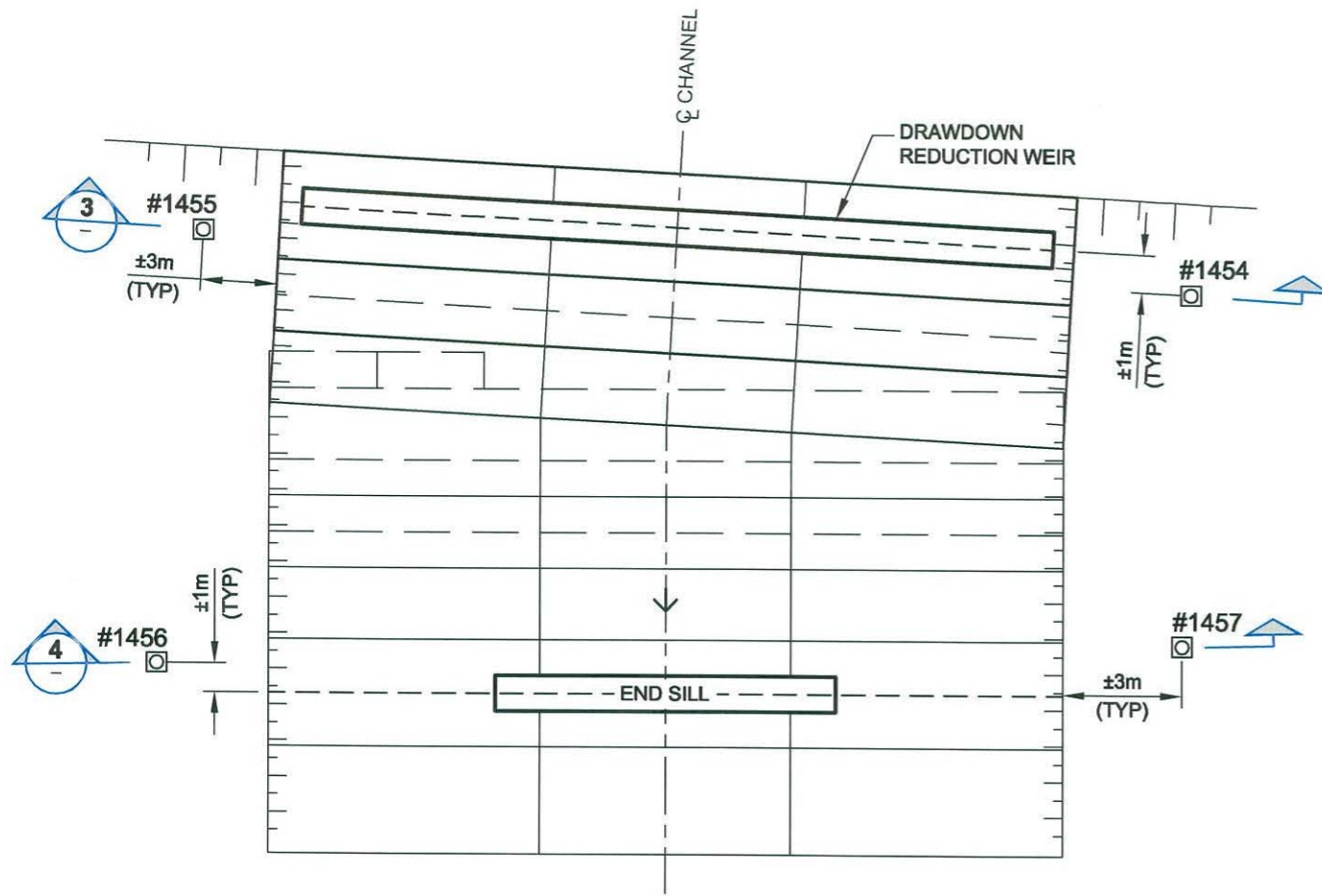
SECTION 2



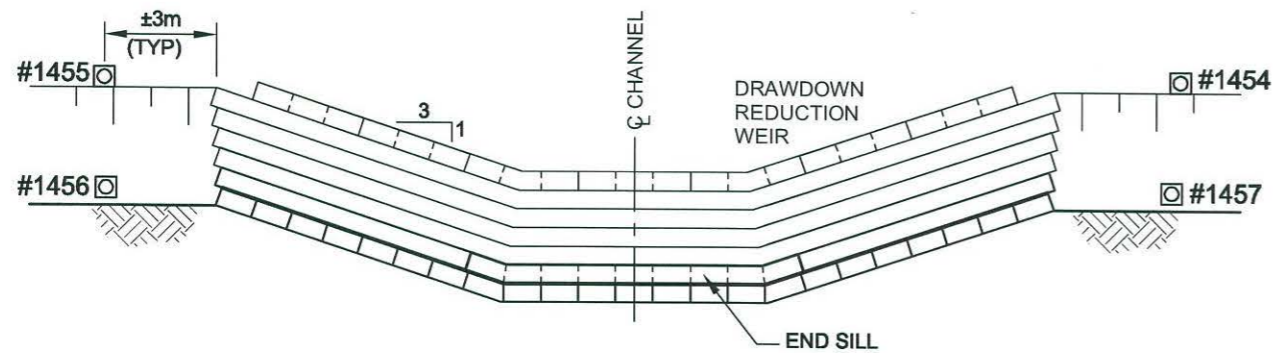
--- BASE LINE SURVEY (2006)
— SURVEY (2007)

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Long Term Performance Monitoring - 2007

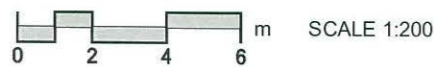
Drop Structure #1



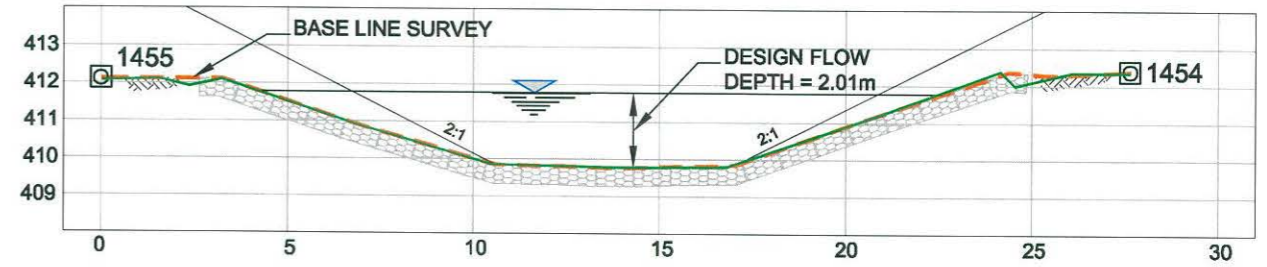
DROP STRUCTURE PLAN VIEW (AS CONSTRUCTED)



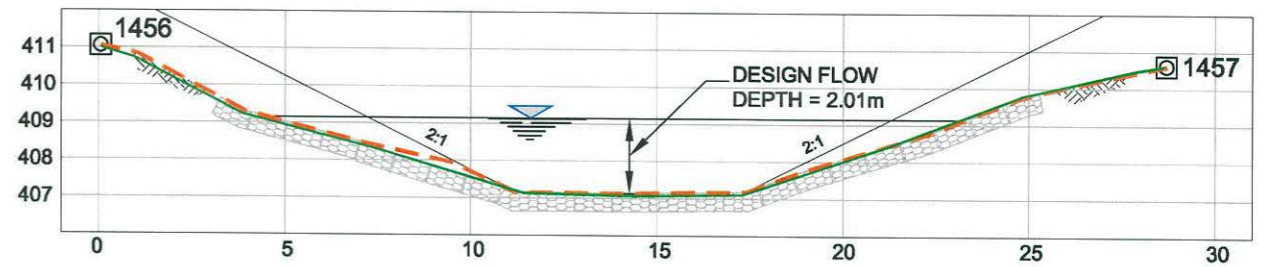
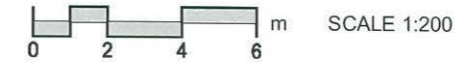
DROP STRUCTURE END VIEW (AS CONSTRUCTED)



☐ CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN) INSTALLED DURING 2006 SURVEY.



SECTION 3



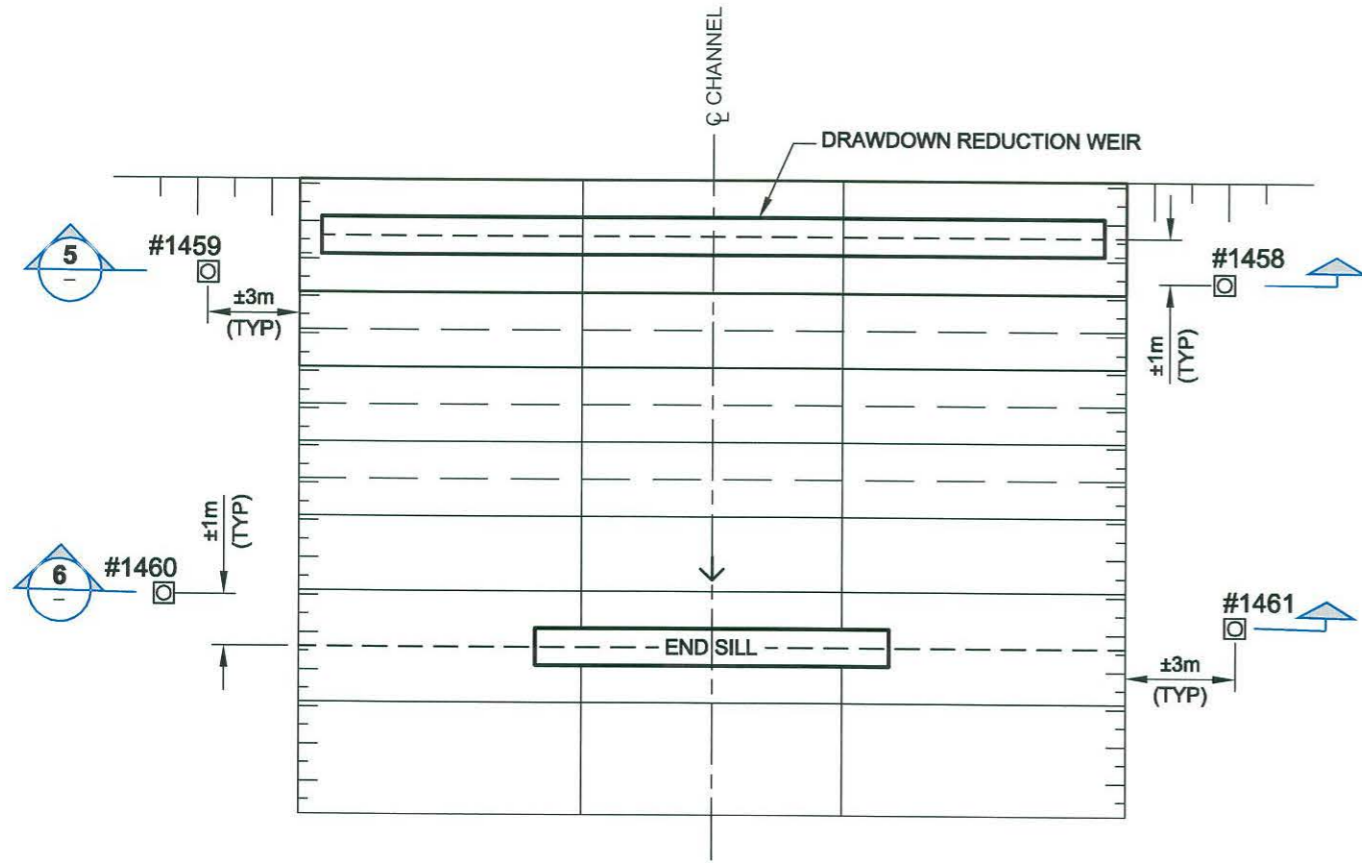
SECTION 4



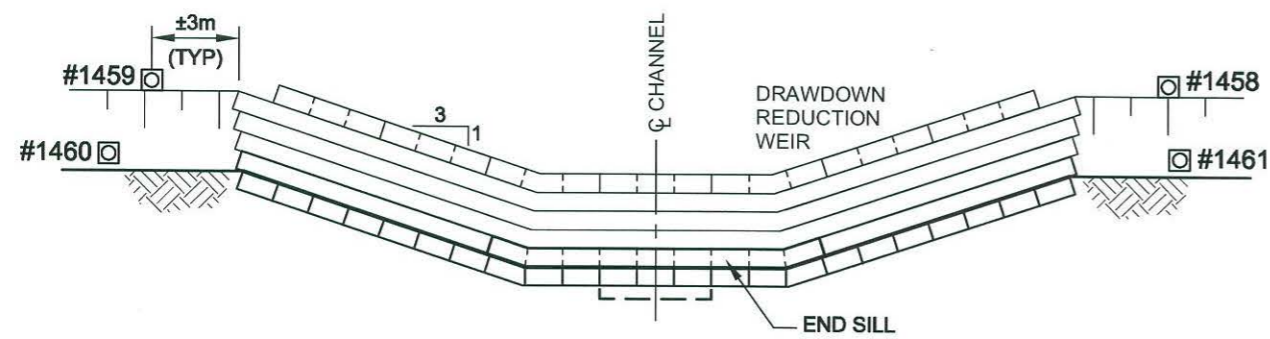
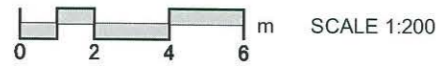
--- BASE LINE SURVEY (2006)
 — SURVEY (2007)

