UMA | AECOM

GOVERNMENT OF YUKON
FORMER CLINTON CREEK ASBESTOS MINE - Long Term Performance Monitoring Program

Prepared by:
UMA Engineering Ltd.
1479 Buffalo Place
Winnipeg, MB R3T 1L7

UMA Project No. 6029 007 00 (4.6.1.3)

August 2006

UMA | AECOM

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

August 31, 2006

UMA Project No. 6029 007 00 (4.6.1.3)

Mr. Hugh Copland, P.Eng., P.Geo.
Government of Yukon - Energy, Mines and Resources
Box 2703 (K-419)
Whitehorse, Yukon
Y1A 2C6

Dear Sir:

Reference Former Clinton Creek Asbestos Mine – Long Term Performance Monitoring Program

Our final report outlining the proposed long term performance monitoring program for the former Clinton Creek Asbestos Mine is attached. The report includes a background of the physical mine site features to be monitored and details of the monitoring program and action plan to be implemented should the identified trigger levels be reached. The recommendations for the scope and frequency of monitoring and site inspections are provided along with a monitoring protocol.

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

Sincerely,

UMA Engineering Ltd.

Ron Typliski, P.Eng.
Regional Vice President
GR/dh

Table of Contents

List of Tables

Drawings

List of Appendices

1.0 Introduction

This report provides our recommendations for a long term performance monitoring program at the former Clinton Creek Asbestos Mine. The purpose of the program is to provide information on the performance of physical mine site features (i.e. waste rock dump, creek stabilization works, Wolverine Creek channel and the tailings pile) and an action plan from which decisions can be made to undertake additional work at the site where required to ensure the long term stability of these features. The monitoring program provides recommended monitoring frequencies and criteria to determine when action is required to undertake repairs to maintain adequate long term performance of i) the Clinton Creek waste rock dump, ii) channel stabilization works constructed at the Hudgeon Lake outlet and iii) the Wolverine Creek tailings pile and rock-lined channel. The terms of reference for this work are outlined in our letter proposal to Mr. Hugh Copland, P.Eng. P.Geo. of the Government of Yukon, Energy, Mines and Resources dated August 31, 2005.

Hazards associated with continued degradation of the Clinton Creek channel through the waste rock dump and the Wolverine Creek channel through the tailings piles have been identified (UMA 2000). Of particular concern are potential risks to human life and property downstream of the mine associated with a sudden breach of the channel blockages. In areas with significant relief, such as the Clinton Creek valley, flooding from failures of channel blockages can be especially dangerous and unrelated to precipitation events that would normally be expected to produce flooding conditions.

With respect to the potential for a breach of channel blockages, the most immediate concern was considered to be at the outlet from Hudgeon Lake. Profiles of the creek channel through the waste rock from 1986, 1999 and 2001, showed progressive channel degradation (i.e. erosion / down-cutting) was occurring spatially along the first 500 m downstream of the outlet. As degradation continued, the toe of the waste rock pile was being undercut and localized slope instabilities were developing. By 2001, conditions had developed to a point where it was feared that normal flow and/or an overtopping event could trigger a breach of the waste rock at the Hudgeon Lake outlet. The consequences of a breach and rapid draining of Hudgeon Lake are discussed in UMA's Risk Assessment Report (UMA 2000). To address this concern, channel stabilization works were constructed at the Hudgeon Lake outlet between 2001 and 2004.

Measures to stabilize the Wolverine Creek tailings pile have also been investigated (UMA 2003). The requirement for these remedial measures was based on the premise that the tailings were moving at rates comparable to those observed at mine closure. Recent surveys however, indicate that the movements are significantly less than previously assumed and some mounding of the tailings in the valley bottom is occurring. A better understanding of the overall behaviour of the tailings piles is necessary to determine the most appropriate strategy to deal with previously identified hazards. In this regard, the implementation of stabilization measures have been deferred until this information becomes available and the need for remedial work is confirmed. Of particular concern with respect to tailings pile stability is the potential for channel degradation where Wolverine Creek passes over the toe of the tailings. In this regard, maintaining the integrity of the rock-lined channel downstream of the tailings is considered essential.

The key to assessing the long term stability of the waste rock dump and tailings piles is routine inspection and monitoring. Observations and survey data obtained will provide the basis for determining the requirement and timing for additional short term and/or long term remedial works. This report provides an overall performance monitoring program with recommended monitoring methods and frequency. The program lays out the course of action should certain trigger levels be reached in the physical condition of the monitored features at the mine site.

2.0 Background

2.1 Clinton Creek Waste Rock Dump

A landslide of the waste rock pile resulted in the formation of Hudgeon Lake in the Clinton Creek valley and the re-routing of Clinton Creek to the north side of the valley. The existing channel through/across the waste rock dump is approximately 800 m long and up to 18 m below the existing mine access road on the south side of the creek channel. At the Hudgeon Lake outlet, the creek channel is about 30 m higher than its original elevation along the valley floor. The creek channel is flanked on the north and south sides by colluvium and waste rock material, respectively for the first 350 m downstream of the Hudgeon Lake outlet (Station 0+00 m). Channel side slopes are typically 1H:1V or steeper and the channel bed contains boulders and cobbles of various sizes. Between about Station 0+225 m to about 0+350 m, bedrock is visible in the channel bottom. Beyond Station 0+350 m, the channel has cut into the argillite bedrock underlying the colluvium and as a result, the north and south banks consist of bedrock and waste rock material, respectively. Although most of the exposed bedrock within the channel has some degree of weathering, the transition between the heavily weathered bedrock and underlying more intact bedrock can be visually identified.

The 1998 site reconnaissance (UMA 1999) confirmed reports by others (Geo-Engineering 1998) that the most immediate concern was the potential for a catastrophic breach of the waste rock (i.e. the landslide dam) at Hudgeon Lake outlet. A comparison of the creek profile surveys from 1999, 2001 and 2004 to the 1986 and earlier profiles, provides evidence of channel degradation from a point just downstream of the lake outlet to about Station 0+500 m (Drawing 01). The degradation also resulted in undercutting of the toe of the waste rock pile and localized slope instabilities (Figure 2-1). As the channel degraded upstream towards the outlet the possibility of normal flow and/or an overtopping event triggering a breach of the waste rock at the lake outlet increased. The consequences of a breach and rapid draining of Hudgeon Lake are discussed in UMA's Risk Assessment report (UMA 2000).

Figure 2-1 Waste Rock Slumping Into Creek Channel (View Downstream)

Four remediation alternatives to mitigate the hazards associated with a breach of the waste rock dump were presented in UMA's Conceptual Design Report (UMA 2002). These alternatives and estimated construction costs included: valley restoration ($30M), conveying creek flow around the waste rock dump via a tunnel ($20M), conveying creek flow via an alternate channel alignment across the middle of the waste rock dump ($14M) and conveying creek flow over the waste rock dump within a stabilized channel along the existing alignment ($7M). Valley restoration and tunnelling were not contingent on stabilizing the waste rock pile. The two channel stabilization alternatives included approximately 600,000 m^3 of waste rock excavation to achieve stable waste rock geometry. It was also pointed out however, that if continued monitoring confirmed that movement rates of the waste rock were sufficiently small or if movements had terminated, the need to stabilize the waste rock dump should be re-evaluated.

Subsequent to preparation of the Conceptual Design Report, waste rock movement monitoring and a detailed survey of the Hudgeon Lake outlet were completed in June 2001. Over the two-year period from July 1999 to June 2001, annual horizontal movements ranging from 1 to 11 cm were observed, or an average annual rate of about 7 cm. Over the same time period, the average rate of vertical settlement was believed to be in the order of 7 cm. The movements confirm previous observations that waste rock pile movements are small and are perhaps decreasing with time. The movements can either be interpreted as small constant strain rates or strain rates that are decreasing with time, and as such are referred to as creep movements (as compared with the large movements observed prior to 1986). These creep movements may continue indefinitely, in particular if caused by continued channel degradation, thawing of permafrost below the channel and/or erosion along the north edge of the waste rock.

Based on the observed waste rock movements and the comparatively lower capital costs, channel stabilization was selected as the preferred remedial option. UMA's 2003 Environmental Liability Report (UMA, 2003) recommended that the channel profile be flattened using flexible grade control structures which can accommodate some continued horizontal and vertical movements. The channel stabilization measures were designed to flatten the channel grade to 0.1 percent by installing flexible gabion drop structures, which were determined to be the most suitable alternative to meet this design objective. The overall channel stabilization design required thirteen drop structures ranging in height from 1.5 to 3 m to achieve the 35 m hydraulic drop between Hudgeon Lake outlet and the natural creek (i.e. valley) bottom at the downstream end of the waste rock dump. Energy dissipation occurs at the drop structures as the water travels over and through the rock filled gabion baskets. The drawdown weir at the top of the structure creates a constriction that reduces the water surface draw-down immediately upstream of the structure and minimizes channel flow velocity upstream of each structure. The end sill prevents a floor jet from developing during high discharges.

Given the possibility of conditions worsening at the Hudgeon Lake outlet before long term remedial measures were completed, staging of the channel stabilization works was recommended. This approach allowed the most immediate concern (i.e. the condition of Hudgeon Lake outlet) to be addressed before construction of channel stabilization works along the entire length of the channel through the waste rock dump. The original design called for construction of four gabion drop structures within the first 150 m of the channel. The first stage of construction of the stabilization works began in the fall of 2002 by Hän Construction Limited under the supervision of UMA Engineering. By the end of the construction season, the first drop structure and regrading of the Hudgeon Lake outlet had been completed (UMA 2003a). During the winter of 2002/2003 the need to stabilize the entire channel was re-evaluated, based on the construction experience gained during Stage I. It was concluded that rather than stabilizing the entire channel, two additional drop structures (i.e. a total of 6 drop structures) would extend the stabilized section to about Station 0+300 m (Drawing 01), where the channel is less susceptible to undercutting due to the exposed bedrock in the channel bottom. The location of the exposed bedrock was estimated from existing photographs of the channel. The Stage II work was undertaken in the summer of 2003 (UMA 2003b).

Following the spring freshet (spring run-off) of 2003, inspection of the Stage I stabilization works completed the previous year revealed some deformation of the first drop structure, loss of material from some of the baskets forming the floor of each step and the development of a scour hole in the channel bottom immediately downstream of the drop structure where there was no downstream structure to provide the design tailwater effect illustrated on Figure 2-2. The largest deformation was on the north side slope at the last row of baskets directly upstream of the scour hole. Deformation of the north flank of the structure farther upstream at the steps was believed to be from settlement of channel fill. The deformations of the structure did not significantly affect the overall hydraulic performance or capacity and the gabion structures were left as is. In 2003 during Stage II construction, several baskets of the first drop structure were opened and topped up with 100 mm or larger diameter gabion fill material to replace the finer material that had been dislodged from the baskets. The scour hole was also addressed during Stage II by installing an extra row of baskets at the downstream end of the drop structure. This extra row of baskets was added to the design details for all subsequent drop structures to minimize the potential for similar scouring to develop between construction stages or in the event that the tailwater effect from a downstream drop structure is reduced. The second structure was completed in 2003 and the last two structures were constructed in 2004 (Stage III). No scour hole developed at the downstream end of Drop structure 2 between Stage II and III. The completed channel stabilization works are shown in profile on Drawing 02. Photographs of the channel, before and after construction are shown on Figure 2-2.

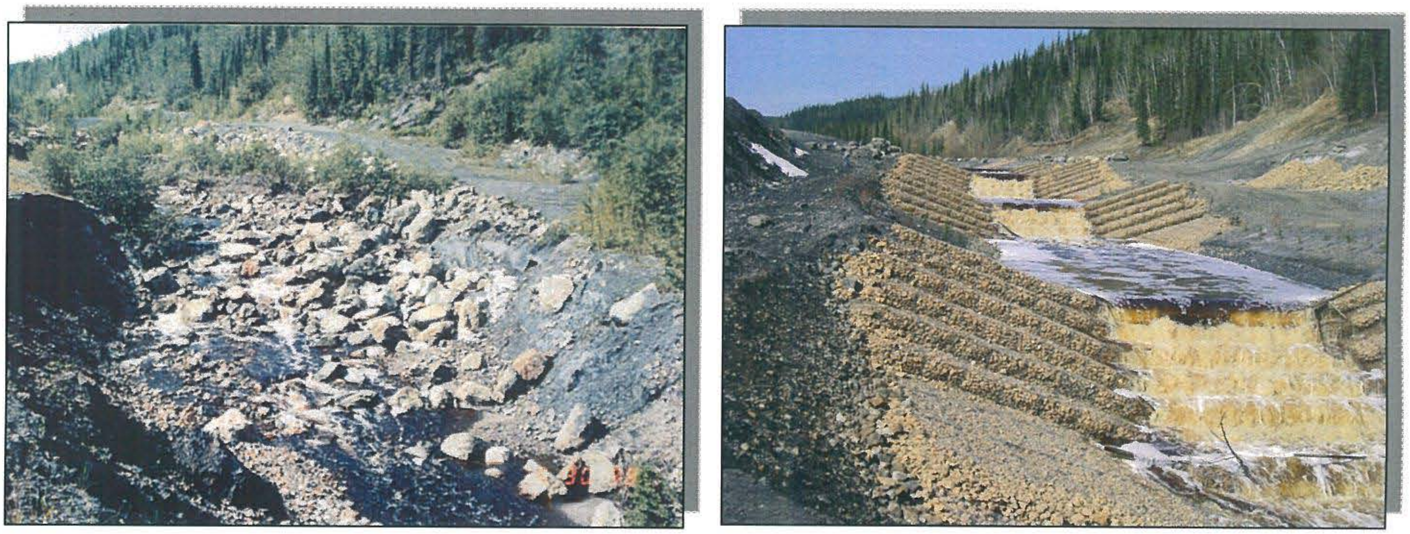


Figure 2-2 Hudgeon Lake Outlet Before (1998) and After Construction of Gabion Drop Structures (2005)

During Stage II construction, the location of the bedrock contact in the channel bottom was confirmed at Station 0+225 m. Based on this information and in consideration of the overall height of the waste rock pile above the channel bottom and lack of construction access on the north side of the channel, the last two drop structures were eliminated from the design and four structures were positioned along the channel with the last structure at Station 0+175 m or about 50 m upstream of where the bedrock contact was visible. The final position of the third and fourth structures was adjusted during construction to better suit the channel geometry and tie into boulders remaining from the original channel stabilization works (UMA 2002). A transition at the downstream end of the stabilized channel section was constructed to minimize the potential for undercutting of the last drop structure. This consisted of adding an additional full row and a partial row of baskets to the downstream end of the last drop structure (UMA 2005) and armouring the channel banks for about 20 m downstream of the last row of baskets (Figures 2-3 and 2-4 note: DS = downstream).

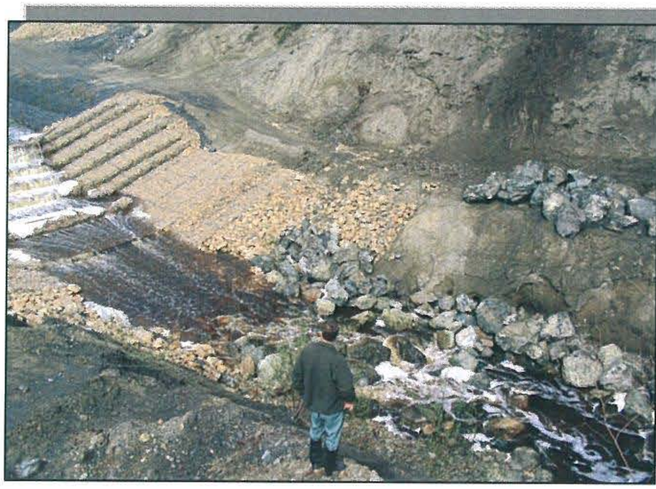


Figure 2-3 Channel Armouring DS of Drop Structure 4

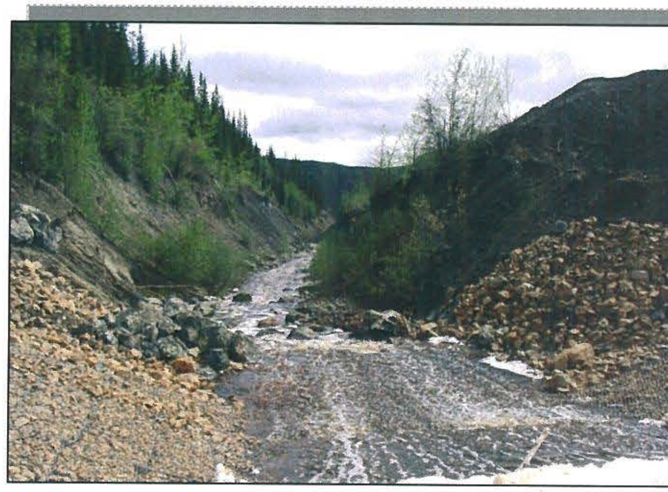


Figure 2-4 Creek Channel DS of Drop Structure 4

As presented in UMA's 2005 site inspection letter (Appendix A), post-construction inspections were carried out by the Government of Yukon (GY) and UMA in May 2005 and by GY staff in June 2005. The condition of the stabilized channel during spring freshet is shown on Figure 2-5. Although at the time of the May inspection water in the channel obscured the baskets forming the floors of the drop structures, the gabion structures appeared to be in good condition with only minor lateral deformation. During the June 2005 inspection, the water levels had dropped enough to reveal that some gabion fill had been washed out of the baskets forming the floor of Drop Structures 3 and 4 (Figure 2-6). It is our understanding that the baskets were opened and topped up in the summer of 2005 under the direction of GY staff (Appendix A).

Figure 2-5 Hudgeon Lake Outlet May 2005

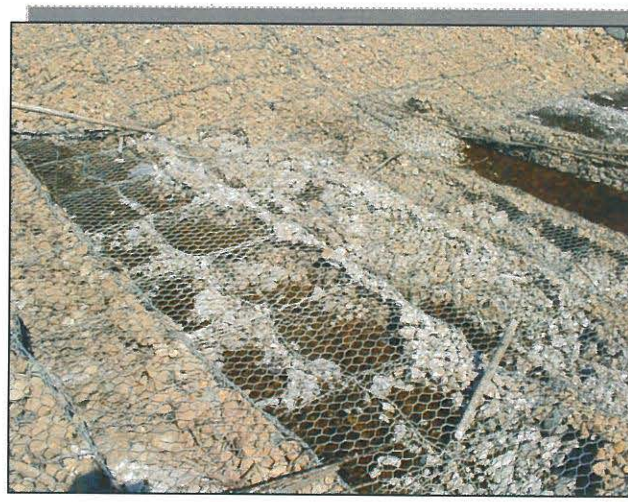


Figure 2-6 Loss of Gabion Fill June 2005

Some post-construction deformation of the gabion structures is expected as the channel fill below the drop structures adjusts. A non-woven geotextile was placed between the compacted fill and the gabion baskets to reduce the potential for erosion beneath the structures. The flexible nature of the gabion baskets will permit the drop structures to accommodate some adjustments without a significant loss of capacity or performance. By design, the fourth structure can accommodate some channel scouring / undercutting before the integrity of the structure is compromised. The first evidence of this will be erosion of the armouring followed by undercutting of bedding material below the last row of baskets. Should this occur, the last few rows of baskets will begin to rotate down into the channel bottom by hinging at their connection points. Left unattended, this situation would gradually worsen until the stability of the fourth structure is jeopardized.

The 2004 survey of the waste rock movement monitors confirmed that creep movements of the waste rock dump are continuing at rate of about 1 to 11 cm per year (UMA 2006). To determine if these creep movements are impacting the gabion drop structures, two measurement locations on each drop structure were identified (UMA 2006) to monitor the closure across the gabion drop structures (i.e. the channel).

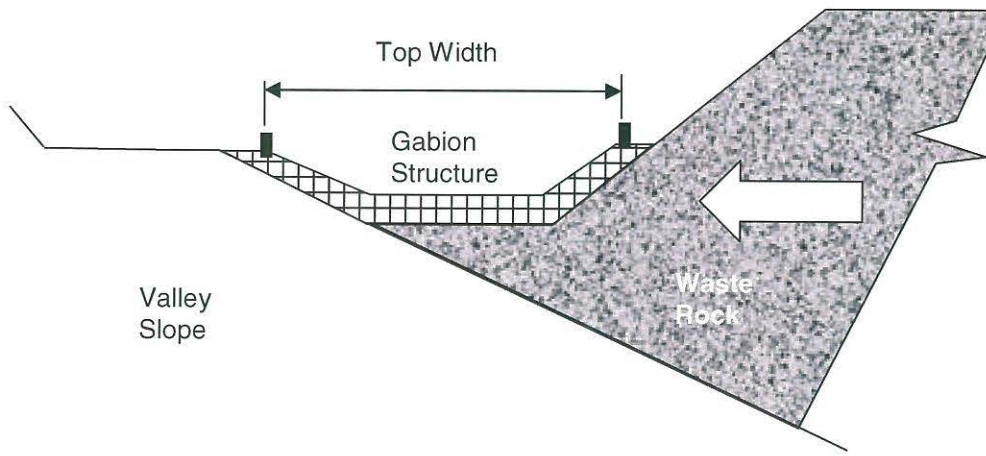


Figure 2-7 Channel Closure Monitoring Points

This is illustrated on Figure 2-7. Comparison of these measurements will determine if the channel closure is related to waste rock movement or independent deformation of the structure. This is important to understand so the long term performance of the stabilization works can be anticipated based on waste rock movement monitoring results. Of concern would be a reduction in hydraulic capacity of the drop structures from settlement or erosion of underlying channel fill and/or closure of the structure due to horizontal waste rock movements. If the capacity is reduced, then some flow events could overtop and by-pass the stabilized portion of the creek channel.

2.2 Tailings Pile and Wolverine Creek Channel

Between 1968 and 1974, tailings were deposited on the upper portion of the west slope of Wolverine Creek valley (referred to as the south lobe). In 1974, rapid downslope movement of the south lobe blocked natural flow in Wolverine Creek backing up approximately 9 m of water behind the landslide material (Figure 2-8). In the spring of 1974, a sudden breach of the channel blockage occurred resulting in flash flooding in the Wolverine Creek valley to the confluence with Clinton Creek where the flooding would have quickly attenuated. The eroded tailings were deposited several metres deep in the creek valley directly downstream of the south lobe. Although the majority of the tailings are believed to have been deposited upstream of the mine access road, some of the finer material including asbestos fibres would have entered the Clinton Creek channel and been deposited possibly as far downstream as the Forty Mile River.

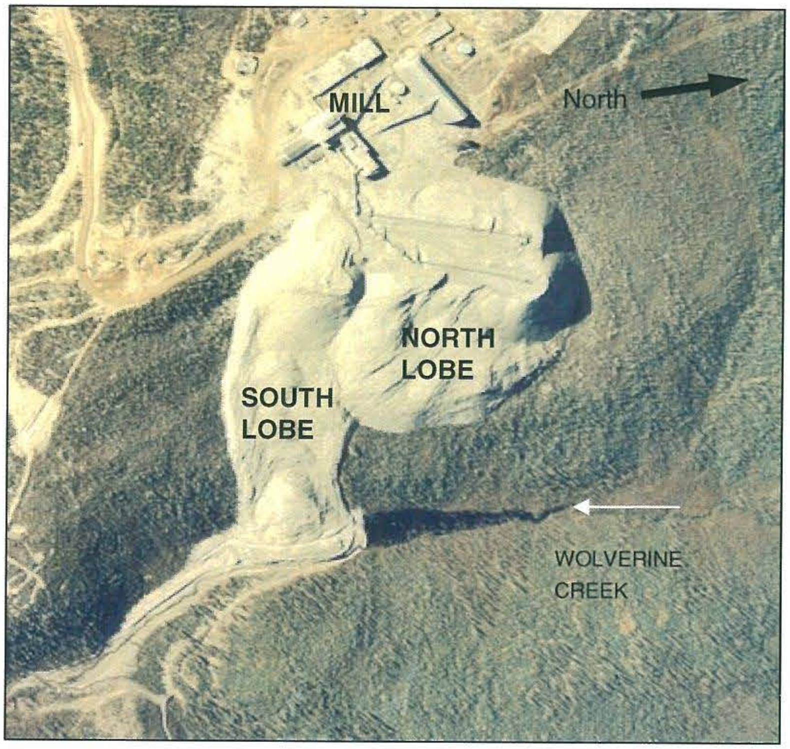


Figure 2-8

Failed South Lobe (1976)

Following the failure of the south lobe, a 9 m deep channel was excavated at the toe of the tailings to facilitate creek flow and a new tailings pile referred to as the north lobe was established north of the failed mass,. By 1977, the north lobe was showing signs of instability and during the last months of mine operation, the tailings were placed in the northwest corner of the north lobe. Partial re-grading of the north and south lobes undertaken in 1978 and 1979 was not successful in stabilizing the tailings. In 1978, channel stabilization measures were constructed in Wolverine Creek across the tailings immediately downstream of the south lobe. These measures consisted of a rock-lined channel with a series of rock weirs along the first 240 m of the channel downstream of the south lobe (Figure 2-9 and Drawing 03).

