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

Clinton Creek Long-Term Monitoring Program

2015 Survey Results

23-Dec-15

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DEC 23/15

**PROJECT NO 307071-01056 - CLINTON CREEK LONG-TERM MONITORING PROGRAM: 2015
SURVEY RESULTS**

Rev	Description	Author	Review	Advisian Approval	Date
0	Issued for Use	 J. Gentles	 A. Timmis	 A. Timmis	23-Dec-15



Government of Yukon Energy, Mines and Resources – Assessment and Abandoned Mines Clinton Creek Long-Term Monitoring Program

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Executive Summary

Overview

This report presents the results of the 2015 Clinton Creek Long-Term Monitoring Program (the program) consisting of:

- Site inspection completed by Advisian on September 16 and 17, 2015.
- 2015 Topographical Survey by Underhill Geomatics Ltd.
- Comparison of the 2015 Topographical Survey data to data collected during previous monitoring programs.
- Review the program and provide recommendations related to improving the efficiency and accuracy of current monitoring practices.

The former Clinton Creek asbestos mine site (the site) is located 80 km northwest of Dawson City, Yukon, near the confluence of Fortymile River and the Yukon River. The movement of waste rock and tailings produced while the mine was active has resulted in the blockage of Clinton Creek and Wolverine Creek, respectively, and the formation of the largely anoxic Hudgeon Lake.

The site consists of the following components:

- Gabion Drop Structures
- Clinton Creek Channel
- Hudgeon Lake Outlet
- Clinton Creek Access Road
- Clinton Creek Crossings
- Clinton Creek Waste Rock Piles
- Wolverine Creek Channel
- Wolverine Creek Tailings Piles
- Wolverine Creek Ponds
- Porcupine Pit
- Snowshoe Pit

The location of the site components are identified on Figure 1001, included in Appendix 1. The conveyance of an extreme flow through the Clinton Creek channel in the summer of 2010 accelerated slope movement in the waste rock and destabilized the Clinton Creek channel, gabion drop structures, and portions of the access road.

The program was developed to monitor, track, and evaluate the topographical changes that occur at the site to achieve the following objectives:

- Capture the year-to-year changes of the site components.
- Assess risk for failure of stabilization works (e.g., the gabion drop structures).
- Evaluate the movement of the waste rock and tailings pile slopes for indications of increased mobility of the material that could pose a hazard to the environment, human safety, traditional land use, or site access that would require preventative intervention.



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Closed Portion of Access Road

The closed portion of the access road is located between Stations 0+340 and 0+410, as shown on Figure 1003 in Appendix 1, at the top of the south Clinton Creek embankment. The embankment began to fail and collapse into the Clinton Creek channel following the extreme flow event in the summer of 2010 and has continued to over-steepen with large tension cracks observed adjacent to the slope.

The top of the embankment continues to migrate south towards the baseline established in 2012 by 35.7 cm averaged over the length of the baseline. However, no trigger related to loss of embankment material or tension crack measurements were exceeded. This portion of the access should be regularly inspected and surveyed on an annual basis to monitor the stability of the slope.

Gabion Drop Structures

The gabion drop structures, comprised of metal gabion baskets filled with rock, were constructed in 2004 and are located between 50 m and 200 m downstream of the Hudgeon Lake outlet. During the summer of 2015, Sidhu Trucking was the prime contractor at the site to complete significant repairs to Drop Structure No. 4 (DS4) and minor repairs to DS1, DS2, and DS3.

Between the periods of 2012-2014 and 2014-2015, average horizontal movement rates decreased at DS1 (-10%) and increased at DS2 (+49%) and DS3 (+121%); however, it is likely that construction activities influenced these results. No triggers related to drop structure geometry or performance were exceeded. The drop structures should continue to be inspected and surveyed on an annual basis and Monitoring Point Nos. 1,461 to 1,465 should be re-established in 2016.

Clinton Creek Channel

Downstream of DS4, the Clinton Creek channel continues southeast to the confluence with Wolverine Creek. Significant geomorphological changes to the channel, including downcutting immediately downstream of DS4 and a shift south along a portion of the channel, occurred following the 2010 extreme flow event.

Between the periods of 2012-2014 and 2014-2015, average channel downcutting decreased by 39% in the upper creek and 88% in the mid-creek. The average channel deposition over this timeframe increased significantly, with the largest increase in deposition rates observed through the downstream portion of the upper creek. No triggers related to channel downcutting/deposition or alignment shifts were exceeded. The channel should continue to be inspected and surveyed on an annual basis.

Clinton Creek Waste Rock Dump

The Clinton Creek waste rock dump, comprised of weak argillite material composed primarily of sand and gravel sized rock fragments with some cobbles and boulders, generally slopes north from a peak northwest of Porcupine Pit to the south embankment of the Clinton Creek channel.



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Between the periods of 2012-2014 and 2014-2015, average horizontal movement rates across the waste rock dump upper slope (elevation > 450 metres above sea level [masl]) increased from 2.8 cm/y to 3.8 cm/y (+36%); however, the increase is less than the 1.4 cm average horizontal precision reported for waste rock dump monitoring points in 2015. Although trigger WR-1 was exceeded, it is not recommended that the response (i.e., to begin planning for a geotechnical assessment of the waste rock dump) is implemented in 2016 as the potential for survey error and the variability of the data set has likely influenced the results and possibly resulted in a false exceedance of the trigger value. The waste rock dump should continue to be inspected annually and surveyed biennially (even numbered years).

Wolverine Creek Tailings Pile

The Wolverine Creek tailings pile, comprised of up to cobble sized rejects from the former crushing operation, generally slopes east from the former mill site across the Wolverine Creek Valley.

Between the periods of 2012-2014 and 2014-2015, average horizontal movement rates across the north lobe, upper slope tailings pile (elevation > 529 masl) decreased from 4.1 cm/y to 3.8 cm/y (-6%). Trigger TP-1 related to average horizontal movement rate was not exceeded. The tailings pile should continue to be inspected annually and surveyed biennially (even numbered years).

Program Review

A high-level review of the current program practices was completed. Recommendations based on this review include:

- Annual inspections of the site components should be completed in August via helicopter by two Professional Engineers licensed to practice by the Association of Professional Engineers of Yukon (APEY) with specializations in hydrotechnical and geotechnical engineering;
- All Health, Safety, and Environment (HSE) planning documents prepared for the inspection should be submitted to AAM;
- Continue to survey waste rock dump and tailings pile using ground survey technology
- AAM should engage the surveyor directly to eliminate the requirement for consultant's site representative during the survey; and
- Continue to complete large and small LTMP programs on a rotating basis.



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1 Introduction

Advisian was engaged by the Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines (AAM) to provide engineering services for the Clinton Creek Long-Term Monitoring Program (the program). This includes a site inspection and oversight of survey data collection by Underhill Geomatics Ltd. (Underhill) at the former Clinton Creek asbestos mine site (the site).

The content and structure of this report are based on AAM's Scope of Work dated June 1, 2015 and Advisian Proposal No. 307071-00987-00-PU-LET-0178-001, Revision 0, dated July 17, 2015.

1.1 Site Overview

1.1.1 Site Components

The site includes the following infrastructure and natural/anthropogenic features (the components):

- Gabion Drop Structures
- Clinton Creek Channel
- Hudgeon Lake Outlet
- Clinton Creek Access Road
- Clinton Creek Crossings
- Clinton Creek Waste Rock Piles
- Wolverine Creek Channel
- Wolverine Creek Tailings Piles
- Wolverine Creek Ponds
- Porcupine Pit
- Snowshoe Pit

The site components are identified on Figures 1001 to 1014, included in Appendix 1.

1.1.2 Site Background

The site is a former asbestos mine which was in operation between 1968 and 1978. The site is located 80 km northwest of Dawson City, Yukon (YT), near the confluence of Fortymile River and the Yukon River (Figure A). During operation, waste rock was placed along the south valley wall of Clinton Creek while tailings from the milling operation were placed along the west valley wall of Wolverine Creek (Figure B). Subsequent movement of the waste rock and tailings have since blocked Clinton Creek and Wolverine Creek, respectively.

1.1.2.1 Clinton Creek and Hudgeon Lake

The blockage of Clinton Creek resulted in impoundment of approximately 10M m³ (R01, UMA 2000) of runoff from the surrounding natural portion of the watershed, forming Hudgeon Lake. Water quality testing indicates that the water impounded in Hudgeon Lake is largely anoxic. Piers were recently constructed at the outlet of Hudgeon Lake to anchor log booms that will retain debris in the lake, which could otherwise collect at one of the drop structures and impede flow.



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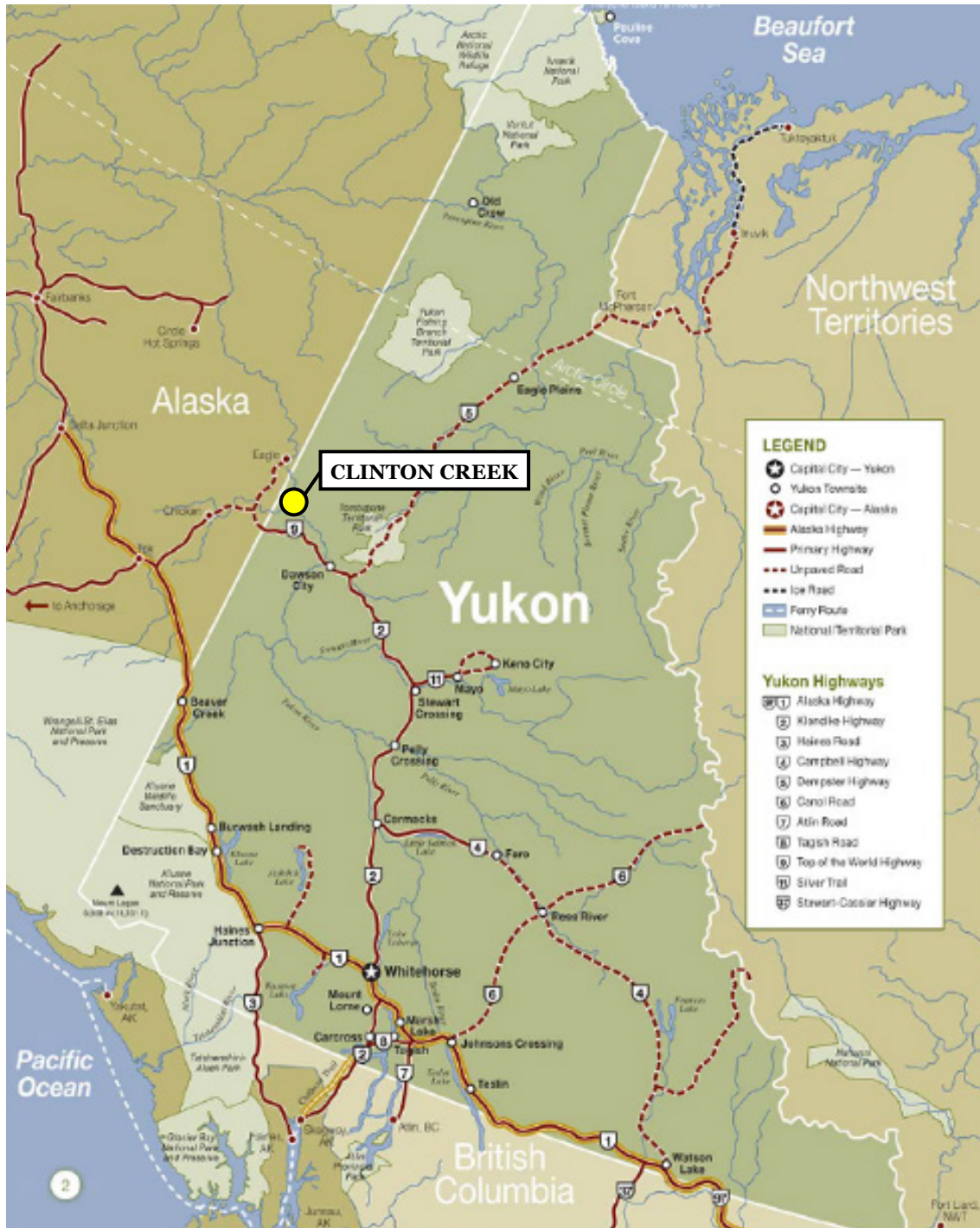


Figure A Clinton Creek Location Map



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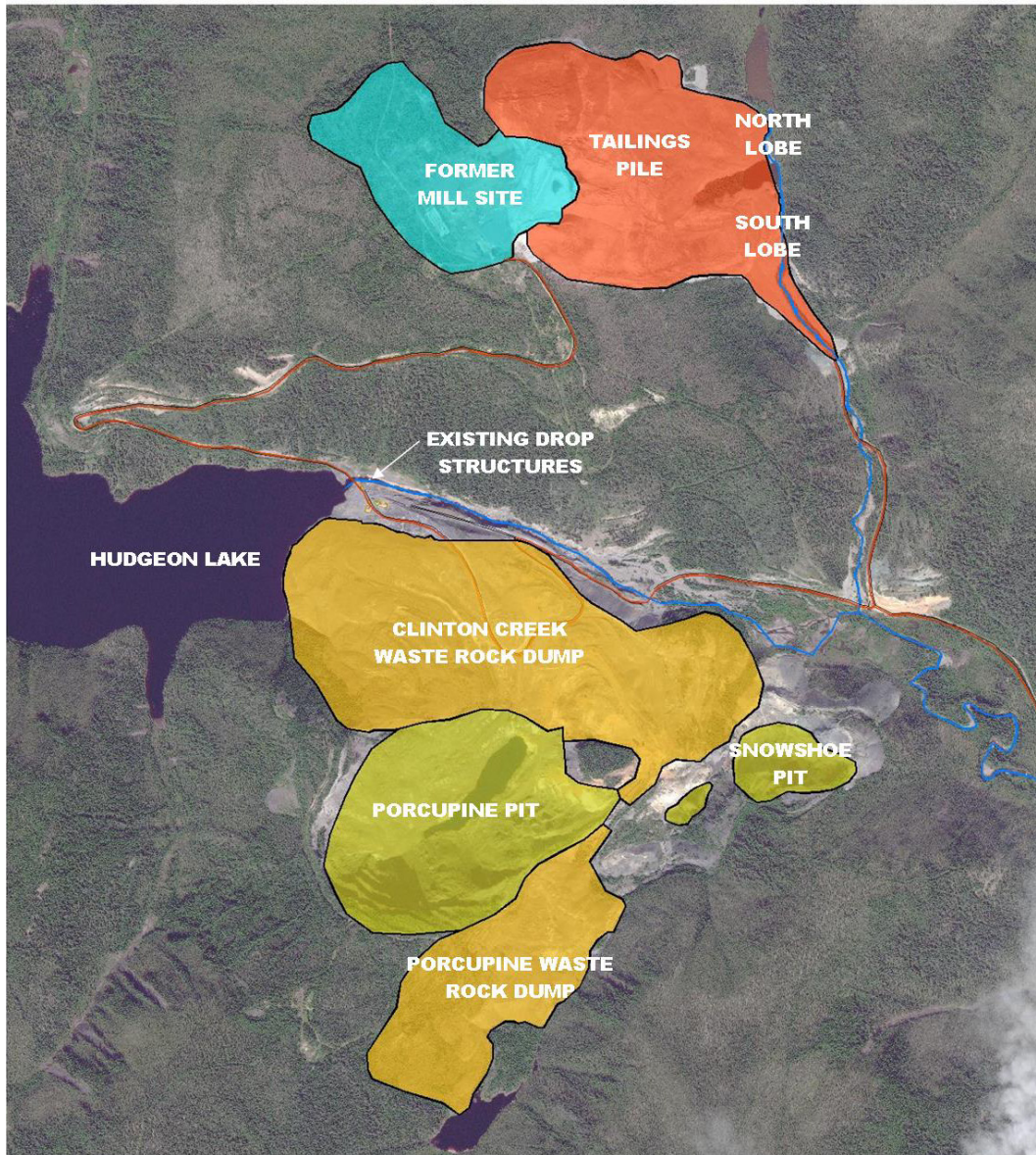


Figure B Clinton Creek Site Map



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Discharge from Hudgeon Lake is conveyed southeast by Clinton Creek to Fortymile River. Four rock gabion drop structures (DS1, DS2, DS3, and DS4) were constructed across the upper portion of Clinton Creek between 2002 and 2004 to stabilize the waste rock pile to the south and promote aeration of discharge from Hudgeon Lake; however, DS4 was destabilized in 2010 (believed to be the result of the conveyance of an extreme flow caused by a blockage of the Hudgeon Lake outlet or intense precipitation) and the channel immediately downstream continues to degrade due to downcutting.