Government of Yukon
 Former Clinton Creek Asbestos Mine
 Long Term Performance Monitoring - 2007

Drop Structure #2



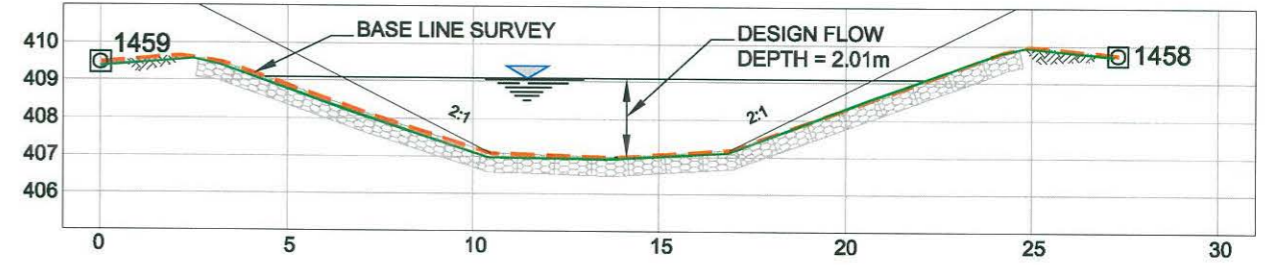
DROP STRUCTURE PLAN VIEW (AS CONSTRUCTED)



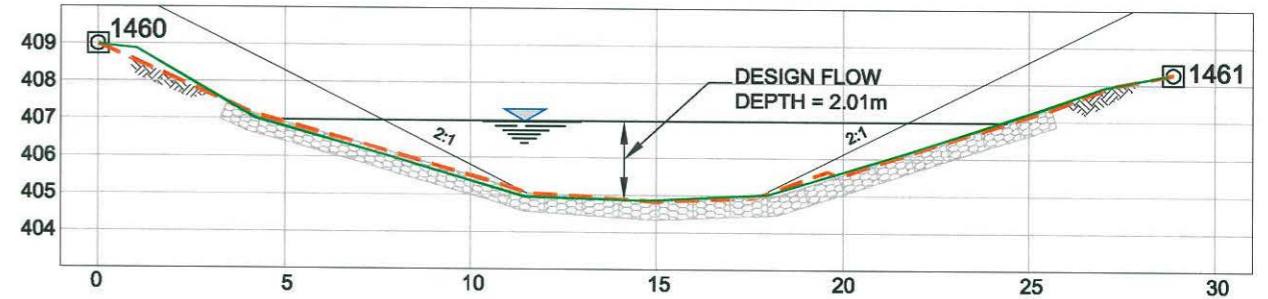
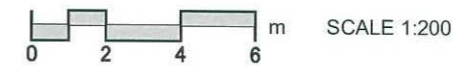
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☐ CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN) INSTALLED DURING 2006 SURVEY.



SECTION 5



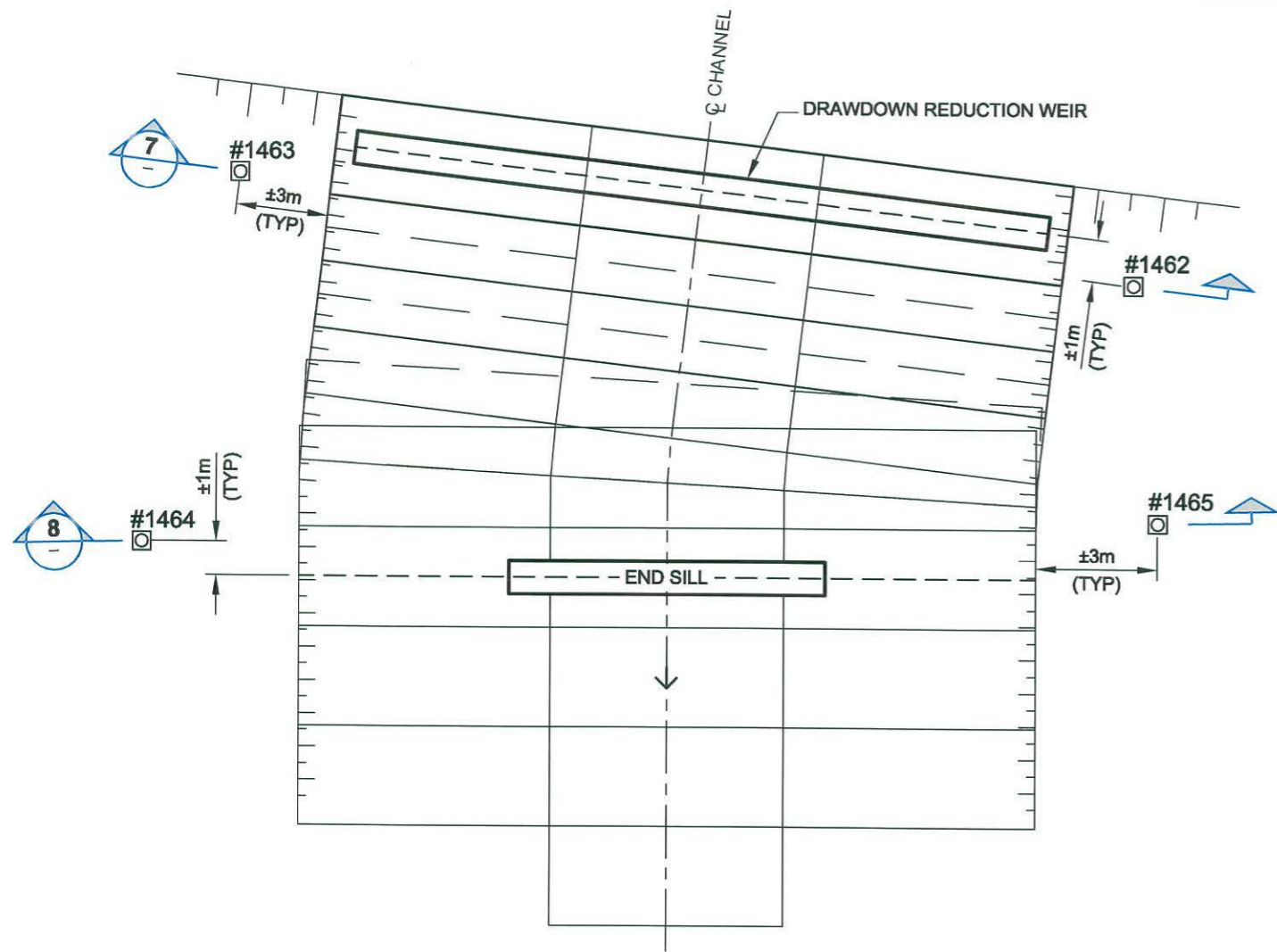
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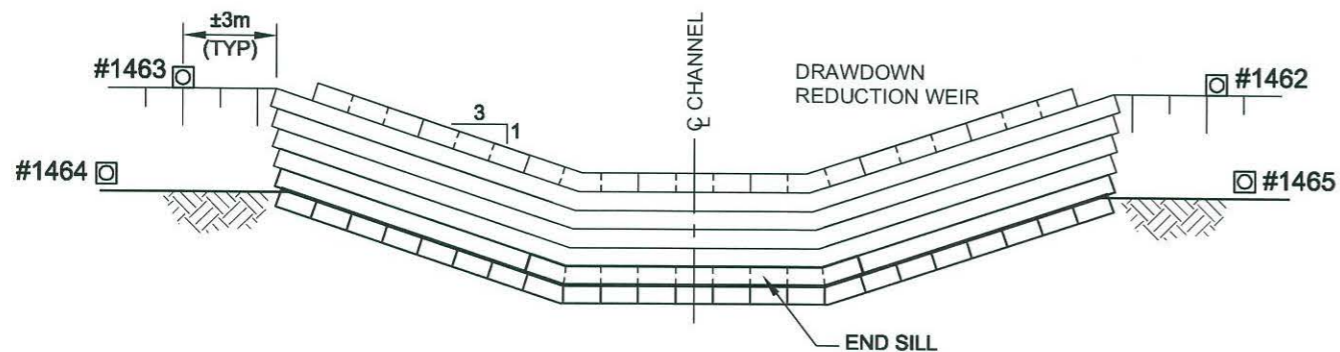
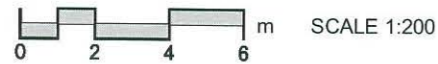
--- BASE LINE SURVEY (2006)
 — SURVEY (2007)

Government of Yukon
 Former Clinton Creek Asbestos Mine
 Long Term Performance Monitoring - 2007

Drop Structure #3



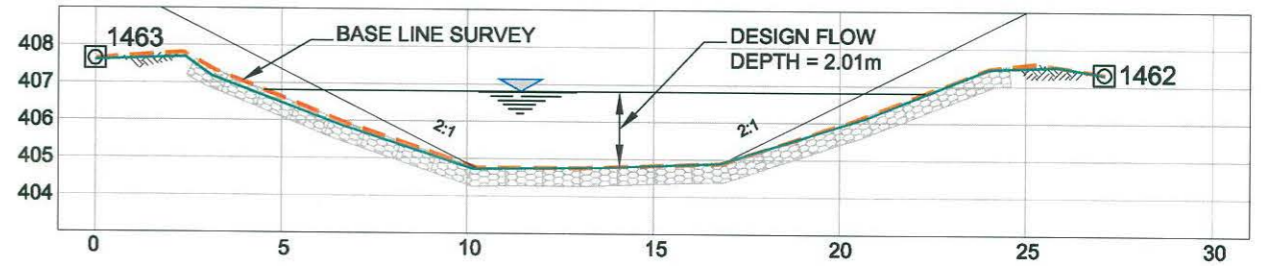
DROP STRUCTURE PLAN VIEW (AS CONSTRUCTED)



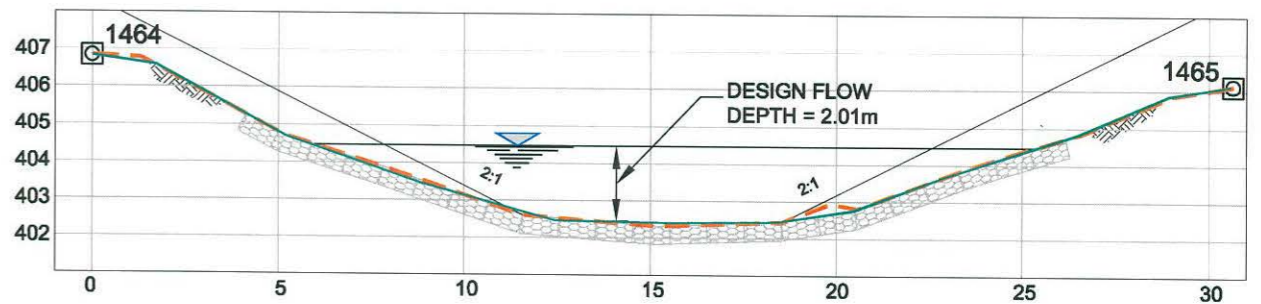
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□ CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN) INSTALLED DURING 2006 SURVEY.