Movement monitoring carried out from 1976 to 1984 confirmed that annual displacement rates of the tailings were much larger for the north lobe as compared to the south lobe. The lower displacement rates of the south lobe were attributed to the toe support provided by the tailings at the bottom of the valley. In general, the displacements varied along the length of each lobe with the largest movements occurring at

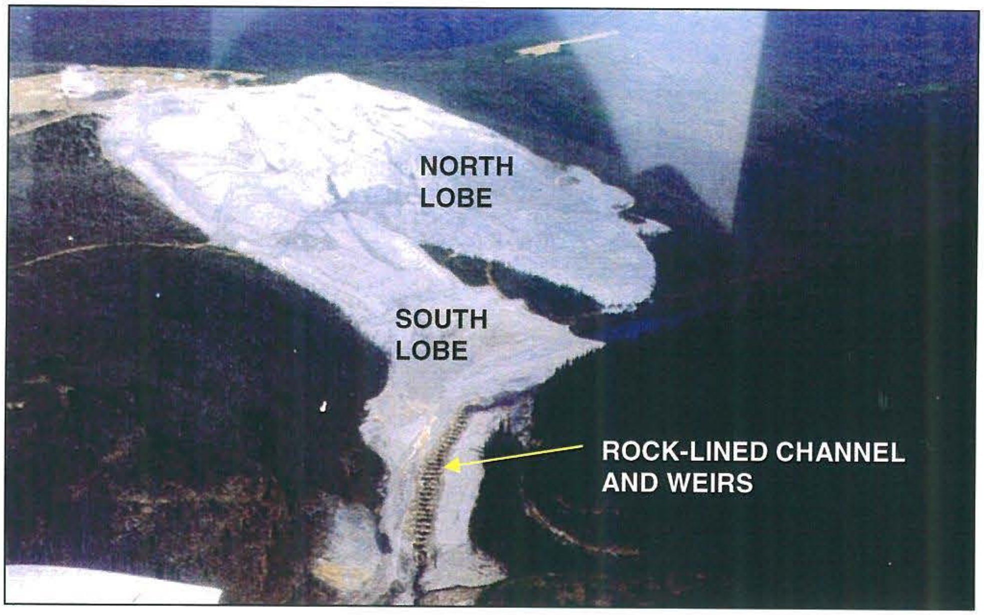


Figure 2-9 Rock-Lined Channel and Weirs (1982)

the toe and small displacements occurring near the top of the slope. The north lobe reached the edge of Wolverine Creek in 1984 and by 1988 reached the opposite side of the valley.

When the original monitoring program ended in 1984 the north and south lobes were moving at rates up to 25 m and 7 m per year, respectively (UMA 2003). The monitoring program was re-instated in 2003 and based on annual monitoring from 2003 to 2005 it was determined that the tailings pile is still moving but at rates less than originally thought (Appendix A). The monitor points have been grouped according to their location on the upper, mid and lower slope areas. The monitors on the upper slope are located above elevation 530 m, the mid slope monitors are located between elevation 425 and 530 m and the lower slope monitors are located below elevation 425 m. As shown in Table 2-1, the annual horizontal movement rates calculated from the 2003, 2004 and 2005 monitoring data (Appendix A) show that the movements are considerably less than those reported in 1984 when the original monitoring program ended. The data from the 2005 monitoring event (Appendix A) suggests that the tailings may be spreading laterally with minimal cross channel movements.

Table 2-1: Annual Movement Rates

SLOPE AREA	NORTH LOBE			SOUTH LOBE		
	1984	2003 to 2004	2004 to 2005	1984	2003 to 2004	2004 to 2005
	(m / year)	(m / year)	(m / year)	(m / year)	(m / year)	(m / year)
Upper	0.4 to 9.0	0.01 to 0.10	0.01 to 0.11	0.5	0.24	0.08 to 0.18
Mid	1.6 to 24.5	0.01 to 0.63	0.02 to 0.53	7	0.4 to 1.0	0.35 to 0.93
Lower	20	0.08 to 0.17	0.06 to 0.18	0.5 to 2.8	0.07 to 0.76	0.05 to 0.66

From a risk management perspective, stabilization of the tailings pile may not be required unless the rate of movements increase and/or transportation of tailings from chronic erosion along the leading edge of the piles into downstream water courses is deemed environmentally unacceptable. With respect to physical stability, the current rate of movement would be classified as very slow with movements either decelerating or nearly steady (TRB, 1978). Unless the rates of movements increase, stabilization of the tailings pile is not considered necessary at this time. Based on the recent movement rates measured for the lower slope area (Table 2-1 and Appendix A) and the height and length of tailings along Wolverine Creek, the volume of tailings eroded annually is estimated to be in the order of 1,000 m3 per year, compared with up to 15,000 m3 previously reported (UMA 2000). In any case, the chronic erosion of tailings has not been identified as an environmental concern.

Physical hazards associated with a breach of the tailings are discussed in UMA's Risk Assessment Report (UMA 2000). With the current height of tailings along the creek channel, the consequences of a breach of the tailings are considered less severe than a breach of the Hudgeon Lake outlet because the volume of water stored upstream of the tailings is small in comparison to the volume of water in Hudgeon Lake. Failure of the rock-lined channel and rock weirs would lead to erosion (i.e. channel degradation) of the underlying tailings in an upstream direction. This erosion would result in progressive loss of toe support of the south lobe and may eventually destabilize the entire tailings mass on the valley slope. A Screening Level Risk Assessment (UMA 2006) concluded that the risk of exposure to airborne asbestos is low given the current site condition (i.e. a crust that is resistant to wind and water erosion has formed on the tailings piles) and use. This conclusion is important because any disturbance of the existing tailings crust would be an unavoidable consequence of regrading operations to stabilize the tailings piles.

Erosion and over-steepening of the leading edge of the tailings causes localized instabilities which sometimes form channel blockages. It is unlikely that these intermittent channel blockages would produce a significant downstream flow increase given the limited volume of water which could be impounded by the blockage. Chronic erosion could be addressed by regrading the leading edge of the tailings and providing erosion protection along the side and base of the creek channel. Long term maintenance of such measures would likely be required since the on-going movements of the tailings would gradually close the stabilized channel.

3.0 Long Term Monitoring and Action Plan

Managing the risks associated with the development of a channel blockage and associated breach includes continued performance monitoring and the development of an action plan which would be triggered by certain events and/or observations. Some circumstances e.g. undermining of the gabion structures along Clinton Creek would require immediate response. Other circumstances e.g. gradual channel closure, would trigger works that could be staged recognizing that time is available before critical conditions are reached.

3.1 Clinton Creek Waste Rock Dump

3.1.1 Closure of Stabilized Channel Section

The existing channel closure monitoring points are measured with a hand tape and have, to date, indicated that the gabions are compressing laterally (Appendix A). It is not certain if the movements of the gabions are a result of waste rock movements or independent deformation of the structure(s). It is therefore important to continue monitoring in the long term to identify if and when maintenance or replacement of the stabilization works are required. In this regard, additional monitoring points are recommended to better understand the deformations of the structures in relation to the waste rock movements. These points should be installed strategically at each of the four structures and surveyed in conjunction with the waste rock monitors. As illustrated on Drawing 04, the proposed monitoring program includes the installation of four movement monitoring points and repetitive surveys of two cross-sections at the upstream and downstream ends of each structure. The monitoring points should be installed and tied in using GPS surveys during the next monitoring event (i.e. in 2006). Cross-sections of the drop structures should be surveyed along the line defined by each pair of these monitoring points. A comparison of the surveyed cross sections over time will allow the change in flow depth for the design discharge to be determined.

To establish the trigger level at which action is required, the gabion drop structures were modelled by incrementally steepening the south slope (i.e. waste rock side) of the gabions and determining the associated channel flow depth. To estimate the change in flow depth at the design discharge (28.9 m^3/s) due to advancement of the waste rock pile toward the channel, it was assumed that:

(a) the horizontal bed portion of the cross-section remained level,
(b) the north slope (i.e. valley side) would remain stationary at 3H:1V side slope,
(c) the south slope (i.e. waste rock side) would remain straight and rotate around the toe location, and
(d) the decrease in top width of the structure due to rotation (steepening) of the south side slope is 50 mm per year.

The change in flow depth due to steepening of the south side slope and decreased top width of the structure was calculated for a series of side slopes and the results are tabulated in Table 3-1.

Table 3-1: Flow Depth Calculations

North Side Slope (H:V)	South Side Slope (H:V)	Flow Depth (m)	Top Width (m)	Elevation Difference (m)	Estimated Years
3 : 1	3 : 1	2.015	21.875	0.00	--
3 : 1	2.9 : 1	2.022	21.850	0.08	<2
3 : 1	2.8 : 1	2.029	21.822	0.16	<2
3 : 1	2.7 : 1	2.035	21.791	0.24	<2
3 : 1	2.6 : 1	2.042	21.758	0.34	2
3 : 1	2.5 : 1	2.049	21.721	0.43	3
3 : 1	2.4 : 1	2.057	21.681	0.54	4
3 : 1	2.3 : 1	2.064	21.637	0.65	5
3 : 1	2.2 : 1	2.071	21.589	0.77	6
3 : 1	2.1 : 1	2.079	21.535	0.89	7
3 : 1	2.0 : 1	2.086	21.475	1.03	9
3 : 1	1.9 : 1	2.094	21.408	1.17	10
3 : 1	1.8 : 1	2.103	21.332	1.32	12

The top width is considered to be the straight line distance between the upper ends of the gabions on the north and south side slopes. The elevation difference is the change in elevation between the top of gabions on the north and south sides. It should be noted that the above dimensions are theoretical only and apply to rotating rectangular units. In reality, the gabions can be expected to bend and deflect in some way during the deformation process. As it is unknown how the gabions will deform, the measured top widths may vary significantly from those noted in Table 3-1.

The trapezoidal cross-section of the gabion drop structures can withstand significant lateral deformation without any significant increase in flow depth. From the results in Table 3-1, it can be seen that after about 9 years time, the top width may be reduced by 0.5 m to about 21.5 m wide and the south side slope could be approximately 2H:1V, which would increase the flow depth by about 0.086 m at the design discharge. This flow depth would still be below the top of the north side gabions and the structure would still be capable of passing the design discharge. The simplified analysis shows that flow depth across the drop structures is not greatly affected by some deformation of the structures. At some point however, over-steepening of the baskets on the sides of the channel could compromise the overall stability of the channel banks before critical flow depths are reached.

ACTION:

It is recommended that planning of remedial works of the gabion structures, including establishing timelines for construction, begin when the monitoring data shows that either the flow depth (i.e. water surface) at the design discharge is within 0.2 m of the top edge of the gabions, the side slope(s) reach 2H:1V, the drop structure measurements as shown on Drawing 04 are 0.5 m less than the baseline readings and/or if the top width determined from the surveyed cross-sections of the drop structures (see Section 4.1 & Appendix B) decreases by a similar amount. The remedial work should be undertaken within one year. At this stage, the feasibility/requirement for waste rock pile stabilization should be revisited. The cost of a geotechnical investigation and preliminary design for waste rock stabilization could be on the order of $250,000.

3.1.2 Channel Degradation

The Clinton Creek channel profile should be routinely surveyed to determine if any measurable degradation of the channel is occurring. This is particularly important immediately downstream of the fourth (last) drop structure (Drawing 02) where degradation progressing upstream would impact the integrity and functionality of the channel stabilization works. Degradation of the channel downstream of the last drop structure is of less consequence to stability of the channel stabilization works but would be expected to trigger localized slope failures and possibly increase the rate of observed waste rock movements. The survey should be completed as done in previous years by taking average points along the centerline. It is suggested that the July 2004 survey shown on Drawing 01 serve as the baseline to which future surveys can be compared to determine the rate and magnitude of degradation.

ACTION:

When the creek channel surveys indicate that 0.5 m of down cutting has occurred immediately downstream of the fourth drop structure, the channel between this drop structure and the point where the bedrock daylights in to the channel bottom (Station 0+225 m) should be lined with cobbles and boulders. The work should be completed as soon as practicable. Planning for this channel revetment work should begin when 0.3 m of degradation has been identified from monitoring surveys and visual observations during site inspections.

Downstream of Station 0+225 m, planning for channel stabilization and any requirements for waste rock stabilization should be undertaken when 1.5 m of channel degradation is evident along a measurable stretch of the channel i.e. localized channel down cutting may not trigger the need for repairs. The timing for repairs can be evaluated once the planning stage is reached. The urgency for repairs will depend on the rate of down cutting measured from the channel profile surveys, the length of channel affected, and visual observations from the site inspections.

3.1.3 Visual Inspections

The stabilized section of the channel should be inspected on a regular basis to assess functionality and check for signs of instability and undermining. Site inspections should be completed annually soon after the spring freshet event has passed. The condition of the rock filled gabion baskets should also be inspected to look for signs of corrosion of the gabion baskets and/or degradation or loss of gabion fill.

ACTION:

Should there be evidence of water flowing below the gabion baskets, undermining and / or piping at any location within the stabilized portion of the channel (Station 0+000 to 0+175 m), immediate action will likely be required to repair the affected works.

Any gabion baskets affected by corrosion should be patched with the same wire mesh that the gabions are constructed of (i.e. PVC coated galvanized wire mesh) and stapled in place using the same stainless steel SPENAX rings used to assemble the gabions. Baskets that require additional gabion fill material should be opened and topped up with gabion fill that is no smaller than 100 mm in diameter and the lids re-attached with stainless steel SPENAX rings. This maintenance work should be completed before the end of the construction season. Gabion fill material left over from construction is stockpiled on site. The remaining gabion baskets and assembly supplies are stored at Gillespie Equipment Rentals in Dawson City, Yukon. (UMA 2005).

3.2 Wolverine Creek Tailings Pile and Rock-Lined Channel

3.2.1 Tailings Pile

The movement monitor points on the tailings pile should be surveyed to determine the magnitude and annual rate of downslope movements. If no significant changes in annual movement rates are observed over time, the movements could be considered as steady state creep movements. A reduction in the rate of downslope movements would indicate overall stability is improving while increased rates of downslope movement would be an indicator of decreasing stability and perhaps the onset of significant landslide activity.

ACTION:

Planning for tailings pile stabilization should be initiated if the annual movement rates from any one monitoring event (bi-annual frequency) increase by an order of magnitude or, if the annual rates of movement from two consecutive monitoring events (bi-annual frequency) show progressively increasing rates of movement. Should such behaviour be observed, the movement monitoring frequency should be increased from bi-annual to annual. Planning should include a geotechnical investigation, establishing the time lines for construction and preliminary design of the remedial work. The cost of the geotechnical investigation could be on the order of $250,000.

3.2.2 Channel Degradation

The channel profile across the tailings piles from Station 1+475 m to a point 100 m past the downstream end of the rock weirs (Station 0+700) should be regularly surveyed to determine if any measurable degradation of the channel is occurring (Drawing 03). The 2003 creek profile survey can serve as the baseline to which future surveys can be compared to determine the rate and magnitude of degradation or possibly vertical rise in the channel bottom due to movements of the tailings across the channel.

ACTION:

Planning for channel stabilization works would be initiated based on the results of both visual inspections and the channel profile surveys. In this regard, planning for stabilization works across the tailings piles (i.e. upstream of the rock lined channel) should be considered when 1 m of channel degradation is evident along a measurable section of the channel between Stations 1+075 to 1+475 (Drawing 03).

Planning for channel stabilization within the rock lined channel should be undertaken when the monitoring results and visual observations from site inspections reveal that 0.5 m of channel degradation is evident along a measurable section of the channel between Stations 0+700 to 1+075 (Drawing 03). Planning may also be triggered as a result of visual inspections. These inspections would assess the potential for failures such as isolated attempts by the creek to break out of the existing channel or erosion at the top of bank from surface runoff, which could trigger a natural channel re-alignment. The planning work should include establishing the time lines for construction and evaluating the need for stabilization of the tailings.

3.2.3 Visual Inspections

It is not considered practical to quantify movements at the rock weirs that would trigger planning for, or implementation of, remedial measures. This assessment is best addressed by annual inspections made by qualified personnel familiar with past performance of the weirs, the nature of the tailings deposit and landslide activity and the consequences of a failure of the weirs.

ACTION:

Planning for maintenance or reconstruction of the rock lined channel and weirs, including establishing construction time lines, should be undertaken when 0.5 m of down cutting within the rock lined channel has occurred and / or if there are signs that creek flow occurred or is occurring outside of the rock lined channel. Should the integrity of the rock-lined channel be compromised, repairs should be undertaken on either an emergency or planned basis. As a minimum, temporary repairs should be undertaken prior to the next spring freshet event.

4.0 Monitoring and Inspections

The following recommendations are provided with respect to continued monitoring and inspections at the former Clinton Creek Asbestos Mine. All survey work to date has been completed by Underhill Geomatics from Whitehorse, Yukon, who are familiar with the site, logistics and monitoring requirements.

Annual inspections should be undertaken by experienced personnel familiar with the site. The inspections should be completed within about one month following each spring freshet event. As a minimum, the areas to be inspected should include the creek stabilization repairs on Clinton Creek, the rock lined channel on Wolverine Creek and the Wolverine Creek channel along the north and south lobes of the tailings pile.

Based on current costs, the annual inspection trip and report is anticipated to cost about $10,000 including time and expenses. Monitoring events that include surveying, data reduction and reporting are anticipated to cost about $40,000.

4.1 Clinton Creek Waste Rock Dump

The current monitoring program includes surveying the movement monitors on the waste rock dump and surveying the Clinton Creek profile on a bi-annual frequency. Monitoring of the waste rock dump was re-instated in 1999 with subsequent monitoring events in 2001, 2003 and 2004. The next scheduled monitoring event is 2006.

As discussed in UMA's report of work undertaken in 2004 (UMA 2006), the number of monitoring points was increased in 2003 from seven to forty-two to aid understanding the movement behaviour of the waste rock pile. A list of the monitoring points and benchmarks for the survey is provided in Appendix B along with the monitoring protocol.

As presented in Section 3.1.1, the scope of the monitoring program needs to be revised to provide a better understanding of the horizontal and vertical deformations of the gabion drop structures in relation to the waste rock movements. The additional survey requirements include establishing four movement monitors at each drop structure (Drawing 04) and surveying cross sections of the drop structures coincident with each pair of movement monitors.

A visual inspection of the completed creek stabilization work was completed in 2005 (Appendix A). Annual inspections should be completed after each spring freshet event.

4.2 Wolverine Creek Tailings Pile and Channel

The current monitoring program includes annual surveying of the movement monitors on the tailings pile. Monitoring of the tailings pile was re-instated in 2003 with subsequent monitoring events in 2004 and 2005. It is recommended that a creek profile survey for Wolverine Creek be added to the monitoring program. The next scheduled monitoring event is August or September 2006.

As discussed in UMA's 2005 Site Inspection and Monitoring Results report (Appendix A), additional monitoring points were added on the south lobe of the tailings pile in 2005 to better understand the movement behaviour. A list of the monitoring points and benchmarks for the survey is provided in Appendix B along with the monitoring protocol.

As presented in Section 3.2.2, the scope of the monitoring program should be revised to include a creek profile survey to determine if any measurable degradation of the channel is occurring. The survey needs to be completed on a bi-annual basis from the upstream end of the north lobe to the downstream end of the rock lined channel. The profile should be compared to the baseline survey taken in 2003 (UMA 2004) which is provided on Drawing 03.

An inspection and condition assessment of the rock lined channel and weirs should be undertaken within the next calendar year, preferably in 2006, by experienced personnel. This work will serve as the baseline for routine inspections in subsequent years.

If we can be of further assistance or should you wish to proceed with any of the recommended engineering work, please contact either of the undersigned. UMA Engineering appreciates the opportunity for continued involvement on this most interesting and challenging project.

Respectfully Submitted,

UMA Engineering Ltd.

Gil Robinson

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

Ken Skaftfeld, P.Eng.
Sr. Geotechnical Engineer
Earth and Environmental

PROFESSIONAL
GR
YUKON
GILBERT G. ROBINSON
TERRITORY
31-Aug-06
ENGINEER

PERMIT TO PRACTICE
Signature Gil Robinson
Date 31-Aug-06
PERMIT NUMBER: PP066
Association of Professional Engineers of Yukon

References

TRB, 1978. Landslides Analysis and Control, Special Report 176. Transporation Research Board National Academy of Sciences.

Geo-engineering (M.S.T.) Ltd., 1998. Northern Affairs Program. Abandoned Clinton Creek Asbestos Mine, Report on 1997 and 1998 Site Inspections.

UMA Engineering Ltd., 1999. Indian and Northern Affairs Canada, Abandoned Clinton Creek Asbestos Mine, 1998 Site Reconnaissance

UMA Engineering Ltd., 2000. Indian and Northern Affairs Canada, Abandoned Clinton Creek Asbestos Mine, Risk Assessment Report.

UMA Engineering Ltd., 2002. Indian and Northern Affairs Canada, Abandoned Clinton Creek Asbestos Mine, Conceptual Design Report.

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

UMA Engineering Ltd., 2003a. Indian and Northern Affairs Canada, Clinton Creek Channel Stabilization (Stage I), Construction Report.