Repairs to DS4 completed in 2015 (including regrading of the waste rock slope, infilling of the downcut channel, and the installation of articulated concrete mat armouring) have addressed the downcutting and should stabilize the channel until long-term mitigation works are implemented. The repair has an anticipated design life of five to ten years.

1.1.2.2 Wolverine Creek

The blockage of Wolverine Creek resulted in the formation of two ponds (collectively the Wolverine Creek ponds) separated by the north lobe of the tailings pile and upstream of the south lobe. Discharge from the ponds is conveyed south by Wolverine Creek to its confluence with Clinton Creek near the site entrance.

1.1.2.3 Site Access Road

The site is accessible through Dawson City via a gravel access road connected to the Top of the World Highway near the village of Forty Mile. The site access road crosses Clinton Creek at the following ford crossings:

- Crossing No. 1, 640 m downstream of DS4
- Crossing No. 2 at the Hudgeon Lake Outlet

Downstream of Crossing No. 1, the site access road is located on the north side of Clinton Creek. Between Crossing Nos. 1 and 2, the site access road is located adjacent to and across the waste rock dump. Beyond Crossing No. 2, the site access road continues along the edge of Hudgeon Lake before switching back to climb the slope above Clinton Creek. The site access road ends at the former Mill site above the tailings pile.

1.1.2.4 Waste Rock Dumps and Pits

There are two open pits located at the site:

- Porcupine Pit – with a maximum pit wall height of approximately 200 m
- Snowshoe Pit – with a maximum pit wall height of approximately 110 m

Approximately 60 million tonnes of waste rock and overburden were deposited over the south slope of the Clinton Creek valley (i.e., the Clinton Creek waste rock dump) with an additional 3 million tonnes of waste rock and overburden placed to the southeast of Porcupine Pit in the Porcupine Pit waste rock dump (RO1, UMA 2000).

1.1.2.5 Mill and Tailings Pile

The former mill site is located at the top of the slope above Clinton Creek and Wolverine Creek. The tailings pile extends from the mill site to the east down the slope where it crosses the Wolverine Creek valley. The bottom portion of the tailings pile formed the north and south lobes, divided by the lower Wolverine Pond.



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1.2 Program Overview

1.2.1 Purpose

The program is required to monitor the condition and performance of the various site components through qualitative (i.e., visual inspection) and quantitative (i.e., movement rates) practices enabling the AAM to identify changes to site components that may indicate instability or degradation that could impact the environment or endanger human health and safety. The program's triggers provide threshold levels at which the AAM should consider implementing pre-established responses (e.g., repairing a drop structure, undertaking a geotechnical assessment).

1.2.2 Frequency

The survey program began with the first round of monitoring in 2004 and the first program report prepared in 2006 (R22 UMA) with subsequent monitoring occurring on a biennial basis. Due to damage to the drop structures caused by the 2010 flood, the 2012 program report (R104, AE 2013) included a recommendation to conduct site-wide visual inspections of the site components listed in Section 1.1.1 and survey the drop structures and creek channel alignment and profile on an annual basis. This recommendation was implemented in 2013 and was referred to as the small LTMP program. The large LTMP program, consisting of a site-wide visual inspection of the site components as well as survey of the following components, was last completed in 2014 and is scheduled to be completed in 2016:

- Drop structures.
- Hudgeon Lake outlet.
- Clinton Creek channel alignment, profile, and selected cross-sections.
- Clinton Creek waste rock dump monitoring points.
- Baseline, tension cracks, and edge of embankment located along the closed portion of the access road.
- Wolverine Creek channel alignment, profile, and selected cross-sections.
- Wolverine Creek ponds.
- Wolverine Creek tailings pile monitoring points.

1.2.3 Objectives

The program was developed to monitor, track, and evaluate the topographical changes that occur at the site to achieve the following objectives:

- Capture the year-to-year changes of the site components.
- Assess risk for failure of stabilization works (e.g., the gabion drop structures).
- Evaluate the movement of the waste rock and tailings pile slopes for indications of increased mobility of the material that could pose a hazard to the environment, human safety, traditional land use, or site access that would require preventative intervention.



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1.2.4 Components

The program is comprised of the following components:

- Site inspection completed by Advisian on September 16 and 17, 2015.
- 2015 Topographical Survey by Underhill.
- Comparison of the 2015 Topographical Survey data to data collected during previous monitoring programs (discussed in Section 3.9) to estimate year-to-year movement rates and geomorphological changes to Clinton Creek and related components (e.g., gabion drop structures, Hudgeon Lake) as well as Wolverine Creek.
- Review the program and provide recommendations related to improving the efficiency and accuracy of current monitoring practices.



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2 Site Inspection

2.1 Overview

Lee Martin, P. Eng. and Jake Gentles, P. Eng. of Advisian conducted the 2015 Long-Term Monitoring Program (LTMP) inspection at the abandoned Clinton Creek mine site on September 16 and 17, 2015. The site visit was conducted to visually assess the condition of various site components and to oversee survey activities completed by Underhill Geomatics Ltd. (Underhill). Site reconnaissance was generally completed on foot with staff driving a pickup truck between site components.

The weather was generally overcast during the inspection with some rainfall in the morning. During the investigation, Sidhu Trucking (Sidhu) was the Prime Contractor at the site to complete significant repairs to DS4 and minor repairs to DS1, DS2, and DS3. All Advisian and Underhill staff completed a site orientation and complied with Sidhu’s health, safety, and environment health, safety, and environment (HSE) requirements.

Site visit photographs can be found in Appendix 2.

2.2 Site Observations

The observations made during the site visit are summarized in Table A. Note that due to construction of a downstream revetment-armoured chute at Drop Structure No. 4 (DS4), discharge from Hudgeon Lake was routed around Drop Structure Nos. 1 to 4 (DS1, DS2, DS3, and Ds4) via a piped diversion with a 2 m-high berm constructed across the Clinton Creek channel at Ford Crossing No. 2.

Table A Summary of Site Observations

Site Component(s)	Appendix 2 Photo Nos.	Observations
Site Access Roads - Top of the World Highway (Hwy) to Forty Mile Bridge	None	This portion of road is in good condition and passable.
Site Access Roads - Forty Mile Bridge to Gate	1 to 3	<p>This portion of road is in fair condition and passable. The road was graded this summer by Sidhu with vegetation pushed back and ad-hoc ditching completed in areas.</p> <p>Several low spots were observed with either standing water or sheet flow across the road impacting the quality of the road surface (e.g., saturated soils and wash-boarding). Low spots of varying degrees of disrepair (e.g., rutting, washboarding, potholes) were observed at 0.3 km, 0.4 km, 0.8 km, 2.1 km, 2.4 km, 2.9 km, 3.1 km, 3.4 km, 3.9 km, 4.0 km, 4.5 km, 5.3 km, 5.9 km, 10.6 km, and 12 km east of the site gate.</p> <p>The embankment on the downslope side of a culvert crossing the access road approximately 1.6 km east of the site gate has eroded exposing approximately 4 m of the culvert outlet and causing tension cracks along the edge of the road.</p> <p>Anti-tamper devices were added to the gate since the 2014 site investigation.</p>



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Site Component(s)	Appendix 2 Photo Nos.	Observations
Site Access Roads - Gate to Ford Crossing No. 2	4 to 7	<p>This portion of road is in fair condition and passable. The road was graded this summer by Sidhu.</p> <p>Note that issues were observed with the culvert conveying Wolverine Creek beneath the access road (discussed in the Wolverine Creek section below).</p> <p>During the investigation, Ford Crossing No. 1, located west of the entrance gate, was replaced by a temporary creek crossing comprised of five CSP culverts topped by coarse gravel. The staff gauge at the crossing was relocated during the installation of the culverts and appears to have been damaged.</p>
Site Access Roads - Ford Crossing No. 2 to Former Mill Site	8 to 9	<p>This portion of the road was in fair condition and passable. Sidhu did not grade this portion of the road and vegetation has encroached into the road, but the vegetation does not impede vehicle passage.</p> <p>Ford Crossing No. 2, located at the Hudgeon Lake outlet, was temporarily replaced by a 2 m high berm composed of cobbles and coarse gravels, similar to the rock contained in the gabion baskets at the time of inspection.</p>
Closed Portion of Access Road	10 to 14	<p>The channel slope adjacent to the closed portion of the access road continues to fail and collapse into the Clinton Creek channel. The slope at this location is significantly over-steepened (vertical in areas) and large tension cracks were observed adjacent to the top of the slope. The slope will continue to fail until it reaches a naturally stable slope (i.e., factor of safety [FOS] = 1), likely at a somewhat steeper gradient than 1H:1V.</p>
Hudgeon Lake Outlet	15 to 19	<p>The lake outlet was blocked at the time of the investigation to enable construction of DS4. Minor damage to the gabion mesh at Ford Crossing No. 1 was noted, with vertical and horizontal displacement noted at the channel toe on the north and south banks.</p>
Boom Abutments	20	<p>The boom abutments appear to be stable with no evident loss of rock armouring. The booms were not in the water at the time of the inspection due to the construction work being undertaken during the 2015 field season (i.e., repairs to the drop structures).</p>
Drop Structure No. 1 (DS1)	21 to 22	<p>Drop structure appears sound with some baskets recently infilled/repared. Minor vegetation (e.g., grasses and tree saplings) observed above the water line and a large piece of woody debris is located at the drawdown weir. Both the tree saplings and debris were marked for removal while the creek diversion is in place. Cobbles were observed between the final gabion course and end sill.</p>
Drop Structure No. 2 (DS2)	21 and 23 to 25	<p>Drop structure appears sound with some baskets recently infilled/repared. Minor vegetation observed above the water line; Tree saplings were marked for removal. Some cobbles were observed between the final gabion course and end sill.</p>
Drop Structure No. 3 (DS3)	21 and 26 to 27	<p>Drop structure appears sound with some baskets recently infilled/repared. Minor vegetation observed above the water line; tree saplings were marked for removal.</p>



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Site Component(s)	Appendix 2 Photo Nos.	Observations
Drop Structure No. 4 (DS4)	21 and 28 to 31	The gabion baskets that are to remain in place following completion of the revetment chute (top six courses) appeared sound with some minor repairs completed and additional mesh installed across the flat portions of Course Nos. 3 to 5. Minor vegetation observed above the water line; tree saplings marked for removal. Gabion baskets located at outside edges of Course Nos. 5 and 6 were displaced downward due to undermining of the underlying granular base material; this deficiency was planned to be rectified by placing additional rockfill on both sides of the creek.
Clinton Creek Channel	32 to 41	<p>No significant channel blockages were observed. Recent slope movement was observed on the north channel slope as fallen trees with retained greenery were noted at the bottom of the slope. We anticipate that the soil portion of this slope, above the bedrock, will continue to retrogressively fail until a stable slope angle is reached.</p> <p>Two trees have fallen across the channel near Monitoring Pin No. 222; however, the channel water level was below the tree trunks and flow was not obstructed. During periods of higher flows, it is likely that these trunks will cause a minor flow restriction. Due to limited accessibility, it is not practical to remove these trees.</p> <p>Localized slope erosion was observed on the south bank of Clinton Creek near cross-section E and the access road. This does not appear to require immediate attention as the slope appears to be stable (i.e., similar state when compared to 2014 photo); however, this location should be monitored for worsening erosion and bank stabilization may be required in the future.</p>
Clinton Creek Waste Rock Pile	42 to 46	<p>No indicators of recent, substantial movement (i.e., greatly in excess of mean annual movement) were observed throughout the waste rock pile.</p> <p>Localized slope erosion was observed near the eastern edge of the waste rock pile, downslope of the abandoned shovel. The slope erosion does not appear to require immediate attention as erosion has exposed large waste rock, which itself provides erosion protection. This location should be monitored for worsening erosion and destabilization.</p> <p>A perched boulder was observed northeast of Porcupine Pit above the access road. The boulder is located in a portion of the site where access is restricted and does not pose an immediate threat to public safety.</p>



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Site Component(s)	Appendix 2 Photo Nos.	Observations
Wolverine Creek Channel	47 to 55	<p>Dense vegetation located at the upstream end of the culvert crossing at the confluence with Clinton Creek has encroached across the creek channel presenting an obstruction to flow. This condition was brought to the attention of AAM during the site visit for potential action by Sidhu while on site.</p> <p>The high flow culvert at this location has been undermined and the adjacent bank has been eroded. Significant erosion of the culvert was noted on the east side of the culvert, adjacent to the undermined area. A piece of rebar was installed across the upstream culvert opening which obstructs flow and does not serve the intended purpose of preventing woody debris from entering the culvert. The rebar should be removed and the culvert bedding gravel repaired. This condition was brought to the attention of AAM during the site visit for potential action by Sidhu while on site.</p> <p>The creek between the confluence and the rock lined channel appears to be stable with some localized bank erosion.</p> <p>The rock lined portion of the channel appears to be stable with no indications of erosion or loss of rock.</p>
Wolverine Ponds	56 to 62	<p>The inlet and outlet of the Wolverine Ponds were not obstructed at the time of the investigation. Flow in the channel between the north and south ponds continues to scour the toe of the tailings pile north lobe while flow in the channel immediately south of the south pond continues to scour the toe of the south lobe.</p>
Wolverine Creek Tailings Pile	63 to 70	<p>No indicators of recent, substantial movement (i.e., greatly in excess of mean annual movement) were observed throughout the tailings pile, although signs of ongoing slumping and gullyng were noted throughout. The tailings pile has many features in common with a rock glacier and is likely behaving in that fashion, with continuous low velocity flow and slump driven by deformation of ice and/or permafrost within the tailings pile.</p>
Porcupine Pit	71 to 73	<p>No observed indicators of recent slope failures. Pit was observed from northeast of the pit at an elevation of 420 m (approximate).</p>
Snowshoe Pit	74	<p>No observed indicators of recent slope failures. Pit was observed from northwest of the pit at an elevation of 420 m (approximate).</p>



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3 Survey Data

3.1 2015 Survey

Underhill was on-site from September 15 to 17, 2015 to collect survey information related to the following site components:

- Closed portion of the access road - baseline pins, edge of embankment, and tension cracks.
- Gabion DS1 to DS4 - cross-sections between Monitoring Pin Nos. 1,450 through 1,463.
- Clinton Creek channel from outlet to confluence with Wolverine Creek - centreline.
- Clinton Creek waste rock pile upper slope monitoring pins (Pin Nos. 81-1, 223, 225, 1,195, 1,834, 2,836, BH-4, 186, and 300).
- Wolverine Creek tailings north lobe upper slope monitoring pins (Pin Nos. 80-1, 80-2, 26, 26-A, BH-14, 1,483, and 1,495).