SECTION 7



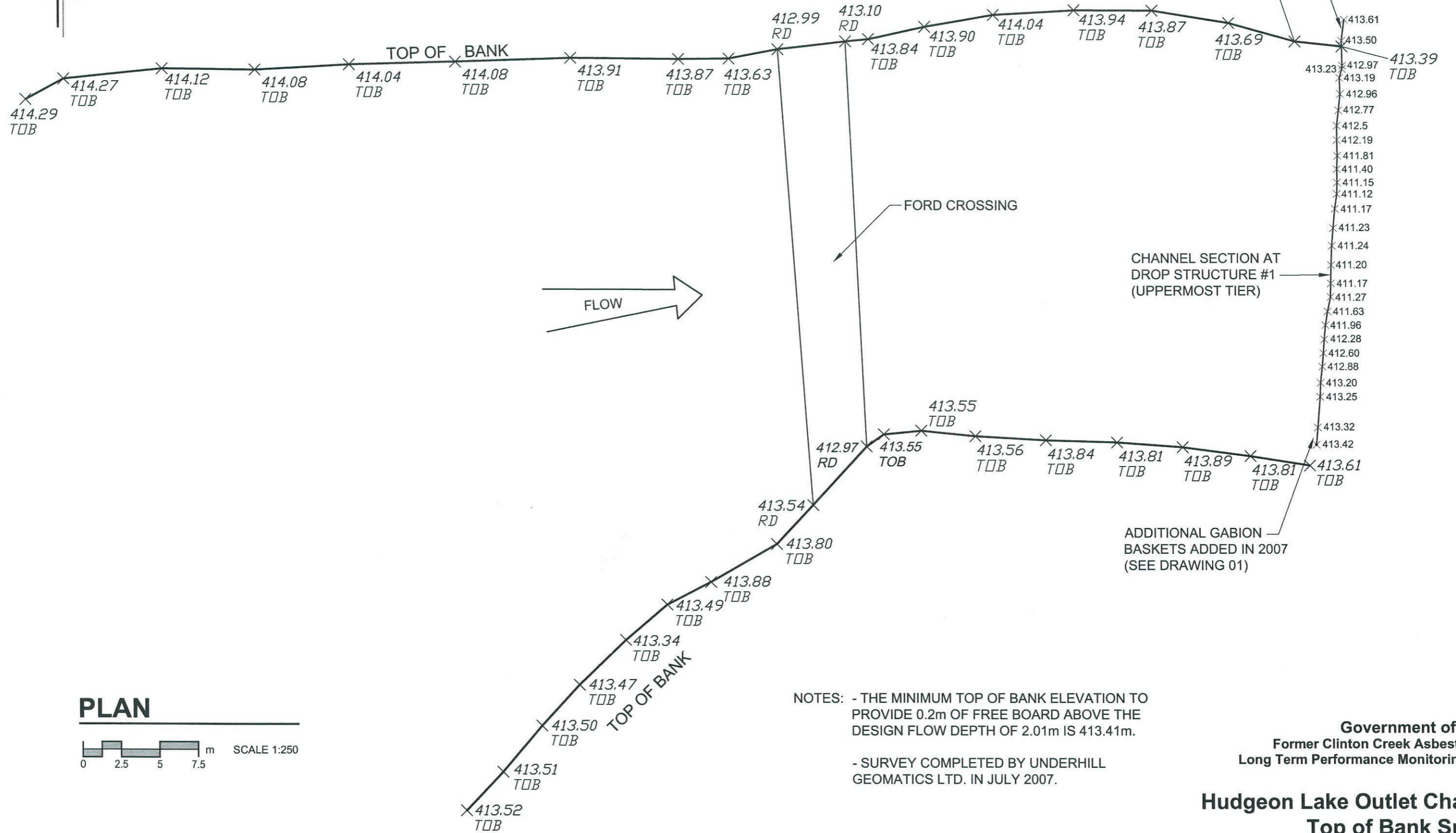
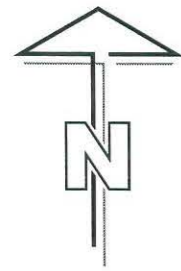
SECTION 8



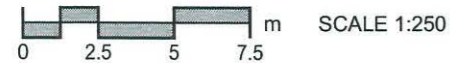
--- BASE LINE SURVEY (2006)
 — SURVEY (2007)

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 Long Term Performance Monitoring - 2007

Drop Structure #4



PLAN

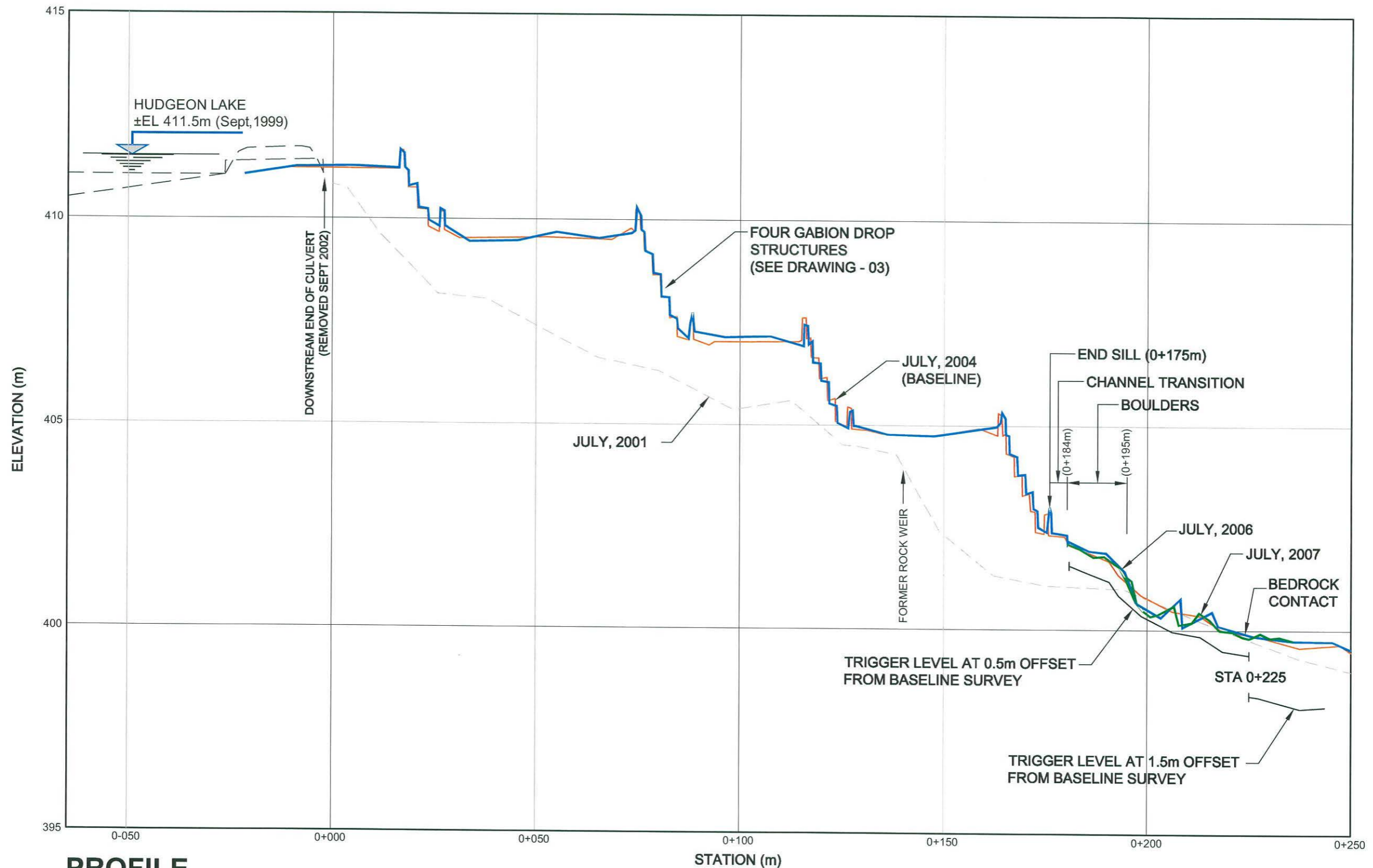


NOTES: - THE MINIMUM TOP OF BANK ELEVATION TO PROVIDE 0.2m OF FREE BOARD ABOVE THE DESIGN FLOW DEPTH OF 2.01m IS 413.41m.

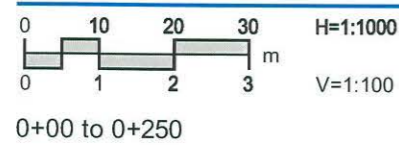
- SURVEY COMPLETED BY UNDERHILL GEOMATICS LTD. IN JULY 2007.

Government of Yukon
Former Clinton Creek Asbestos Mine
Long Term Performance Monitoring - 2007

Hudgeon Lake Outlet Channel Top of Bank Survey



PROFILE

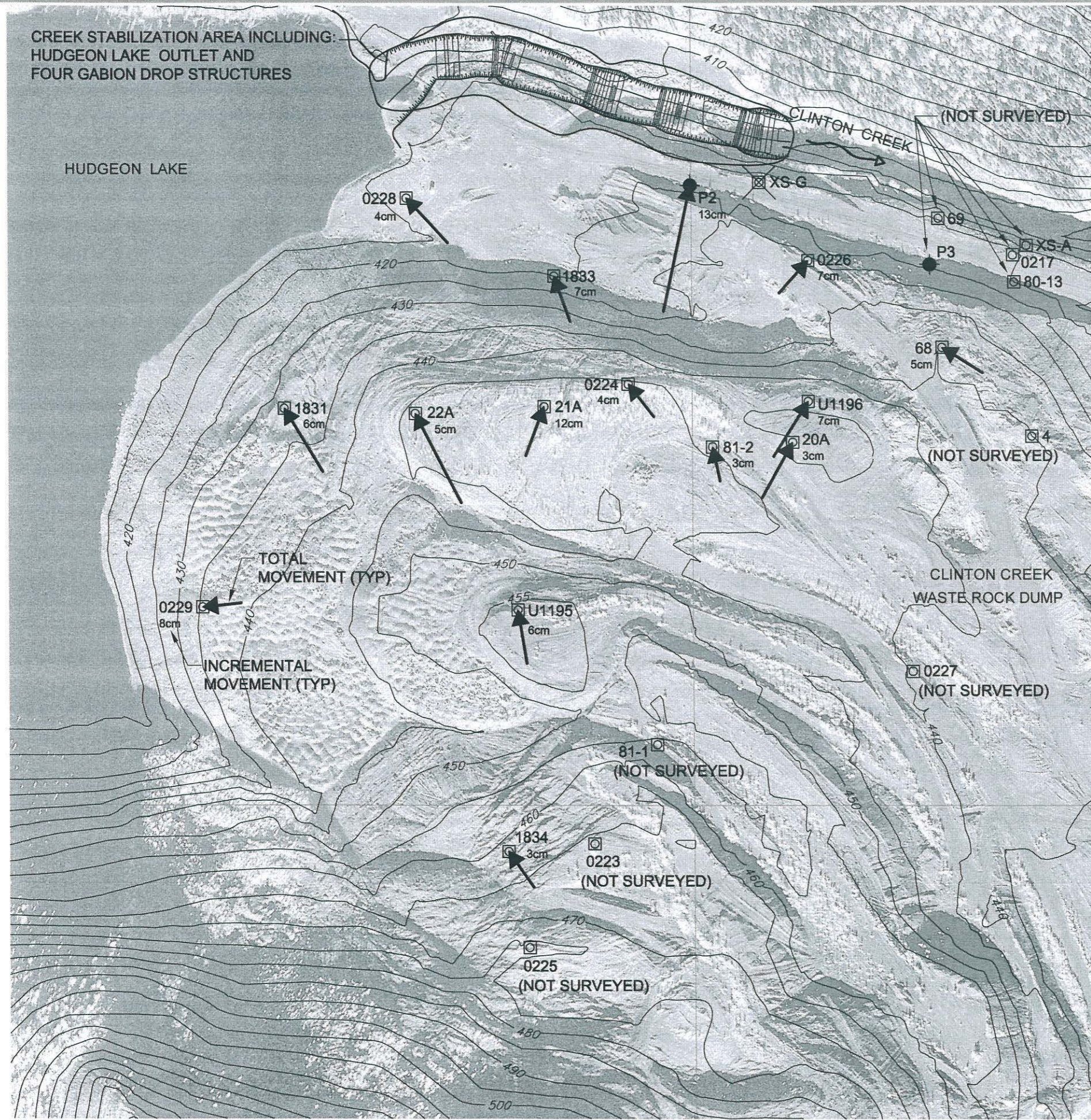


LEGEND

- PROFILE 2001
- PROFILE 2004 (BASELINE FOR LONG TERM MONITORING)
- PROFILE 2006
- PROFILE 2007

Government of Yukon
 Former Clinton Creek Asbestos Mine
 Long Term Performance Monitoring - 2007

Clinton Creek Channel Profile Station 0-050 to 0+250



ELEVATION >450± - UPPER SLOPE
 ELEVATION >420± <450± - MID SLOPE
 ELEVATION <420± LOWER SLOPE

- 0226 □ MONITOR LOCATION (ACTIVE)
- XS-G □ MONITOR LOCATION (DESTROYED)
- P2 ● PIEZOMETER LOCATION
- 8cm INCREMENTAL MOVEMENT (JULY 2006 - JULY 2007)
- 20cm → TOTAL MOVEMENT VECTOR (BASELINE TO JULY 2007)