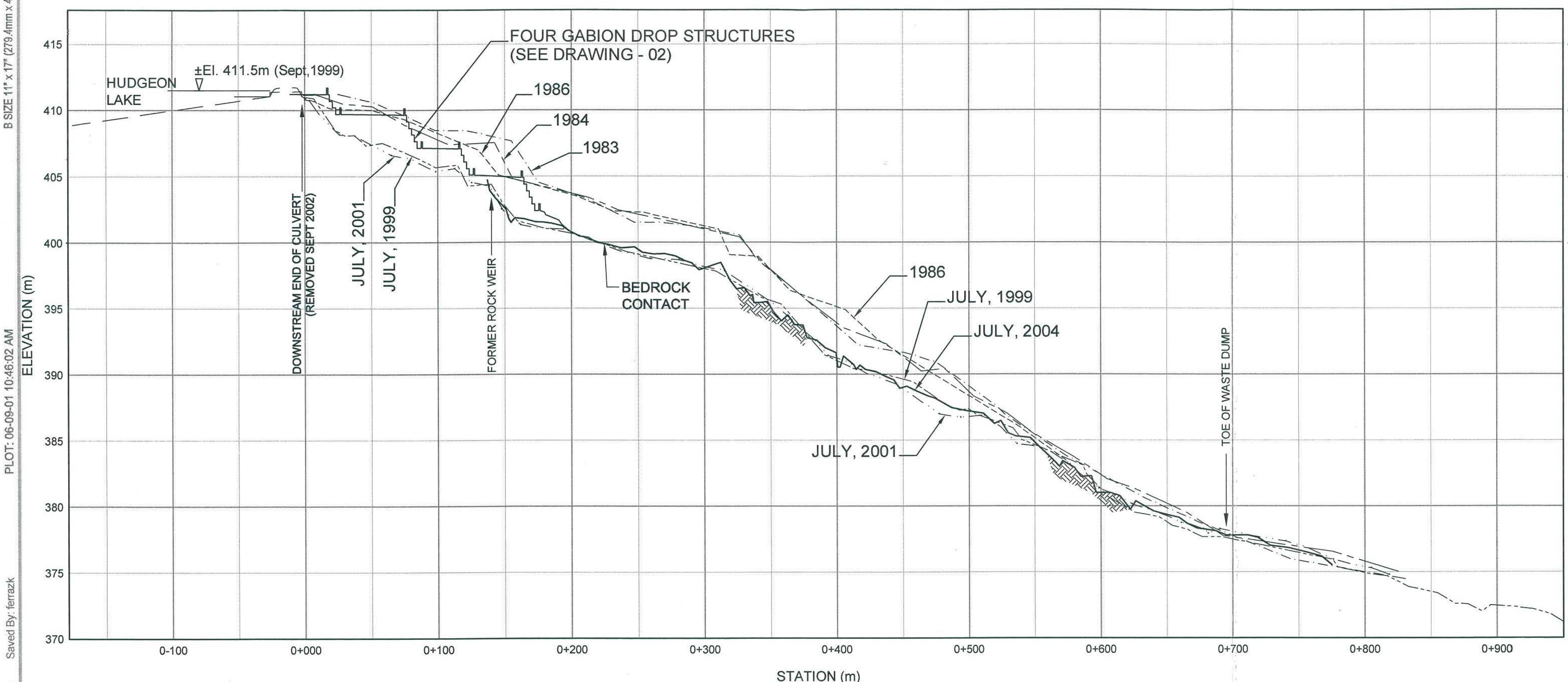
UMA Engineering Ltd., 2003b. Government of Yukon, Clinton Creek Channel Stabilization (Stage II), Construction Report.

UMA Engineering Ltd., 2004. Government of Yukon, Former Clinton Creek Asbestos Mine – Hazard Assessment Report - June 2004.

UMA Engineering Ltd., 2005. Government of Yukon, Clinton Creek Channel Stabilization (Stage III) Construction Report – February 2005.

UMA Engineering Ltd., 2006. Government of Yukon, Former Clinton Creek Asbestos Mine – Summary of 2004 Hazard Mitigation Work, Monitoring and a Screening Level Risk Assessment for Airborne Asbestos – March 2006.

Drawings



PROFILE

H=1:3000
V=1:300

STATION	NORTHING	EASTING
0+000	7,147,427	512,863
0+250	7,147,366	513,113
0+500	7,147,272	513,363
0+750	7,147,204	513,613

COORD: UTM ZONE 7W NAD83

LEGEND

- PROFILE 1983
- PROFILE 1984
- PROFILE 1986
- PROFILE 1999
- PROFILE 2001
- PROFILE 2004 (BASELINE FOR LONG TERM MONITORING)

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

Clinton Creek Channel Profile

Drawing - 01

UMA | AECOM

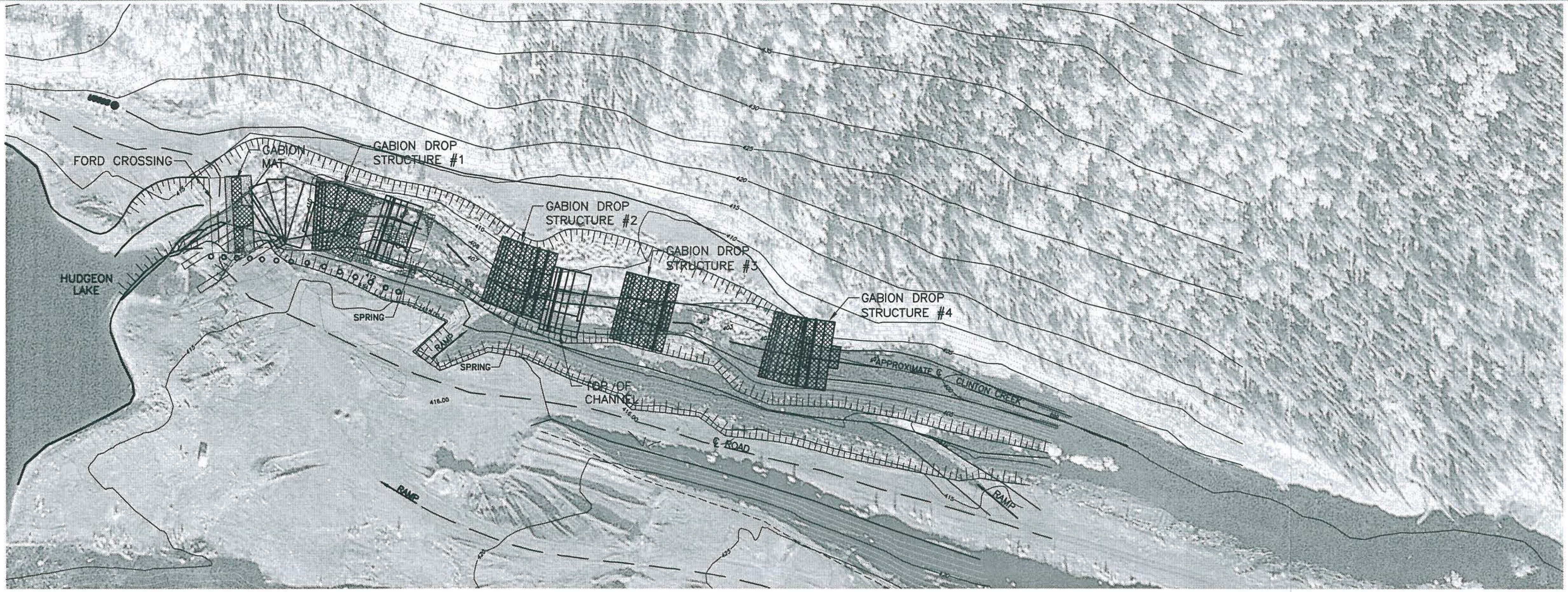
B SIZE 11" x 17" (279.4mm x 431.8mm)
PLOT: 06-09-01 10:46:02 AM
Saved By: ferrazk
UMA FILE NAME: 6029-007-00_01-H-F001_RX.dwg

B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 06-09-01 10:46:57 AM

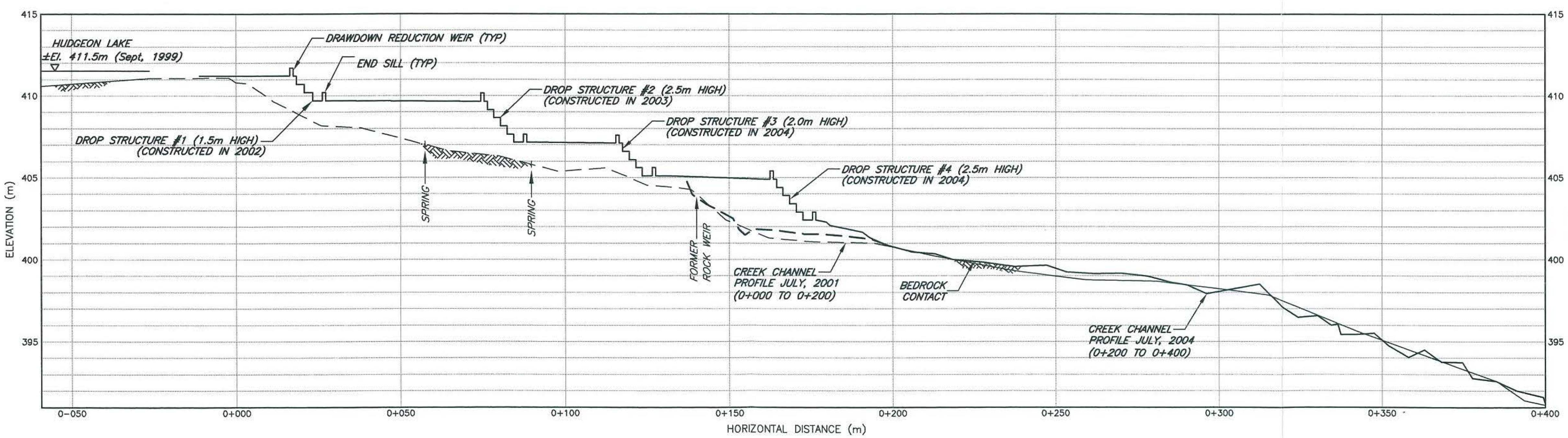
Saved By: ferrazk

UMA FILE NAME: 6029-007-00_01-H-F002_RX.dwg



CLINTON CREEK CHANNEL

SCALE 1:750



CLINTON CREEK CHANNEL PROFILE

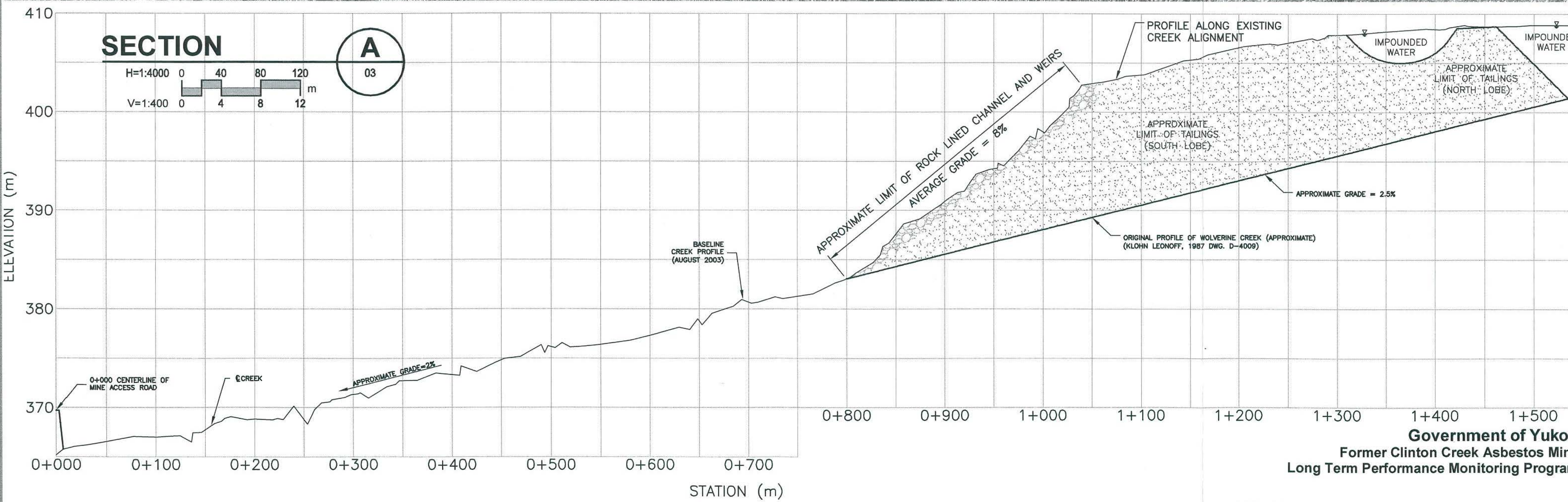
VER. SCALE 1:150
HOR. SCALE 1:750

UMA | AECOM

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

Stabilized Channel Plan and Profile

Drawing - 02



B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 06-09-01 10:47:33 AM

Saved By: ferrazk

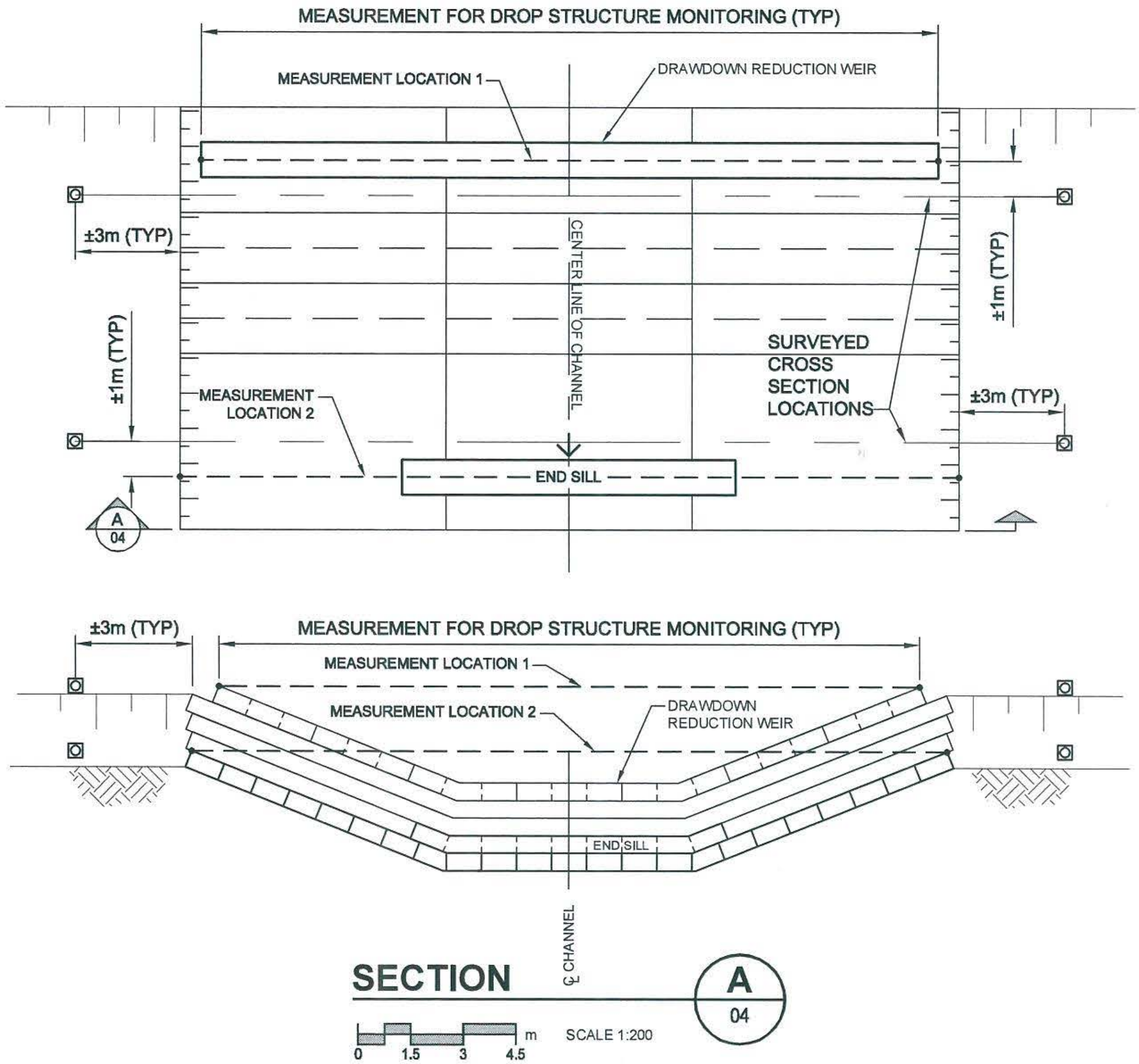
UMA FILE NAME: 6029-007-00_01-H-F003_RX.dwg

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

UMA | AECOM

Wolverine Creek Plan and Profile

Drawing - 03



BASELINE READINGS (m)		
DROP STRUCTURE	MEASUREMENT LOCATION 1	MEASUREMENT LOCATION 2
1	19.62	21.00
2	19.49	21.15
3	19.44	21.50
4	19.61	21.48

▢ PROPOSED CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN)

NOTE: TO BE INSTALLED DURING 2006 SURVEY.

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

Drop Structure Monitoring

Appendix A
2005 Site Inspection and Monitoring Results

June 19, 2006 UMA Project No. 6029 007 00 (4.6.1.2)

Mr. Hugh Copland, P.Eng., P.Geo.
Government of Yukon - Energy, Mines and Resources
Box 2703 (K-419)
Whitehorse, Yukon
Y1A 2C6

Dear Hugh:

Re: Former Clinton Creek Asbestos Mine – 2005 Engineering Services: Site Inspection and Monitoring Results

A site inspection was completed in May 2005 followed by a survey (completed by others) of the movement monitoring points on the Wolverine Creek tailings pile in September 2005. Observations from the site inspection and a discussion of the movement monitoring results are provided below. The site inspection identified minor maintenance work for the channel stabilization works consistent with previous years. The tailings movement rates are generally similar to or less than those measured from 2003 to 2004. The additional monitoring points installed in 2005 on the south lobe should help to better understand the movement behaviour and consequences of continued movement. These consequences and levels which would trigger further investigations or remedial measures are described in UMA's Long-Term Performance Monitoring report (UMA 2006a)

Based on recommendations from the last monitoring event (UMA 2006), the tailings monitors are scheduled to be surveyed again in 2006 after which further recommendations can be made regarding the frequency of monitoring. No changes to the tailings monitoring program are expected for 2006. Ideally the monitors will be surveyed in the first 2 weeks of September to provide about 12 months between surveys following the protocol provided with the 2005 monitoring request (Appendix C).

1.0 SITE INSPECTION

On May 22, 2005 a site inspection was undertaken by Gil Robinson. P.Eng. of UMA Engineering with assistance from Hugh Copland P.Eng., P.Geo. of the Government of Yukon. The inspection was undertaken after the spring freshet to evaluate the condition of the creek stabilization repairs on Clinton Creek, which were completed the previous summer. While on-site, a photographic record of the rock lined channel on Wolverine Creek was completed and the Wolverine Creek tailings pile was also visited to aid in interpreting the movement monitoring results from 2004.

1.1 Clinton Creek Channel

The purpose of the inspection was to observe the condition of the creek channel stabilization works, which were completed in September 2004 (UMA 2005), and identify maintenance requirements for 2005. Some minor maintenance work has been required in previous years to replace granular fill in some of the baskets, in particular after the post-construction freshet events in 2003 and 2004 Of particular interest for the 2005 inspection was determining the condition of the transition between the last drop structure and the unstabilized creek channel.The inspection consisted of a visual condition assessment, photograph documentation and taking measurements at two locations across each drop structure. The gabion measurement program was implemented to help determine if the gabions were being impacted by on-going creep movements of the adjacent waste rock pile (UMA 2006). Digital photographs taken during the inspection are provided on the attached Compact Disc.

Due to the flow depth over the gabions at the time of the inspection (approximately 600 mm deep over the drawdown weirs), it was not possible to confirm the extent of the gabion fill material that was washed out of the baskets during the spring freshet event. As illustrated in Photograph 1, taken about 1 month after the site inspection, some gabion fill had been washed out of the baskets forming the floor of Drop Structures 3 and 4, constructed in 2004. Similar material loss occurred in Drop Structures 1 and 2 during the first spring freshet event that passed following each year of construction. The material loss observed in previous years was mitigated by opening the affected baskets and topping them off with 100 to 200 mm diameter gabion fill material. No noticeable material loss has since been observed in the baskets that were topped off.

As illustrated by the white water in Photograph 2, the gabions forming the floor of each step in the structure are subjected to the highest energy and turbulence from the water flowing over the drop structure. The turbulence results in smaller particles being washed out of the baskets along with some re-arrangement of the gabion fill and deformation of the baskets. The production of smaller particle sizes (less than 75mm) was unavoidable due to the stationary screening operation used to process the gabion fill. Some minor channel erosion was evident between Drop Structures 2 & 3 and 3 & 4 where the channel fill is mainly argillite waste rock. As illustrated below the high water line visible on Photograph 3, the finer sized particles have been washed from the surface leaving a veneer of gravel to cobble sized particles. Similar channel erosion was not evident between Drop Structures 1 and 2 where cobbles and boulders were used to line the channel. Given the veneer of larger particles remaining on the slopes and the flat channel grade (approximately 0.1 percent) it is expected that the existing channel armouring between the drop structures is sufficient. In the event that erosion continues, some of the remaining gabion fill could be used for armouring the channel between Drop Structures 2 & 3 and 3 & 4. Horizontal measurements of the four gabion drop structures were taken as recommended in the monitoring plan described in UMA 2006. The results are discussed under the 2005 Monitoring Results section of this letter.

The portion of the Clinton Creek channel most susceptible to erosion is just past the downstream end of the last drop structure (Drop Structure #4) where there is a transition from the stabilized portion of the channel to the existing creek channel. As illustrated on Photograph 4, the channel transition downstream of Drop Structure 4 showed signs of some erosion on the left hand (north) side of the channel and shifting of some of the large boulders. It was anticipated that this might occur and that some maintenance work would be required in 2005 to adjust and infill the armouring after the first spring fresh. Minimal, if any, erosion occurred on the right hand side of the channel (Photograph 5).

In September 2004, tree planting and grass seeding was undertaken at various areas of the former mine site. Of most concern are the willow shoots and small coniferous trees planted in the creek channel between the drop structures, as shown on Photograph 3. The channel has been designed with a very flat gradient of about 0.01 percent to reduce the flow velocity and potential for erosion of the channel between the drop structures (UMA 2003) and therefore does not to be stabilized with vegetation. In addition, the channel was designed to pass a certain creek flow and did not account for hydraulic losses resulting from trees in the channel cross-section. Removal of this vegetation is recommended.

The recommended maintenance work for 2005 is summarized as follows:

Gabion Baskets - open and top off all gabion baskets where there is a void in the basket that is 100mm deep or greater. Top off baskets with 100 to 200 mm diameter gabion fill which is available on site. Re-attach basket lids to the basket frame with stainless steel staples.

Channel transition downstream of Drop Structure 4 – No work is required on the right hand (i.e. waste rock) side of the channel at this time. On the left hand side of the channel, infill voids in the boulders with gabion fill and place additional boulders on the channel slope. Sketches of the proposed maintenance work are provided in Appendix A.

Vegetation - Remove all non-grass vegetation located within the channel cross-section.

1.2 Wolverine Creek – Rock Lined Channel

While on-site for the inspection work of the Clinton Creek channel stabilization works, the condition of the rock lined portion of Wolverine Creek, located just down stream of the south lobe of the tailings pile, was inspected and photographed. Photographs are provided on the attached Compact Disc. In general, the rock lined channel originally constructed in 1978 is functional. Some trees have grown in and around the channel (Photograph 6) 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 lined wiers (Photograph 6).

There is no immediate maintenance to be undertaken on the rock weirs pending further inspection by UMA in 2006 as part of the recommended long term performance monitoring program (UMA 2006a).

1.3 Wolverine Creek Tailings

The lower portion of the tailings pile was inspected to further evaluate the movement trends from the 2003 and 2004 tailings pile monitoring surveys. It appears that the tailings on the South Lobe may be spreading laterally at the valley bottom and not moving directly east across the valley (UMA 2006). Photograph 7 illustrates how the tailings have mounded up in the bottom of the Wolverine Creek valley (i.e. leading edge of the toe of the south lobe) while a low area remains on the north edge of the lower slope area. Recent monitoring results also suggest that the South Lobe may be moving into the lower area. Based on the monitoring results from 2004 and the observations made during the site visit, It is recommended that 11 new monitoring points (2005-01 to 2005 –11) be established during the 2005 movement monitoring survey. A Memorandum to the Government of Yukon was prepared in August 2005 to providing the details of the 2005 tailings monitoring survey, including the locations for the new monitoring points. A copy of the Memorandum is provided in Appendix B.

2.0 2005 MONITORING RESULTS

The 2005 monitoring program at the former Clinton Creek Mine consisted of measuring the gabion drop structures for signs of lateral displacements and surveying the movement monitors on the tailings pile. An overview of the monitoring plan for this site, including recommendations for 2005, can be found in a previous report (UMA 2006).