Underhill established new monitoring points/monuments at the following locations:

- Monument above Wolverine Creek to provide line of sight to a portion of Wolverine Creek.
- Slope monitoring pins at waste rock toe adjacent to lower portion of Clinton Creek (Stations 0+700, 0+800, and 0+900).
- Slope monitor pins at the base of Snowshoe Pit (two pins).
- Baseline spikes at the closed portion of the access road extending 15 m at either end (10 spikes).

At Advisian’s request, Underhill surveyed the two slope monitoring pins located on the natural slope located north of Clinton Creek and established in 2014.

A compilation of the processed survey data is presented in Appendix 3.

3.2 Coordinate System

The 2015 Survey data was provided using the coordinate system attributes presented in Table B.

Table B 2015 Survey Attributes

2015 Survey System Attribute	Value
North American Datum (NAD)	NAD83
Zone	Zone 7
Vertical Datum	CGVD28
Geoid	Model HTv2.0



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3.3 Survey Control

To facilitate the collection of survey data using two remote receivers (rovers), Underhill established a base station at Control Point Nos. 3,819 or 2,834, depending on the portion of the site being surveyed. The coordinates of the stable Control Station Nos. 1,086 and 1,192 were held by the base station to continuously derive its coordinates using a least square adjustment of global positioning system (GPS) observations. The coordinates of the control points and control stations are presented in Table C.

Table C Control Coordinates

Identification (ID)	Northing (m)	Easting (m)	Orthometric Height (metres above sea level [masl])
No. 2834	7,148,172.671	513,447.756	606.786
No. 3819	7,147,223.092	513,111.927	441.839
No. 1086	7,147,972.219	513,176.710	590.955
No. 1192	7,147,563.984	512,278.758	441.231

3.4 Quality Control (QC)

During survey collection, the base station and rover would receive and process the same satellite signal to establish GPS coordinates. GEOLAB software was used to complete three-dimensional (3D) least square adjustments based on the variance between coordinates derived from the satellite signal and those derived from the control stations. As variance/co-variance information from GPS software can generally be overly optimistic, software parameters were changed to scale the variance/co-variance matrices for constrained adjustments by the a posteriori variance factor. The base station would then transmit correction data to the rover.

Underhill reported 95% confidence limits for the precision of the RTK survey results of less than 3 cm horizontally and vertically.

3.5 Quality Assurance (QA)

Underhill employed the following quality assurance (QA) procedures to limit the collection of inaccurate survey data and promote the overall accuracy of the survey data:

- Various checks were performed to confirm the coordinates and elevation of the base station during setup and prior to shutting down (e.g., comparing the height measured using both metric and imperial units, checking the correct coordinates of control points and control stations).
- The rod height for the two rovers was measured each day.
- During base station setup, coordinates were recorded for at least one known point to confirm the base station coordinates were accurate. Prior to shutting down the base station, a similar process was undertaken to confirm that the base station had not changed since it was set-up.
- Rover units utilized a lock survey style and could only save coordinates based on a fixed solution.
- Rover units continuously provided horizontal and vertical precision and alerted the surveyors when precision was greater than 3 cm.



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3.6 Data Collection

The 2015 Survey included the collection of data for the 20 points: 10 on the upper slope of the waste rock dump (tabulated in Section 5.4), three along the toe of the waste rock dump, and seven on the north lobe, upper slope of the tailings pile (tabulated in Section 5.5).

3.7 New and Replacement Monitoring Points

To facilitate monitoring of the movement of the natural slopes north of Clinton Creek and east of Wolverine Creek, the monitoring pins are summarized in Table D.

Table D New Monitoring Points

PIN ID	Northing (m)	Easting (m)	Elevation (masl)	Location Description
4411	7,147,103.569	513,565.429	384.039	South bank of Clinton Creek at Sta. 0+700
4410	7,147,152.249	513,482.743	387.974	South bank of Clinton Creek at Sta. 0+800
4412	7,147,068.525	513,652.784	375.511	South bank of Clinton Creek at Sta. 0+900

3.8 Non-surveyed Components

The following components were not surveyed or established as part of the 2015 Survey:

- Monitoring points at DS4 (1,462 to 1,465) were disturbed or destroyed due to construction activity at DS4 and were not re-established due to likelihood of disturbance by construction equipment.
- New monitoring pins adjacent to each pair of drop structures monitoring pins due to construction activity at DS4.
- Two slope monitoring pins at the top of Snowshoe Pit due to accessibility and time constraints.

3.9 Previous Surveys

The results of previous survey programs were used for comparative purposes (e.g., changes to creek channel profiles) and to calculate movement and movement rates of monitoring points. The previous survey programs used to complete these analyses are summarized in Table E.



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Table E Previous Survey Programs

Period	Engineering Consultant	Reference Document
August 2003	UMA	R03
July 2006	UMA	R24
July 2010	AECOM	R51
September 2010	AECOM	R51
August 2011	AECOM	R103
August 2012	Associated Engineering Ltd. (AE)	R104
August 2013	AE	R55
September 2014	WorleyParsons	2014



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4 Methodology

The following section discusses the methodology used to assess the results of the 2015 Survey.

4.1 Comparison

The following comparisons between previous survey data and the 2015 Survey data were completed with results presented in Section 5 of this report within the individual site component subsections.

4.1.1 Monitoring Points

The incremental and total horizontal movement vectors (including azimuth and magnitude) at each monitoring point were determined by calculating the distance between the coordinates recorded for each point over the various monitoring period. These movements were the basis for the annual movement rate statistics (mean, maximum, and minimum) that are presented and discussed in this report.

4.1.2 Alignments, Profiles, and Cross-Sections

The 2015 alignments and profiles for Clinton Creek, based on the creek centreline coordinates, were compared to the alignments and profiles presented in previous program reports. The following measurements between the 2015 and previous program alignments/profiles were calculated along the creek centreline:

- Horizontal displacement – horizontal movement of the creek centreline.
- Downcutting – downward vertical movement indicative of localized channel erosion.
- Deposition – upward vertical movement indicative of localized soil deposition.

These measurements are indicative of geomorphological changes the creeks have experienced between monitoring periods.

4.2 Timeframes

Timeframes were selected to reflect, where possible, five significant periods:

1. Prior to the 2010 extreme flow event (pre-July 2010).
2. Immediately before and after the 2010 extreme flow event (July to September 2010).
3. The two years following the 2010 extreme flow event (September 2010 to August 2012).
4. The two years between August 2012 and September 2014.
5. The previous year (September 2014 to September 2015).

In some circumstances, these periods were revised based on the availability of survey data for specific site components.

By categorizing the data into these timeframes, results could be averaged or aggregated to facilitate comparison between periods and the identification of trends.

The timeframes presented were defined by start and end dates. The timeframes used to analyze each site component are indicated in Table F.



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Table F Timeframes

Site Component Analyzed	Timeframes Used
Closed Portion of Clinton Creek Access Road	<ul style="list-style-type: none"> ▪ August 2012 to September 2014 ▪ September 2014 to September 2015
Gabion Drop Structures	<ul style="list-style-type: none"> ▪ July 2006 to July 2010 ▪ July 2010 to September 2010 ▪ September 2010 to August 2012 ▪ August 2012 to September 2014 ▪ September 2014 to September 2015
Clinton Creek Channel	<ul style="list-style-type: none"> ▪ July 2004 to September 2010 ▪ September 2010 to August 2012 ▪ August 2012 to September 2014 ▪ September 2014 to September 2015
Clinton Creek Waste Rock Dump	<ul style="list-style-type: none"> ▪ July 2003 to July 2010 ▪ July to September 2010 ▪ September 2010 to August 2012 ▪ August 2012 to September 2014 ▪ September 2014 to September 2015
Wolverine Creek Tailings Pile	<ul style="list-style-type: none"> ▪ August 2003 to July 2010 ▪ July to September 2010 ▪ September 2010 to August 2012 ▪ August 2012 to September 2014 ▪ September 2014 to September 2015

4.3 Triggers and Monitoring Recommendations

During the course of the program, various triggers have been established and linked to site components. For the purposes of the program, a trigger is defined as a quantitative value assigned to a specific attribute of a site component that, when exceeded, should prompt a pre-defined response to address the stability of the component.

Similarly, various monitoring recommendations, linked to site components, have been made by previous consultants.

A summary of the Clinton Creek triggers and monitoring recommendations are presented in Appendices 4 and 5, respectively.

Assessment of the triggers included the following steps:

1. Evaluate whether the trigger has been exceeded.
2. Evaluate whether the appropriate action was taken and, if not, identify any factors that prevented action from being taken.
3. Determine whether the trigger is appropriate or requires revision.



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Assessment of the monitoring recommendations included the following steps:

1. Confirm that the recommendation has been implemented.
2. Identify any factors that prevented the implementation.
3. Determine whether the recommendation remains valid or requires revision.

The results of these assessments are discussed in Section 5 in the individual site component subsections.



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5 Performance Monitoring

The following section presents and discusses the survey results for the site components surveyed in 2015 (Figure 1001, Appendix 1).

5.1 Closed Portion of Access Road

Based on observations made during the 2012 program, a portion of the Clinton Creek site access road, from Stations 0+340 to 0+410, was closed due to the presence of extensive tension cracks and embankment failures. The portion of the site access road was blocked using chains attached to concrete lock blocks at the east end and an earth berm at the west end (Photo A) with the site access road relocated across the waste rock pile.



Photo A Closed Portion of Clinton Creek Site Access Road - Looking East (Downstream)

This portion of the site access road was surveyed as part of the 2012 program. A baseline was established, offset to the south from the edge of the Clinton Creek channel embankment, with metal spikes set every 3 m. The movement of these spikes as well as changes to the location of the edge of embankment were calculated and are discussed in subsequent sections. Note that survey was limited to the closed portion of the site access road.



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5.1.1 Survey

The survey of the closed portion of the Clinton Creek site access road was accomplished by recording coordinates for the following points (established in 2012):

- Total of 23 metal spikes installed along the baseline established in 2012.
- Total of 10 metal spikes installed in 2015 to extend the baseline to the east and west (five at each end).
- Along the edge of the Clinton Creek channel bank.
- The location of visible tension cracks perpendicular to the metal spikes.

A horizontal accuracy of ± 0.67 cm was reported for the control station used to survey the closed portion of the Clinton Creek access road.

5.1.2 Results

For the purposes of this analysis the following timeframes were considered:

- August 2012 to September 2014
- September 2014 to September 2015

These timeframes were selected to identify changes to movement and embankment loss rates observed over the past 12 months to improve the understanding of recent and current site conditions. Representative data for the movement of the baseline and loss of the embankment is presented in Table G.

Table G Clinton Creek Access Road Movement (2012 to 2015)

Category	Parameters	2012 to 2014	2014 to 2015	Change
Baseline	Average Horizontal Movement (cm/y)	1.55	1.64	+5.8%
Baseline	Maximum Horizontal Movement (cm/y)	3.13	3.19	+1.9%
Baseline	Horizontal Azimuth ¹	354 degrees	14 degrees	20 degrees
Embankment Edge	Average offset south (cm/y)	15.2	35.1	+132%
Embankment Edge	Maximum offset south* (cm/y)	102	202	+98%
Embankment Edge	Change to average horizontal offset to baseline (cm/y) ²	16.7	35.7	+114%

*Note that the maximum offset observed in 2015 did not coincide with the location of the maximum offset observed in 2014.

¹Horizontal azimuth parameter represents the average direction of movement recorded at each baseline stake.

²Average distance between each baseline stake and the embankment as measured perpendicular to the baseline.

Tension crack data is presented in Table H.

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Table H Clinton Creek Access Road Tension Cracks

Parameter	2014	2015
Maximum Crack Width (cm)	26.0	28.0
Average Crack Width (cm)	10.1	15.8
Number of survey points recorded at tension cracks perpendicular to the 2012 baseline with width greater than 0.5 cm	63	42
Total number of cracks	Not measured	30
Total Crack Length (m)	Not measured	124
Average Crack Length (m)	Not measured	4.1
Longest Crack Length (m)	Not measured	30.5

5.1.3 Results Summary

Between 2014 and 2015, the average offset between the top of the Clinton Creek embankment and the baseline decreased by 35.7 cm, averaged over the length of the baseline, due to the loss of embankment material likely caused by instability at the toe. During this timeframe, the majority of the increased embankment loss occurred between Sta. 0+060 to 0+068 (relative to the baseline), expanding the portion of the embankment at which significant migration was observed in 2014 (Sta. 0+047 to 0+062). A maximum offset of 2.02 m/y was observed at Sta. 0+064 (relative to the baseline) as shown on Figure 1003.

Baseline horizontal movement rates observed in 2015 were consistent with those observed in 2014 with a 5.8% increase in average movement and a 1.9% increase in maximum movement; however, the baseline movement was towards the northeast at 14 deg. representing a 20-deg. change from the northwest movement observed in 2014.

5.1.4 Triggers and Recommendations

The four triggers for the closed portion of the Clinton Creek access road established in the 2014 LTMP report, along with the values observed in 2015, are presented in Table I.

Table I Clinton Creek Access Road (Closed Portion) Trigger Results

ID	Description	Trigger Value	Action	2015 Value
AR-1 (2014)	Average horizontal movement of baseline from previous year	Increase of 10 cm from previous year	Develop mitigation plan	+0.09 cm/y
AR-2 (2014)	Loss of embankment based on offset from previous year	1.0 m/y	Develop mitigation plan	0.35 m/y
AR-3 (2014)	Total length of observed tension cracks	Increase of 20% from previous year	Develop mitigation plan	124 m (not measured in 2014)
AR-4 (2014)	Average number of cracks observed perpendicular to each baseline pin	Increase of 20% from previous year	Develop mitigation plan	42 (33% decrease)

Note that the four trigger values were not exceeded in 2015.



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The monitoring recommendations relevant to the closed portion of the Clinton Creek access road are presented in Table J.

Table J Clinton Creek Access Road (Closed Portion) Monitoring Recommendations

ID	Description	Implementation	Validity
AR-A (R51)	Monitor (i.e., inspect and survey) the tension cracks along the closed portion of the site access road on an annual basis	Inspection and survey data collection completed in 2015	Valid - practice should continue
AR-B (R104)	Install depth gauge at Clinton Creek Ford #1 (R104)	Completed – refer to recommendation AR-E below	Requires re-establishment.
AR-C (2014)	Extend the baseline to the north and south by 15 m	Completed in 2015	Completed
AR-D (2014)	Survey points recorded at the start, end, and changes in direction (greater than 30 deg.) of each tension crack	Completed in 2015	Valid - practice should continue
AR-E (New)	Re-survey depth gauge at Ford Crossing No. 1 as part of 2016 LTMP to re-establish elevation	To be implemented in 2016	Required to determine whether ford crossing can be safely used based on water depth

5.2 Gabion Drop Structures

Four gabion drop structures, constructed in 2004, are located between 50 m and 200 m downstream of the Hudgeon Lake outlet. Each drop structure is comprised of metal gabion baskets filled with rock installed in successive layers installed across the creek channel (Photo B).

The drop structures were installed to stabilize the creek channel which had undergone significant geomorphological changes (e.g., significant erosion and scour), following the waste rock failure that blocked the Clinton Creek valley. The installation of the drop structures resulted in four significant changes to channel invert elevation concentrated over short lengths such that the remainder of the channel can be relatively flat, limiting flow velocities and erosion.