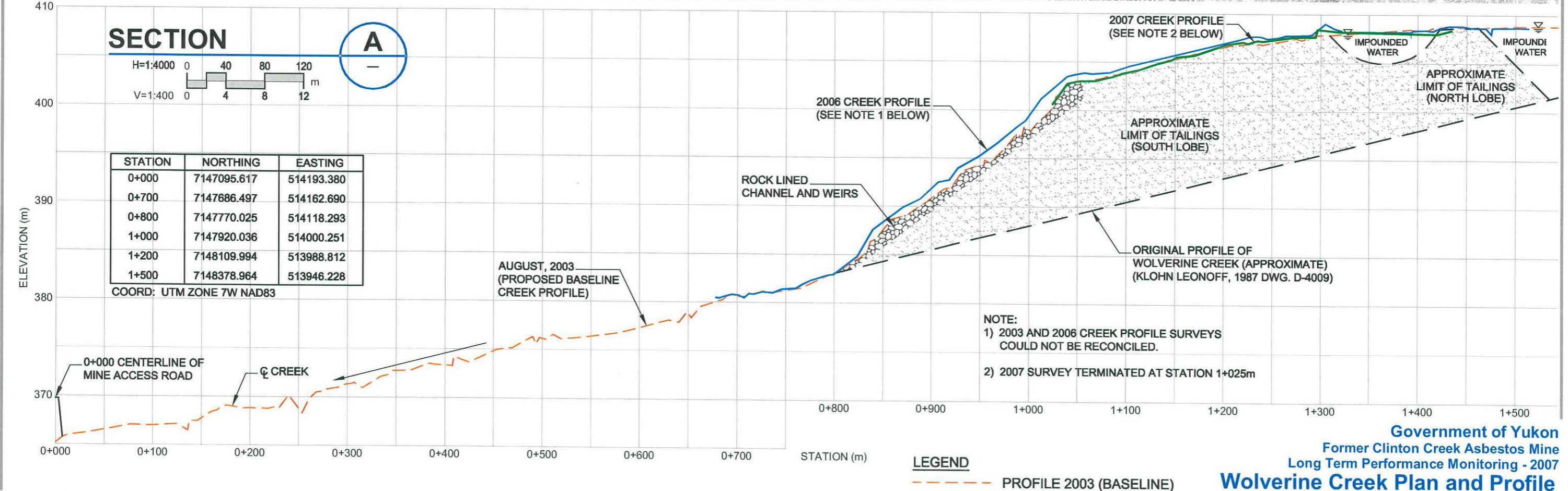
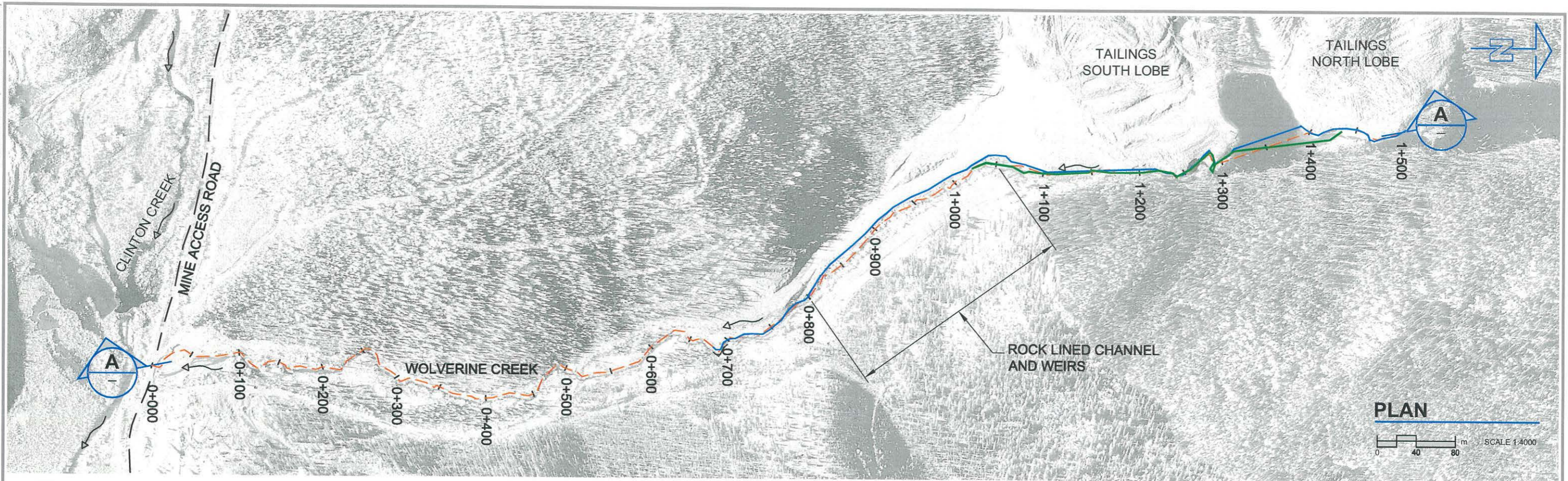
PLAN



UTM ZONE 7 NAD83
 IMAGE DATE 1999

Government of Yukon
 Former Clinton Creek Asbestos Mine
 Performance Monitoring

Clinton Creek Waste Rock Dump Movement Monitoring (2007)



Government of Yukon
Former Clinton Creek Asbestos Mine
Long Term Performance Monitoring - 2007
Wolverine Creek Plan and Profile

Appendix A
Recommendations for 2007 Maintenance Work

(Letter to Government of Yukon dated July 17, 2007)

UMA Engineering Ltd.
1479 Buffalo Place
Winnipeg, Manitoba R3T 1L7
T 204.284.0580 F 204.475.3646 www.uma.aecom.com

July 17, 2007

UMA Project: 6029 009 00 01 (4.6)

Mr. Hugh Copland, P.Eng., P.Geol.
Project Manager
Government of Yukon
Energy, Mines and Resources
Room 210 – 419 Range Road
P. O. Box 2703 (K-419)
Whitehorse, Yukon
Y1A 2C6

Dear Hugh:

**Re: Former Clinton Creek Mine
Recommendations for 2007 Maintenance Work**

The following maintenance work is recommended based on the site inspection conducted on July 4, 2007:

Stabilized Portion of the Clinton Creek Channel

Hudgeon Lake Outlet Channel

If the survey results from the July 4, 2007 survey indicate that the ground surface adjacent to the top of the channel upstream of Drop Structure #1 is less than elevation 413.4 m, it will be necessary to place additional fill material along this portion of the channel to ensure that at least 0.2 m of freeboard is provided. The need for this work will be confirmed once the survey results are received from Underhill Geomatics.

Gabion Drop Structures

- Top off gabion baskets (approximately 20 baskets) with 100 to 150 mm diameter rocks from the remaining stock piles of gabion fill material. The baskets to be topped off are located in Drop Structures 2, 3 and 4 and were marked with orange flagging at the time of the site visit. In general, the baskets to be filled have voids below the wire mesh that are about 150 to 200 mm deep and are located on the flat portion of the steps, not on the side slopes.
- Drop Structures 2, 3 and 4: As illustrated on Figure 01, there are small piles of gabion fill located on the surface of the gabion baskets adjacent to the outside corners of the End Sill. These rock piles need to be removed because they impact the cross-sections surveyed at these locations. The cross-section survey forms a component of the performance monitoring program.
- Drop Structure #2: place a patch over the hole on Tier #4 (middle step of the drop structure). The hole is located on the flat section of this row of baskets to the right of centerline (when facing downstream), as illustrated on Figure 02. The patch can be made by cutting a 1m x 1m panel from one of the leftover gabion baskets and should be fastened to the damaged basket using the C-rings used to assemble the gabion baskets.

- Drop Structure #3: remove the cobbles and boulders resting against the outside edges of the end sill. Water flowing over the drop structures, particularly at higher flows, may produce a 'rocking action' of the cobbles and boulders that could result in abrasion of the PVC coating on the gabions and expose the wire mesh leading to abrasion of the galvanized wire and premature corrosion.
- Remove all timber and logs trapped in the stabilized portion of the creek channel. The wood can be stockpiled on the south side of the channel for use by others as firewood.
- Remove all trees (mainly willows) growing inside the stabilized channel.
- Drop Structure #1:
 - It is our understanding that the Department of Fisheries and Oceans has asked if the water level in Hudgeon Lake is being impacted by Drop Structure #1 because the top row of baskets, including the drawdown weir, have plugged with organics. The organics have reduced the amount of water than can flow through the rock filled gabion baskets.

During the site inspection it was decided that one cell (1 m x 1 m x 0.5 m) could be removed from the drawdown weir to reduce the impact of the organics which have partially plugged the draw down weir. Creating an opening in the weir should allow the lake level to draw down to about the invert of the outlet channel upstream of the drop structure. Figures 03 and 04 illustrate the cell that can be removed, which is the end cell of the gabion basket. It is preferred to remove the end cell since the end panels of each basket have more reinforcement than the internal dividers, which will provide an extra layer of mesh covering the end of the adjacent basket.

Once the gabion fill is removed from the basket it may be necessary to allow the lake level to draw down for a few days to facilitate the remainder of the work. Once the lake level has reduced by about 300 mm, the wire mesh forming top and sides (upstream and downstream sides) of the cell need to be cut to form 3 flaps. The cuts should be made so that the bottom panel and the end panels of the cell/basket are left in their current position fastened to the adjacent basket. The flaps shall be wrapped around and fastened to protect and reinforce the end of the newly exposed face (internal cell diaphragm) of the basket. Use the C-ring staples to fasten the flaps to the diaphragm.

- As illustrated on the attached sketch (Figure 04), three gabion baskets shall be added to the top row of the drop structure at the top of the channel slope on each side of the drop structure. This work is required to maintain a minimum of 0.2 m of free board during high flow events. One basket should be installed beside the existing basket at the top of the channel slope and the extra basket placed on top straddling the last two baskets on channel slope. A third basket should be placed on top of the existing row of baskets at a 45 degree angle to re-direct water back into the channel in the event where the channel is running at or slightly above capacity.

Creek Channel Downstream of Drop Structure #4

- A short stretch of the channel between the last drop structure and the point where bedrock is exposed in the channel needs to have some scour holes filled in with rock to prevent further deterioration. This section of the channel is critical to minimize channel degradation and the potential for undermining of the last drop structure. Figure 05 illustrates where the work is to be done. The open water areas in the creek

bottom should be partially filled with 300 to 600 mm diameter boulders spaced about 300 to 500 mm apart. The resulting voids should be infilled with rocks less than 300 mm diameter in size and placed to a depth that maintains the general grade of the channel. It is expected that the upper 1/3 to 1/4 of the boulders will protrude above the rock used to infill the voids between the boulders. The rocks and boulders placed on the bottom of the channel should tie into the rocks lining the north side of the channel.

- The boulders on the north side of the channel should have the voids infilled with smaller rocks (100 to 200 mm diameter) to protect the underlying fine grained soil from erosion during high flow events.

Wolverine Creek

Rock Lined Channel

In general the rock lined section of the Wolverine Creek channel is in good repair after about 30 years of use. Based on the site inspection observations, the only work recommended at this time is to remove debris (e.g. wood posts) and trees from the middle area of the channel (Figure 06) because they may restrict flow during high flow events and increase the likelihood of water overtopping the channel sides and eroding the tailings in the adjacent area. The trees located within 2 m of the boulders forming the sides of the channel should be left in place. The trees to be removed should be cut-off about 200 mm above the creek channel base. Place the cut portion of the tree amongst the trees to be left in place along the outside edges the channel.

Channel Across the South Lobe of the Tailings Pile

The channel across the South Lobe is in a similar condition to that observed in previous site inspections. There is an old beaver dam at the upstream end of the South Lobe that redirects the creek flow directly back at the tailings pile and has resulted in some erosion of the tailings in this area, as illustrated on Figure 07. If feasible, the beaver dam should be removed to allow the creek flow to run parallel to the edge of the tailings. There have been no signs of recent beaver activity in the last two site visits so it is not expected that the dam will be reconstructed.

Sincerely,

UMA Engineering Ltd.



Gil Robinson, M.Sc., P.Eng.
Geotechnical Engineer
Earth and Water
/dh



Figure 01: Remove deposit of gabion fill at outside corners of end sills.