UMA | AECOM

2.1 Clinton Creek - Gabion Drop Structure Monitoring

Horizontal measurements of the gabion drop structures were taken during the May 2005 site inspection and are provided in Table C-1 (Appendix C). Each drop structure was measured at the two locations shown on Drawing C-1 and illustrated on the two photographs in Appendix C. Previous (i.e. baseline) readings were only available for Measurement Location #1 on Drop Structures 1 to 3. Where no previous readings were recorded, the May 2005 measurements will serve as baseline readings for future monitoring. At Drop Structures 1 to 3, the distances measured across the drawdown weir were 1 to 12 cm shorter than those taken the previous year. The shorter distances measured may be a result of creep movements of the adjacent waste rock pile, post-construction settlement of the drop structures and/or some minor displacements resulting from the spring freshet event. Long term monitoring, including the installation of additional cross-channel reference points will assist in determining the nature of these movements and their potential impact on the integrity of the channel stabilization works (UMA 2006a).

2.2 Tailings Pile Movement Monitoring

The tailings monitors were surveyed on 17 September 2005 by John Tom Tom and Jean-Louis Salesse of Underhill Geomatics Ltd. in Whitehorse, YK. Thirty-nine existing movement monitors were surveyed using Global Positioning Survey (GPS) referenced to the UTM NAD 83 (Zone 7) co-ordinate system. The monitoring program details, including the locations of eleven new monitor points (2005-01 to 2005-11) on the South Lobe, are provided in Appendix B. The previous monitoring event was completed in September 2004 and the results are discussed in a previous report (UMA,2006). The monitoring results from September 2005 are provided in Appendix D.

The monitor point locations on the tailings pile are shown on Drawing D-1 in Appendix D. The monitors on the North and South lobe of the tailings pile have been grouped according to their location on the slope, that is the upper, mid and lower slope areas (Drawing D-1). The monitors on the upper slope are located above elevation 530 m, the mid slope monitors are located between elevation 425 and 530 m and the lower slope monitors are located below elevation 425 m. For the current monitoring period from September 2004 to September 2005, the direction of movement of each monitoring point is indicated by the vector on Drawing D-1. The measured movement in centimetres for the same time period is shown near the vector. For comparative purposes, the same drawing for the previous monitoring period (2003 to 2004) has also been included in Appendix D (Drawing 3-3 from UMA 2006). Movement rates are summarized as metres per year based on the average rate measured over the previous year. These annual rates can then be compared with annual rates described in previous reports before and after mine closure. The results are summarized in Table 1 below:

Table 1: Range of Annual Movement Rates

SLOPE AREA	NORTH LOBE			SOUTH LOBE		
	1984	2003 to 2004	2004 to 2005	1984	2003 to 2004	2004 to 2005
	(m / yr)	(m / yr)	(m / yr)	(m / yr)	(m / yr)	(m / yr)
Upper	0.4 to 9.0	0.01 to 0.10	0.01 to 0.11	0.5	0.24	0.08 to 0.18
Mid	1.6 to 24.5	0.01 to 0.63	0.02 to 0.53	7	0.4 to 1.0	0.35 to 0.93
Lower	20	0.08 to 0.17	0.06 to 0.18	0.5 to 2.8	0.07 to 0.76	0.05 to 0.66

UMA | AECOM

2.2.1 South Lobe

The average horizontal movement rates for the south lobe measured for the current monitoring period (September 2004 to September 2005) range from 0.13 to 0.76 m per year (Table D-1, Appendix D). These values are about 0.02 to 0.11 m per year less than those measured during the previous monitoring period (2003_ to 2004). The upper slope is the least active area, consistent with previous monitoring data, with movements rates of 0.08 to 0.18 m/yr.. The mid-slope area is the most active with annual movement rates of ranging from 0.35 to 0.93 m . Movement rates ranging from 0.05 to 0.66 m per year were measured for the lower slope area.

The small movement rates on the upper slope area are not unexpected because the original landslide did not encompass much of this area, which may be due to a slight decrease in the inclination of the underlying valley slope. This feature is visible on some aerial photograph images of the tailings area (UMA 2003). The mid slope is most active and is coincident with the main area of the original landslide which occurred in 1974 (UMA 2003). As mounding of tailings occurs in the valley bottom (i.e. lower slope area), the movement rates in the mid-slope area may continue to decrease as toe support due to mounding increases. It is expected that the variability in movement magnitudes and directions on the lower slope are due to mounding of the tailings in the valley bottom and the non-uniform development of passive resistance.

As illustrated in Photograph 7 taken from the northern edge of the lower slope area, the tailings appear to be moving in the direction of least resistance (i.e. where less tailings have mounded up) or towards the pond between the lobes. The general direction of movement of the tailings is shown on Drawing D-2, which was generated by drawing a smooth fit line along the vectors for Monitors 1084, 1485, 24A, 24B, 24D, SL-3 and 1484. The tailings in the mid slope area have a gentle curve to the north which becomes more pronounced on the lower slope area, where the height of mounded tailings is noticeably less (Photograph 7). Consistent with historical monitoring trends, the tailings in the area of Monitors 25B, SL-1 and SL-2 are generally moving eastwards towards the creek channel. Future monitoring of the additional points added in 2005 should help to interpret the movement behaviour in this area of the tailings.

2.2.2 North Lobe

As shown in Table 1, movement rates for the north lobe are consistently lower than the sloth lobe for the upper, mid and lower slope areas. On average, the annual horizontal movement rates measured for the current monitoring period (September 2004 to September 2005) are within about +/-0.03 m per year of the results from the previous year (Table D-1, Appendix D). The upper slope is the least active area with rates of 0.01 to 0.11 m/yr. The small movements of the upper slope are not unexpected since the original landslide did not encompass much of this area (UMA 2003). In comparing the movement vectors on Drawings D-1 and Drawing 3-3 (UMA 2006), the upper slope monitors moved in an easterly direction over the last monitoring period as compared to a northerly direction in the previous monitoring period. There is no explanation for this other than the main failure scarp is located nearby along the 530 m elevation contour, or about 50 m downslope from Monitors 80-2, 26A and 80-1. Localized sloughing along the head scarp may result in some year to year variation of the movement vectors. The westward movement of Monitor BH-14 (T7) can not be explained but is not of particular concern as it is located well away from the active mass movement of the tailings.

The largest movements on the north lobe (greater than 0.13 m) were measured along the south and east edges of the mid slope area (i.e. all mid-slope monitors except 1085, 500-1 and 650-1). The direction of movement (i.e. easterly / downslope) was consistent with the previous monitoring period. The group of mid-slope monitors just upslope from the 425 m contour moved 0.13 to 0.17 m. On the south edge, Monitors 80-4 and 80-5 moved 0.59

UMA | AECOM

and 0.4 m, respectively. These two monitors moved about 0.30 m more than the other monitors on the North Lobe. The lower slope area was slightly less active than the mid slope area with movements less than 0.13 m. In general, the lower slope is moving easterly but the southern edge may also be moving south into the pond between the two lobes.

Please contact the undersigned should you have any questions.

Sincerely,

UMA Engineering Ltd.

Gil Robinson

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

Encl.

cc: Ken Skaftfeld

References

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

UMA Engineering Ltd., 2005. Government of Yukon, Clinton Creek Channel Stabilization (Stage III) Construction Report – February 2005.

UMA Engineering Ltd., 2006. Government of Yukon, Former Clinton Creek Asbestos Mine – Summary of 2004 Hazard Mitigation Work, Monitoring and a Screening Level Risk Assessment for Airborne Asbestos – March 2006.

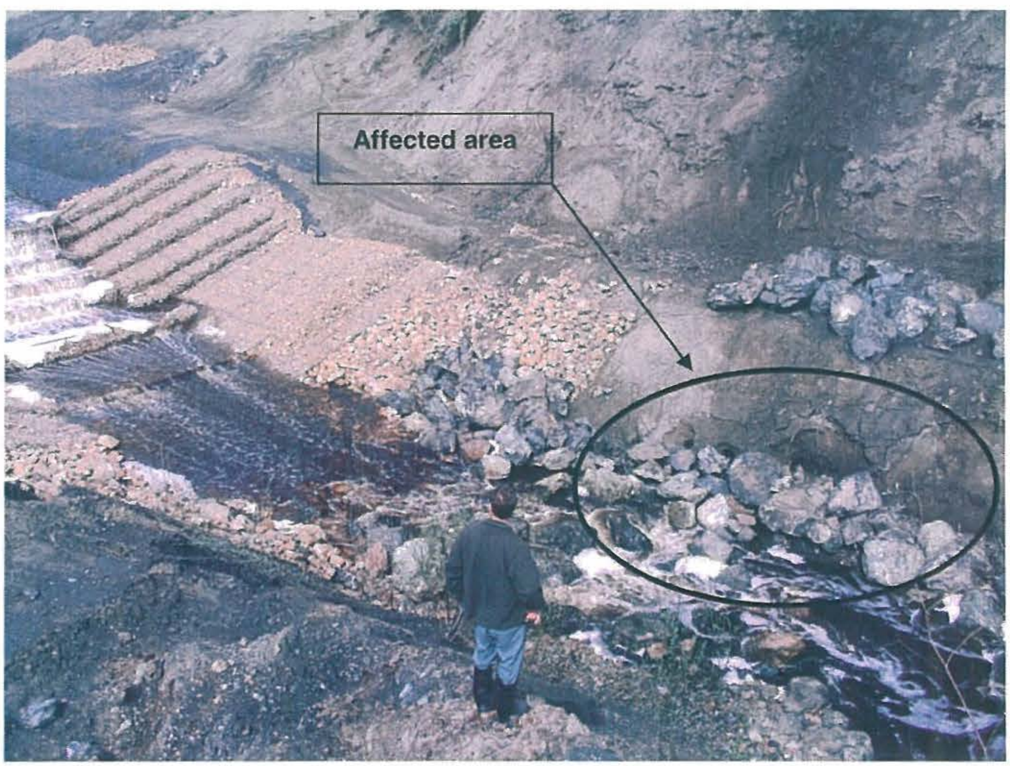
UMA Engineering Ltd., 2006a. Government of Yukon, Former Clinton Creek Asbestos Mine – Long-Term Performance Monitoring Program – June 2006.

Photographs

Photograph 1: Erosion of gabion fill from baskets following first spring freshet event

Photograph 2: Turbulence and energy dissipation on lower baskets of each tier.

Photograph 3: High water line from spring freshet and vegetation planted on channel slopes.



Photograph 4: Erosion on left hand side of the channel transition downstream of Drop Structure 4.

Photograph 5: Minimal erosion on right hand side of the channel transition down-stream of Drop Structure 4.

Photograph 6: Wolverine Creek - Rock lined channel: trees growing in channel and some sedimentation occurring.

Photograph 7: South Lobe of tailings pile taken facing south from the north end of the lower slope near Wolverine Creek.

Appendix A

2005 Maintenance Work

Robinson, Gil

From: Robinson, Gil
Sent: Wednesday, August 03, 2005 10:58 AM
To: Frank.Patch
Cc: hugh.copland@gov.yk.ca
Subject: Clinton Creek: Creek Stabilization_2005 maintenance

Attachments: Creek Stabilization_2005 maintenance.PDF

Creek
bilization_2005 mair
i Frank,

Hugh mentioned last week that Han Construction will soon be mobilizing to do some expected maintenance work on some of the gabion drop structures (top off gabion baskets with 4 to 6 inch diameter rock). When we were on-site in May, Hugh and I talked about a couple of other maintenance items that should be done at the same time.

1) vegetation (trees) planted on the channel slopes between the drop structures should be removed as they restrict flow in the channel, particularly sa the trees start to grow and produce seed for new trees. The channel cross-section was not designed to include hydraulic resistance due to trees so in the event of high flows, there is a chance that the channel won't be able to handle the flow. We recommend that the trees be replanted at least 10 m away from the channel crest to permit access for maintenance when required.

2) some minor work also needs to be done on the left hand side of the channel at the transition downstream of the last drop structure (Drop Structure #4). The work involves placing additional boulders on the channel slope and infilling boulders with gabion fill. This work was expected once the boulders settled in during/after the spring freshet. I have attached some sketches to illustrate the work required.

Please confirm that you received this email and call to discuss if required.

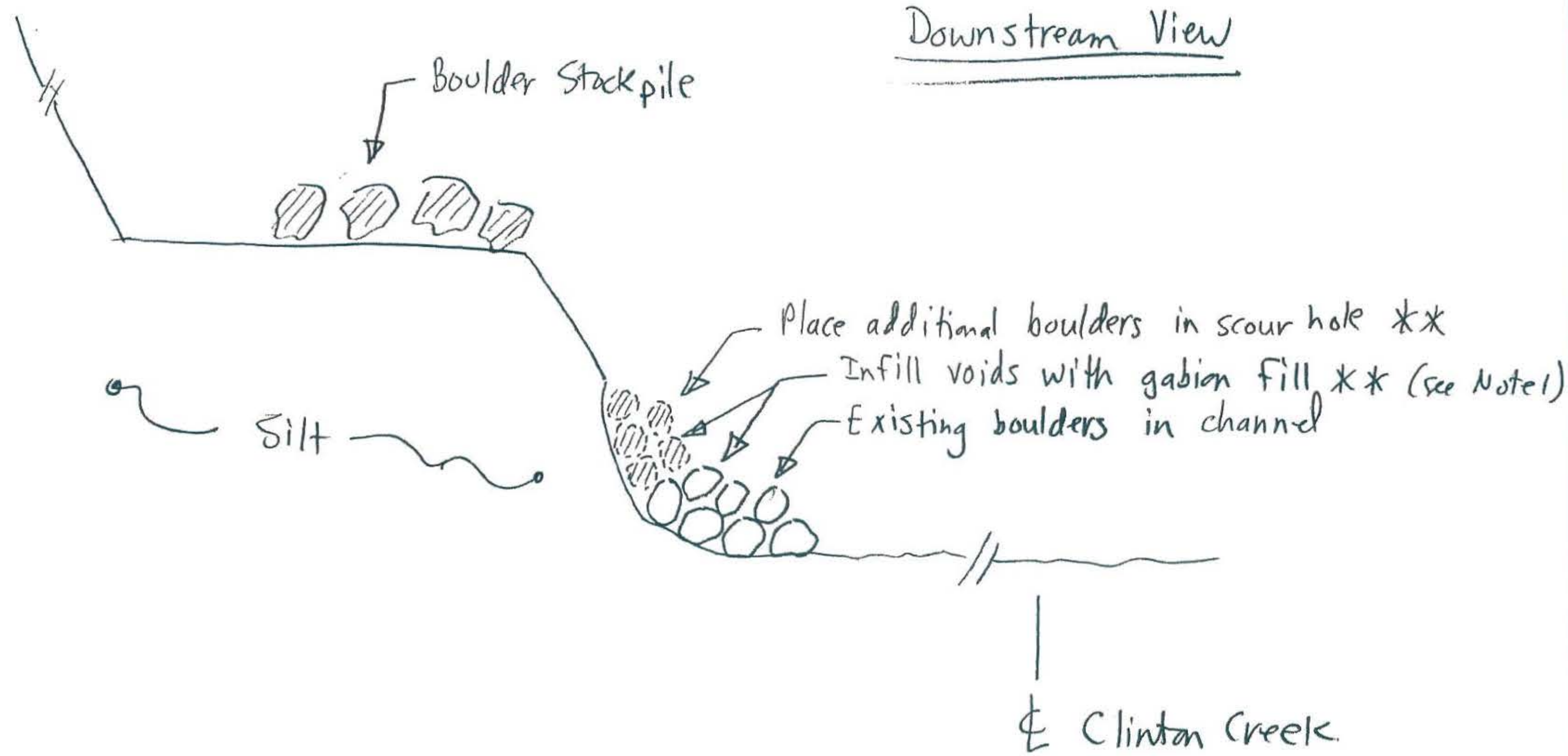
Hope you are keeping well,

Gil


Stockpile of gabion fill and oversize rock
Infill voids between boulders with gabion fill. Place using machine. Final placement by hand to ensure voids are well filled.
Place additional boulders to fill in scour hole. See attached sketch.

UMA Engineering Ltd.
1479 Buffalo Place, Winnipeg, MB R3T 1L7 Canada

PROJECT NO. 60290070 0 | SHEET NO.: 1 OF 1
DATE: 2-August-2005
DESIGNED BY: GR | CHECKED BY:
CLIENT: Government of Yukon
PROJECT: Clinton Creek Channel Stabilization



Notes) 1) infilling voids should be finished by hand placing rocks into voids to ensure voids are well filled. Placement by machine only will not sufficiently fill voids to minimize scouring of silt behind boulders.

Channel Transition Area Downstream of Drop Structure #4.

Appendix B

2005 Tailings Monitoring Program

UMA | AECOM

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

Memorandum

Date:	8 August 2005
To:	Hugh Copland
From:	Gil Robinson
Subject:	Clinton Creek – 2005 Tailings Survey
Project number:	6029-007-00

Distribution: Frank Patch (GY), Ken Skaftfeld (UMA)

Based on the results of the 2004 tailings pile survey and our site visit in May 2005, we recommend adding eleven monitoring points to the south lobe of the tailings pile. The additional monitoring points are required to understand the movement behaviour and trends of the south lobe of the tailings pile. The results from the 2004 monitoring suggest that the lower slope area of the tailings may be moving in a north easterly direction and not directly east, as first thought.

Once the survey is completed, please have a spreadsheet emailed to us with all the survey information, as illustrated on the attached table from the September 2004 survey. We will update the tailings monitoring spreadsheets and interpret the results once the survey information is received.

Information For Co-ordinating 2005 Tailings Survey:

- In 2004, the survey was co-ordinated through Randy Lee at Underhill Geomatics and the survey was completed by Eldon Pfeiffer. Ideally the same surveyor will go this year. If not, they should talk with Eldon before heading out,
- Monitoring protocol is attached and should be adhered to,
- Site plans showing benchmarks and monitoring locations are attached,
- UTM co-ordinates for benchmarks and monitoring points are attached,
- Approximate UTM co-ordinates for new monitoring points are included with the attached monitoring points,
- A Garmin handheld GPS file has also been provided with the route for monitoring. This route should help to minimize climbing during the survey,
- Two people should be sent for the survey due to remote location and site conditions,
- Vehicle access across Clinton Creek crossings should be confirmed before mobilizing surveyors.

Gil Robinson

Gil Robinson

Former Clinton Creek Asbestos Mine
Tailings Pile Monitoring Protocol
June 2005

1. Set-up GPS base station near mill site at BM-U1086.

2. Check control points to confirm BM-U1086 is stable (see Table B-1).

3. Once control has been verified start survey of monitoring points.

4. Tailings:
   - Setup RTK base station near crest of tailings pile (U 2834),
   - Face Wolverine Creek when surveying,
   - survey ground level on the side of the pin furthest from the creek.

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine
UMA Job No.: 6029-006-01

TABLE B-1) BENCHMARKS AT FORMER CLINTON CREEK MINE

UTM NAD83 ZONE 7N

Based on 1999 Air Photo Control (U1189 Destroyed)
Set new Control Points U1086 and U1836. Tied 2001 Control Points in stable areas

	Northing (m)	Easting (m)	Elevation (m)	ID
1086	7,147,972.205	513,176.707	590.950	U1086
1182	7,146,634.155	513,637.686	465.460	U1182
1190	7,149,824.696	512,500.926	609.520	U1190
1191	7,147,605.454	513,589.857	528.930	U1191
1192	7,147,564.047	512,278.761	441.290	U1192
1193	7,146,545.113	513,572.457	456.430	U1193
1200	7,147,166.861	513,662.996	375.480	U1200
1836	7,146,656.183	513,597.724	476.540	U1836
2834	7,148,172.722	513,447.467	607.224	U2834
2836	7,146,814.577	513,092.158	478.422	U2836
5698	7,147,458.764	512,825.164	415.050	U5698
5699	7,147,485.368	512,618.332	425.550	U5699
5700	7,147,657.353	512,155.907	481.380	U5700

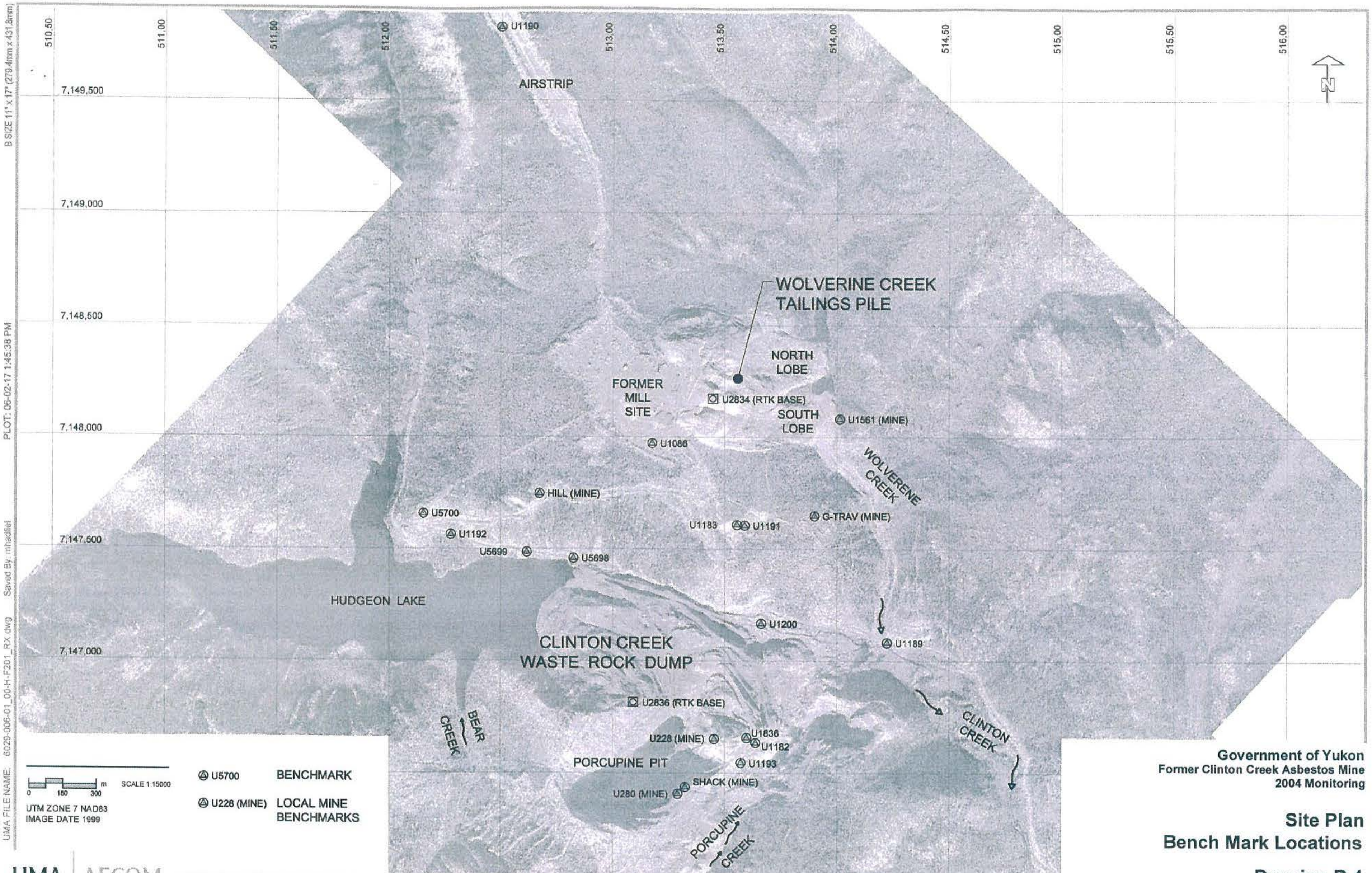
Local Mine Ground Control Transformed to UTM

Transformation based on U5698,U5699,U5700,U1182 common 2001 and 2003 ties.(U1184 not found)
Used U5698 as base. LDD handles scale to ground and rotation -0°17'15" to grid. Manually scale to metric.
Elevation differences based on U1561 (UTM = 423.803m., LOCAL = 1389.87ft.)