DS3 and DS4 were significantly damaged due to extreme flows driven by a large precipitation event, and a possible blockage of Hudgeon Lake, in August 2010 (R100, AECOM 2010). The following emergency repairs to the drop structures were completed in 2011 (R94, AECOM 2011):

- Filled Gabion Baskets - Tiers 1 to 4 (DS1 and DS3) and Tiers 1 to 5 (DS2)
- Filled Floor Gabion Baskets - DS1
- Installed Riprap downstream of DS2 End Sill
- Installed New End Sill, downstream Gabion Baskets, and Riprap at DS3



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Photo B Drop Structure No. 1 Looking West (Upstream)

Although repairs to DS4 were planned for fall 2011, they were not completed due to access and safety issues. The following repairs to DS4 were completed in 2015:

- Regrading of a portion of the Clinton Creek south embankment to a 2H:1V side slope.
- Removal of damaged/undermined courses of gabion baskets.
- Infilling of the scoured channel downstream of DS4.
- Installation of an articulated concrete revetment mat complete with ground anchors and armoured transitions.
- Minor repairs to DS1, DS2, DS3, and a portion of DS4 including the removal of vegetation, replacement of damaged mesh, replenishment of gabion rock, and the placement of additional mesh at selected locations.



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Photo C **Repaired Drop Structure No. 4 Looking North**

Permanent monitoring points (located on the north and south banks of the channel, upstream and downstream of the drop structures) were installed in September 2006 to enable the collection of cross sections at the same locations year to year. Prior to 2006, the extent of survey data collection at the drop structures was limited and, therefore, was not used to calculate movement rates.

The following monitoring points have been lost and re-established:

- 1,453 re-established in 2012
- 1,454 re-established in 2012
- 1,459 re-established in 2012
- 1,460 re-established in 2012 and again in 2015
- 1,461 re-established in 2012

5.2.1 Survey

The 2015 Survey of the gabion drop structures was accomplished by recording coordinates for the following points:

- Ground level at monitoring points located on the north and south banks of the channel, upstream and downstream of the drop structure – 12 total.



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- Two cross-sections at each drop structure between the monitoring points capturing the top extents, toes, centreline, and water level - six total (the DS4 cross-sections were not surveyed due to ongoing construction activities).

During the survey, discharge from Hudgeon Lake was bypassed from the lake outlet to a point downstream of DS4. Consequently, the drop structures were in the dry, with all surface features clearly visible.

Due to construction activities at DS4, the DS4 monitoring points were destroyed. They were not re-established as part of the survey due to the likelihood that they would be disturbed by the ongoing construction activities. They should be re-established as part of the 2016 LTMP survey.

5.2.2 Results

For the purposes of this analysis the following timeframes were considered:

- July 2006 to July 2010
- July to September 2010
- September 2010 to August 2012
- August 2012 to September 2014
- September 2014 to September 2015

These timeframes were selected to simplify the data analysis by categorizing results based on periods over which it was estimated that hydraulic and geomorphological conditions were largely similar from year to year. This includes the period between July and September 2010, which covers the monitoring surveys completed prior to and following the extreme flow event in the summer of 2010. Periods with shorter durations were selected to analyse recent surveys results (in 2012, 2014, and 2015) to improve the understanding of recent and current site conditions.

5.2.2.1 Cross-Section Geometry

Geometrical data for the gabion drop structures was collected as part of previous program surveys, beginning in 2006. The movement rates for each drop structure section (calculated as the average movement of the two monitoring points that comprise each section, irrespective of direction) are summarized in Table K.

Table K Drop Structure Horizontal Average Horizontal Movement (cm/y)

Location	2006 to 2010	Jul to Sept 2010	Sept 2010 to 2012	2012 to 2014	2014 to 2015
DS1 - Upstream	1.0	12.2	2.6	2.0	1.7
DS1 - Downstream	1.4	5.4	1.1	1.6	1.6
DS2 - Upstream	1.0	12.2	3.8	2.0	2.9
DS2 - Downstream	2.5	10.0	5.7	3.6	5.4
DS3 - Upstream	3.0	13.8	2.3	2.4	5.3
DS3 - Downstream	1.0	3.9	N/A	2.0	4.9



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Note that six drop structure monitoring points (Nos. 1,453, 1,454, 1,459, 1,460, and 1,461) were either disturbed or lost between September 2010 and August 2012 and re-established in August 2012. Movement rates calculated for these monitoring points for the period Sept 2010 to 2012 were not included in the analysis. Monitoring Point No. 1,460 was lost between September 2014 and September 2015 and re-established in September 2015. The movement rate calculated for this monitoring point for the period between 2014 and 2015 was not included in the analysis.

Horizontal movement rates, averaged for each drop structure’s four monitoring points, over the five timeframes are presented as Figure C.

Horizontal movement measurements from monitoring cycle completed between 2006 and 2015 are presented in Figure D to Figure F. The maximum, minimum, and average movement measurements recorded at the four monitoring points associated with each drop structure are presented along with the average movement rate by timeframe. As movement in any individual year occurred along different vectors than movement over the timeframes, the movement rates averaged by timeframe tended to be lower than the individual survey averages (i.e., measurements in 2008 indicated movement along a different vector than movement along the 2006 to July 2010 timeframe).

Selected drop structure parameters based on 2012 and 2014 surveys, along with the percent change or quantity change, are presented in Table L, Table M, and Table N.

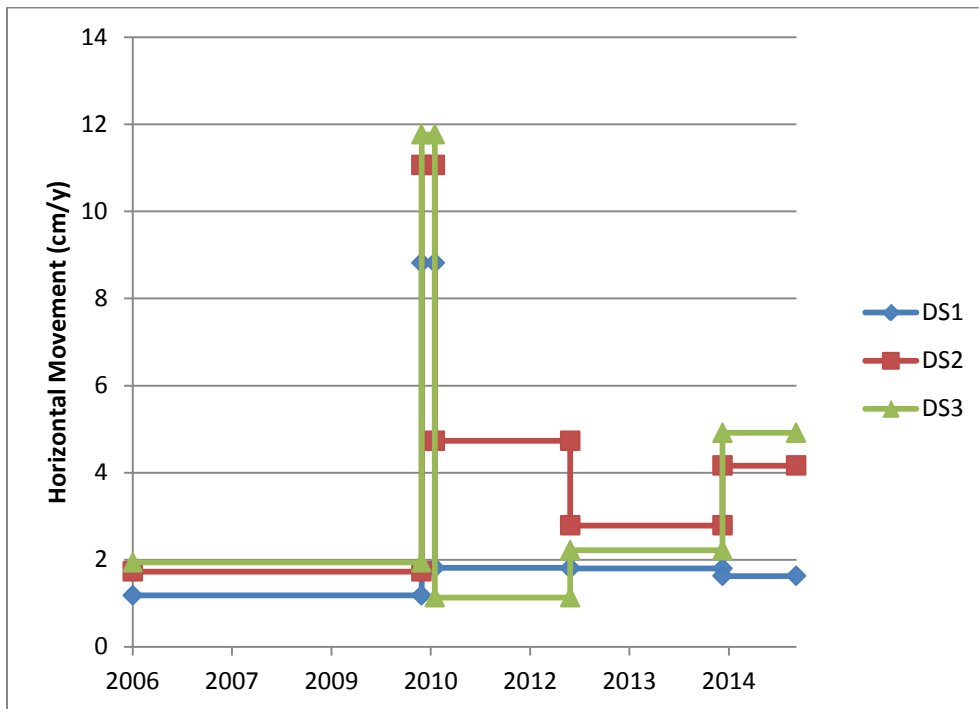


Figure C Drop Structure Average Horizontal Movement Rates by Timeframe



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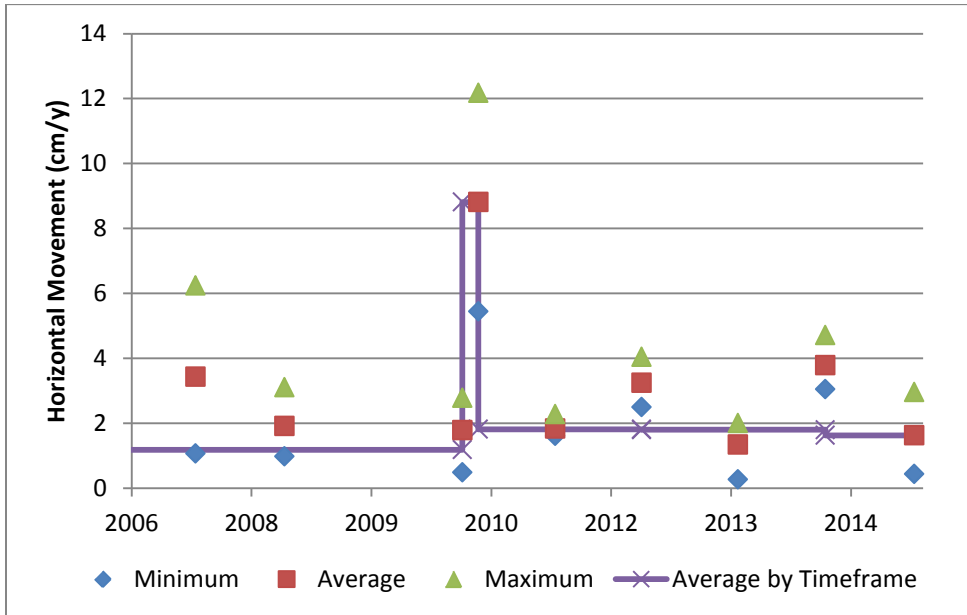


Figure D DS1 Horizontal Movement Rates

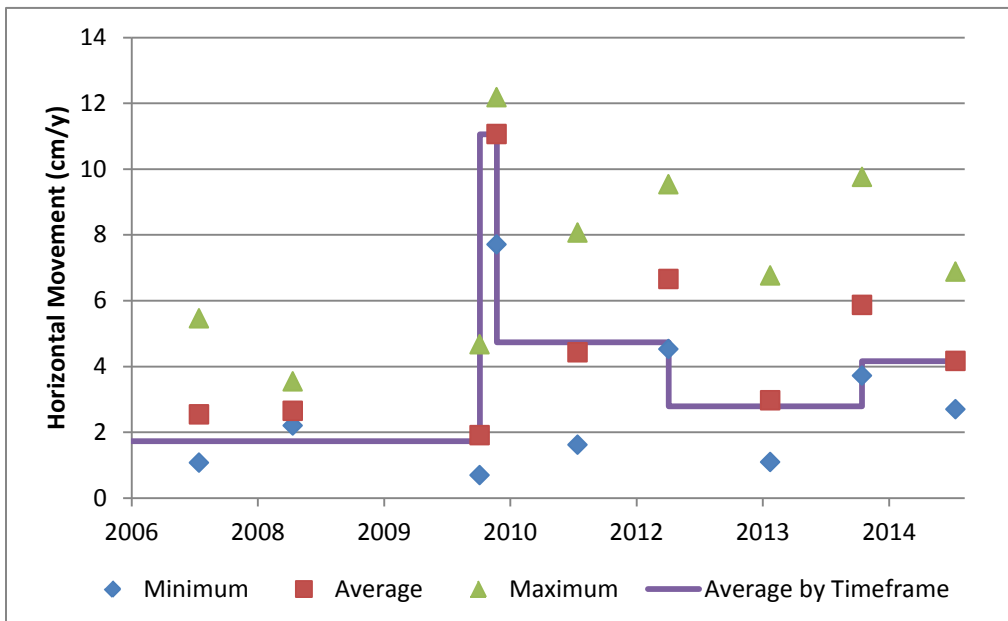


Figure E DS2 Horizontal Movement Rates



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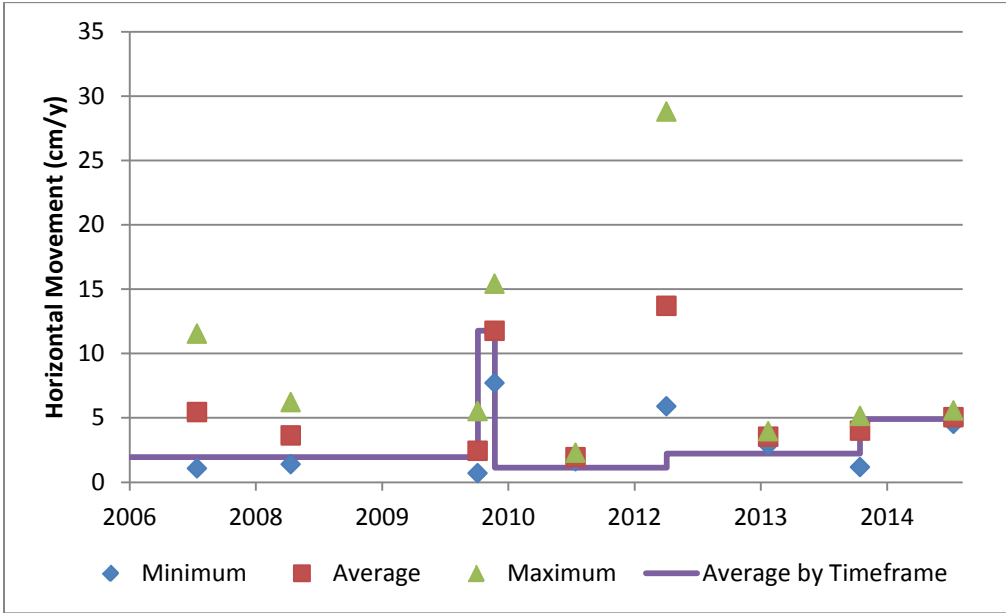


Figure F DS3 Horizontal

Table L Selected DS1 Parameters (2014 to 2015)

Parameter	2006 (Baseline)	2014	2015	% Change/ Δ 2014-2015
Average bottom width (m) ¹	6.9	8.2	6.4	-21.9%
Average side slopes ²	3.2H:1V	3.7H:1V	3.6H:1V	-2.7%
Upstream invert elevation (masl) ³	411.27	411.15	411.11	$\Delta = -4$ cm
Downstream invert elevation (masl) ³	409.76	409.90	409.79	$\Delta = -11$ cm
Average end area (m ²) ⁴	30.6	27.7	26.9	-2.9%

Table M Selected DS2 Parameters (2014 to 2015)

Parameter	2006 (Baseline)	2014	2015	% Change/ Δ 2014-2015
Average bottom width (m) ¹	6.3	7.7	6.7	-12.9%
Average side slopes ²	3.1H:1V	3.5H:1V	3.1H:1V	11.4%
Upstream invert elevation (masl) ³	409.76	409.54	409.50	$\Delta = +4$ cm
Downstream invert elevation (masl) ³	407.14	406.99	406.97	$\Delta = -2$ cm
Average end area (m ²) ⁴	34.5	33.5	31.7	-5.4%



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Table N Selected DS3 Parameters (2014 to 2015)

Parameter	2006 (Baseline)	2014	2015	% Change/ Δ 2014-2015
Average bottom width (m) ¹	6.3	7.8	6.4	-17.9%
Average side slopes ²	3.2H:1V	3.6H:1V	3.3H:1V	-8.3%
Upstream invert elevation (masl) ³	406.97	406.69	406.66	$\Delta = -3$ cm
Downstream invert elevation (masl) ³	404.83	404.42	404.53	$\Delta = +11$ cm
Average end area (m ²) ⁴	36.0	31.3	32.0	+2.2%

¹Average bottom width measurement was based on the distance between the estimated channel toes identified on the surveyed drop structure cross-section.

²The initial slope measured from the bottom of the channel to approximately half way up the slope.

³Invert elevations were based on the lowest point identified on the surveyed drop structure cross-section.

⁴End area boundaries were defined by the channel bottom, between the assumed outside edges of the gabion baskets.

The rate of change to invert elevations for the upstream and downstream sections for all drop structures between 2014 and 2015 are shown in Figure G.