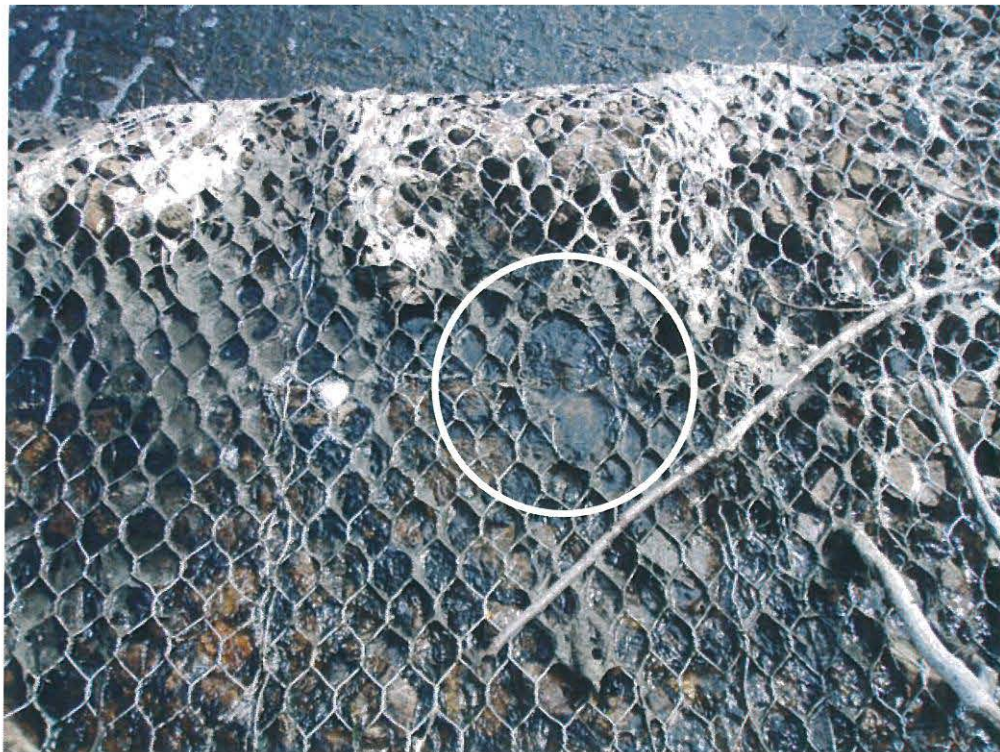


Figure 02 - Drop Structure #2, Middle Tier: Hole in basket to be patched.

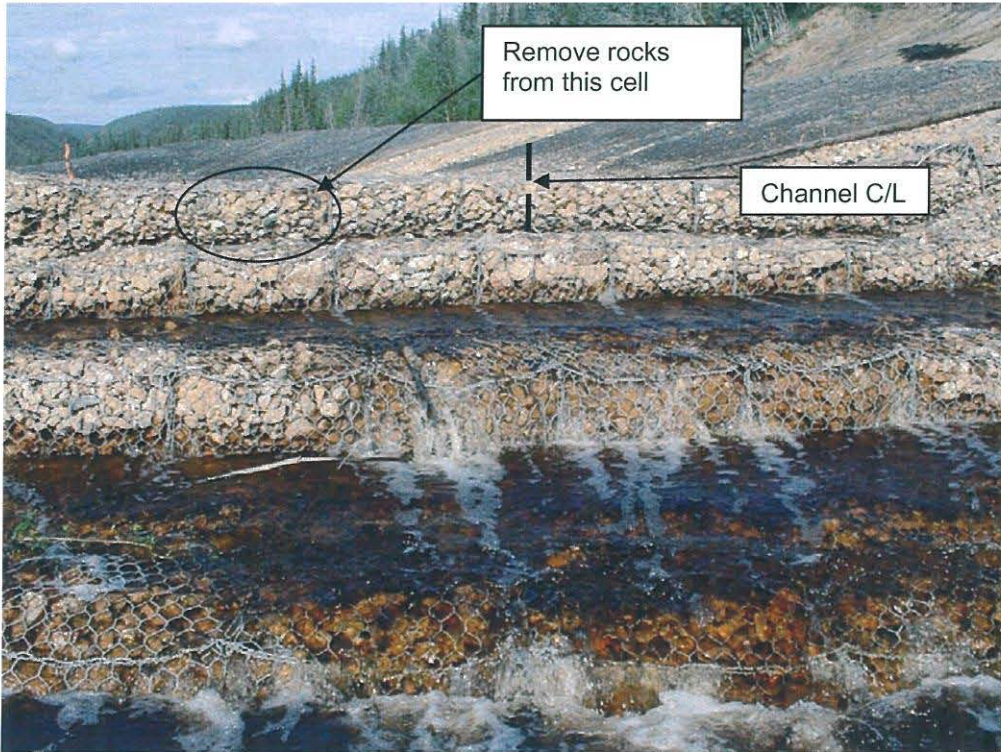


Figure 03 - Drop Structure #2, draw down weir: Remove rocks from the cell shown in the photograph.

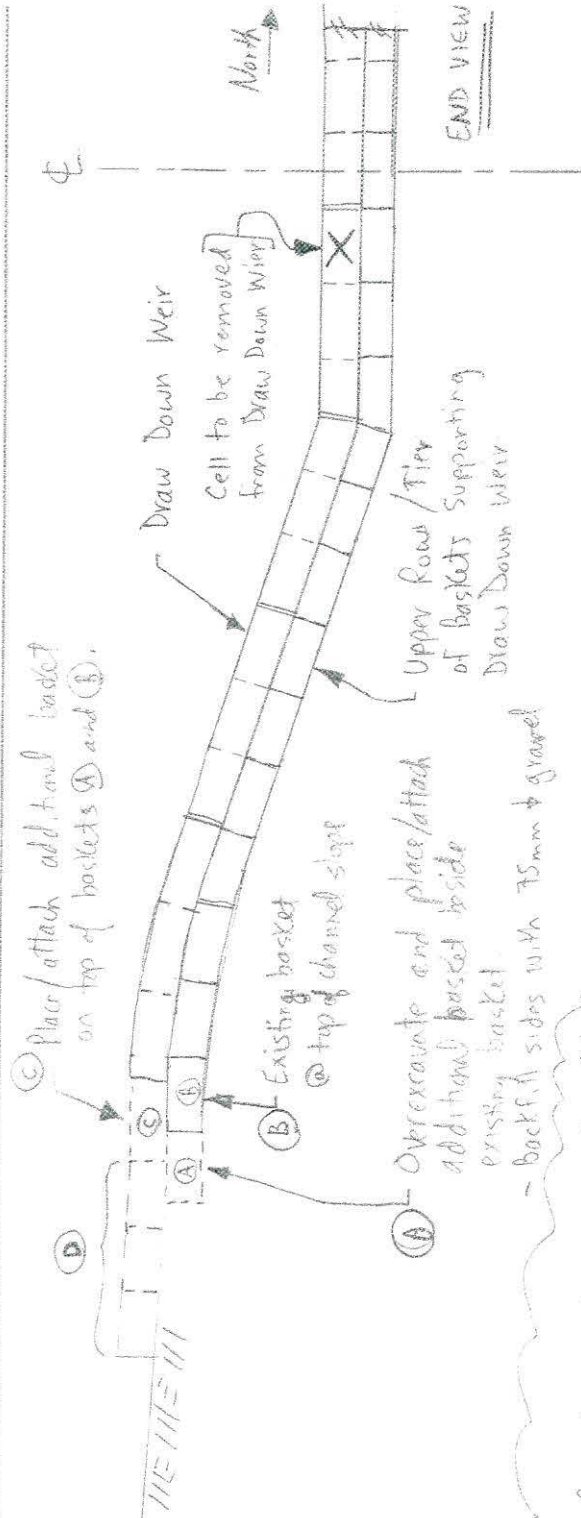
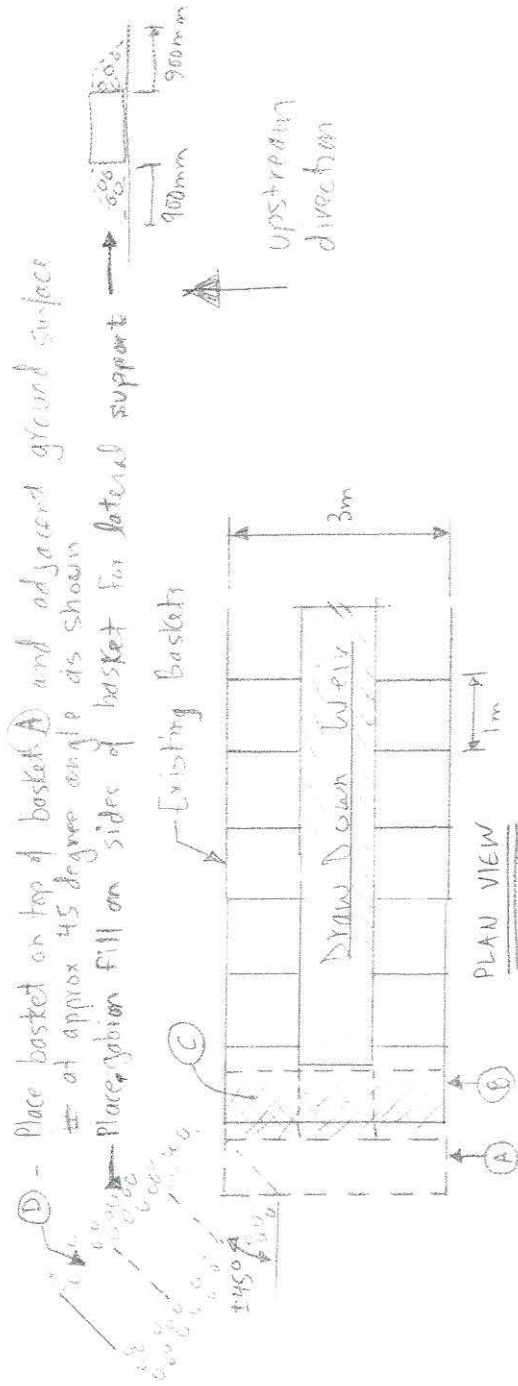


FIGURE 04

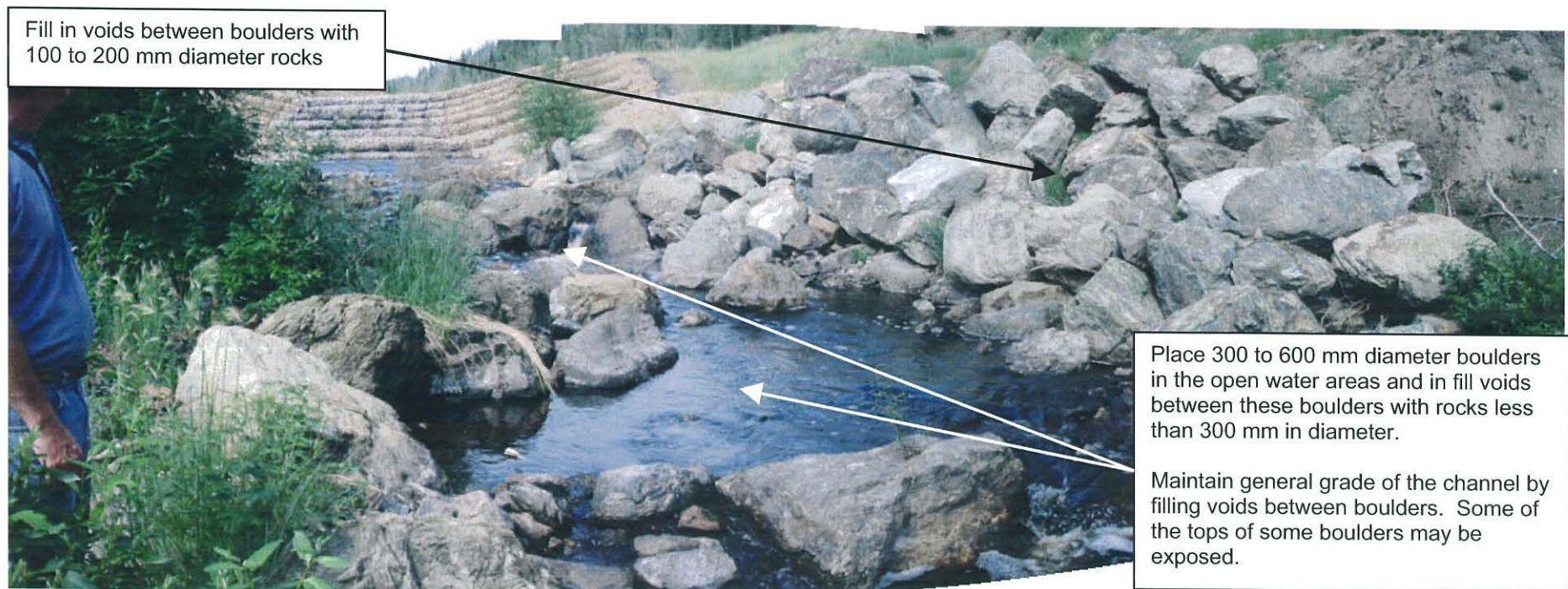


Figure 05 - Channel transition downstream of Drop Structure #4: Channel armoring required.