	Northing (m)	Easting (m)	Elevation (m)	ID
228	7,146,650.833	513,454.406	500.740	U228
280	7,146,404.795	513,292.824	501.030	U280
300	7,147,747.252	512,674.428	509.290	HILL
400	7,146,435.213	513,325.619	495.390	SHACK
900	7,147,649.576	513,899.213	489.860	GTRAV
1561	7,148,082.327	514,012.370	423.800	U1561

Survey By: Underhill Geomatics - Whitehorse, YT
Surveyor: John Tom Tom / Jean-Louis Salesse
Datum: NAD83, UTM Zone 7 Coordinates

Monitoring Sept. 23, 2004				
Station	**Northing**	**Easting**	**Elevation**	**Comment**
24	7,148,033.895	513,525.561	549.553	
26	7,148,341.494	513,483.546	575.081	
1083 / NL-2	7,148,354.012	513,936.519	414.078	
1084	7,148,017.993	513,618.378	516.095	
1085	7,148,346.060	513,666.411	488.824	
1484	7,148,149.184	513,961.975	417.949	
1485	7,148,018.022	513,703.459	480.101	
1489	7,148,305.198	513,928.504	413.635	
1491	7,148,376.821	513,868.989	432.316	
1492	7,148,053.727	513,409.949	609.982	
1495	7,148,526.645	513,528.950	529.066	
2834	7,148,172.721	513,447.481	607.227	RTK base for tailings survey
1483	7,148,233.020	513,412.679	608.997	
24-A	7,148,035.439	513,775.702	464.888	
24-B	7,148,045.334	513,833.263	445.888	
24-D	7,148,071.928	513,920.650	422.279	
25-B	7,148,065.753	513,948.634	422.031	
26-A	7,148,339.318	513,540.493	557.740	
350-1A	7,148,298.609	513,822.642	448.002	
350-2A	7,148,300.538	513,873.845	428.576	
350-3A	7,148,312.197	513,899.138	417.275	
500-1	7,148,343.237	513,725.526	474.010	
500-2	7,148,344.367	513,842.258	438.050	
650-1	7,148,408.753	513,701.306	483.907	
650-2	7,148,400.253	513,816.079	439.717	
80-1	7,148,408.034	513,543.064	555.613	
80-2	7,148,290.083	513,549.484	552.632	
80-4	7,148,201.727	513,689.474	501.415	
80-5	7,148,249.423	513,718.768	481.074	
80-7	7,148,344.005	513,890.893	422.399	
80-9	7,147,996.383	513,970.725	411.035	
BH-14 T7	7,148,488.334	513,562.988	530.299	
BH-16 T8 CORD	7,148,048.627	513,761.307	464.593	
BH-16 T8 POST	7,148,048.841	513,761.873	464.910	
NL-1	7,148,365.727	513,942.447	413.164	
NL-2		see 1083		NL-2 and 1083 are the same point
NL-3	7,148,334.731	513,926.880	417.046	
NL-4	7,148,307.194	513,912.986	416.159	
NL-5	7,148,275.174	513,896.964	415.416	
SL-1	7,148,079.086	513,970.461	419.764	
SL-2	7,148,087.009	513,956.878	422.458	
SL-3	7,148,100.541	513,933.163	420.779	
New For 2005 - Approximate Co-ordinates For layout				
NL-Base	7,148,161	513,836		existing point to be tied in
SL-4	7,148,113	513,905		existing point to be tied in
SL-5	7,148,134	513,878		existing point to be tied in
2005-01	7,148,100	513,758		new point for 2005
2005-02	7,148,118	513,817		new point for 2005
2005-03	7,148,108	513,870		new point for 2005
2005-04	7,148,047	513,876		new point for 2005
2005-05	7,148,000	513,782		new point for 2005
2005-06	7,148,000	513,866		new point for 2005
2005-07	7,148,000	513,945		new point for 2005
2005-08	7,148,039	513,971		new point for 2005
2005-09	7,148,124	513,969		new point for 2005
2005-10	7,148,147	513,925		new point for 2005
2005-11	7,148,176	513,942		new point for 2005



UMA | AECOM

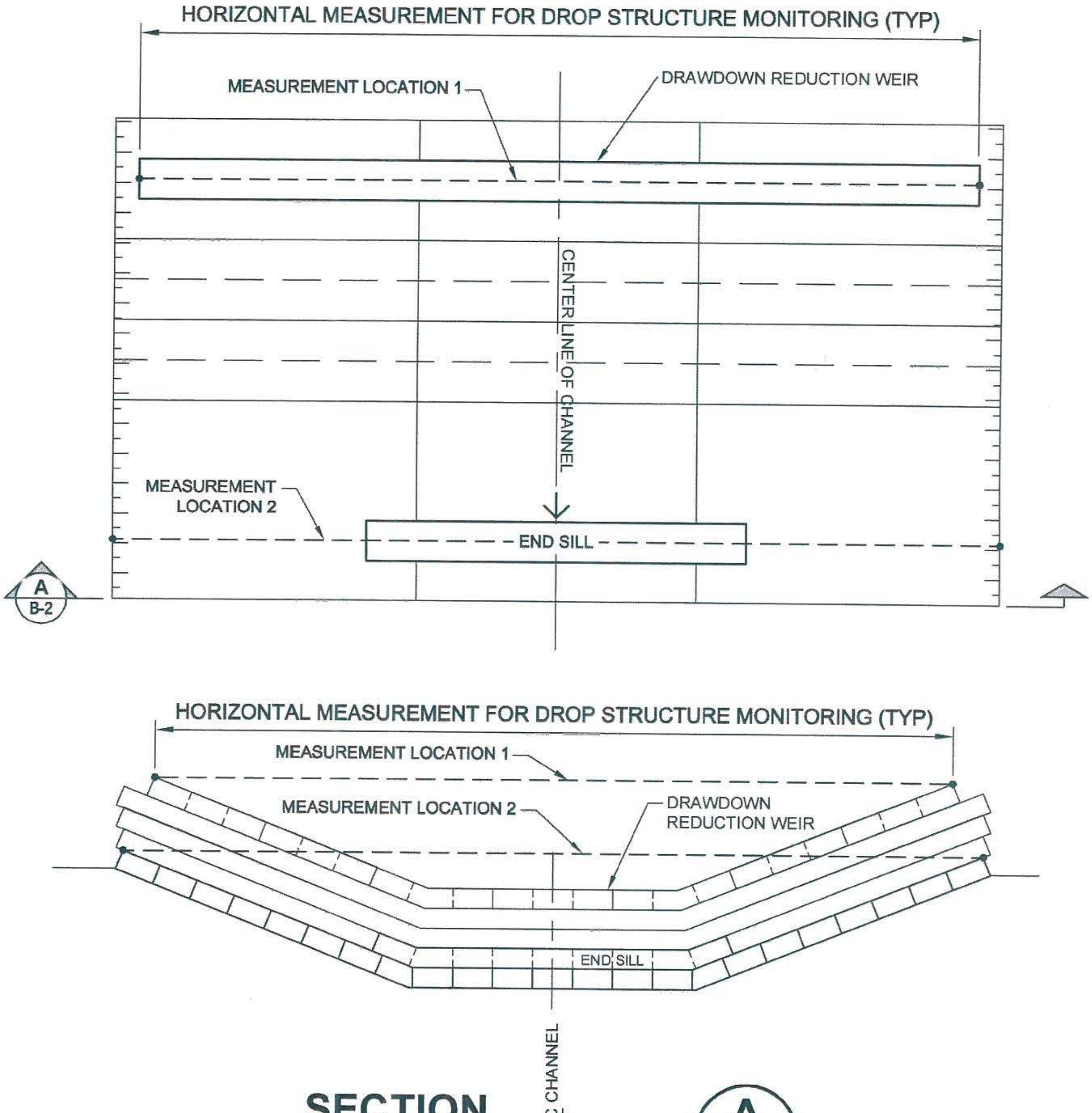
Government of Yukon
Former Clinton Creek Asbestos Mine
2004 Monitoring

Site Plan
Bench Mark Locations

Drawing B-1

Appendix C

Gabion Drop Structure Monitoring



SECTION A / B-2

0 1.5 3 4.5 m SCALE 1:150

Government of Yukon
Former Clinton Creek Asbestos Mine

Drop Structure Monitoring

UMA | AECOM

Drawing - C-1

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine - Channel Stabilization
Job No.: 6029-007-00
Date: 22-May-05

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)			Comment
	Date 29-Jul-04	Date: 22-May-05 measurement	change	
1	19.62	19.57	-0.05	
2	19.49	19.48	-0.01	
3	19.44	19.32	-0.12	
4	n/a	19.61	n/a	baseline

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

Drop Structure	Horizontal Distance Across Drop Structure (metres)			Comment
	Date 29-Jul-04	Date: 22-May-05 measurement	change	
1	n/a	21.00	n/a	baseline
2	n/a	21.15	n/a	baseline
3	n/a	21.50	n/a	baseline
4	n/a	21.48	n/a	baseline

Photograph C1: Gabion drop structure – measurement location 1 across drawdown weir.

Photograph C2: Gabion drop structure - measurement location 2 across end sill.

Appendix D

Tailings Movement Monitoring

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine - Tailings Movement Monitoring
UMA Job No.: 6029-005-00 6029-006-00 6029-007-00
Date: 31-Aug-03 Jul / Sep 2004 Sep-05

Table D-1) Wolverine Creek Tailings Pile - Movement Monitoring Summary

		Annual Horizontal Movement Rates (m per year)					
		North Lobe			South Lobe		
	Monitoring Period:	1) Aug 03 to Jul 04	2) Sep 04 to Sep 05	rate change	1) Aug 03 to Jul 04	2) Sep 04 to Sep 05	rate change
Upper Slope	average	0.04	0.06	0.02	0.15	0.13	-0.02
	maximum	0.10	0.11	0.01	0.24	0.18	-0.06
	minimum	0.01	0.01	0.00	0.07	0.08	0.01
Mid Slope	average	0.21	0.18	-0.03	0.87	0.76	-0.11
	maximum	0.63	0.53	-0.10	1.02	0.93	-0.09
	minimum	0.01	0.02	0.01	0.43	0.35	-0.08
Lower Slope	average	0.11	0.12	0.01	0.45	0.39	-0.06
	maximum	0.17	0.18	0.01	0.76	0.66	-0.10
	minimum	0.08	0.06	-0.02	0.07	0.05	-0.02

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine - Tailings Movement Monitoring
UMA Job No.: 6029-005-00 6029-006-00 6029-007-00
Date: 31-Aug-03 Jul / Sep 2004 Sep-05

Tailings Stability - Upper Slopes (Elevation > 530 m)

North Lobe

Monitor	Date	UTM Coordinates			Time		Horizontal Movement			Vertical Movement		
		Northing (metres)	Easting (metres)	Elevation (metres)	total (days)	incremental (days)	total (metres)	increment (metres)	rate (metres/year)	total (metres)	incremental (metres)	rate (metres/year)
1483	21-Aug-03	7,148,233.01	513,412.67	609.08	0	0						
	28-Jul-04	7,148,233.01	513,412.69	609.02	342	342	0.03	0.03	0.03	-0.06	-0.06	-0.06
	23-Sep-04	7,148,233.02	513,412.68	609.00	399	57	0.02	-0.01	-0.07	-0.08	-0.03	-0.16
	17-Sep-05	7,148,233.03	513,412.71	608.96	758	359	0.05	0.03	0.03	-0.12	-0.04	-0.04
26	21-Aug-03	7,148,341.45	513,483.53	575.11	9,275	7,007	2.12	0.44	0.02	-0.95	-0.43	-0.02
	28-Jul-04	7,148,341.48	513,483.55	575.10	9,617	342	2.15	0.03	0.04	-0.96	-0.01	-0.01
	23-Sep-04	7,148,341.49	513,483.55	575.08	9,674	57	2.15	0.00	0.00	-0.97	-0.01	-0.10
	17-Sep-05	7,148,341.47	513,483.57	575.01	10,033	359	2.16	0.01	0.01	-1.05	-0.07	-0.07
80-2	21-Aug-03	7,148,290.05	513,549.41	552.78	7,294	7,007	1.71	0.74	0.04	-0.57	-0.57	-0.03
	28-Jul-04	7,148,290.09	513,549.50	552.65	7,636	342	1.80	0.09	0.10	-0.70	-0.13	-0.14
	23-Sep-04	7,148,290.08	513,549.48	552.63	7,693	57	1.79	-0.01	-0.09	-0.72	-0.02	-0.12
	17-Sep-05	7,148,290.08	513,549.57	552.50	8,052	359	1.87	0.09	0.09	-0.86	-0.14	-0.14
26-A	21-Aug-03	7,148,339.30	513,540.50	557.82	9,275	7,007	2.50	0.72	0.04	-0.83	-0.83	-0.04
	28-Jul-04	7,148,339.32	513,540.52	557.75	9,617	342	2.51	0.01	0.01	-0.90	-0.07	-0.08
	23-Sep-04	7,148,339.32	513,540.49	557.74	9,674	57	2.49	-0.02	-0.15	-0.91	-0.01	-0.06
	17-Sep-05	7,148,339.34	513,540.56	557.65	10,033	359	2.55	0.06	0.06	-1.01	-0.10	-0.10
80-1	21-Aug-03	7,148,407.98	513,543.04	555.71	7,294	7,007	2.07	1.60	0.08	-1.97	-1.97	-0.10
	28-Jul-04	7,148,408.01	513,543.07	555.61	7,636	342	2.09	0.02	0.02	-2.06	-0.10	-0.10
	23-Sep-04	7,148,408.03	513,543.06	555.61	7,693	57	2.08	-0.01	-0.07	-2.06	0.00	0.00
	17-Sep-05	7,148,408.01	513,543.12	555.49	8,052	359	2.14	0.06	0.06	-2.19	-0.12	-0.13
BH-14 (T7)	21-Aug-03	7,148,488.36	513,563.01	530.33	0	0						
	28-Jul-04	7,148,488.36	513,563.01	530.29	342	342	0.01	0.01	0.01	-0.04	-0.04	-0.05
	23-Sep-04	7,148,488.33	513,562.99	530.30	399	57	0.03	0.03	0.17	-0.03	0.01	0.08
	17-Sep-05	7,148,488.34	513,562.87	530.24	758	359	0.14	0.11	0.11	-0.09	-0.06	-0.06
1495	21-Aug-03	7,148,526.59	513,528.92	529.06	0	0						
	28-Jul-04	7,148,526.62	513,528.97	529.05	342	342	0.06	0.06	0.06	-0.01	-0.01	-0.01
	23-Sep-04	7,148,526.65	513,528.95	529.07	399	57	0.06	0.01	0.04	0.01	0.01	0.08
	17-Sep-05	7,148,526.65	513,529.00	528.97	758	359	0.10	0.04	0.04	-0.09	-0.10	-0.10

		Horizontal increment	Horizontal rate	Vertical total	Vertical incremental	Vertical rate
Average	Aug 03 to Jul 04	0.04	0.04	-0.68	-0.06	-0.06
	Jul 04 to Sep 04	0.00	-0.02	-0.68	-0.01	-0.04
	Sep 04 to Sep 05	**0.06**	**0.06**	**-0.77**	**-0.09**	**-0.09**
Maximum	Aug 03 to Jul 04	0.09	0.10	-0.01	-0.01	-0.01
	Jul 04 to Sep 04	0.03	0.17	0.01	0.01	0.08
	Sep 04 to Sep 05	**0.11**	**0.11**	**-0.09**	**-0.04**	**-0.04**
Minimum	Aug 03 to Jul 04	0.01	0.01	-2.06	-0.13	-0.14
	Jul 04 to Sep 04	-0.02	-0.15	-2.06	-0.03	-0.16
	Sep 04 to Sep 05	**0.01**	**0.01**	**-2.19**	**-0.14**	**-0.14**

South Lobe

Monitor	Date	UTM Coordinates			Time		Horizontal Movement			Vertical Movement		
		Northing (metres)	Easting (metres)	Elevation (metres)	total (days)	incremental (days)	total (metres)	increment (metres)	rate (metres/year)	total (metres)	incremental (metres)	rate (metres/year)
1492	21-Aug-03	7,148,053.74	513,409.91	610.07	1,496	1,496	0.30	0.30	0.07	-0.42	-0.42	-0.10
	28-Jul-04	7,148,053.72	513,409.97	609.98	1,838	342	0.36	0.06	0.07	-0.50	-0.09	-0.09
	23-Sep-04	7,148,053.73	513,409.95	609.98	1,895	57	0.34	-0.02	-0.14	-0.50	0.00	-0.01
	17-Sep-05	7,148,053.69	513,410.03	609.80	2,254	359	0.42	0.08	0.08	-0.69	-0.18	-0.19
24	21-Aug-03	7,148,033.83	513,525.34	549.69	9,275	7,007	10.88	9.03	0.47	-5.54	-5.54	-0.29
	28-Jul-04	7,148,033.87	513,525.57	549.55	9,617	342	11.10	0.22	0.24	-5.68	-0.14	-0.15
	23-Sep-04	7,148,033.90	513,525.56	549.55	9,674	57	11.09	-0.01	-0.05	-5.67	0.01	0.04
	17-Sep-05	7,148,033.91	513,525.74	549.37	10,033	359	11.27	0.18	0.18	-5.86	-0.19	-0.19

		Horizontal increment	Horizontal rate	Vertical total	Vertical incremental	Vertical rate
Average	Aug 03 to Jul 04	0.14	0.15	-3.09	-0.11	-0.12
	Jul 04 to Sep 04	-0.01	-0.10	-3.09	0.00	0.01
	Sep 04 to Sep 05	**0.13**	**0.13**	**-3.27**	**-0.19**	**-0.19**
Maximum	Aug 03 to Jul 04	0.22	0.24	-0.50	-0.09	-0.09
	Jul 04 to Sep 04	-0.01	-0.05	-0.50	0.01	0.04
	Sep 04 to Sep 05	**0.18**	**0.18**	**-0.69**	**-0.18**	**-0.19**
Minimum	Aug 03 to Jul 04	0.06	0.07	-5.68	-0.14	-0.15
	Jul 04 to Sep 04	-0.02	-0.14	-5.67	0.00	-0.01
	Sep 04 to Sep 05	**0.08**	**0.08**	**-5.86**	**-0.19**	**-0.19**

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine - Tailings Movement Monitoring
UMA Job No.: 6029-005-00 6029-006-00 6029-007-00
Date: 31-Aug-03 Jul / Sep 2004 Sep-05

Tailings Stability - Mid Slopes (Elevation 425 to 530 m)

North Lobe

Monitor	Date	UTM Coordinates			Time		Horizontal Movement			Vertical Movement		
		Northing (metres)	Easting (metres)	Elevation (metres)	total (days)	incremental (days)	total (metres)	increment (metres)	rate (metres/year)	total (metres)	incremental (metres)	rate (metres/year)
80-4	21-Aug-03	7,148,201.56	513,688.82	501.73	7,294	7,007	15.93	14.32	0.75	-5.41	-5.41	-0.28
	28-Jul-04	7,148,201.69	513,689.40	501.49	7,636	342	16.52	0.59	0.63	-5.65	-0.24	-0.26
	23-Sep-04	7,148,201.73	513,689.47	501.42	7,693	57	16.60	0.08	0.52	-5.73	-0.07	-0.47
	17-Sep-05	7,148,201.81	513,689.99	501.18	8,052	359	17.12	0.52	0.53	-5.96	-0.24	-0.24
80-5	21-Aug-03	7,148,249.32	513,718.34	481.19	7,294	7,007	21.58	17.47	0.91	-8.31	-8.31	-0.43
	28-Jul-04	7,148,249.41	513,718.73	481.10	7,636	342	21.98	0.40	0.43	-8.40	-0.09	-0.10
	23-Sep-04	7,148,249.42	513,718.77	481.07	7,693	57	22.02	0.04	0.27	-8.43	-0.02	-0.16
	17-Sep-05	7,148,249.49	513,719.16	480.92	8,052	359	22.41	0.39	0.40	-8.59	-0.16	-0.16
1085	21-Aug-03	7,148,346.05	513,666.41	488.88	0	0						
	28-Jul-04	7,148,346.06	513,666.43	488.84	342	342	0.02	0.02	0.02	-0.04	-0.04	-0.04
	23-Sep-04	7,148,346.06	513,666.41	488.82	399	57	0.01	-0.01	-0.09	-0.06	-0.01	-0.09
	17-Sep-05	7,148,346.06	513,666.46	488.72	758	359	0.05	0.04	0.04	-0.16	-0.10	-0.10
500-1	21-Aug-03	7,148,343.22	513,725.53	474.09	9,088	7,007	107.37	43.86	2.28	-46.56	-15.13	-0.79
	28-Jul-04	7,148,343.24	513,725.54	474.02	9,430	342	107.38	0.01	0.01	-46.63	-0.07	-0.07
	23-Sep-04	7,148,343.24	513,725.53	474.01	9,487	57	107.37	-0.01	-0.09	-46.64	-0.01	-0.06
	17-Sep-05	7,148,343.24	513,725.55	473.95	9,846	359	107.39	0.02	0.02	-46.70	-0.06	-0.06
650-1	21-Aug-03	7,148,408.73	513,701.26	483.95	9,088	7,007	83.33	24.10	1.26	-31.32	-11.57	-0.60
	28-Jul-04	7,148,408.75	513,701.33	483.92	9,430	342	83.40	0.06	0.07	-31.35	-0.03	-0.03
	23-Sep-04	7,148,408.75	513,701.31	483.91	9,487	57	83.38	-0.02	-0.12	-31.36	-0.01	-0.07
	17-Sep-05	7,148,408.75	513,701.34	483.87	9,846	359	83.42	0.04	0.04	-31.39	-0.03	-0.03
350-1A	21-Aug-03	7,148,298.59	513,822.46	448.09	9,078	7,007	149.66	72.05	3.75	-52.52	-25.55	-1.33
	28-Jul-04	7,148,298.61	513,822.64	448.01	9,420	342	149.85	0.18	0.20	-52.61	-0.08	-0.09
	23-Sep-04	7,148,298.61	513,822.64	448.00	9,477	57	149.85	0.00	0.00	-52.61	0.00	-0.03
	17-Sep-05	7,148,298.64	513,822.81	447.93	9,836	359	150.01	0.16	0.16	-52.69	-0.07	-0.08
500-2	21-Aug-03	7,148,344.36	513,842.07	438.14	9,078	7,007	159.40	66.97	3.49	-61.43	-26.78	-1.40
	28-Jul-04	7,148,344.36	513,842.27	438.06	9,420	342	159.60	0.20	0.21	-61.51	-0.08	-0.08
	23-Sep-04	7,148,344.37	513,842.26	438.05	9,477	57	159.59	-0.01	-0.07	-61.52	-0.01	-0.08
	17-Sep-05	7,148,344.37	513,842.43	438.00	9,836	359	159.77	0.17	0.18	-61.57	-0.05	-0.05
650-2	21-Aug-03	7,148,400.26	513,815.95	439.87	9,078	7,007	134.07	35.78	1.86	-44.69	-11.93	-0.62
	28-Jul-04	7,148,400.25	513,816.10	439.75	9,420	342	134.21	0.14	0.15	-44.81	-0.12	-0.12
	23-Sep-04	7,148,400.25	513,816.08	439.72	9,477	57	134.19	-0.02	-0.11	-44.84	-0.04	-0.24
	17-Sep-05	7,148,400.24	513,816.21	439.67	9,836	359	134.32	0.13	0.13	-44.89	-0.04	-0.05
350-2A	21-Aug-03	7,148,300.52	513,873.67	428.71	9,070	7,007	163.89	72.97	3.80	-61.41	-29.09	-1.52
	28-Jul-04	7,148,300.53	513,873.83	428.58	9,412	342	164.05	0.16	0.17	-61.54	-0.13	-0.14
	23-Sep-04	7,148,300.54	513,873.85	428.58	9,469	57	164.07	0.01	0.08	-61.55	-0.01	-0.04
	17-Sep-05	7,148,300.52	513,873.98	428.51	9,828	359	164.20	0.14	0.14	-61.61	-0.06	-0.07
1491	21-Aug-03	7,148,376.83	513,868.79	432.49	0	0						
	28-Jul-04	7,148,376.82	513,869.00	432.34	342	342	0.21	0.21	0.22	-0.15	-0.15	-0.16
	23-Sep-04	7,148,376.82	513,868.99	432.32	399	57	0.20	-0.01	-0.04	-0.17	-0.02	-0.13
	17-Sep-05	7,148,376.85	513,869.15	432.27	758	359	0.36	0.16	0.17	-0.22	-0.05	-0.05