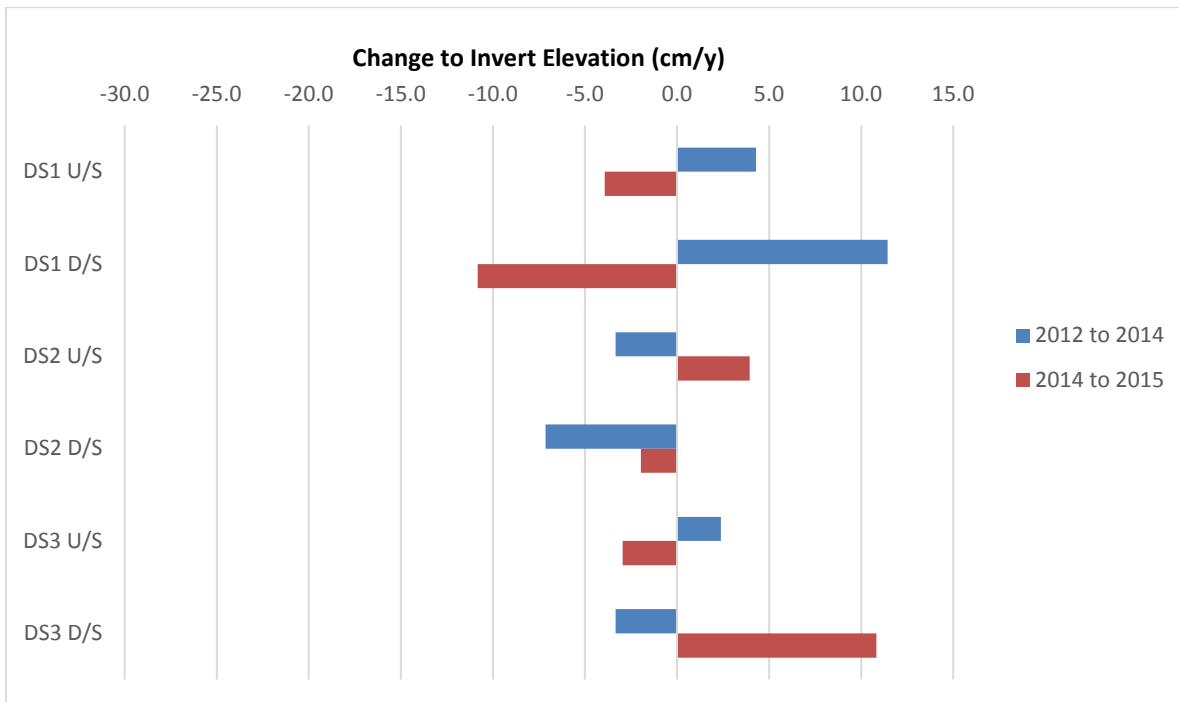


Figure G Rate of Change of Drop Structure Invert Elevations



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5.2.2.2 Freeboard

The estimated freeboard depth at each drop structure is presented in Table O. These estimates are based on the hydraulic calculations completed as part of the design of the drop structures and a 50-year peak design flow of 34 m³/s (R22, UMA 2003); however, the longitudinal slope variable has since increased from 0.1% to 1.0%. The cross-sectional area and wetted perimeter have also changed based on the 2015 survey results. These changes to the channel geometry have altered the estimated flow depth and, consequently, the estimated freeboard at each drop structure. The freeboard depth was calculated based on the distance between the estimated water surface during the 50-year peak flow condition and the top of the gabion baskets as recorded in the 2014 survey.

Table O Freeboard Estimates at Drop Structure Monitoring Cross-Sections

Drop Structure	Estimated Channel Slope (%)	Estimated Gabion Basket Elevation (masl)	Estimated Flow Depth (m)	Estimated Flow Elevation (masl)	Estimated Freeboard (m)
DS1 (U/S)	1.9	413.43	1.05	412.32	1.27
DS1 (D/S)	2.0	411.56	1.01	410.76	0.76
DS2 (U/S)	1.9	411.82	1.03	410.82	1.25
DS2 (D/S)	2.9	409.05	0.94	408.25	1.14
DS3 (U/S)	1.7	408.79	1.05	407.86	1.08
DS3 (D/S)	2.5	406.46	1.01	405.87	0.92

5.2.2.3 Movement Triggers

The triggers associated with the drop structures are based on the following measurements:

- Drop structure side slopes.
- Freeboard provided for the 50-year design flow of 33.8 m³/s (R48, UMA 2003) measured from the estimate water surface elevation and the top of gabion baskets upstream of the structure. Updated calculations based on a 1.0% longitudinal slope, which reflects in-situ hydraulic conditions based on the survey data, and the design section indicate a modified baseline freeboard height of approximately 1.2 m).
- Width of the drop structure at the drawdown reduction weir (between the upper monitoring points). As only DS1 was constructed with a drawdown reduction weir, it is recommended that this trigger is revised based on the width of the drop structure between the upstream monitoring points (refer to recommendation DS-G below).
- Width of the drop structure at the end sill (between the lower monitoring points).

The surveyed trigger results for DS1 to DS3 are presented in Table P, Table Q, and Table R.



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Table P DS1 Trigger Results

Measurement	Trigger Value	Baseline Value ²	2015 Value
Average north side slope	<2H:1V	3H:1V	3.2H:1V
Average south side slope	<2H:1V	3H:1V	4.0H:1V
Freeboard (m) ¹	<0.3	1.2	1.11
Distance between upstream monitoring points (m)	<27.1	27.6	27.5 (-0.3%)
Distance between downstream monitoring points (m)	<28.2	28.7 ³	28.7 (no change)
Δ avg. cross-sectional end area since previous monitoring period (m ²)	>+/-10%	27.7 ⁴	26.9 (-2.7%)

Table Q DS2 Trigger Results

Measurement	Trigger Value	Baseline Value ²	2015 Value
Average north side slope	<2H:1V	3H:1V	2.7H:1V
Average south side slope	<2H:1V	3H:1V	3.5H:1V
Freeboard (m) ¹	<0.3	1.2	1.00
Distance between upstream monitoring points (m)	<27.0	27.5 ³	27.5 (no change)
Distance between downstream monitoring points (m)	<28.1	28.6	28.1 (-1.7%)
Δ avg. cross-sectional end area since previous monitoring period (m ²)	>+/-10%	31.4 ⁴	31.7 (+1.0%)

¹Distance from estimated peak water surface elevation (based on 50-year design flow) and the top of the gabion baskets at the upstream end of the drop structure.

²Based on design values presented on Drawing 04 in the 2005 Long Term Performance Monitoring Program report (R22, UMA, 2006)

³Baseline values at the DS1 downstream, DS2 upstream, and DS3 upstream monitoring points were determined by 2012 measurements as monitoring points at these locations were re-established in 2012.

⁴Based on end area measurements observed in 2014.



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Table R DS3 Trigger Results

Measurement	Trigger Value	Baseline Value ²	2015 Value
Average north side slope	<2H:1V	3H:1V	3.0H:1V
Average south side slope	<2H:1V	3H:1V	3.7H:1V
Freeboard (m) ¹	<0.3	1.2	0.93
Distance between upstream monitoring points (m)	<26.0	26.53 ³	26.4 (-0.4%)
Distance between downstream monitoring points (m)	<27.3	27.85 ⁵	27.8 (no change)
Δ avg. cross-sectional end area since previous monitoring period (m ²)	>+/-10% RPC	31.3 ⁴	32.0 (+2.4%)

¹Distance from estimated peak water surface elevation (based on 50-year design flow) and the top of the gabion baskets at the upstream end of the drop structure.

²Based on design values presented on Drawing 04 in the 2005 Long Term Performance Monitoring Program report (R22, UMA, 2006)

³Baseline values at the DS1 downstream, DS2 upstream, and DS3 upstream monitoring points were determined by 2012 measurements as monitoring points at these locations were re-established in 2012.

⁴Based on end area measurements observed in 2014.

⁵Baseline values at the DS3 downstream monitoring points were determined by 2015 measurements as monitoring points at these locations were re-established in 2015.

5.2.3 Results Summary

Between the periods of 2012 to 2014 and 2014 to 2015, the average horizontal movement rate decreased at DS1 (-10%) and increased at DS2 (+49%) and DS3 (+121%). It is likely that these rate changes were influenced by the construction activities that were completed at DS4 in 2015 including the installation of high-density polyethylene (HDPE) bypass piping along the south bank, movement of heavy equipment and materials along the south and north banks, as well as regrading of the waste rock slope south of the drop structures.

Between the 2014 and 2015 surveys, the invert elevations observed at the DS2 upstream and DS3 downstream increased between 3.9 cm and 10.8 cm while the invert elevations at all other drop structure sections decreased between -2.0 cm and -10.8 cm. The change in average cross-sectional area over this period ranged from -2.7% (DS1) to +2.4% (DS3). The width between monitoring points generally decreased up to -1.7% at DS2 downstream; although the current width at DS2 is at the threshold value, it is possible this was influenced by the construction activities that occurred during the 2011 field season. As DS2 appears to be in good condition and is functioning as intended, it is recommended that the value for trigger DS-3 be changed to >1.0 m (refer to recommendation DS-I below).

The results of the revised flow calculations indicate that, based on the drop structure geometry observed in 2015, the freeboard provided during conveyance of the design flow (50-year return period peak instantaneous flow of 33.8 m³/s) would range from 0.76 to 1.27 m.



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5.2.4 Triggers and Recommendations

Existing triggers associated with the gabion drop structures are presented in Table S.

Table S Drop Structure Triggers

ID	Description	Trigger Value	Action	Status
DS-1 (R22)	Change to drop structure geometry: steepened side slope	<2H:1V	Develop mitigation plan for drop structures at which trigger has been exceeded	Not triggered
DS-2 (R22)	Change to drop structure geometry: minimum freeboard at design flow	<0.30 m	Develop mitigation plan for drop structures at which trigger has been exceeded	Not triggered
DS-3 (2014)	Change to drop structure geometry: distance between monitoring points	>0.50 m	Develop mitigation plan for drop structures at which trigger has been exceeded	Not triggered – refer to recommendation DS-I below
DS-4 (R22)	Visual evidence of water flowing below gabion baskets or undermining baskets	N/A	Immediate appropriate repair prior to the end of the construction season	DS4 repaired in 2015
DS-5 (R22)	Visual evidence of damage to gabion mesh	N/A	Repair wire mesh and SPENAX rings as appropriate prior to the end of construction season	Minor repairs completed at all drop structures in 2015
DS-6 (2014)	Change to cross-sectional end area since previous monitoring period	>10%	Develop mitigation plan for drop structures at which trigger has been exceeded	Not triggered

The six triggers were not exceeded in 2015.

The ongoing and outstanding monitoring recommendations relevant to the drop structures are summarized in Table T.

Table T Drop Structure Monitoring Recommendations

ID	Description	Implementation	Validity
DS-A (R51)	Monitor (i.e., inspect and survey) drop structures on an annual basis	Ongoing - inspection and survey of all drop structures completed in 2013 and 2014	Valid - practice should continue
DS-B (R104)	Undertake further geotechnical investigation and evaluation to provide a more in-depth discussion on possible causes for differing movement rates between the gabion monitors and waste rock dump monitors	Not implemented	Valid - should be completed prior to site-wide remediation



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ID	Description	Implementation	Validity
DS-C (2014)	Install additional monitoring points along the waste rock dump toe aligned with the drop structures. A total of eight points should be installed with each point located 20 m south of the monitoring point on the south creek embankment	Not completed due to construction activity at DS4. Should be completed as part of 2016 LTMP	To improve understanding of influence of waste rock movement on drop structures
DS-D (2014)	Establish new monitoring points and cross-section downstream of DS4 that can be safely accessed	Not completed due to construction activity at DS4	Not needed - DS4 repaired in 2015 requiring the establishment of new monitoring points in 2016
DS-E (2014)	Future survey should include the clear and explicit identification of break points (e.g., toe and top of embankment) through drop structure cross-sections and the edges of each course of gabion baskets along the drop structure centreline	Implemented as part of 2015 survey	To facilitate the measurement of drop structure cross-section parameters and the review of drop structure profiles
DS-F (2014)	Change trigger DS-2 from <0.2 m freeboard to <0.3 m freeboard during conveyance of the 50-year peak flow and adopt revised design flows shown on Figure Nos. 1009 to 1012, Appendix 1	Included on 2015 LTMP drawings	To reflect revised peak flow depth and current hydraulic design practices
DS-G (2014)	Change trigger DS-3 to measure the drop structure width between the upstream and downstream monitoring points rather than at the upstream drawdown weir and between the downstream monitoring points	Completed in 2015	Only DS1 was installed with a drawdown weir.
DS-H (New)	Re-establish drop structure Monitoring Point Nos. 1,462 to 1,465	To be implemented in 2016	Required to monitor movement at DS3 and DS4
DS-I (New)	Change DS-3 trigger value to a change of drop structure width greater than 1.0 m	To be implemented in 2016	DS-2 downstream at trigger threshold and appears to be in stable condition

5.3 Clinton Creek Channel

Downstream of DS4, the Clinton Creek channel continues south east to the confluence with Wolverine Creek. Following the large flow event in 2010, the portion of the creek channel immediately downstream of DS4 has eroded down to bedrock and compromised the south channel embankment and the closed portion of the Clinton Creek Access Road (Section 5.1). At that time, the alignment of the lower portion of the creek, beyond station 0+700, shifted south to the toe of the waste rock.



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Figures showing the following Clinton Creek channel components are included in Appendix 1:

- Centreline alignments - Figure 1002
- Vertical profiles - Figures 1004 to 1007



Photo D Clinton Creek Channel Upstream of Ford Crossing No.1 - Looking East (Downstream)

5.3.1 Survey

The Clinton Creek channel centreline was surveyed from the Hudgeon Lake outlet to the just downstream of Ford Crossing No. 1 to establish the horizontal and vertical alignment of the channel.

For the purposes of this analysis, the Clinton Creek channel is divided into the following reaches:

- Drop structures: Sta. 0+000 to Sta. 0+200: DS1 to DS4 discussed in Section 5.2.
- Upper Creek: Sta. 0+200 to Sta. 0+680: aligned through the canyon and adjacent to the closed portion of the Clinton Creek access road.
- Mid Creek: Sta. 0+680 to Sta. 0+871: beyond the re-aligned channel (post-2010 extreme flow event).



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Only a portion of the mid-creek was surveyed in 2015, up to Ford Crossing No. 1 at Sta. 0+871 rather than up to Sta. 0+913 as in previous years due to the incorrect survey limits being provided to Underhill. However, due to the relative stability of the channel downstream of Ford Crossing No. 1, it is not necessary for the lower creek to be surveyed on an annual basis (refer to recommendation CC-H below).

Total movement rates (i.e., calculated based on the difference between the 2003 coordinates of the monitoring point and the 2015 coordinates) and incremental movement rates (i.e., calculated based on the difference between the 2012 to 2014 and 2014 to 2015 periods) for the waste rock dump are shown on Figures 1012 and 1013, see Appendix 1.

5.3.2 Results

The previous longitudinal profile data indicates that the upper section and mid-section of the Clinton Creek channel underwent the geomorphological changes as presented in Table U and Table V between 2004 (when the baseline was established) and 2015. For the purposes of this analysis the following timeframes were considered:

- July 2004 to September 2010
- September 2010 to August 2012
- August 2012 to September 2014
- September 2014 to September 2015

Vertical profiles and horizontal alignments recorded at the start and end of each timeframe were compared in Autodesk Civil3D with various functions in this program used to calculate the results shown.