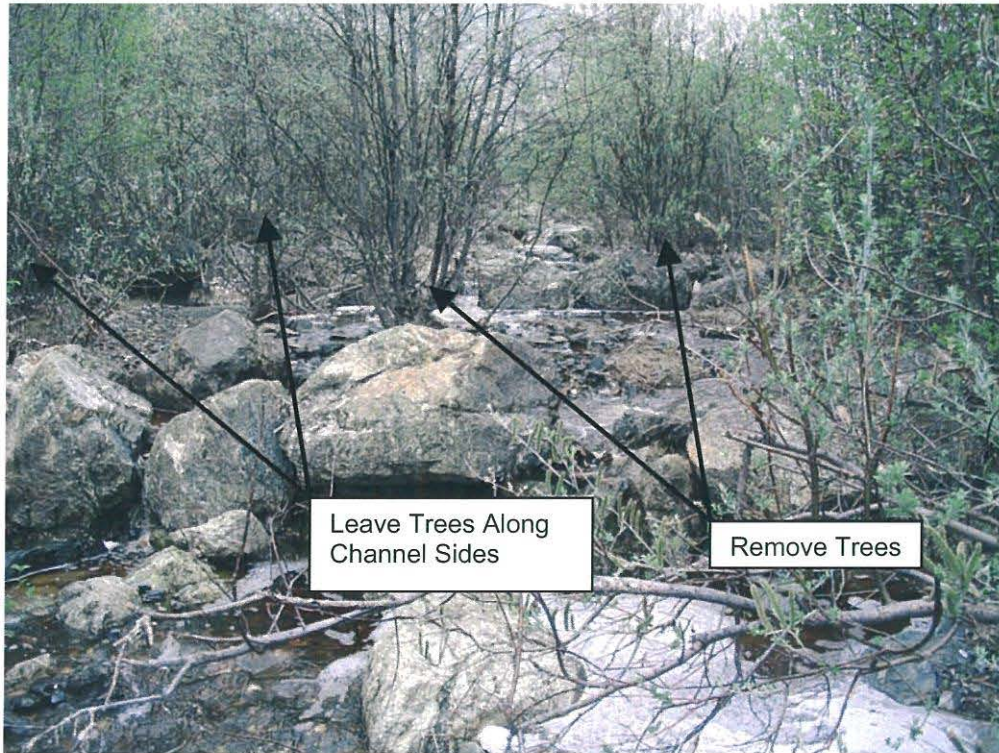


Figure 06 - Wolverine Creek – rock lined channel: remove debris and trees growing in the channel, leave trees growing along the outer 2 m width of the channel.



Figure 07 - Wolverine Creek along south lobe of tailings pile: Beaver dam to be removed if possible.

Appendix B
Survey Results From Underhill Geomatics

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM (AUGUST 2006)

**UTM COORDINATES
NAD 83, Zone 7, 141° West**

Survey date 28-Jul-06

CONTROL			
	NORTHING	EASTING	ORTHOMETRIC HEIGHT
1086	7147972.219	513176.710	590.955
1192	7147564.009	512278.758	441.286
2834	7148172.719	513447.524	607.146
2835	7147272.645	513147.179	432.938
2836	7146814.619	513092.380	478.168
5698	7147458.764	512825.164	415.050

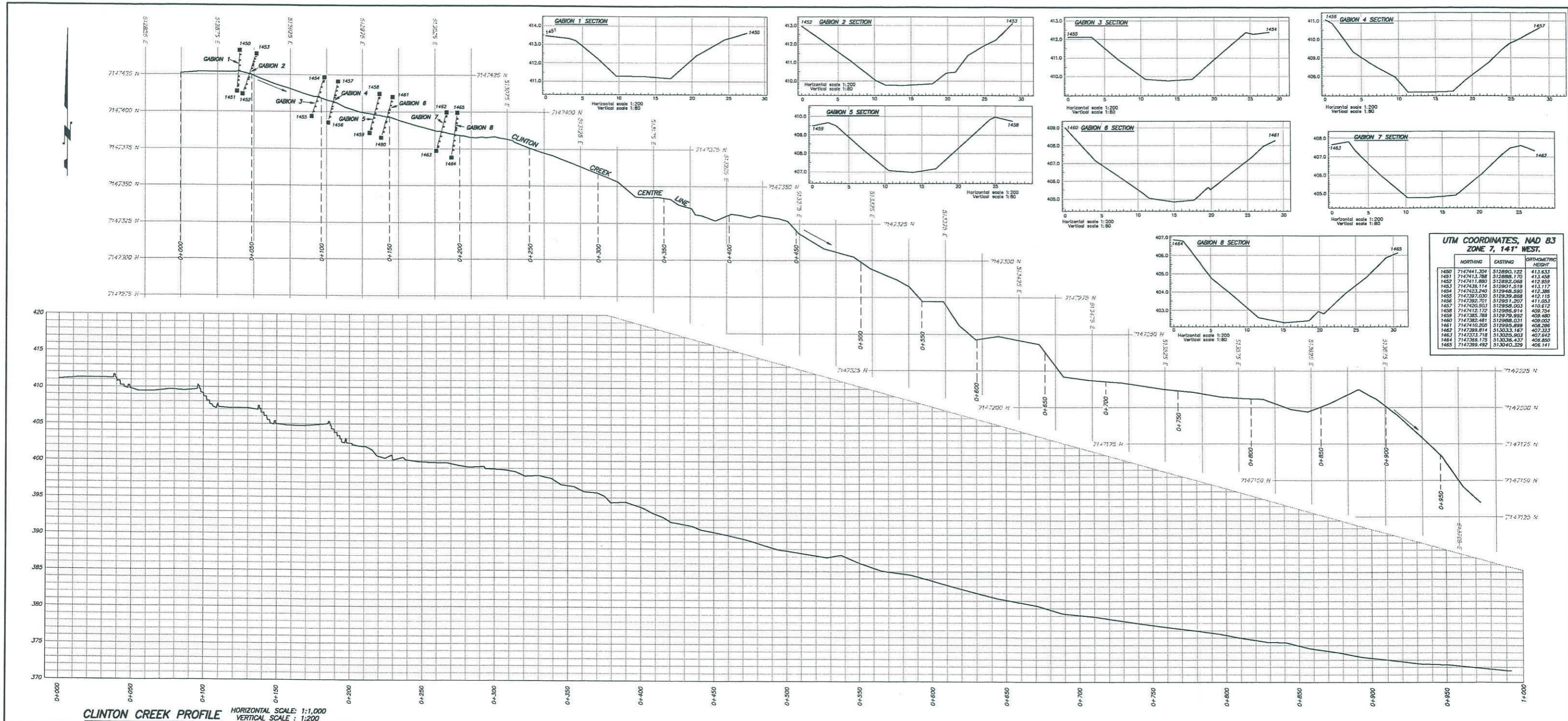
Coordinates are NAD 83 UTM grid, derived from a least squares adjustment of GPS observations holding values of stations 5698 and 1086 fixed in 3D.

WOLVERINE CREEK TAILINGS PILES			
	NORTHING	EASTING	ORTHOMETRIC HEIGHT
2834	7,148,172.719	513,447.524	607.146
1083	7,148,354.026	513,936.743	414.061
1084	7,148,018.002	513,618.940	515.984
1085	7,148,346.077	513,666.465	488.816
1483	7,148,233.057	513,412.703	608.996
1484	7,148,150.100	513,962.627	417.980
1485	7,148,018.164	513,705.012	479.623
1489	7,148,305.124	513,928.618	413.619
1491	7,148,376.898	513,869.237	432.339
1492	7,148,053.676	513,410.039	609.788
1495	7,148,526.672	513,529.020	529.058
2005-02	7,148,118.323	513,817.414	447.768
2005-05	7,148,000.645	513,782.242	464.513
2005-1	7,148,100.130	513,758.452	463.638
2005-10	7,148,146.969	513,925.660	411.802
2005-11	7,148,176.453	513,942.334	411.957
2005-3	7,148,108.351	513,870.582	428.035
2005-4	7,148,047.268	513,876.558	428.263
2005-6	7,147,999.736	513,866.222	433.216
2005-7	7,148,000.073	513,945.390	416.364
2005-8	7,148,038.813	513,971.059	415.789
2005-9	7,148,124.552	513,969.464	420.278
24	7,148,033.921	513,525.892	549.369
24-A	7,148,035.660	513,777.191	464.471
24-B	7,148,045.693	513,834.658	445.459
24-D	7,148,072.445	513,921.532	422.294
25-B	7,148,065.812	513,949.047	422.148
26	7,148,341.500	513,483.576	575.067
26-A	7,148,339.326	513,540.543	557.709
350-1A	7,148,298.652	513,822.903	447.931
350-2A	7,148,300.519	513,874.081	428.520
350-3A	7,148,312.162	513,899.340	417.289
500-1	7,148,343.238	513,725.559	474.095
500-2	7,148,344.388	513,842.527	438.022
650-1	7,148,408.772	513,701.346	483.893
650-2	7,148,400.246	513,816.267	439.697
80-1	7,148,408.021	513,543.144	555.553
80-2	7,148,290.088	513,549.604	552.541
80-4	7,148,201.897	513,690.347	501.140
80-5	7,148,249.549	513,719.405	480.959
80-7	7,148,343.990	513,891.158	422.372
80-9	7,147,996.355	513,970.798	411.120
BH-14	7,148,488.374	513,563.023	530.338
BH-16 T8 CORD	7,148,048.791	513,762.765	464.195
BH-16 T8 POST	7,148,048.998	513,763.332	464.461
NL-1	7,148,365.702	513,942.695	413.153
NL-3	7,148,334.747	513,927.079	417.084
NL-4	7,148,307.120	513,913.194	416.112
NL-5	7,148,275.137	513,897.102	415.414
NL-BASE	7,148,154.782	513,836.229	431.376
SL-1	7,148,078.843	513,971.095	419.835
SL-2	7,148,087.075	513,957.681	422.654
SL-3	7,148,101.129	513,933.984	420.863
SL-4	7,148,115.912	513,907.912	416.816
SL-5	7,148,133.855	513,876.515	422.785

Real Time Kinematic base for tailings survey

CLINTON CREEK WASTE ROCK DUMP			
	NORTHING	EASTING	ORTHOMETRIC HEIGHT
2835	7,147,272.645	513,147.179	432.938
4	7,147,211.160	513,193.613	435.063
68	7,147,262.021	513,142.361	434.310
69	7,147,335.493	513,140.519	414.910
217	7,147,314.718	513,183.156	414.858
218	7,147,222.197	513,433.176	388.091
219	7,147,292.124	513,274.621	404.621
220	7,147,223.417	513,430.884	388.680
222	7,147,269.510	513,334.934	397.993
223	7,146,978.118	512,942.727	467.206
224	7,147,241.171	512,963.286	444.785
225	7,146,918.769	512,905.177	475.145
226	7,147,311.555	513,066.415	426.359
227	7,147,076.818	513,124.774	439.453
228	7,147,347.133	512,836.728	413.920
229	7,147,113.553	512,719.106	437.385
1194	7,147,017.427	513,472.438	433.084
1195	7,147,111.952	512,899.496	456.561
1196	7,147,231.284	513,066.231	443.966
1493	7,146,801.846	513,576.599	452.894
1830	7,146,523.788	513,455.675	471.728
1831	7,147,227.356	512,766.550	432.713
1832	7,146,537.038	513,483.162	473.681
1833	7,147,302.781	512,921.237	418.345
1834	7,146,973.691	512,893.357	461.090
1837	7,146,502.876	513,411.444	470.239
1838	7,146,491.872	513,380.525	468.381
1839	7,146,861.403	513,285.195	428.595
2836	7,146,814.581	513,092.369	478.120
2838	7,147,271.247	513,328.531	399.085
2839	7,147,334.925	513,144.941	414.601
20-A	7,147,207.883	513,057.144	445.691
21-A	7,147,228.259	512,915.109	446.383
22-A	7,147,224.400	512,841.264	444.813
570S	7,146,977.441	513,497.335	436.715
80-13	7,147,299.345	513,183.823	413.104
80-14	7,147,267.647	513,283.104	403.797
81-1	7,147,034.804	512,978.920	455.183
81-2	7,147,205.278	513,011.594	443.711
84-1	7,147,201.090	513,504.630	381.825
BH-02	7,146,883.125	513,275.133	424.243
BH-1	7,146,863.698	513,381.506	422.917
BH-10	7,147,354.500	512,999.344	415.985
BH-4	7,146,871.229	513,025.091	471.130
BH-7	7,147,239.444	513,347.502	397.338
BH-8	7,147,182.915	513,461.402	387.241
BH-9	7,147,309.300	513,135.533	415.189
photo-target	7,147,186.132	513,554.593	379.038
ROD	7,146,818.359	513,088.055	478.312
XS-A	7,147,315.671	513,189.815	413.347
XS-B	7,147,293.671	513,274.181	404.307
XS-E	7,147,224.660	513,432.163	387.587