Average	Aug 03 to Jul 04	0.20	0.21	-31.27	-0.10	-0.11
	Jul 04 to Sep 04	0.01	0.04	-31.29	-0.02	-0.14
	Sep 04 to Sep 05	**0.18**	**0.18**	**-31.38**	**-0.09**	**-0.09**
Maximum	Aug 03 to Jul 04	0.59	0.63	-0.04	-0.03	-0.03
	Jul 04 to Sep 04	0.08	0.52	-0.06	0.00	-0.03
	Sep 04 to Sep 05	**0.52**	**0.53**	**-0.16**	**-0.03**	**-0.03**
Minimum	Aug 03 to Jul 04	0.01	0.01	-61.54	-0.24	-0.26
	Jul 04 to Sep 04	-0.02	-0.12	-61.55	-0.07	-0.47
	Sep 04 to Sep 05	**0.02**	**0.02**	**-61.61**	**-0.24**	**-0.24**

South Lobe

Monitor	Date	UTM Coordinates			Time		Horizontal Movement			Vertical Movement		
		Northing (metres)	Easting (metres)	Elevation (metres)	total (days)	incremental (days)	total (metres)	increment (metres)	rate (metres/year)	total (metres)	incremental (metres)	rate (metres/year)
1084	21-Aug-03	7,148,017.97	513,617.95	516.26	0	0						
	28-Jul-04	7,148,017.98	513,618.35	516.10	342	342	0.40	0.40	0.43	-0.16	-0.16	-0.17
	23-Sep-04	7,148,017.99	513,618.38	516.10	399	57	0.43	0.03	0.16	-0.16	-0.01	-0.06
	17-Sep-05	7,148,018.02	513,618.72	516.02	758	359	0.77	0.34	0.35	-0.24	-0.08	-0.08
1485	21-Aug-03	7,148,017.91	513,702.37	480.46	0	0						
	28-Jul-04	7,148,018.00	513,703.32	480.19	342	342	0.95	0.95	1.02	-0.27	-0.27	-0.29
	23-Sep-04	7,148,018.02	513,703.46	480.10	399	57	1.09	0.14	0.89	-0.36	-0.09	-0.56
	17-Sep-05	7,148,018.12	513,704.37	479.82	758	359	2.00	0.91	0.93	-0.64	-0.29	-0.29
BH-16 (T8)	21-Aug-03	7,148,048.49	513,760.30	464.94	0	0						
	28-Jul-04	7,148,048.61	513,761.19	464.65	342	342	0.90	0.90	0.96	-0.29	-0.29	-0.31
	23-Sep-04	7,148,048.63	513,761.31	464.59	399	57	1.02	0.12	0.77	-0.35	-0.05	-0.35
	17-Sep-05	7,148,048.72	513,762.13	464.34	758	359	1.84	0.82	0.84	-0.60	-0.25	-0.26
24A	21-Aug-03	7,148,035.28	513,774.68	465.27	9,275	7,007	83.16	61.43	3.20	-21.10	-21.10	-1.10
	28-Jul-04	7,148,035.42	513,775.58	464.94	9,617	342	84.07	0.91	0.97	-21.43	-0.33	-0.35
	23-Sep-04	7,148,035.44	513,775.70	464.89	9,674	57	84.20	0.13	0.81	-21.49	-0.05	-0.34
	17-Sep-05	7,148,035.58	513,776.55	464.66	10,033	359	85.06	0.86	0.88	-21.71	-0.23	-0.23
24B	21-Aug-03	7,148,045.09	513,832.26	446.30	9,275	7,007	81.91	61.11	3.18	-20.06	-20.06	-1.04
	28-Jul-04	7,148,045.31	513,833.13	446.00	9,617	342	82.81	0.90	0.96	-20.36	-0.30	-0.32
	23-Sep-04	7,148,045.33	513,833.26	445.89	9,674	57	82.94	0.13	0.85	-20.47	-0.11	-0.69
	17-Sep-05	7,148,045.55	513,834.05	445.62	10,033	359	83.75	0.81	0.83	-20.74	-0.27	-0.27

Average	Aug 03 to Jul 04	0.81	0.87	-8.50	-0.27	-0.29
	Jul 04 to Sep 04	0.11	0.70	-8.57	-0.06	-0.40
	Sep 04 to Sep 05	**0.75**	**0.76**	**-8.79**	**-0.22**	**-0.23**
Maximum	Aug 03 to Jul 04	0.95	1.02	-0.16	-0.16	-0.17
	Jul 04 to Sep 04	0.14	0.89	-0.16	-0.01	-0.06
	Sep 04 to Sep 05	**0.91**	**0.93**	**-0.24**	**-0.08**	**-0.08**
Minimum	Aug 03 to Jul 04	0.40	0.43	-21.43	-0.33	-0.35
	Jul 04 to Sep 04	0.03	0.16	-21.49	-0.11	-0.69
	Sep 04 to Sep 05	**0.34**	**0.35**	**-21.71**	**-0.29**	**-0.29**

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine - Tailings Movement Monitoring
UMA Job No.: 6029-005-00 6029-006-00 6029-007-00
Date: 31-Aug-03 Jul / Sep 2004 Sep-05

Tailings Stability - Lower Slopes (Elevation <425 m)

North Lobe

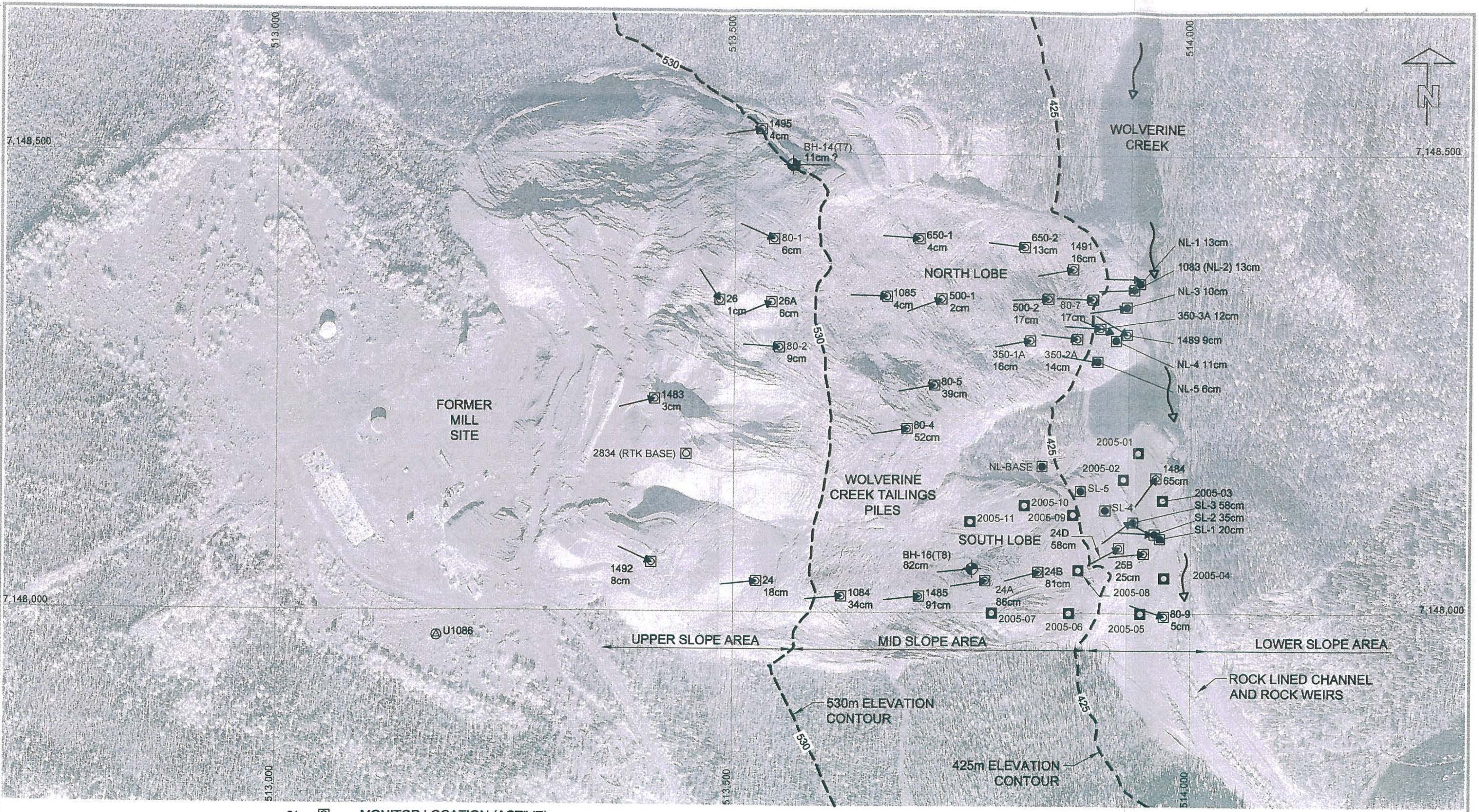
Monitor	Date	UTM Coordinates Northing (metres)	UTM Coordinates Easting (metres)	UTM Coordinates Elevation (metres)	Time total (days)	Time incremental (days)	Horizontal Movement total (metres)	Horizontal Movement increment (metres)	Horizontal Movement rate (metres/year)	Vertical Movement total (metres)	Vertical Movement incremental (metres)	Vertical Movement rate (metres/year)
80-7	21-Aug-03	7,148,344.01	513,890.73	422.54	7,294	7,007	84.36	64.90	3.38	-23.45	-23.45	-1.22
	28-Jul-04	7,148,344.00	513,890.89	422.43	7,636	342	84.52	0.16	0.17	-23.56	-0.11	-0.12
	23-Sep-04	7,148,344.01	513,890.89	422.40	7,693	57	84.52	0.00	0.03	-23.59	-0.03	-0.21
	17-Sep-05	7,148,344.00	513,891.07	422.38	8,052	359	84.70	0.17	0.18	-23.61	-0.02	-0.02
350-3A	21-Aug-03	7,148,312.23	513,899.00	417.39	9,064	7,007	167.16	67.37	3.51	-67.47	-27.66	-1.44
	28-Jul-04	7,148,312.20	513,899.14	417.31	9,406	342	167.30	0.14	0.15	-67.55	-0.08	-0.08
	23-Sep-04	7,148,312.20	513,899.14	417.28	9,463	57	167.29	0.00	-0.02	-67.59	-0.04	-0.25
	17-Sep-05	7,148,312.19	513,899.26	417.28	9,822	359	167.42	0.12	0.12	-67.58	0.00	0.00
1489	21-Aug-03	7,148,305.23	513,928.45	413.70	0	0						
	28-Jul-04	7,148,305.19	513,928.51	413.66	342	342	0.08	0.08	0.08	-0.04	-0.04	-0.04
	23-Sep-04	7,148,305.20	513,928.50	413.64	399	57	0.06	-0.01	-0.09	-0.06	-0.03	-0.16
	17-Sep-05	7,148,305.15	513,928.58	413.62	758	359	0.15	0.09	0.09	-0.08	-0.02	-0.02
NL-1	28-Jul-04	7,148,365.73	513,942.45	413.19	0	0						
	23-Sep-04	7,148,365.73	513,942.45	413.16	57	57	0.01	0.01	0.03	-0.02	-0.02	-0.15
	17-Sep-05	7,148,365.72	513,942.59	413.16	416	359	0.14	0.13	0.13	-0.03	0.00	-0.01
1083 (NL-2)	21-Aug-03	7,148,354.01	513,936.37	414.10	0	0						
	28-Jul-04	7,148,354.00	513,936.52	414.10	342	342	0.15	0.15	0.16	0.00	0.00	-0.01
	23-Sep-04	7,148,354.01	513,936.52	414.08	33	-309	0.15	0.00	0.00	-0.02	-0.02	0.02
	17-Sep-05	7,148,354.02	513,936.65	414.05	758	359	0.28	0.13	0.14	-0.05	-0.03	-0.03
NL-3	28-Jul-04	7,148,334.73	513,926.88	417.07	0	0						
	23-Sep-04	7,148,334.73	513,926.88	417.05	57	57	0.00	0.00	0.03	-0.02	-0.02	-0.13
	17-Sep-05	7,148,334.75	513,926.99	417.08	416	359	0.10	0.10	0.10	0.01	0.03	0.03
NL-4	28-Jul-04	7,148,307.20	513,913.00	416.19	0	0						
	23-Sep-04	7,148,307.19	513,912.99	416.16	57	57	0.02	0.02	0.13	-0.03	-0.03	-0.20
	17-Sep-05	7,148,307.14	513,913.12	416.11	416	359	0.13	0.11	0.11	-0.08	-0.05	-0.05
NL-5	28-Jul-04	7,148,275.21	513,896.96	415.46	0	0						
	23-Sep-04	7,148,275.17	513,896.96	415.42	57	57	0.04	0.04	0.26	-0.04	-0.04	-0.26
	17-Sep-05	7,148,275.16	513,897.05	415.39	416	359	0.10	0.06	0.06	-0.07	-0.03	-0.03

Average	Aug 03 to Jul 04	0.11	0.11	-18.23	-0.05	-0.05
	Jul 04 to Sep 04	0.01	0.05	-11.42	-0.03	-0.17
	Sep 04 to Sep 05	**0.12**	**0.12**	**-11.44**	**-0.02**	**-0.02**
Maximum	Aug 03 to Jul 04	0.16	0.17	0.00	0.00	-0.01
	Jul 04 to Sep 04	0.04	0.26	-0.02	-0.02	0.02
	Sep 04 to Sep 05	**0.17**	**0.18**	**0.01**	**0.03**	**0.03**
Minimum	Aug 03 to Jul 04	0.08	0.08	-67.55	-0.11	-0.12
	Jul 04 to Sep 04	-0.01	-0.09	-67.59	-0.04	-0.26
	Sep 04 to Sep 05	**0.06**	**0.06**	**-67.58**	**-0.05**	**-0.05**

South Lobe

Monitor	Date	UTM Coordinates Northing (metres)	UTM Coordinates Easting (metres)	UTM Coordinates Elevation (metres)	Time total (days)	Time incremental (days)	Horizontal Movement total (metres)	Horizontal Movement increment (metres)	Horizontal Movement rate (metres/year)	Vertical Movement total (metres)	Vertical Movement incremental (metres)	Vertical Movement rate (metres/year)
24D	21-Aug-03	7,148,071.59	513,920.05	422.39	9,103	7,007	63.31	50.43	2.63			
	28-Jul-04	7,148,071.88	513,920.59	422.29	9,445	342	63.92	0.60	0.64	-0.10	-0.10	-0.11
	23-Sep-04	7,148,071.93	513,920.65	422.28	9,502	57	63.99	0.07	0.47	-0.11	-0.01	-0.06
	17-Sep-05	7,148,072.22	513,921.17	422.27	9,861	359	64.57	0.58	0.59	-0.12	-0.01	-0.01
25B	21-Aug-03	7,148,065.68	513,948.29	422.02	9,096	7,007	50.24	35.01	1.82	1.18	1.18	0.06
	28-Jul-04	7,148,065.72	513,948.61	422.03	9,438	342	50.56	0.32	0.34	1.19	0.01	0.01
	23-Sep-04	7,148,065.75	513,948.63	422.03	9,495	57	50.59	0.03	0.18	1.19	0.00	-0.01
	17-Sep-05	7,148,065.78	513,948.89	422.10	9,854	359	50.84	0.25	0.26	1.26	0.07	0.07
80-9	21-Aug-03	7,147,996.44	513,970.69	411.11	7,294	7,007	11.83	11.29	0.59	3.07	3.07	0.16
	28-Jul-04	7,147,996.41	513,970.75	411.09	7,636	342	11.89	0.06	0.07	3.05	-0.02	-0.03
	23-Sep-04	7,147,996.38	513,970.73	411.04	7,693	57	11.88	-0.01	-0.04	2.99	-0.05	-0.33
	17-Sep-05	7,147,996.37	513,970.77	411.06	8,052	359	11.93	0.05	0.05	3.02	0.03	0.03
1484	21-Aug-03	7,148,148.49	513,961.52	417.94	0	0						
	28-Jul-04	7,148,149.07	513,961.93	417.98	342	342	0.71	0.71	0.76	0.04	0.04	0.04
	23-Sep-04	7,148,149.18	513,961.98	417.95	399	57	0.83	0.12	0.76	0.01	-0.03	-0.19
	17-Sep-05	7,148,149.71	513,962.36	417.93	758	359	1.49	0.65	0.66	-0.01	-0.01	-0.02
SL-1	28-Jul-04	7,148,078.88	513,970.45	419.86	0	0						
	23-Sep-04	7,148,079.09	513,970.46	419.76	57	57	0.20	0.20	1.30	-0.09	-0.09	-0.60
	17-Sep-05	7,148,078.87	513,970.86	419.83	416	359	0.40	0.20	0.20	-0.03	0.06	0.06
SL-2	28-Jul-04	7,148,086.80	513,956.84	422.53	0	0						
	23-Sep-04	7,148,087.01	513,956.88	422.46	57	57	0.21	0.21	1.38	-0.07	-0.07	-0.45
	17-Sep-05	7,148,086.98	513,957.37	422.60	416	359	0.56	0.35	0.35	0.08	0.15	0.15
SL-3	28-Jul-04	7,148,100.47	513,933.11	420.80	0	0						
	23-Sep-04	7,148,100.54	513,933.16	420.78	57	57	0.09	0.09	0.59	-0.02	-0.02	-0.13
	17-Sep-05	7,148,100.89	513,933.63	420.83	416	359	0.67	0.58	0.59	0.03	0.05	0.05

Average	Aug 03 to Jul 04	0.43	0.45	1.04	-0.02	-0.02
	Jul 04 to Sep 04	0.10	0.66	0.56	-0.04	-0.25
	Sep 04 to Sep 05	**0.38**	**0.39**	**0.60**	**0.05**	**0.05**
Maximum	Aug 03 to Jul 04	0.71	0.76	3.05	0.04	0.04
	Jul 04 to Sep 04	0.21	1.38	2.99	0.00	-0.01
	Sep 04 to Sep 05	**0.65**	**0.66**	**3.02**	**0.15**	**0.15**
Minimum	Aug 03 to Jul 04	0.06	0.07	-0.10	-0.10	-0.11
	Jul 04 to Sep 04	-0.01	-0.04	-0.11	-0.09	-0.60
	Sep 04 to Sep 05	**0.05**	**0.05**	**-0.12**	**-0.01**	**-0.02**



B SIZE 11" x 17" (279.4mm x 431.8mm)   PLOT: 06/06/19 10:18:58 AM   Saved By: jviberg   UMA FILE NAME: 6029-006-01_03-H-F041_RX.dwg

0 40 80 120 m SCALE 1:4000

UTM ZONE 7 NAD83
IMAGE DATE 1999

24	[active symbol]	MONITOR LOCATION (ACTIVE)
2005-01	[added symbol]	MONITOR LOCATION (ADDDED IN 2005)
22cm		RECORDED MOVEMENT (SEPT 2004 - SEPT 2005)
	→	MOVEMENT VECTOR (SEPT 2004 - SEPT 2005)
SL/NL-01	[pin symbol]	VISUAL ALIGNMENT PIN
BH-14 (T7)	[test hole symbol]	1978 TEST HOLE LOCATION

COMPASS BEARING FROM NL-BASE ALONG PINS NL-1 TO NL-5
DECLINATION: 30°
BEARING: 208°

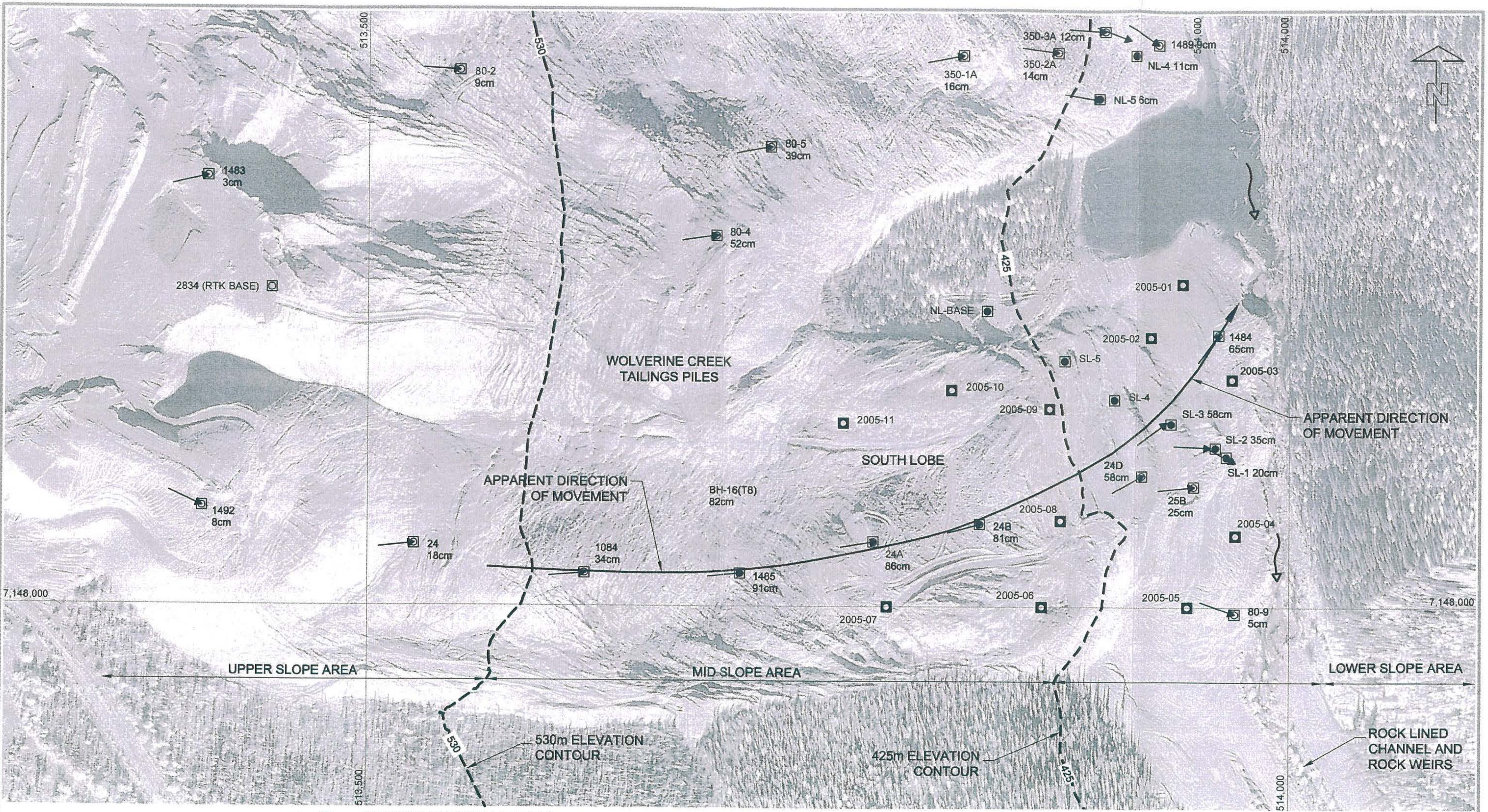
COMPASS BEARING FROM NL-BASE ALONG PINS SL-1 TO SL-5
DECLINATION: 30°
BEARING: 121°