Table U Upper Clinton Creek and Drop Structure Transition Zone Geomorphological Changes (2004 to 2015)

Measurement	Sta. 0+200 to Sta. 0+420				Sta. 0+420 to Sta. 0+680			
	2004 to 2010	2010 to 2012	2012 to 2014	2014 to 2015	2004 to 2010	2010 to 2012	2012 to 2014	2014 to 2015
Channel length - downcutting (m) ¹	220	77	99	95	72	157	223	70
Average channel downcutting (cm) ²	206	14	12	11	38	22	24	11
Maximum channel downcutting (cm)	449	51	57	29	105	87	66	34
Channel length - deposition (m) ¹	0	143	121	95	188	103	37	190
Average channel deposition (cm) ²	N/A	13	14	12	72	22	14	26
Maximum channel deposition (cm)	N/A	47	57	36	180	53	41	184



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Measurement	Sta. 0+200 to Sta. 0+420				Sta. 0+420 to Sta. 0+680			
	2004 to 2010	2010 to 2012	2012 to 2014	2014 to 2015	2004 to 2010	2010 to 2012	2012 to 2014	2014 to 2015
Average channel centreline horizontal shift and direction (m) ³	8.4 south	1.7 north	0.7 south	0.4 south	0.9 north	0.4 north	1.5 north	0.9 south
Maximum channel centreline horizontal shift and direction (m)	20.9 south	6.7 north	4.2 south	7.0 south	8.7 north	2.4 north	8.2 north	6.7 south

¹Channel length - downcutting/deposition based on length of channel over which downcutting/deposition was observed.

²Average calculated as the area between the profiles divided by the length of channel over which downcutting/deposition was observed (e.g., “Average channel downcutting” = downcut area measured between profiles/“Channel length - downcutting”).

³Average horizontal shift calculated as the two-dimensional area measured between the centrelines - in the predominant north/south direction - divided by the total channel length.

Table V Mid-Clinton Creek Geomorphological Changes (2010 to 2015)

Measurement	2010 to 2012	2012 to 2014	2014 to 2015 ¹
Channel length - downcutting (m)	222	225	101
Average channel downcutting (cm)	20	67	7
Maximum channel downcutting (cm)	64	142	27
Channel length - deposition (m)	11	8	90
Average channel deposition (cm)	8	30	18
Maximum channel deposition (cm)	21	21	39
Average channel centreline horizontal shift & direction (m)	1.0 north	1.2 north	0.4 south
Maximum channel centreline horizontal shift & direction (m)	6.2 north	5.9 north	1.8 south

¹A 40 m long portion of the mid-creek, downstream of Ford Crossing No. 1, was not surveyed in 2015, resulting in shorter downcutting and deposition channel lengths measurements than in previous timeframes.

These results were used to estimate the average channel downcutting and deposition rates and percent change over the four time frames (Table W and Table X).



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Table W Clinton Creek Rates of Change by Timeframe (2004 to 2015) - Upper Creek

Rate	2004 to 2010	2010 to 2012	2012 to 2014	2014 to 2015
Average channel downcutting (cm/m/y) ¹	13.8	5.1	6.5	4.0
Average channel deposition (cm/m/y) ¹	4.5	4.6	2.2	13.3

Table X Clinton Creek Rates of Change by Timeframe (2012 to 2015) - Mid Creek

Rate	2010 to 2012	2012 to 2014	2014 to 2015
Average channel downcutting (cm/m/y) ¹	10.1	30.9	3.7
Average channel deposition (cm/m/y) ¹	0.2	0.5	8.2

¹Average channel downcutting/deposition calculated as the total downcutting measured(in cm) along the channel section divided by the total length (in m) of the channel section.

The results in Table W and Table X provide an overall indication of how much the channel is experiencing downcutting or deposition as a whole, and the difference between the two values (downcutting and deposition) is an approximation of the net change. For example between September 2014 and September 2015, the mid-creek portion of the channel underwent an estimated 3.7 cm average downcutting and 8.2 cm deposition, with an approximate net deposition of 4.5 cm along this reach of the channel.

5.3.3 Results Summary

Between the periods 2012-2014 and 2014-2015, the average channel downcutting decreased by 39% in the upper creek and 88% in the mid-creek. The average channel deposition over this period increased significantly in the upper and mid creek. Observed deposition was greatest through the downstream portion of the upper creek which may indicate that material has been mobilized along the steep channel banks immediately downstream of the drop structures and deposited downstream.

Between 2014 and 2015, the channel centreline shifted south by an average of 0.7 m through the upper creek and 0.4 m through the mid-creek. The maximum channel shifts to the south in the upper creek was 7.0 m and 1.8 m along the mid-creek.

5.3.4 Triggers and Recommendations

Existing and new triggers for the Clinton Creek channel downstream of DS4 are presented in Table Y. The new triggers are based on the observations made following the 2010 extreme flow event. They are based on current site conditions and should not be applied to historical data (i.e., although the trigger values may have been exceeded during previous timeframes, the recommended action should only be taken if the trigger value is exceeded during future monitoring periods).



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Table Y Clinton Creek Channel Triggers

ID	Description	Trigger Value	Action	Status
CC-1 (R22)	Channel downcut over the 50 m channel segment downstream of DS4 to Sta. 0+250	>0.5 m (from 2006 baseline)	Begin planning for channel and waste rock stabilization	Triggered in 2010, site-wide remediation planning underway
CC-2 (R22)	Channel downcut over a measurable (>50m) stretch of the channel downstream of Sta. 0+250	>1.5 m (from 2006 baseline)	Begin planning for channel and waste rock stabilization	Triggered in 2010, site-wide remediation planning underway
CC-3 (2014)	Channel deposition downstream of DS4 over channel segment (minimum length of 50 m)	>0.3 m from previous monitoring period	Develop localized mitigation plan	Not triggered, should be used as a trigger in future LTMPs
CC-4 (2014)	Mid-creek channel centreline shifts south, into the waste rock dump	>5 m from previous monitoring period	Develop localized mitigation plan	Not triggered, should be used as a trigger in future LTMPs

The monitoring recommendations relevant to the Clinton Creek channel are summarized in Table Z.

Table Z Clinton Creek Channel Monitoring Recommendations

ID	Description	Implementation	Validity
CC-A (R51)	Environmental assessment to determine impacts of stabilization measures at Clinton Creek channel	Not completed	Valid - should be completed prior to site-wide remediation
CC-B (R51)	Inspect and survey the Clinton Creek channel on an annual basis (R104)	Inspection of channel up to confluence with Wolverine Creek and survey of upper and mid-creek portions of channel completed in 2015	Refer to recommendation CC-H below
CC-C (R104)	Survey of Cross-Sections A to E along Clinton Creek should be completed on a biennial basis	Should be completed as part of 2016 LTMP	Valid - practice should continue
CC-D (R104)	Install additional monitoring pins adjacent to where Clinton Creek has relocated closer to the waste rock area	Completed in 2015	Valid - refer to recommendation CC-G below
CC-E (R104)	Complete geotechnical investigation of Clinton Creek waste rock dump	Not completed	Valid - should be completed prior to site wide remediation



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ID	Description	Implementation	Validity
CC-F (2014)	Survey of Cross-Section F along Clinton Creek should be completed on a biennial basis	Should be completed as part of 2016 LTMP	Survey required to compare cross-section to previous years and identify geomorphological/topographical changes
CC-G (2014)	AAM should consider installing monitoring pins along south slope of Clinton Creek near Stations 0+700, 0+800, and 0+900	Implemented in 2015	Implemented
CC-H (New)	The upper creek (Sta. 0+200 to Sta. 0+680) and mid-creek (Sta. 0+680 to Sta. 0+913) portions of the channel should be surveyed annually, with the lower creek (Sta. 0+913 to confluence with Wolverine Creek) portion of the channel surveyed on a biennial basis	Survey of upper creek and portion of mid-creek surveyed in 2015, upper, mid-, and lower creek portions should be surveyed as part of 2016 LTMP	Lower creek is stable compared to upper and mid-creek portions of channel and does not require annual survey

5.4 Clinton Creek Waste Rock Dump

The Clinton Creek waste rock dump generally slopes north from a peak northwest of Porcupine Pit (approximate elevation of 477.3 m) to the south embankment of the Clinton Creek channel. The waste rock is comprised of weak argillite material composed primarily of sand and gravel sized rock fragments with some cobbles and boulders. The results of a stability analysis completed in 2002 indicate that the ongoing waste rock movement is the result of a very weak foundation layer and the thawing of permafrost underneath the waste rock (R47, UMA 2002).

The waste rock dump is divided into three segments:

- Upper slope - above the 450 masl
- Mid slope - between the 450 masl and 420 masl
- Lower slope - below the 420 masl

Total movement rates, calculated based on the difference between the 2003 coordinates of the monitoring point and the 2015 coordinates, and incremental movement rates, calculated based on the difference between the 2012-2014 as well as 2014-2015 monitoring point coordinates, for the waste rock dump are shown on Figures 1011 and 1012 (Appendix 1).

5.4.1 Survey

The 2015 survey of the waste rock dump was limited to the upper slope and was completed by measuring the coordinates of the monitoring points used to assess waste rock movement presented in Table AA. This table also presents the segment of the waste rock dump in which the monitoring point is located and the year in which it was established. Two monitoring points established on the natural slope north of Clinton Creek in 2014 were also surveyed in 2015.



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Table AA Summary of 2015 Waste Rock Dump, Upper Slope Monitoring Points

Segment	Monitoring Point	Year Established
Upper Slope	81-1	2001
	223	2003
	225	2003
	1,195	2001
	1,834	2003
	BH-4	2012
	BH-4 Cable ¹	2012
	2,836	2012
	186	2012
	300	2012
Natural Slope Above Clinton Creek	183	2014
	184	2014

¹Monitoring Point No. BH-4 cable was excluded from the analysis. Coordinates for BH-4 cable were recorded at the point where a black cable enters the ground (as opposed to other monitoring points at which a shot is recorded at the top of a piece of rebar driven into the ground). As annual variations occur at or near the ground surface it is unlikely that the same ground feature is recorded during each LTMP survey. It is recommended that this monitoring point is excluded (i.e., is not surveyed or included in the analysis) from future LTMPs (refer to recommendation WR-E below).

Underhill reported an average horizontal precision of 1.4 cm in 2015 for the waste rock dump, upper slope monitoring points.

5.4.2 Horizontal Movement by Monitoring Cycle

Monitoring point horizontal movement measured between monitoring cycles represent short-term variations in soil movement, irrespective of the direction of movement.

Horizontal movement measurements from each monitoring cycle completed between 2003 and 2015 are presented in Figure H.

The graph presents the first quartile (bottom of red rectangle), third quartile (top of green rectangle), median value (boundary between green and red rectangles), as well as minimum and maximum values (black vertical lines extending above and below rectangles).



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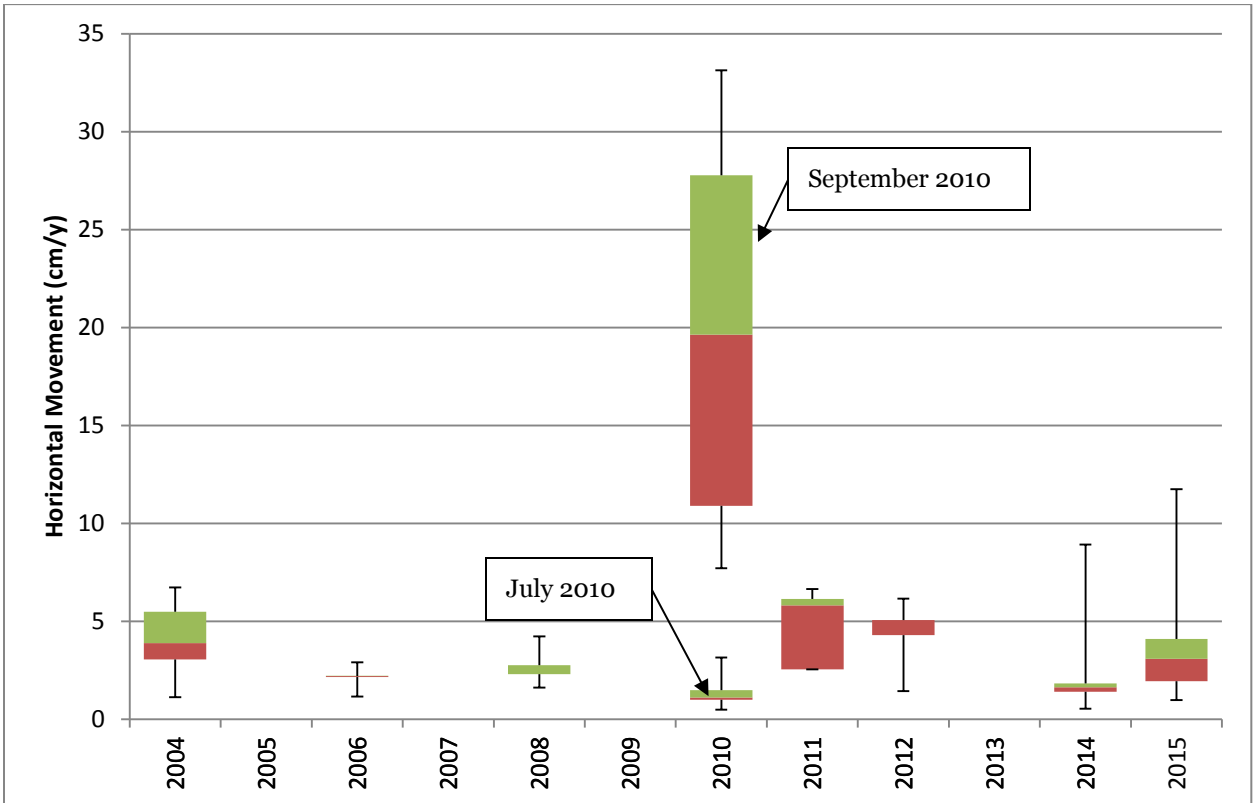


Figure H Waste Rock Dump Movement Rates - Upper Slope

Note that in some years, the majority of movement rates were at or near the median with outliers above or below this value. Consequently, the quartile data points were less than 0.1 and are not visible in the graph. In such cases, the median value is located at the top edge of the third quartile (in red) or the lower edge of the second quartile (in green).

5.4.3 Horizontal Movement by Monitoring Point

Table BB summarizes horizontal movement rate averages and standard deviations of each monitoring point on the upper waste rock dump between 2003, or the year in which the point was established, and 2015.

Table BB Upper Slope Waste Rock Dump Horizontal Movement Rate Statistics (by Monitoring Point)

Monitoring Point	Timeframe	Average Movement Rate (cm/y)	Standard Deviation
81-1	2003-2015	3.6	2.9
223	2003-2015	4.8	5.7
225	2003-2015	5.3	8.5



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Monitoring Point	Timeframe	Average Movement Rate (cm/y)	Standard Deviation
1,195	2003-2015	3.1	3.1
1,834	2003-2015	7.0	10.0
BH-4	2012-2015	1.7	0.3
2,836	2012-2015	9.2	3.6
186	2012-2015	7.2	2.5
300	2012-2015	2.6	2.2

The standard deviation of the horizontal movement observed at all waste rock dump monitoring points between 2003 and 2015 was calculated as 7.62 cm; however, when the movements observed between July and September 2010 are excluded, the standard deviation is reduced to 2.56 cm.

5.4.4 Principal Direction of Movement

The principal direction of movement was calculated for each monitoring point based on the coordinates recorded in the year the monitoring point was established and the coordinates recorded in 2015. At each monitoring point, the soil movement azimuths observed during each monitoring cycle were compared to the principal direction of movement to estimate short-term variations in the direction of soil movement.

Figure I illustrates how the principal direction of movement differs between monitoring cycles.