Real Time Kinematic base for waste rock dump survey



**UTM COORDINATES, NAD 83
ZONE 7, 141° WEST.**

	NORTHING	EASTING	ORTHOMETRIC HEIGHT
1450	7147441.324	5128803.222	413.833
1451	7147413.788	5128802.170	413.458
1452	7147411.880	5128802.068	412.859
1453	7147428.114	5129012.519	413.117
1454	7147423.240	5129468.580	412.386
1455	7147387.030	5129399.868	412.115
1456	7147382.701	5129512.207	411.053
1457	7147455.053	5129508.003	410.612
1458	7147412.172	512986.814	409.754
1459	7147385.789	5129799.982	409.480
1460	7147382.481	512986.831	409.005
1461	7147410.205	5129955.899	408.286
1462	7147388.814	5130333.167	407.323
1463	7147373.718	5130255.803	407.642
1464	7147388.175	5130336.437	408.850
1465	7147388.492	5130410.329	406.141

CLINTON CREEK PROFILE
 HORIZONTAL SCALE: 1:1,000
 VERTICAL SCALE: 1:200

UNDERHILL GEOMATICS LTD.
 PROFESSIONAL LAND SURVEYORS
 WHITEHORSE, YUKON TERRITORY

Iron Bar placed shown thus ■
 Distances shown are horizontal at general ground level and are expressed in metres.
 Coordinates are NAD 83, Zone 7, derived from GPS dual frequency phase observations holding coordinates of UGL station 2835 fixed in 3D

REV	Y	M	D	REVISION DESCRIPTION	DRN	CHK	APP	CLND
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GOVERNMENT OF YUKON **CLINTON CREEK PROFILE**
 LONG TERM PERFORMANCE MONITORING PROGRAM

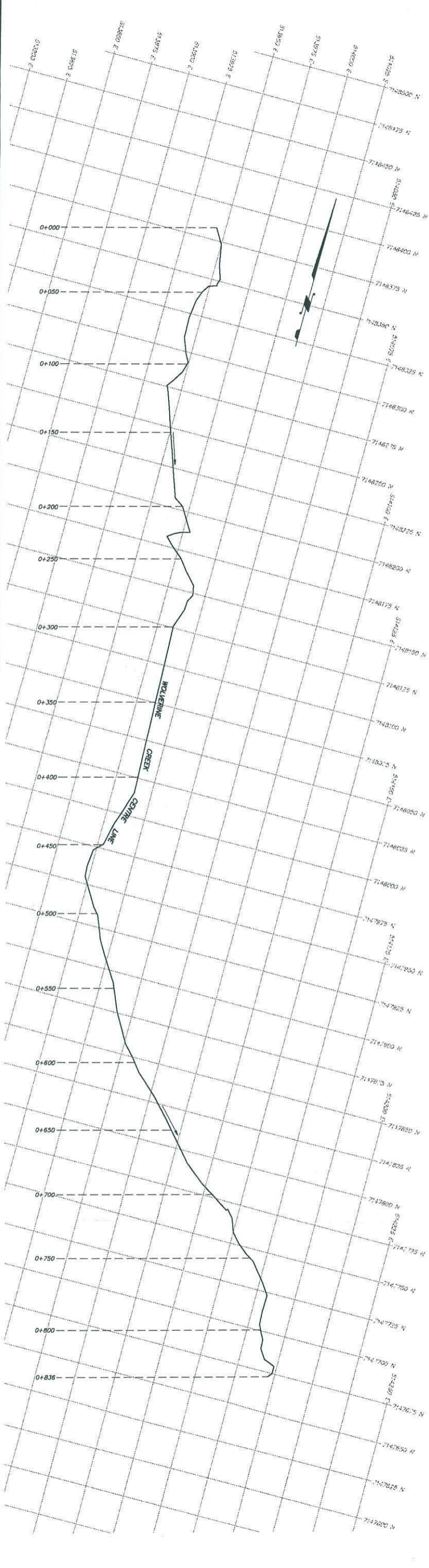
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Distances shown are horizontal of ground ground level and are expressed in metres.
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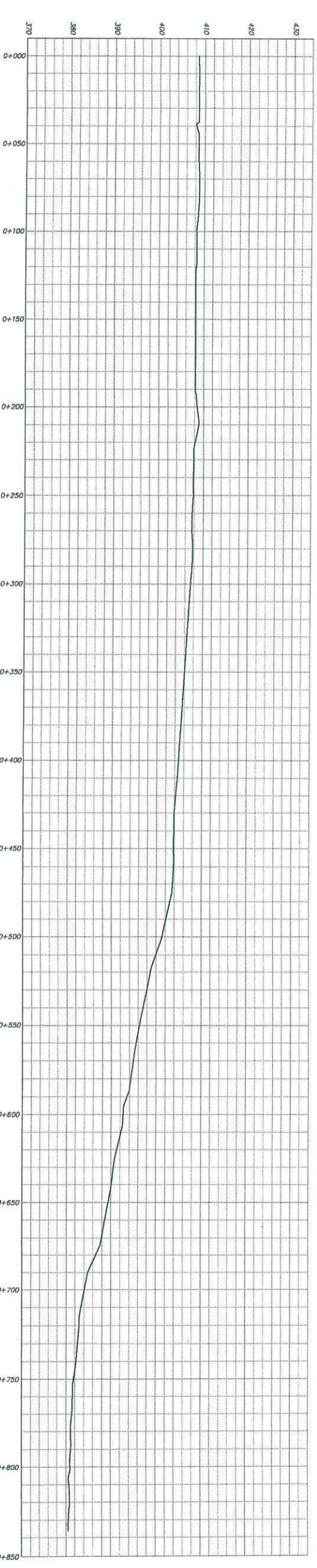
REV	T	M	D	REVISION DESCRIPTION	DATE	BY	CHK	APP
0	08	08	18	ISSUED				

SCALE		THE NUMBER		THE NUMBER		THE NUMBER	
1:1000		06086		SK5570		1/1	

GOVERNMENT OF YUKON		WOLVERINE CREEK PROFILE	
		LONG TERM PERFORMANCE MONITORING PROGRAM	



WOLVERINE CREEK PROFILE
 HORIZONTAL SCALE: 1:1,000
 VERTICAL SCALE: 1:200



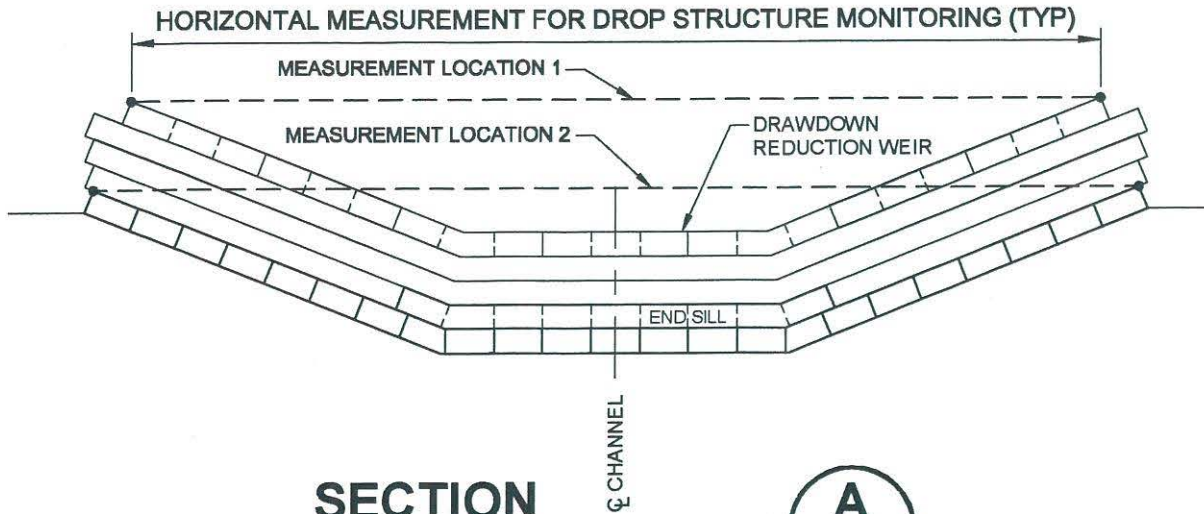
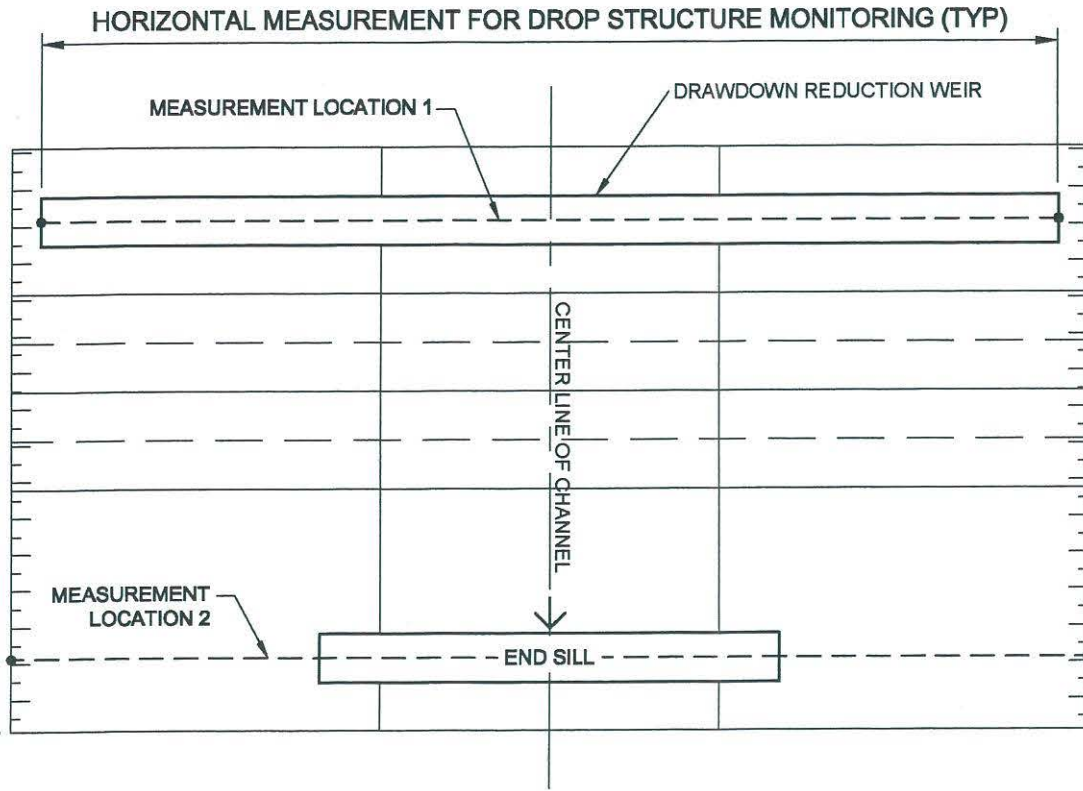
Appendix C
Gabion Drop Structure Monitoring

A SIZE 8.5" x 11" (215.9mm x 279.4mm)

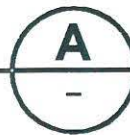
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Saved By: jylberg

UMA FILE NAME: 6029-009-00_02-H-F031_RX.dwg



SECTION



SCALE 1:150

Government of Yukon
Former Clinton Creek Asbestos Mine
Long Term Performance Monitoring

Drop Structure Measurement Locations

Client: Government of Yukon
 Project: Former Clinton Creek Asbestos Mine - Channel Stabilization
 Job No.: 6029-009-00
 Date: 21-Sep-07

Table C-1) Former Clinton Creek Asbestos Mine - Clinton Creek Drop Structure Monitoring

Measurement Location #1 - Across Drawdown Weir

Drop Structure	Horizontal Distance Across Drop Structure (metres)						Incremental Change (m) June 2006 to July 2007	Total Change (m)	Comment
	Date 29-Jul-04	Date 22-May-05	Date 21-Jun-06	Date 03-Oct-06	Date 04-Jul-07	Date 21-Sep-07			
1	19.62	19.57	19.57	19.58	19.51	19.55	-0.06	-0.07	survey tags 1 & 2
2	19.49	19.48	19.48	19.48	19.43	19.48	-0.05	-0.01	survey tags 5 & 6
3	19.44	19.32	19.25	19.21	19.14	19.17	-0.11	-0.27	survey tags 9 & 10
4	n/a	19.61	19.55	19.51	19.43	19.46	-0.12	-0.15	survey tags 13 & 14