UMA | AECOM

Government of Yukon
Former Clinton Creek Asbestos Mine
2005 Engineering Services

Wolverine Creek Tailings Pile
2005 Movement Monitoring

Drawing - D-1



24	◎	MONITOR LOCATION (ACTIVE)
2005-01	◘	MONITOR LOCATION (ADDDED IN 2005)
22cm		RECORDED MOVEMENT (SEPT 2004 - SEPT 2005)
	→	MOVEMENT VECTOR (SEPT 2004 - SEPT 2005)
SL/NL-01	●	VISUAL ALIGNMENT PIN
BH-14 (T7)		1978 TEST HOLE LOCATION

0 20 40 60 m SCALE 1:2000

UTM ZONE 7 NAD83
IMAGE DATE 1999

COMPASS BEARING FROM NL-BASE ALONG PINS NL-1 TO NL-5
DECLINATION: 30°
BEARING: 208°

COMPASS BEARING FROM NL-BASE ALONG PINS SL-1 TO SL-5
DECLINATION: 30°
BEARING: 121°

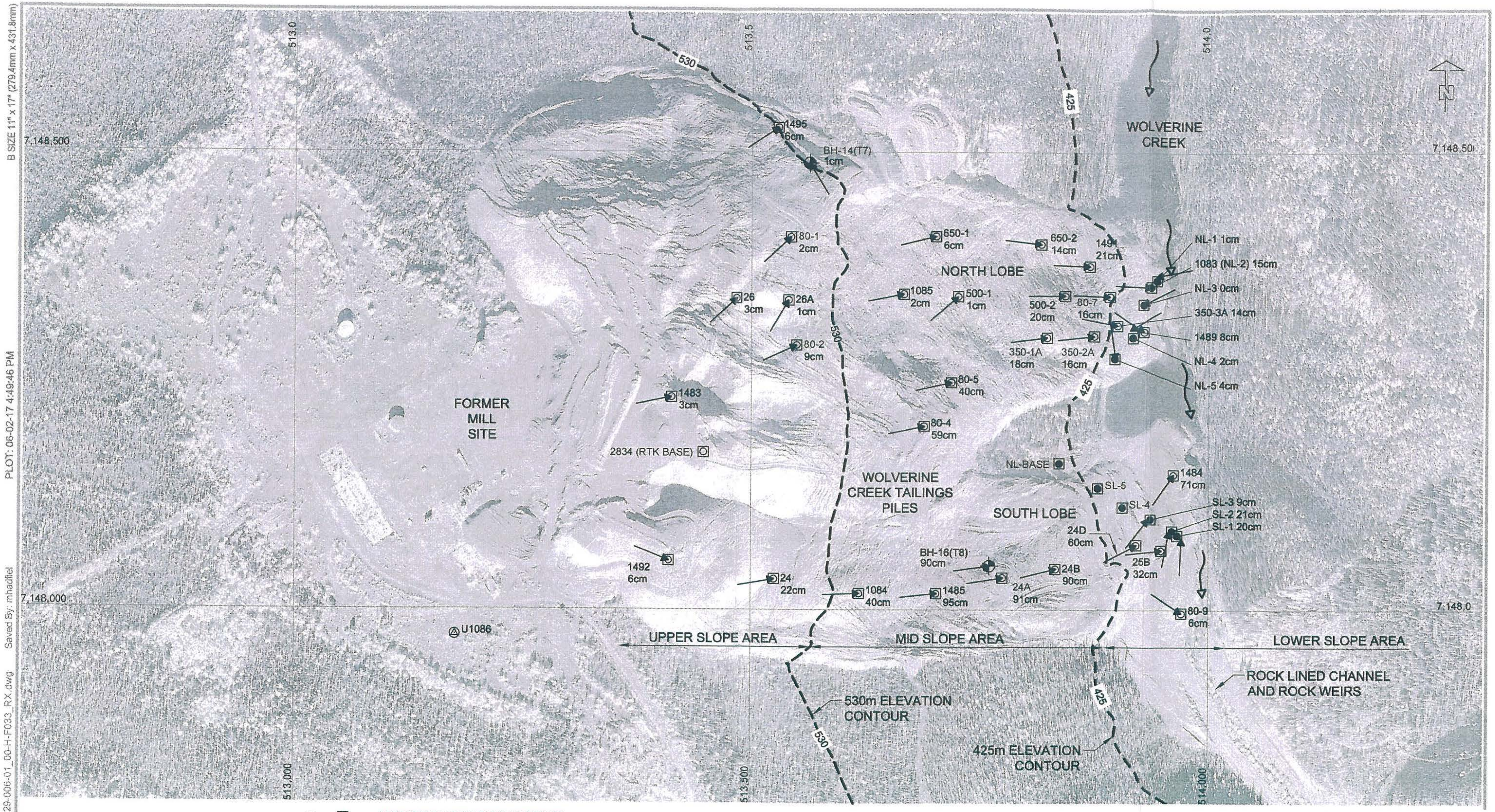
Government of Yukon
Former Clinton Creek Asbestos Mine
2005 Engineering Services

Wolverine Creek Tailings Pile Direction of Movement

Drawing - D-2

UMA | AECOM

B SIZE 11" x 17" (279.4mm x 431.8mm)
PLOT: 06/06/19 10:21:57 AM
Saved By: jviberg
UMA FILE NAME: 6029-006-01_03-H-F042_RX.dwg



B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 06-02-17 4:49:46 PM

Saved By: mhadfiel

UMA FILE NAME: 6029-006-01_00-H-F033_RX.dwg

m SCALE 1:4000
0 40 80 120

UTM ZONE 7 NAD83
IMAGE DATE 1999

24 ◻	MONITOR LOCATION (ACTIVE)
22cm	RECORDED MOVEMENT (AUGUST 2004 - JULY 2004)
SL/NL-01 ◼	VISUAL ALIGNMENT PIN
BH-14 (T7) ⊕	1978 TEST HOLE LOCATION
⟶	MOVEMENT VECTOR (AUGUST 2004 - JULY 2004)

COMPASS BEARING FROM NL-BASE ALONG PINS NL-1 TO NL-5
DECLINATION: 30°
BEARING: 208°

COMPASS BEARING FROM NL-BASE ALONG PINS SL-1 TO SL-5
DECLINATION: 30°
BEARING: 121°

Government of Yukon
Former Clinton Creek Asbestos Mine
2004 Monitoring

Wolverine Creek Tailings Pile Movement Monitoring

Drawing 3-3

UMA | AECOM

Appendix B
Monitoring Protocol

Former Clinton Creek Asbestos Mine
Monitoring Protocol
June 2006

1. Set-up GPS base station near Mill Site at BM-U1086. (Ref. Drawing B-1, Table B-1)

2. Check control points to confirm BM-U1086 is stable (Ref. Drawing B-1, Table B-1).

3. Once control has been verified start survey of movement monitoring points.

4. Waste Rock Pile (ref: Drawing B-2):
   - Setup RTK base station on Waste Rock pile at U2836,
   - Face Clinton Creek (CC) when surveying points,
   - Survey ground level at the base of the pin on the side of the pin furthest from the creek.

5. Porcupine Pit Slope Monitors (ref: Drawing B-2):
   - Face the open pit when surveying,
   - survey ground level at the base of the pin on the side of the pin furthest from the pit.

6. Clinton Creek Channel Stabilization – Drop Structure Monitoring (ref: Drawing B-3):
   - **2006 Survey: install 4 pins at each drop structure as shown on Drawing B-3**
   - Face creek when surveying,
   - survey ground level at the base of the pin on the side of the pin furthest from the creek.
   - Survey cross-sections of drop structures along the line between the two sets of movement monitoring pins at each structure. As a minimum, take survey shots on top of the gabions at top of slope, mid-slope, toe of slope and centerline.

7. Clinton Creek Centreline Profile Survey (ref. Drawing B-4):
   - Establish TBM's (check 2004 survey files for locations),
   - Start at Station 0+00m (see Table below for co-ordinates),
   - Survey from Station 0+000 to 0+800 m

Clinton Creek Profile Survey: Station Co-ordinates

STATION (m)	NORTHING	EASTING
0+000	7,147,427	512,863
0+250	7,147,366	513,113
0+500	7,147,272	513,363
0+750	7,147,204	513,613
	UTM NAD 83 Zone 7W	

8. Tailings (Ref Drawing B-5):
   - Setup RTK base station near crest of tailings pile (U 2834),
   - Face Wolverine Creek when surveying,
   - survey ground level at the base of the pin on the side furthest from the creek.

9. Wolverine Creek Centreline Profile Survey (Ref Drawing B-6):
   - Establish TBM's if required (check 2003 survey for locations),
   - Start at Station 0+700 m (see Table below for co-ordinates),
   - Survey from Station 0+700 to 1+500 m

Wolverine Creek Profile Survey: Station Co-ordinates

STATION (m)	NORTHING	EASTING
0+000	7,147,095.6	514,193.4
0+700	7,147,686.5	514,162.7
0+800	7,147,770.0	514,118.3
1+000	7,147,920.0	514,000.3
1+200	7,148,110.0	513,988.8
1+500	7,148,379.0	513,946.2
	UTM NAD 83 Zone 7W	

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine
UMA Job No.: 6029-007-00 **Date:** August 2006

Table B-1) Benchmarks at Former Clinton Creek Mine

UTM NAD83 ZONE 7N

Based on 1999 Air Photo Control (U1189 Destroyed)
Set new Control Points U1086 and U1836. Tied 2001 Control Points in stable areas

	Northing (m)	Easting (m)	Elevation (m)	ID
1086	7,147,972.205	513,176.707	590.950	U1086
1182	7,146,634.155	513,637.686	465.460	U1182
1190	7,149,824.696	512,500.926	609.520	U1190
1191	7,147,605.454	513,589.857	528.930	U1191
1192	7,147,564.047	512,278.761	441.290	U1192
1193	7,146,545.113	513,572.457	456.430	U1193
1200	7,147,166.861	513,662.996	375.480	U1200
1836	7,146,656.183	513,597.724	476.540	U1836
2834	7,148,172.722	513,447.467	607.224	U2834
2836	7,146,814.577	513,092.158	478.422	U2836
5698	7,147,458.764	512,825.164	415.050	U5698
5699	7,147,485.368	512,618.332	425.550	U5699
5700	7,147,657.353	512,155.907	481.380	U5700

Local Mine Ground Control Transformed to UTM by Underhill Geomatics

Transformation based on U5698,U5699,U5700,U1182 common 2001 and 2003 ties.(U1184 not found)
Used U5698 as base. LDD handles scale to ground and rotation -0°17'15" to grid. Manually scale to metric.
Elevation differences based on U1561 (UTM = 423.803m., LOCAL = 1389.87ft.)

	Northing (m)	Easting (m)	Elevation (m)	ID
228	7,146,650.833	513,454.406	500.740	U228
280	7,146,404.795	513,292.824	501.030	U280
300	7,147,747.252	512,674.428	509.290	HILL
400	7,146,435.213	513,325.619	495.390	SHACK
900	7,147,649.576	513,899.213	489.860	GTRAV
1561	7,148,082.327	514,012.370	423.800	U1561

LOCAL MINE GROUND SYSTEM (feet)

2003 GPS Control transformed to ground

	Northing (ft)	Easting (ft)	Elevation (ft)	ID
1086	113,283.833	107,216.924	1,938.260	U1086
1182	108,884.267	108,707.955	1,526.550	U1182
1190	119,375.619	105,029.244	1,999.190	U1190
1191	112,073.197	108,566.986	1,734.780	U1191
1192	111,958.873	104,262.818	1,447.250	U1192
1193	108,593.080	108,492.379	1,496.920	U1193
1200	110,632.388	108,799.766	1,231.340	U1200
1836	108,957.224	108,577.153	1,562.900	U1836
5698	111,604.300	106,054.560	1,361.160	U5698
5699	111,695.030	105,376.109	1,395.610	U5699
5700	112,267.162	103,861.093	1,578.780	U5700

Local Mine Control From Historical Files

	Northing (ft)	Easting (ft)	Elevation (ft)	ID
228	108,941.540	108,107.020	1,642.290	U228
280	108,136.470	107,572.500	1,643.240	U280
300	112,553.880	105,564.450	1,670.330	HILL
400	108,235.800	107,680.660	1,624.750	SHACK
900	112,213.030	109,583.730	1,606.590	GTRAV
1561	113,631.480	109,961.620	1,389.870	U1561

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine
UMA Job No.: 6029-007-00
Date: August 2006

Upper Slope) Elevation > 450m
Mid-Slope) Elevation 420 to 450m
Lower Slope) Elevation < 420m

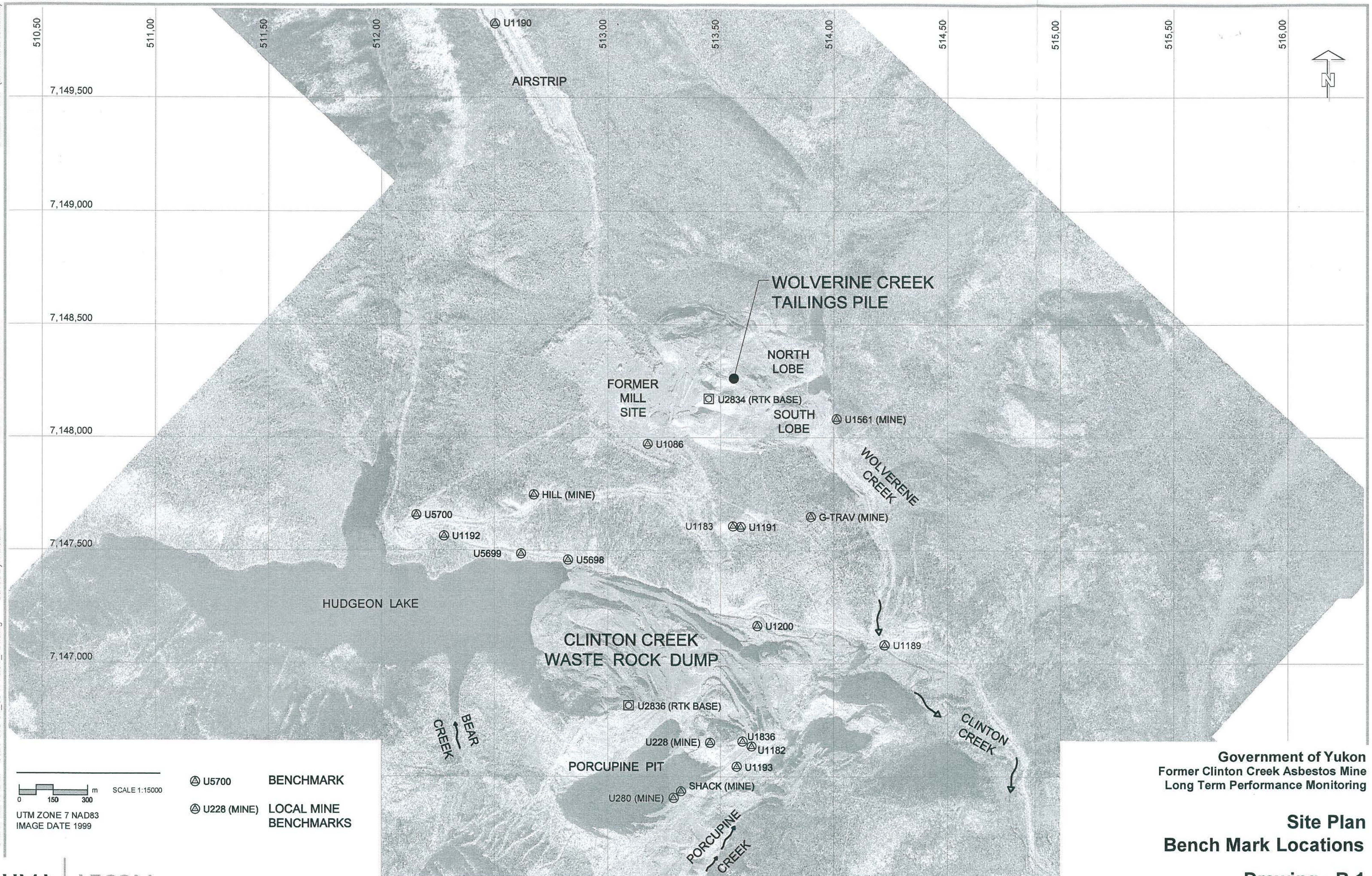
Table B-2) Clinton Creek Waste Rock Dump Instrumentation

Description	ID	Location	Type	Stick Up (cm)	Stick Up (feet)	Serial No on Prism	Marker Cone	Monitor Tag	Underhill Geomatics Tag	Underhill Survey (Aug 21/03) UTM NAD 83 Northing	Easting	Elevation	Comments
Movement Monitor	0225	Upper Slope						0225	0225	7,146,918.716	512,905.221	475.17	
Movement Monitor	0223	Upper Slope						0223	0223	7,146,978.053	512,942.739	467.22	
Movement Monitor	1834	Upper Slope						1834	1834	7,146,973.618	512,893.433	461.12	
Movement Monitor	UU1195	Upper Slope	Bench Mark	NA				UU1195		7,147,111.936	512,899.532	456.59	
Movement Monitor	81-1	Upper Slope		143	4.69			81-1		7,147,034.819	512,978.933	455.27	Old Pin
Movement Monitor	21-A	Mid-Slope	Prism	121	3.97			21-A		7,147,228.197	512,915.152	446.54	Old Pin with prism
Movement Monitor	20-A	Mid-Slope	Prism	130	4.27			20-A		7,147,207.859	513,057.137	445.83	Old Pin with prism
Movement Monitor	22-A	Mid-Slope		122			YES	22-A		7,147,224.290	512,841.309	444.99	
Movement Monitor	0224	Mid-Slope						0224	0224	7,147,241.091	512,963.327	444.85	Old pin found
Movement Monitor	UU1196	Mid-Slope	Bench Mark	NA				UU1196		7,147,231.232	513,066.175	444.08	
Movement Monitor	81-2	Mid-Slope		135	4.43		YES	81-2		7,147,205.285	513,011.562	443.75	Old Pin
Movement Monitor	0227	Mid-Slope						0227	0227	7,147,076.844	513,124.776	439.48	
Movement Monitor	0229	Mid-Slope						0229	0229	7,147,113.528	512,719.142	437.43	Old Pin found
Movement Monitor	4	Mid-Slope		52	1.71			4		7,147,211.284	513,193.636	435.18	Old Pin
Movement Monitor	68	Mid-Slope		120	3.94		YES	68		7,147,262.029	513,142.415	434.42	
Movement Monitor	UU1194	Mid-Slope	Bench Mark	NA				UU1194		7,147,017.321	513,472.438	433.19	
Local Mine Ground Co	1831	Mid-Slope						1831	1831	7,147,227.179	512,766.646	432.85	
Movement Monitor	19	Mid-Slope	3/4" diam. Bar	156	5.12		YES	19		7,147,124.347	513,365.638	429.24	located 3m east of #19-B
Movement Monitor	19-B	Mid-Slope	1/2" diam. Bar	62	2.03			19-B		7,147,126.637	513,363.485	429.13	was 19. Should be 19-B
Movement Monitor	1839	Mid-Slope	Marker					1839	1839	7,146,861.354	513,285.180	428.66	Marker Pin for T2
Movement Monitor	0226	Lower Slope						0226	0226	7,147,311.525	513,066.355	426.46	Was Underhill tag CP1635-1.
Movement Monitor	1833	Lower Slope	3/8" Steel Pin					1833	1833	7,147,302.699	512,921.250	418.34	
~~Movement Monitor~~	XS-G	Lower Slope	3/4" Steel Pin					n/a		7,147,356.110	513,038.841	416.54	**Destroyed**
Piezometer	P2	Lower Slope	1" white pipe					P2		7,147,354.357	512,999.352	416.10	P1 destroyed
Piezometer	P3	Lower Slope	1" white pipe					P3		7,147,309.317	513,135.578	415.35	
Movement Monitor	69	Lower Slope	Marker?	54	1.77			69		7,147,335.532	513,140.577	414.90	Mon 69 in previous UMA survey
Movement Monitor	0217	Lower Slope	Marker	33	1.08			0217	0217	7,147,314.731	513,183.178	414.87	XS-A in previous UMA survey
Movement Monitor	0228	Lower Slope						0228	0228	7,147,346.995	512,836.840	413.95	
Movement Monitor	80-13	Lower Slope	3/8" Steel Pin					80-13		7,147,299.401	513,183.839	413.08	Found on South Side of Road
Movement Monitor	XS-A	Lower Slope	3/4" Steel Pin	33	1.08			XS-A		7,147,320.214	513,190.989	411.33	Nearly in Creek
Movement Monitor	0219	Lower Slope	Marker			NA		0219	0219	7,147,292.121	513,274.646	404.60	Monitor 83 in previous UMA Survey
Movement Monitor	XS-B	Lower Slope	3/4" Steel Pin	64	2.10			XS-B		7,147,293.649	513,274.196	404.28	Nearly in Creek
Movement Monitor	80-14	Lower Slope	3/4" Steel Pin			NA		80-14	No	7,147,267.767	513,283.109	403.77	Found on South Side of Road
Movement Monitor	0222	Lower Slope	Marker	58	1.90			0222	0222	7,147,269.485	513,334.964	398.01	XS-C in previous UMA Survey
Piezometer	P4	Lower Slope	1" white pipe					P4		7,147,239.500	513,347.557	397.28	
Movement Monitor	0220	Lower Slope	Marker	72	2.36	NA		0220	0220	7,147,223.417	513,430.902	388.65	XS-E in previous UMA Survey
Movement Monitor	0218	Lower Slope	Marker	67	2.20	NA		0218	0218	7,147,222.214	513,433.185	388.04	Mon-X in previous UMA Survey
Movement Monitor	XS-E	Lower Slope	3/4" Steel Pin	NA		NA		XS-E	No	7,147,224.703	513,432.222	387.53	
Piezometer	P5	Lower Slope	1" white pipe					P5		7,147,182.931	513,461.461	387.21	
Movement Monitor	84-1	Lower Slope	Marker	54	1.77			84-1		7,147,201.069	513,504.647	381.77	
PORCUPINE PIT AREA													
Movement Monitor	1839	north of pit	Marker					1839	1839	7,146,861.354	513,285.180	428.66	located at entrance to open pit
Movement Monitor	U1493	NE of pit	Marker					U1493	U1493	7,146,801.561	513,576.663	453.00	Located NW od former crusher building
Movement Monitor	1832	West pit slope	Marker					1832	1832	7,146,537.063	513,483.131	473.62	Pit Slope Monitor
Movement Monitor	1830	West pit slope	Marker					1830	1830	7,146,523.769	513,455.681	471.67	Pit Slope Monitor
Movement Monitor	1837	West pit slope	Marker					1837	1837	7,146,502.874	513,411.468	470.22	Pit Slope Monitor
Movement Monitor	1838	West pit slope	Marker					1838	1838	7,146,491.909	513,380.524	468.34	Pit Slope Monitor, original markings show '320'
1978 TEST HOLE LOCATIONS (WITH THERMISTORS)													
BH - 1 (T1)	T1	Mid-Slope	cable	NA				BH - 1 (T1)		7,146,863.402	513,381.017	422.96	Borehole / Thermistor
BH - 2 (T2)	T2	Mid-Slope	cable	NA				BH - 2 (T2)		7,146,882.784	513,274.725	424.28	Borehole / Thermistor
~~BH-4 (T3)~~	T3	Upper Slope	cable	NA									Borehole / Thermistor - cable cut
~~BH-6 (T4)~~	T4	Lower Slope											**Destroyed**

Client: Government of Yukon
Project: Former Clinton Creek Asbestos Mine
UMA Job No.: 6029-007-00 **Date:** August 2006
Survey By: Underhill Geomatics - Whitehorse, YT

Table B-3) Wolverine Creek Tailings Pile - Movement Monitor Summary
Datum: NAD83, UTM Zone 7 Coordinates