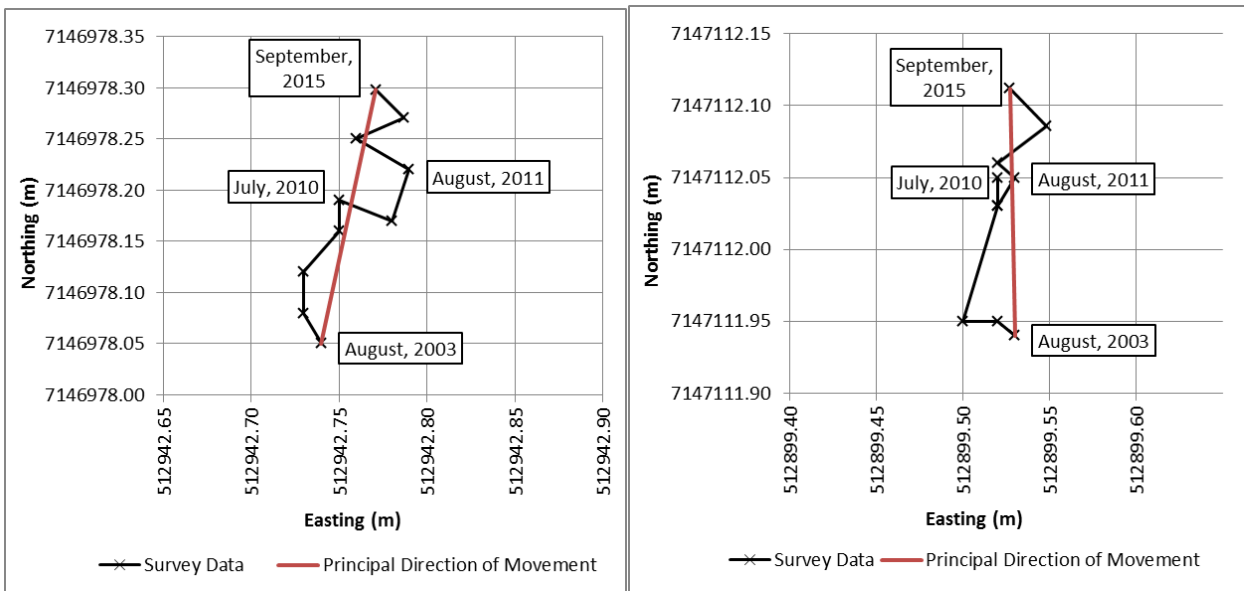


Figure I Principal Direction of Movement for Monitoring Point Nos. 223 (Left) and 1,195 (Right)



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Table CC summarizes the horizontal movement rates and principal direction of movement of each monitoring point on the upper waste rock dump between the date the point was originally established and 2015.

Table CC Upper Slope Waste Rock Dump Total Horizontal Movement Rates (by Monitoring Point)

Monitoring Point	Timeframe	Principal Direction of Movement (Azimuth)	Total Movement in Principal Direction (cm)	Movement Rate in Principal Direction (cm/y)
81-1	2003-2015	54 degrees	5	0.4
223	2003-2015	7 degrees	25	2.1
225	2003-2015	2 degrees	20	1.6
1,195	2003-2015	359 degrees	17	1.4
1,834	2003-2015	344 degrees	26	2.2
BH-4	2012-2015	164 degrees	3	0.9
2,836	2012-2015	76 degrees	26	8.3
186	2012-2015	85 degrees	24	7.8
300	2012-2015	355 degrees	6	1.8

Table DD presents the variability of the soil movement azimuth to the direction of principal movement at each monitoring point based on average, standard deviation, and range of angular difference.

Table DD Upper Slope Waste Rock Dump Movement Variability by Monitoring Point

Monitoring Point	Average Difference to Principal Direction (2003 to 2015)	Standard Deviation	Range
81-1	66 degrees	48 degrees	5-144 degrees
223	35 degrees	35 degrees	4-117 degrees
225	42 degrees	26 degrees	7-83 degrees
1,195	53 degrees	53 degrees	1-179 degrees
1,834	42 degrees	37 degrees	3-116 degrees
BH-4	57 degrees	26 degrees	38-75 degrees
2,836	1 degrees	0.1 degrees	1.0-1.2 degrees
186	5 degrees	4 degrees	2-8 degrees
300	29 degrees	14 degrees	19-39 degrees

A similar analysis was undertaken to quantify variability by year, presented in Table EE.



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Table EE Upper Slope Waste Rock Dump Movement Variability by Year

Years	Average Angular Difference to Principal Direction (2003 to 2015)	Standard Deviation	Range
2003-2004	68 degrees	40 degrees	32-132 degrees
2004-2006	32 degrees	37 degrees	5-84 degrees
2006-2008	26 degrees	10 degrees	15-38 degrees
2008-Jul 2010	23 degrees	21 degrees	1-54 degrees
Jul 2010-Sep 2010	114 degrees	41 degrees	77-179 degrees
Sep 2010-2011	20 degrees	15 degrees	4-38 degrees
2011-2012	76 degrees	41 degrees	44-144 degrees
2012-2014	32 degrees	23 degrees	1-72 degrees
2014-2015	27 degrees	26 degrees	1-75 degrees

5.4.5 Horizontal Movement by Timeframe

Horizontal movement rates were grouped by timeframes over which the magnitudes of movement rates were similar. This enabled the simplified presentation of movement rates averaged over several monitoring cycles.

For the purposes of this analysis the following timeframes were considered:

- July 2003 to July 2010
- July to September 2010
- September 2010 to August 2012
- August 2012 to September 2014
- September 2014 to September 2015

July 2003 was selected as the starting date for this analysis, as the majority of monitoring points were established during this monitoring period. Table FF summarizes the waste rock dump horizontal average (with average azimuths) and maximum movement rates (with azimuths) observed between five timeframes.

Table FF Upper Slope Waste Rock Dump Horizontal Movement Rates (2003 to 2015)

Timeframe	Average Movement Rate (cm/y) and Azimuth	Maximum Movement Rate (cm/y) and Azimuth
2003 to July 2010	1.67 (347.7 degrees)	2.78 (332.1 degrees)
July 2010 to September 2010	19.83 (108.4 degrees)	33.14 (99.5 degrees)
September 2010 to August 2012	2.76 (338.6 degrees)	4.42 (346.0 degrees)
August 2012 to September 2014	2.8 (73.2 degrees)	8.92 (83.3 degrees)
September 2014 to September 2015	3.8 (40.6 degrees)	11.74 (74.5 degrees)



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Horizontal movement rates observed over the five timeframes, with standard deviation, are presented as Figure J.

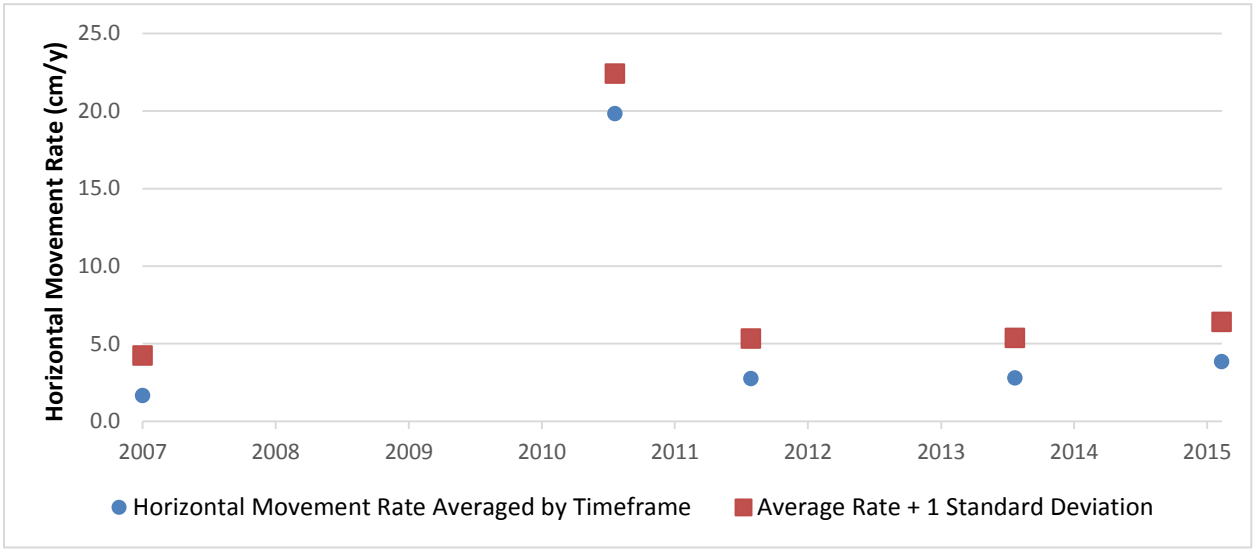


Figure J Average Waste Rock Dump Horizontal Movement Rates - Upper Slope

The data was used to estimate the change in average movement rates and azimuth between the timeframes, with the results presented in Table GG.

Table GG Upper Slope Waste Rock Dump Change in Movement by Timeframe

Timeframe	Average Movement (% Change) ¹	Δ Average Azimuth ²	Maximum Movement (% Change)
2003-July 2010 versus Jul 2010-September 2010	+1,089%	121 degrees	+1,092%
July 2010-September 2010 versus September 2010-2012	-86%	130 degrees	-87%
September 2010-2012 versus 2012-2014	1%	95 degrees	102%
2012-2014 to 2014-2015	36%	33 degrees	32%

¹Change in movement calculated as (average movement rate between 2014 to 2015 - average movement rate between 2012 to 2014)/average movement rate between 2012 to 2014 and represented as a percent change (e.g., for upper slope 2012-2014 to 2014-2015 [3.8-2.8] /2.8 = 36%).

²Change in average azimuth calculated as the difference between the average movement vector azimuth (i.e., the average direction in which the monitoring points in a slope section are moving, relative to north) between two time frames. (e.g., for upper slope July-September 2010 to September 2010-2012 [360 degrees - 338.6 degrees + 108.4 degrees = 129.8 degrees]). Note that changes in azimuth must be less than 180 degrees.



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5.4.6 Results Summary

Between the periods of 2012-2014 and 2014-2015, the average horizontal movement rates observed through the upper slope of the waste rock dump increased from 2.8 cm/y to 3.8 cm/y (+36%). This increase does not appear to be significant at this point.

It should be noted that the 1.1 cm increase between these periods is less than the 1.4 cm average horizontal precision reported for shots taken at the waste rock dump monitoring points in 2015.

The largest variations in horizontal movement rates between monitoring cycles, irrespective of direction, were observed at Monitoring Point Nos. 225 and 1,834 with standard deviations of 8.5 cm/y and 10.0 cm/y, respectively (refer to Table BB). The largest variations between principal direction and the movement azimuths observed during monitoring cycle were observed at Monitoring Point Nos. 81-1, 1,195, and BH-4 with difference to principal direction averages of 66 degrees, 53 degrees, and 57 degrees, respectively. The largest variation between principal direction and movement azimuths observed at all monitoring points occurred during the July 2010 to September 2010 monitoring cycle with a difference to principal direction average of 114 degrees and standard deviation of 41 degrees.

5.4.7 Triggers and Recommendations

The trigger for Waste Rock Dump established in the 2014 LTMP report, along with the value observed in 2015, is presented in Table HH ; however, it is recommended that the trigger value is changed to include standard deviation (refer to recommendation WR-F below). The standard deviation should take into account potential survey error and movement variability.

Table HH Waste Rock Dump (Upper Slope) Trigger Results

ID	Description	Trigger Value	2015 Value
WR-1	Average monitoring point horizontal movement rate - per slope section	Movement rate (cm/y) > than movement rate from previous monitoring cycle	+36%

Trigger WR-1 was exceeded in 2015 for the upper slope of the waste rock dump. The following actions are the recommended responses to the exceedance of the trigger:

- If movement rate increase is between 0% and 30%, monitoring points should be surveyed the following year.
- If movement rate increase is 30% or greater or if movement rate has increased over two consecutive years, begin planning for a geotechnical assessment (including drilling and modelling) to determine whether stabilization is required.

The average measured movement rate of the upper slope increased by 36% from the previous monitoring cycle representing the second monitoring cycle in a row in which the average movement rate increased. However, the movement rate increase of 1.1 cm/y, is less than the average horizontal precision of 1.4 cm reported by Underhill, and movement rates increased by only 1% between the monitoring cycle ending in 2012 and the monitoring cycle ending in 2014. Additionally, the difference between the movement rates observed between 2014-2015 (3.8 cm/y) and 2012-2014 (2.8 cm/y) is less than one standard deviation of the movement rates observed from 2003 to 2015 (2.6 cm), exclusive of July to September 2010. The potential for error related to survey accuracy



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and stability at individual monitoring points is likely to have a significant influence on the data set and calculations This would likely result in a false exceedance of the trigger value.

Therefore, it is not recommended that a geotechnical assessment is undertaken in 2016. Waste rock upper slope monitoring points should be surveyed again in 2016, as planned. If movement rates increase over the coming year, with consideration given to survey error and data variability, a geotechnical assessment should be undertaken.

The monitoring recommendations relevant to the waste rock dump are presented in Table II.

Table II Waste Rock Dump Monitoring Recommendations

ID	Description	Implementation	Validity
WR-A (R51)	Visual inspection of the waste rock dump should be completed on an annual basis with survey completed on a biennial basis	Inspection and survey of upper slope completed in 2015	Valid - practice should continue
WR-B (R104)	Trigger level for waste rock monitors should be further investigated and implemented	Completed in 2014	Completed
WR-C (2014)	Survey upper slope monitoring points in 2015 and compare to 2014 data	Completed in 2015	Completed
WR-F (New)	Excluded monitoring point BH-4 Cable from future LTMPs	Should be implemented as part of 2016 LTMP	BH-4 Cable cannot be surveyed consistently as it is not considered to be stable (i.e., it consists of a flexible cable rather than a piece of rebar driven into the ground)
WR-G (New)	Change WR-1 trigger value to: movement rate (cm/y) > movement rate from previous monitoring cycle plus standard deviation of all movement rates between 2003 and current year, exclusive of July to September 2010	Should be implemented as part of 2016 LTMP	Required to take into account survey error and movement variability



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5.5 Wolverine Creek Tailings Pile

The Wolverine Creek tailings pile (Photo H) generally slopes east from the former mill site (approximate elevation of 609 masl) across the Wolverine Creek Valley.

The tailings slope is comprised of up to cobble sized rejects from the former crushing operation, which are coarser than traditional tailings. The results of a stability analysis completed in 2003 indicate that the mode of failure was a translational slide (resulting from a steep foundation slope and build-up of pore water pressure) with the failure plane located within the overburden and/or weathered argillite layers (R21, UMA 2003).

The lower tailings slope is divided into a north lobe and south lobe, separated by one of two ponds. Stream flow discharging from the ponds has created a channel through the tailings resulting in chronic loading of suspended tailings material in Wolverine Creek.

The tailings slope is divided into the following segments:

- Upper Slope - above 529 masl
- Mid Slope - between 529 masl and 425 masl
- Lower Slope - below 425 masl

Total movement rates (i.e., calculated based on the difference between the 2003 coordinates of the monitoring point and the 2015 coordinates) and incremental movement rates (i.e., calculated based on the difference between the 2012 to 2014 and 2014 to 2015 periods) for the tailings pile are shown on Figures 1014 and 1015, see Appendix 1.

5.5.1 Survey

The 2015 Survey of the tailings pile was limited to the north lobe, upper slope and was accomplished by recording the coordinates of the monitoring points presented in Table JJ. The tables include the segment of the tailings pile in which the monitoring point is located and the year in which it was established.

Table JJ Summary of 2015 North Lobe, Upper Slope Tailings Pile Monitoring Points

Monitoring Point	Year Established
80-1	2003
80-2	2003
26	2003
26-A	2003
BH-14	2003
1,483	2003
1,495	2003

Underhill reported an average horizontal precision of 1.5 cm in 2015 for the north lobe, upper slope tailings pile slope monitoring points.



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5.5.2 Horizontal Movement by Monitoring Cycle

Horizontal movement measurements from each monitoring cycle completed between 2003 and 2015 are presented in Figure K.

The graph presents the first quartile (bottom of red rectangle), third quartile (top of green rectangle), median value (boundary between green and red rectangles), as well as minimum and maximum values (black vertical lines extending above and below rectangles).