Measurement Location #2 - Across Lower Tier In-Line With End Sill

Drop Structure	Horizontal Distance Across Drop Structure (metres)						Incremental Change (m) June 2006 to July 2007	Total Change (m)	Comment
	Date 29-Jul-04	Date 22-May-05	Date 21-Jun-06	Date 03-Oct-06	Date 04-Jul-07	Date 21-Sep-07			
1	n/a	21.00	20.99	20.90	20.83	20.85	-0.16	-0.15	survey tags 3 & 4
2	n/a	21.15	21.06	21.05	21.01	21.01	-0.05	-0.14	survey tags 7 & 8
3	n/a	21.50	21.31	21.31	21.25	21.24	-0.06	-0.26	survey tags 11 & 12
4	n/a	21.48	21.46	21.36	21.34	21.35	-0.12	-0.13	survey tags 15 & 16

Year	Monitored By	Average	-0.09	-0.15
2004	UMA	Minimum	-0.05	-0.01
2005	UMA	Maximum	-0.16	-0.27
2006	Gov of Yukon			
2007	UMA (July) / GY (Sept)			

Survey tags installed in September 2006

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine
Job No.: 6029-009-00
Date: 04-Jul-07

**Table C-6) Former Clinton Creek Asbestos Mine - Clinton Creek Drop Structure Monitoring
 Channel Closure Monitor Pins #1450 to #1465**

Location #1 - Across The Drawdown Weir

Drop Structure	Horizontal Distance Across Drop Structure (metres)						Total Change (m)	Comment
	Date	Date	Date	Date	Date	Date		
	28-Jul-06	04-Jul-07						
1	27.59	27.56					-0.03	survey tags 1450 & 1451
2	27.62	27.60					-0.02	survey tags 1454 & 1455
3	27.28	27.21					-0.07	survey tags 1458 & 1459
4	27.09	27.11					0.02	survey tags 1462 & 1463

Location #2 - Across Lower Tier

Drop Structure	Horizontal Distance Across Drop Structure (metres)						Total Change (m)	Comment
	Date	Date	Date	Date	Date	Date		
	28-Jul-06	04-Jul-07						
1	28.83	28.76					-0.07	survey tags 1452 & 1453
2	28.62	28.58					-0.04	survey tags 1456 & 1457
3	28.82	28.69					-0.13	survey tags 1460 & 1461
4	30.57	30.53					-0.04	survey tags 1464 & 1465

Year	Monitored By
2006	Installed by Underhill Geomatics Limited
2007	Underhill Geomatics Limited

Average	-0.05
Maximum	0.02
Minimum	-0.13

Appendix D
Waste Rock Dump Movement Monitoring Results

Table D-1) Waste Rock Dump Stability - Summary of Monitors Surveyed in July 2007

Monitor	Date	UTM Coordinates			Horizontal Movement				Vertical Movement			
		Northing (metres)	Easting (metres)	Elevation (metres)	total (metres)	total	increment (metres)	rate (metres/year)	total (metres)	incremental (metres)	rate (metres/year)	
UPPER SLOPE MONITORS												
1195 Upper Slope	19-Jun-01	7,147,111.83	512,899.53	456.62	0.10	0.00	0.10	0.05	0.16	0.16	0.08	
	20-Aug-03	7,147,111.94	512,899.53	456.59	0.20	0.11	0.11	0.05	0.13	-0.03	-0.01	
	28-Jul-04	7,147,111.95	512,899.52	456.60	0.22	0.12	0.02	0.02	0.14	0.01	0.01	
	28-Jul-06	7,147,111.95	512,899.50	456.56	0.22	0.13	0.03	0.01	0.10	-0.04	-0.02	
	04-Jul-07	7,147,112.01	512,899.50	456.54	0.27	0.18	0.06	0.06	0.08	-0.02	-0.03	
1834 Upper Slope	19-Jun-01	n/a										
	20-Aug-03	7,146,973.62	512,893.43	461.12	0.00	0.00						
	28-Jul-04	7,146,973.64	512,893.38	461.09	0.06	0.06	0.06	0.06	-0.03	-0.03	-0.03	
	28-Jul-06	7,146,973.69	512,893.36	461.09	0.11	0.11	0.06	0.03	-0.03	0.00	0.00	
	04-Jul-07	7,146,973.72	512,893.36	461.08	0.13	0.13	0.03	0.03	-0.04	-0.01	-0.01	
MID SLOPE MONITORS												
20A Mid Slope	19-Jun-01	7,147,207.71	513,057.05	445.86	9.00	0.00	0.22	0.11	2.21	0.05	0.03	
	20-Aug-03	7,147,207.86	513,057.14	445.83	9.17	0.17	0.17	0.08	2.24	-0.03	-0.01	
	28-Jul-04	7,147,207.85	513,057.12	445.74	9.15	0.15	0.02	0.03	2.33	-0.09	-0.09	
	28-Jul-06	7,147,207.88	513,057.14	445.69	9.19	0.19	0.05	0.02	2.38	-0.05	-0.03	
	04-Jul-07	7,147,207.91	513,057.16	445.66	9.22	0.22	0.03	0.03	2.41	-0.03	-0.03	
21A Mid Slope	19-Jun-01	7,147,228.14	512,915.05	446.57	9.45	0.00	0.20	0.10	-3.12	0.05	0.02	
	20-Aug-03	7,147,228.20	512,915.15	446.54	9.50	0.11	0.11	0.05	-3.15	-0.03	-0.02	
	28-Jul-04	7,147,228.18	512,915.11	446.43	9.48	0.07	0.04	0.05	-3.26	-0.11	-0.11	
	28-Jul-06	7,147,228.26	512,915.11	446.38	9.56	0.13	0.08	0.04	-3.31	-0.05	-0.02	
	04-Jul-07	7,147,228.30	512,915.11	446.37	9.60	0.17	0.12	0.13	-3.33	-0.06	-0.02	
22A Mid Slope	19-Jun-01	7,147,224.10	512,841.41	445.02	12.02	0.00	0.19	0.10	4.45	-0.03	-0.02	
	20-Aug-03	7,147,224.29	512,841.31	444.99	12.23	0.22	0.22	0.10	4.48	-0.03	-0.01	
	28-Jul-04	7,147,224.27	512,841.30	444.88	12.22	0.21	0.02	0.02	4.59	-0.11	-0.12	
	28-Jul-06	7,147,224.40	512,841.26	444.81	12.35	0.33	0.13	0.07	4.66	-0.07	-0.03	
	04-Jul-07	7,147,224.45	512,841.23	444.77	12.40	0.39	0.05	0.06	4.70	-0.04	-0.05	
68 Mid Slope	19-Jun-01	7,147,261.98	513,142.46	434.49	7.86	0.00	0.02	0.01	-2.56	-0.15	-0.08	
	20-Aug-03	7,147,262.03	513,142.42	434.42	7.86	0.07	0.07	0.03	-2.63	-0.07	-0.03	
	28-Jul-04	7,147,262.00	513,142.42	434.33	7.84	0.05	0.03	0.04	-2.72	-0.09	-0.09	
	28-Jul-06	7,147,262.02	513,142.36	434.31	7.81	0.11	0.06	0.03	-2.74	-0.02	-0.01	
	04-Jul-07	7,147,262.06	513,142.33	434.27	7.82	0.15	0.05	0.05	-2.78	-0.04	-0.04	
81-2 Mid Slope	19-Jun-01	7,147,205.22	513,011.60	443.70	2.70	0.00	0.15	0.08	-2.04	0.04	0.02	
	20-Aug-03	7,147,205.29	513,011.56	443.75	2.73	0.07	0.07	0.03	-1.99	0.05	0.02	
	28-Jul-04	7,147,205.26	513,011.60	443.71	2.73	0.03	0.05	0.05	-2.03	-0.04	-0.05	
	28-Jul-06	7,147,205.28	513,011.59	443.71	2.74	0.05	0.02	0.01	-2.03	0.00	0.00	
	04-Jul-07	7,147,205.31	513,011.58	443.69	2.76	0.09	0.03	0.04	-2.05	-0.02	-0.02	
224 Mid Slope	19-Jun-01	n/a										
	20-Aug-03	7,147,241.09	512,963.33	444.85	0.00	0.00						
	28-Jul-04	7,147,241.12	512,963.29	444.82	0.04	0.04	0.04	0.05	-0.03	-0.03	-0.03	
	28-Jul-06	7,147,241.17	512,963.29	444.79	0.09	0.09	0.05	0.03	-0.06	-0.03	-0.02	
	04-Jul-07	7,147,241.19	512,963.25	444.74	0.12	0.12	0.04	0.04	-0.11	-0.05	-0.05	
229 Mid Slope	19-Jun-01	n/a										
	20-Aug-03	7,147,113.53	512,719.14	437.43	0.00	0.00						
	28-Jul-04	7,147,113.49	512,719.14	437.37	0.04	0.04	0.04	0.05	-0.06	-0.06	-0.06	
	28-Jul-06	7,147,113.55	512,719.11	437.39	0.04	0.04	0.07	0.04	-0.05	0.02	0.01	
	04-Jul-07	7,147,113.52	512,719.04	437.37	0.11	0.11	0.08	0.08	-0.06	-0.02	-0.02	
1196 Mid Slope	19-Jun-01	7,147,231.16	513,066.14	444.13	0.17	0.00	0.17	0.09	0.03	0.03	0.01	
	20-Aug-03	7,147,231.23	513,066.18	444.08	0.25	0.08	0.08	0.04	-0.02	-0.05	-0.02	
	28-Jul-04	7,147,231.26	513,066.20	444.05	0.29	0.12	0.04	0.04	-0.06	-0.03	-0.03	
	28-Jul-06	7,147,231.28	513,066.23	443.97	0.32	0.16	0.04	0.02	-0.14	-0.08	-0.04	
	04-Jul-07	7,147,231.35	513,066.26	443.93	0.39	0.23	0.07	0.08	-0.18	-0.04	-0.04	
1831 Mid Slope	19-Jun-01	n/a										
	20-Aug-03	7,147,227.18	512,766.65	432.85	0.00	0.00						
	28-Jul-04	7,147,227.23	512,766.60	432.79	0.07	0.07	0.07	0.08	-0.06	-0.06	-0.07	
	28-Jul-06	7,147,227.36	512,766.55	432.71	0.20	0.20	0.13	0.07	-0.14	-0.07	-0.04	
	04-Jul-07	7,147,227.41	512,766.51	432.67	0.27	0.27	0.06	0.07	-0.18	-0.04	-0.04	
LOWER SLOPE MONITORS												
1833 Lower Slope	19-Jun-01	n/a										
	20-Aug-03	7,147,302.70	512,921.25	418.34	0	0.00	0	0	0	0	0.00	
	28-Jul-04	7,147,302.69	512,921.27	418.30	0.02	0.02	0.02	0.02	-0.04	-0.04	-0.04	
	28-Jul-06	7,147,302.78	512,921.24	418.35	0.08	0.08	0.10	0.05	0.01	0.04	0.02	
	04-Jul-07	7,147,302.84	512,921.20	418.34	0.15	0.15	0.07	0.07	0.00	-0.01	-0.01	
226 Lower Slope	19-Jun-01	n/a										
	20-Aug-03	7,147,311.53	513,066.36	426.46	0.00	0.00						
	28-Jul-04	7,147,311.54	513,066.40	426.43	0.04	0.04	0.04	0.05	-0.03	-0.03	-0.03	
	28-Jul-06	7,147,311.56	513,066.42	426.36	0.07	0.07	0.03	0.01	-0.10	-0.07	-0.04	
	04-Jul-07	7,147,311.62	513,066.44	426.32	0.13	0.13	0.07	0.07	-0.14	-0.04	-0.04	
228 Lower Slope	19-Jun-01	n/a										
	20-Aug-03	7,147,347.00	512,836.84	413.95	0	0.00						
	28-Jul-04	7,147,347.03	512,836.79	413.88	0.06	0.06	0.06	0.07	-0.07	-0.07	-0.08	
	28-Jul-06	7,147,347.13	512,836.73	413.92	0.18	0.18	0.12	0.06	-0.03	0.04	0.02	
	04-Jul-07	7,147,347.15	512,836.70	413.86	0.21	0.21	0.04	0.04	-0.09	-0.06	-0.07	
P2 Lower Slope	19-Jun-01	7,147,354.12	512,999.27	416.14	0.17	0.00	0.17	0.09	-0.09	-0.09	-0.05	
	20-Aug-03	7,147,354.36	512,999.35	416.10	0.42	0.25	0.25	0.11	-0.13	-0.04	-0.02	
	28-Jul-04	7,147,354.41	512,999.36	415.98	0.47	0.30	0.05	0.05	-0.25	-0.12	-0.13	
	28-Jul-06	7,147,354.50	512,999.34	415.99	0.56	0.39	0.10	0.05	-0.25	0.00	0.00	
	04-Jul-07	7,147,354.63	512,999.38	416.05	0.69	0.52	0.13	0.14	-0.18	0.06	0.07	