Station	Northing	Easting	Elevation	Comment
24	7,148,033.895	513,525.561	549.553	
26	7,148,341.494	513,483.546	575.081	
1083 / NL-2	7,148,354.012	513,936.519	414.078	
1084	7,148,017.993	513,618.378	516.095	
1085	7,148,346.060	513,666.411	488.824	
1484	7,148,149.184	513,961.975	417.949	
1485	7,148,018.022	513,703.459	480.101	
1489	7,148,305.198	513,928.504	413.635	
1491	7,148,376.821	513,868.989	432.316	
1492	7,148,053.727	513,409.949	609.982	
1495	7,148,526.645	513,528.950	529.066	
2834	7,148,172.721	513,447.481	607.227	RTK base for tailings survey
1483	7,148,233.020	513,412.679	608.997	
24-A	7,148,035.439	513,775.702	464.888	
24-B	7,148,045.334	513,833.263	445.888	
24-D	7,148,071.928	513,920.650	422.279	
25-B	7,148,065.753	513,948.634	422.031	
26-A	7,148,339.318	513,540.493	557.740	
350-1A	7,148,298.609	513,822.642	448.002	
350-2A	7,148,300.538	513,873.845	428.576	
350-3A	7,148,312.197	513,899.138	417.275	
500-1	7,148,343.237	513,725.526	474.010	
500-2	7,148,344.367	513,842.258	438.050	
650-1	7,148,408.753	513,701.306	483.907	
650-2	7,148,400.253	513,816.079	439.717	
80-1	7,148,408.034	513,543.064	555.613	
80-2	7,148,290.083	513,549.484	552.632	
80-4	7,148,201.727	513,689.474	501.415	
80-5	7,148,249.423	513,718.768	481.074	
80-7	7,148,344.005	513,890.893	422.399	
80-9	7,147,996.383	513,970.725	411.035	
BH-14 T7	7,148,488.334	513,562.988	530.299	
BH-16 T8 CORD	7,148,048.627	513,761.307	464.593	
BH-16 T8 POST	7,148,048.841	513,761.873	464.910	
NL-1	7,148,365.727	513,942.447	413.164	
NL-2		see 1083		NL-2 and 1083 are the same point
NL-3	7,148,334.731	513,926.880	417.046	
NL-4	7,148,307.194	513,912.986	416.159	
NL-5	7,148,275.174	513,896.964	415.416	
SL-1	7,148,079.086	513,970.461	419.764	
SL-2	7,148,087.009	513,956.878	422.458	
SL-3	7,148,100.541	513,933.163	420.779	
New Points Established in 2005				
NL-Base	7,148,154.79	513,836.26	431.47	existing point tied in
SL-4	7,148,115.67	513,907.57	416.88	existing point tied in
SL-5	7,148,133.63	513,876.08	422.91	existing point tied in
2005-01	7,148,100.15	513,757.89	463.73	new point for 2005
2005-02	7,148,118.21	513,816.95	447.89	new point for 2005
2005-03	7,148,108.16	513,870.12	428.18	new point for 2005
2005-04	7,148,047.07	513,876.04	428.36	new point for 2005
2005-05	7,148,000.57	513,781.55	464.67	new point for 2005
2005-06	7,147,999.72	513,865.78	433.29	new point for 2005
2005-07	7,148,000.11	513,945.37	416.35	new point for 2005
2005-08	7,148,038.85	513,970.98	415.77	new point for 2005
2005-09	7,148,124.38	513,969.23	420.18	new point for 2005
2005-10	7,148,146.69	513,925.39	411.78	new point for 2005
2005-11	7,148,176.10	513,942.17	411.91	new point for 2005



B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 06-09-01 10:35:08 AM

Saved By: mhadfiel

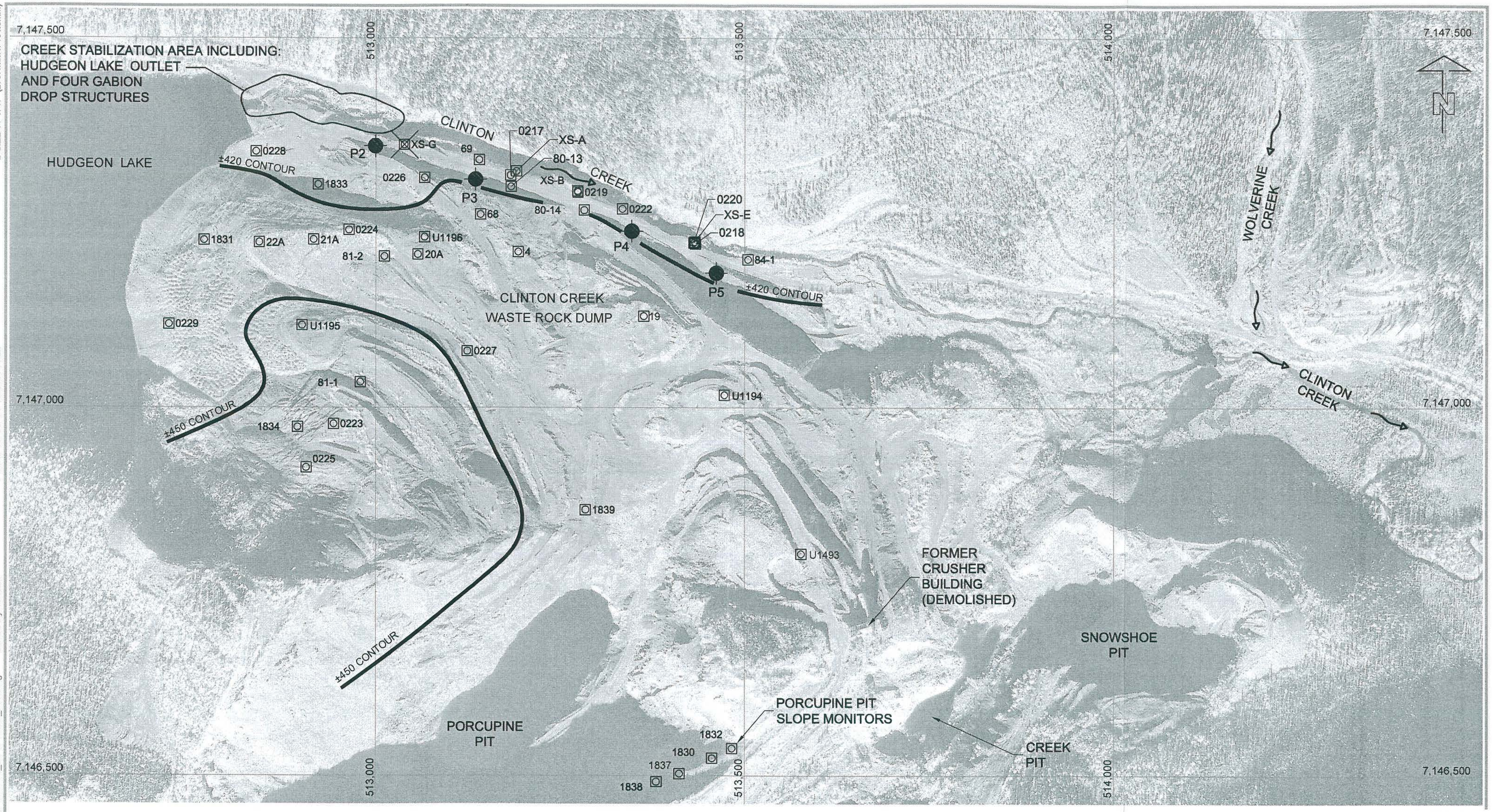
UMA FILE NAME: 6029-006-01_03-H-F201_RX.dwg

UMA | AECOM

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

Site Plan
Bench Mark Locations

Drawing - B-1



SCALE 1:5000

0 50 100 m

UTM ZONE 7 NAD83
IMAGE DATE 1999

0226 ⊡	MONITOR LOCATION (ACTIVE)	ELEVATION >450± - UPPER SLOPE
XS-G ⊠	MONITOR LOCATION (DESTROYED)	ELEVATION >420± <450± - MID SLOPE
P2 ●	PIEZOMETER LOCATION	ELEVATION <420± LOWER SLOPE

B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 06-09-01 10:37:14 AM

Saved By: ferrazk

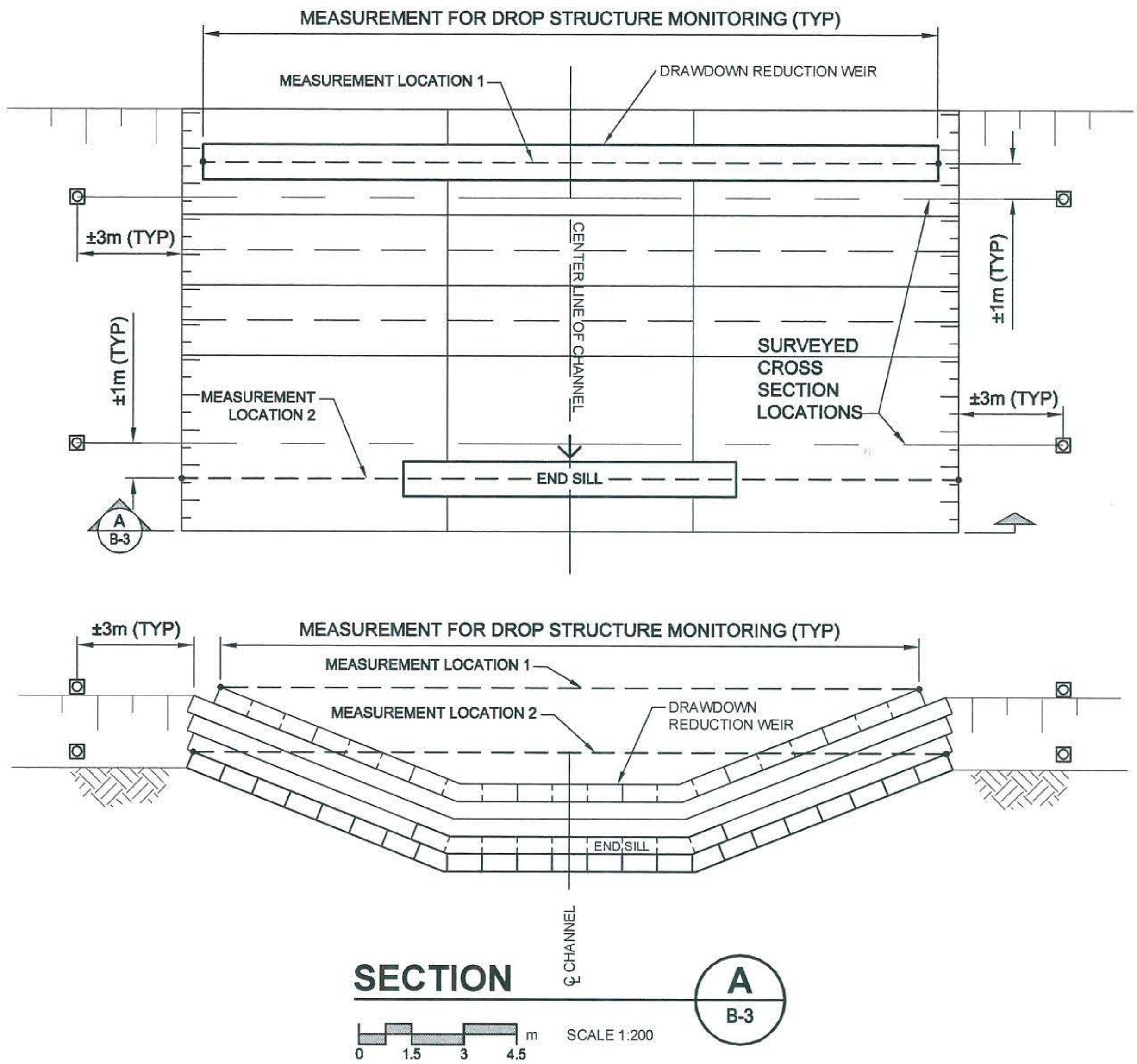
UMA FILE NAME: 6029-006-01_03-H-F202_RX.dwg

UMA | AECOM

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

Clinton Creek Waste Rock Dump Movement Monitors

Drawing - B-2



BASELINE READINGS (m)		
DROP STRUCTURE	MEASUREMENT LOCATION 1	MEASUREMENT LOCATION 2
1	19.62	21.00
2	19.49	21.15
3	19.44	21.50
4	19.61	21.48

NOTE: MONITORING LOCATIONS APPLY TO ALL FOUR DROP STRUCTURES.

▢ PROPOSED CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN)

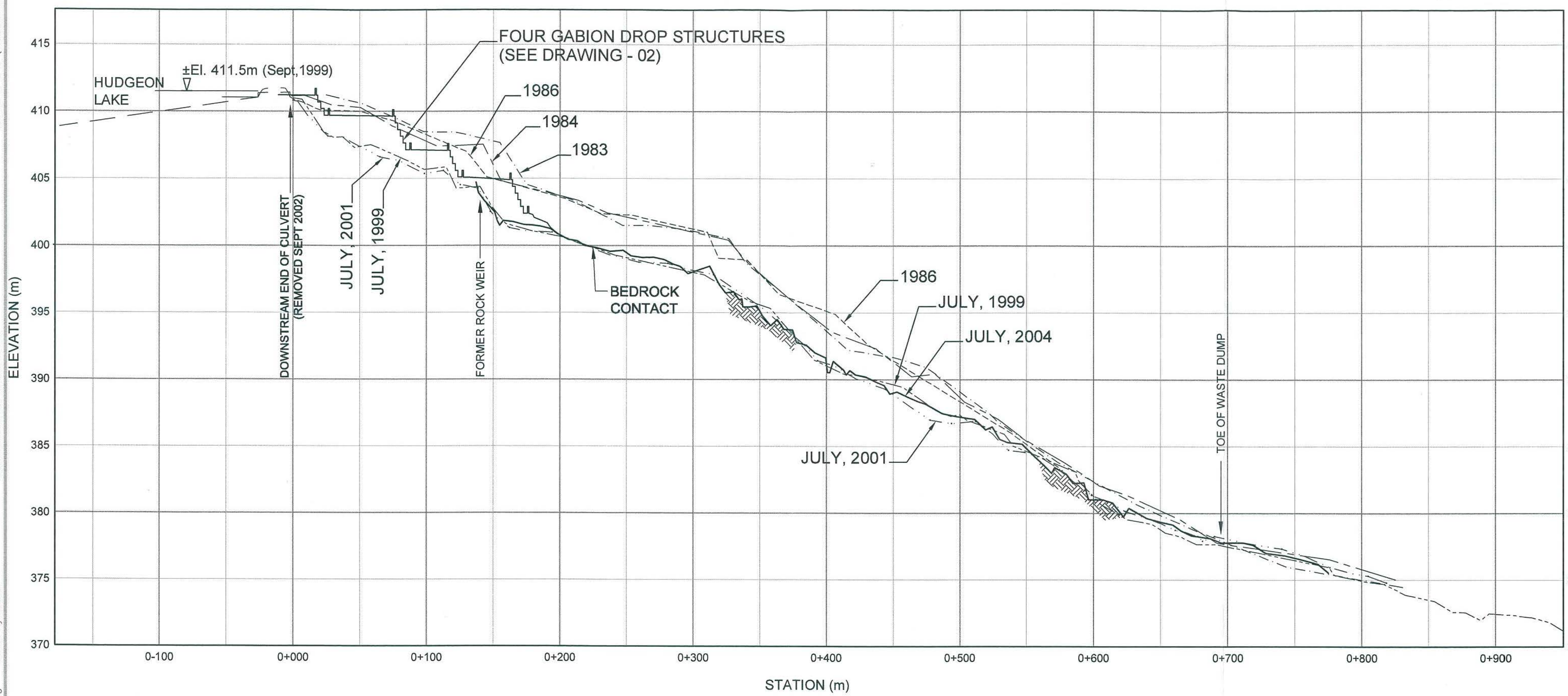
NOTE: TO BE INSTALLED DURING 2006 SURVEY.

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

Drop Structure Monitoring

UMA | AECOM

Drawing - B-3



PROFILE

H=1:3000

V=1:300

STATION	NORTHING	EASTING
0+000	7,147,427	512,863
0+250	7,147,366	513,113
0+500	7,147,272	513,363
0+750	7,147,204	513,613

COORD: UTM ZONE 7W NAD83

LEGEND

- PROFILE 1983
- PROFILE 1984
- PROFILE 1986
- PROFILE 1999
- PROFILE 2001
- PROFILE 2004 (BASELINE FOR LONG TERM MONITORING)

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

Clinton Creek Channel Profile

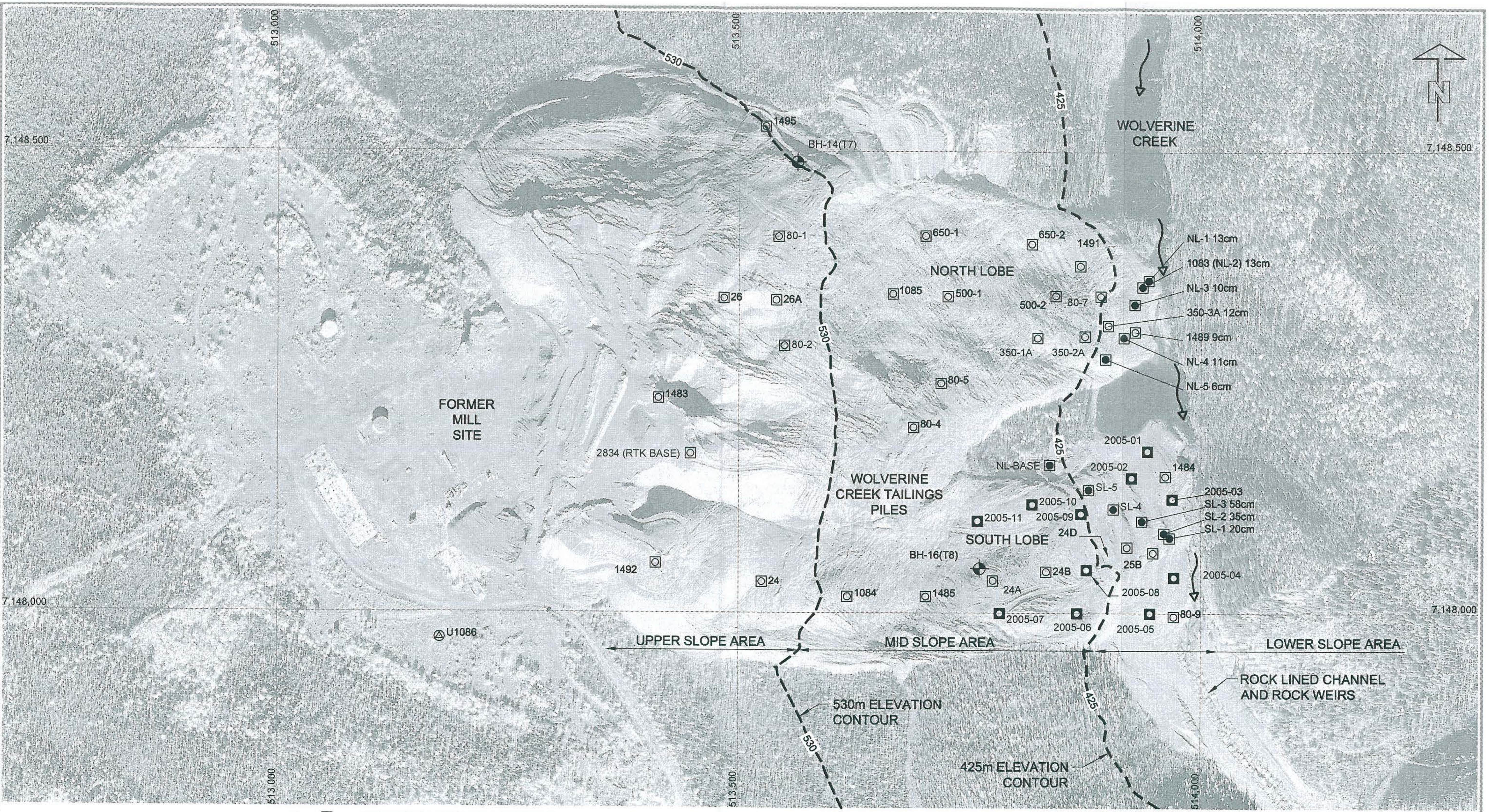
Drawing - B-4

B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 06-09-01 10:38:39 AM

Saved By: ferrazk

UMA FILE NAME: 6029-006-01_03-H-F205_RX.dwg



0 40 80 120 m SCALE 1:4000

UTM ZONE 7 NAD83
IMAGE DATE 1999

24	MONITOR LOCATION (ACTIVE)
2005-01	MONITOR LOCATION (ADDDED IN 2005)
SL/NL-01	VISUAL ALIGNMENT PIN
BH-14 (T7)	1978 TEST HOLE LOCATION

COMPASS BEARING FROM NL-BASE ALONG PINS NL-1 TO NL-5
DECLINATION: 30°
BEARING: 208°

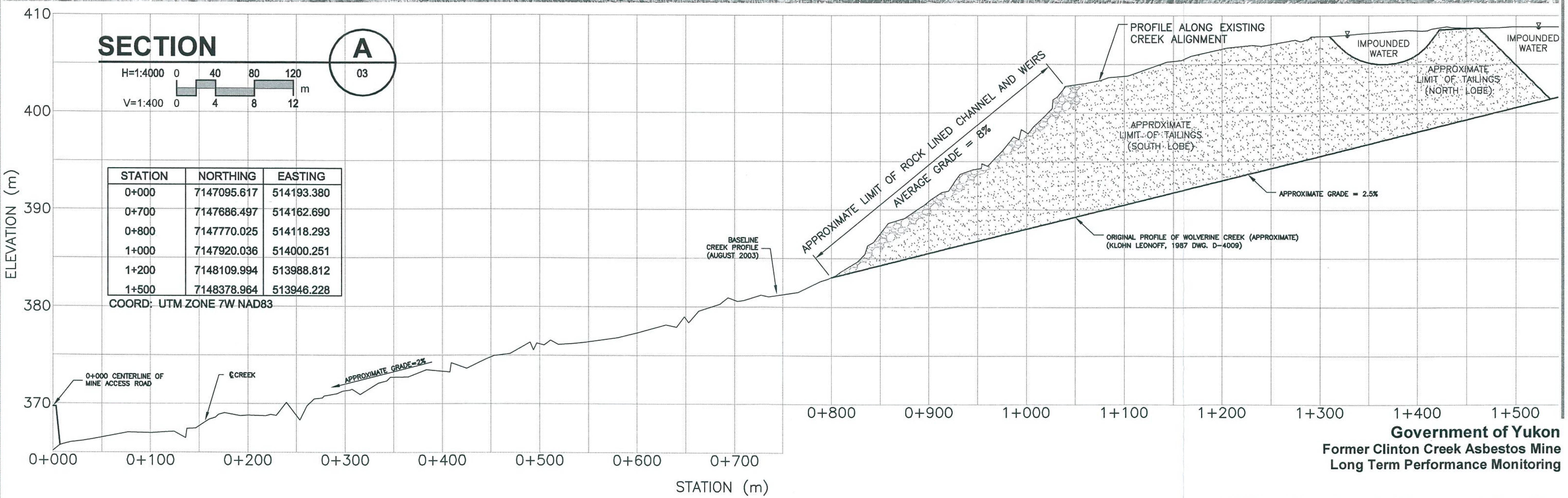
COMPASS BEARING FROM NL-BASE ALONG PINS SL-1 TO SL-5
DECLINATION: 30°
BEARING: 121°

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

Wolverine Creek Tailings Pile Movement Monitors

UMA | AECOM

Drawing - B-5



STATION	NORTHING	EASTING
0+000	7147095.617	514193.380
0+700	7147686.497	514162.690
0+800	7147770.025	514118.293
1+000	7147920.036	514000.251
1+200	7148109.994	513988.812
1+500	7148378.964	513946.228

COORD: UTM ZONE 7W NAD83

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

UMA | AECOM

Wolverine Creek Plan and Profile
Drawing - B-6