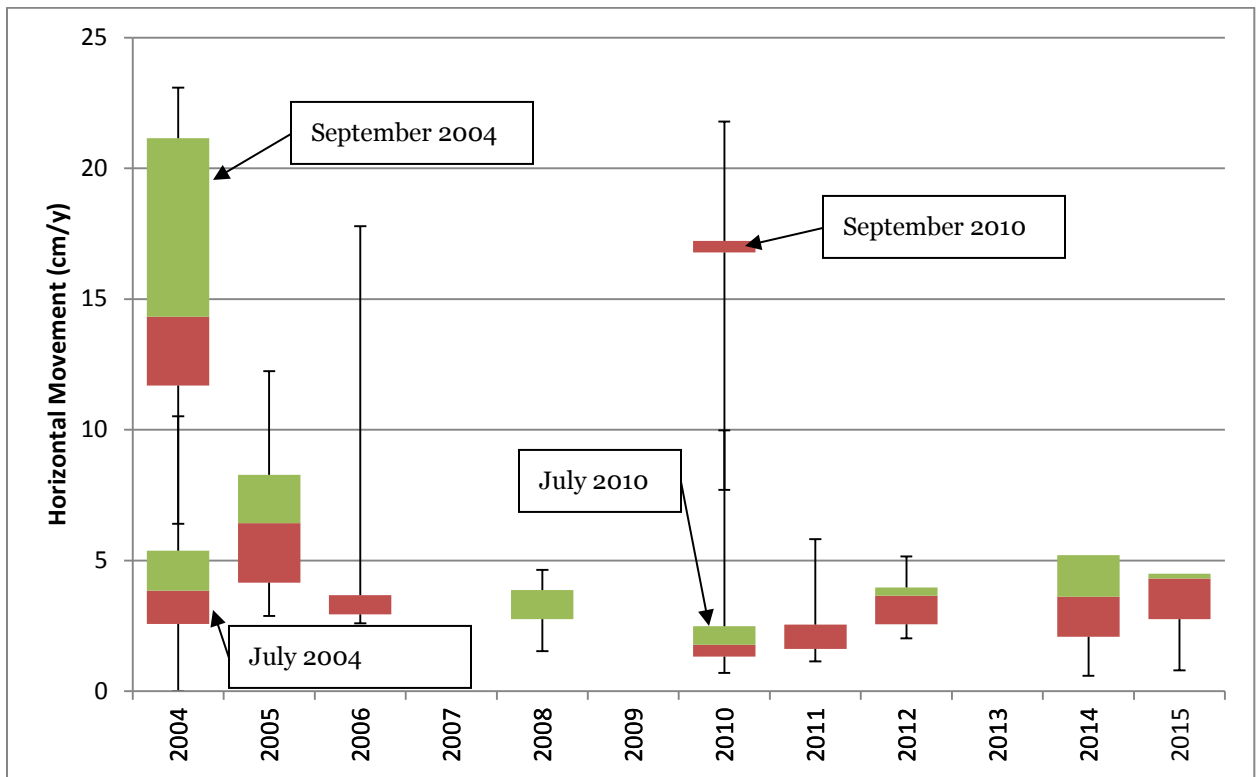


Figure K Tailings Pile Movement Rates - North Lobe, Upper Slope

Note that in some years, the majority of movement rates were at or near the median with outliers above and/or below this value. Consequently, the quartile data points were less than 0.1 and are not visible in the graph. In such cases, the median value is located at the top edge of the third quartile (in red) or the lower edge of the second quartile (in green).



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5.5.3 Horizontal Movement by Monitoring Point

Table KK summarizes horizontal movement rate averages and standard deviations of each monitoring point on the upper waste rock dump between the 2003, or the year in which the point was established, and 2015.

Table KK North Lobe, Upper Slope Tailings Pile Horizontal Movement Rate Statistics (by Monitoring Point)

Monitoring Point	Timeframe	Average Movement Rate (cm/y)	Standard Deviation
80-1	2003-2015	5.9	5.1
80-2	2003-2015	7.7	4.6
26	2003-2015	4.7	5.9
26-A	2003-2015	6.1	6.3
BH-14	2003-2015	9.1	7.6
1,483	2003-2015	4.3	4.8
1,495	2003-2015	5.5	6.2

The standard deviation of the horizontal movement observed at all tailings pile monitoring points between 2003 and 2015 was calculated as 5.91 cm; however, when the movements observed between July and September 2010 are excluded, the standard deviation is reduced to 2.21 cm.



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5.5.4 Principal Direction of Movement

Figure L illustrates how the principal direction of movement differs between monitoring cycles.

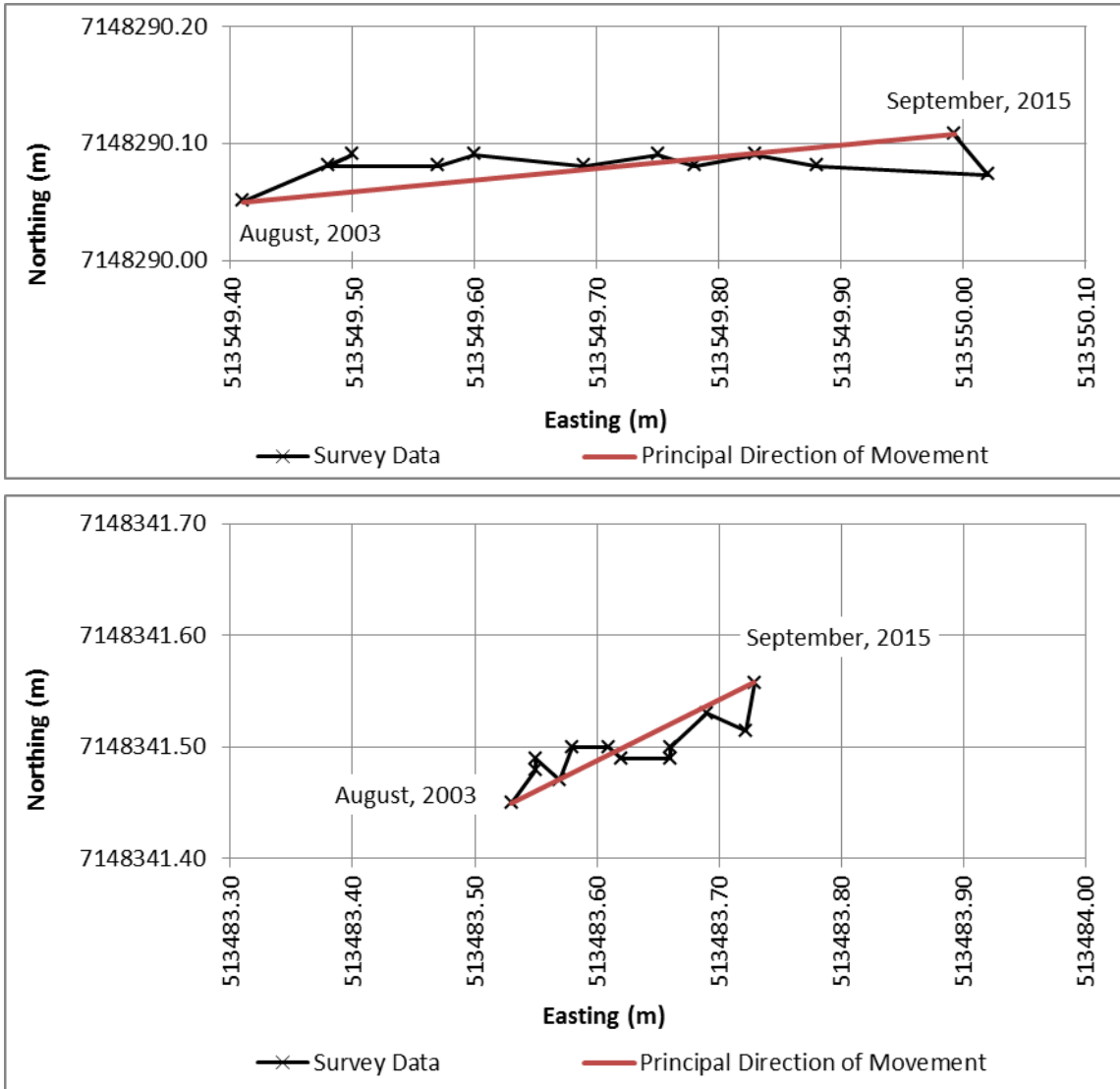


Figure L Principal Direction of Movement for Monitoring Point Nos. 80-2 (Top) and 26 (Bottom)



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Table LL summarizes the horizontal movement rates and principal direction of movement of each monitoring point on the upper waste rock dump between the date the point was originally established and 2015.

Table LL North Lobe, Upper Slope Tailings Pile Horizontal Movement Rates (by Monitoring Point)

Monitoring Point	Timeframe	Principal Direction of Movement (Azimuth)	Total Movement in Principal Direction (cm)	Movement Rate in Principal Direction (cm/y)
80-1	2003-2015	70 degrees	36	3.0
80-2	2003-2015	84 degrees	60	5.0
26	2003-2015	62 degrees	23	1.9
26-A	2003-2015	53 degrees	17	1.4
BH-14	2003-2015	29 degrees	17	1.4
1,483	2012-2015	60 degrees	14	1.1
1,495	2012-2015	53 degrees	33	2.8

Table MM presents the variability of the soil movement azimuth to the direction of principal movement at each monitoring point based on average, standard deviation, and range of angular difference.

Table MM North Lobe, Upper Slope Tailings Pile Movement Variability by Monitoring Point

Monitoring Point	Average Difference to Principal Direction (2003 to 2015)	Standard Deviation	Range
80-1	33 degrees	35 degrees	1-100 degrees
80-2	40 degrees	53 degrees	1-173 degrees
26	48 degrees	20 degrees	20-70 degrees
26-A	69 degrees	63 degrees	2-173 degrees
BH-14	77 degrees	62 degrees	6-179 degrees
1,483	56 degrees	49 degrees	1-160 degrees
1,495	39 degrees	38 degrees	2-117 degrees

A similar analysis was undertaken to quantify variability by year, presented in Table NN.



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Table NN North Lobe, Upper Slope Tailings Movement Variability by Year

Years	Average Difference to Principal Direction (2003 to 2015)	Standard Deviation	Range
2003-July 2004	28 degrees	22 degrees	4-70 degrees
July 2004-September 2004	123 degrees	37 degrees	70-173 degrees
September 2004-2005	43 degrees	54 degrees	1-155 degrees
2005-2006	51 degrees	62 degrees	1-173 degrees
2006-2008	18 degrees	16 degrees	2-41 degrees
2008-July 2010	86 degrees	71 degrees	10-179 degrees
July 2010-September 2010	20 degrees	15 degrees	1-38 degrees
September 2010-2011	51 degrees	38 degrees	7-115 degrees
2011-2012	25 degrees	10 degrees	14-44 degrees
2012-2014	36 degrees	18 degrees	6-56 degrees
2014-2015	89 degrees	25 degrees	52-117 degrees

5.5.5 Horizontal Movement by Timeframe

For the purposes of this analysis, the following timeframes were considered:

- August 2003 to July 2010
- July 2010 to September 2010
- September 2010 to August 2012
- August 2012 to September 2014
- September 2014 to September 2015

August 2003 was selected as the starting date for this analysis as the majority of monitoring points were established either during or before this monitoring period. Table OO summarize the tailings pile horizontal average (with average azimuths) and maximum movement rates (with azimuths) between five timeframes.

Table OO North Lobe, Upper Slope Tailings Pile Horizontal Movement Rates (2003 to 2015)

Timeframe	Average Movement Rate (cm/y) and Azimuth	Maximum Movement Rate (cm/y) and Azimuth
2003 to 2010	2.34 (66.7 degrees)	4.95 (83.3 degrees)
July 201-September 2010	16.39 (87.1 degrees)	21.79 (90.0 degrees)
September 2010-2012	2.73 (64.2 degrees)	5.36 (90 degrees)
2012-2014	4.08 (80.2 degrees)	9.78 (64.7 degrees)
2014-2015	3.83 (340.2 degrees)	7.16 (327.4 degrees)



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Horizontal movement rates observed over the five timeframes, with one standard deviation, are presented as Figure M.

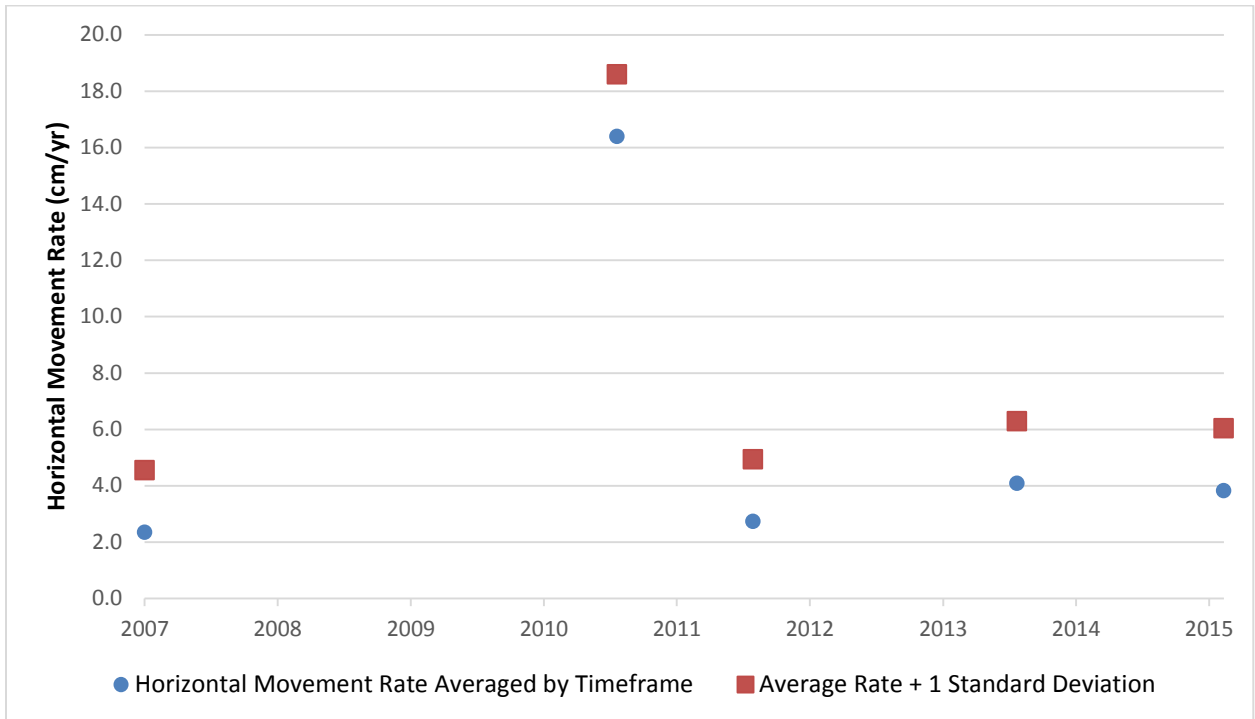


Figure M Average Tailings Pile Horizontal Movement Rates - North Lobe, Upper Slope

The data was used to calculate changes to average horizontal movement rates and azimuth between the timeframes with results presented in Table PP.

Table PP North Lobe, Upper Slope Tailings Horizontal Movement Rates (2003 to 2015)

Timeframe	Average Movement Rate (% Change)	Δ Average Azimuth
2003-July 2010 to July-September 2010	+599%	20.4
July 2010-September 2010 to September 2010-2012	-83%	22.9
September 2010-2012 to 2012-2014	+49%	16
2012-2014 to 2014-2015	-6%	100



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5.5.6 Results Summary

Between the period 2012-2014 and 2014-2015, the average rate of horizontal movement through the north lobe, upper slope of the tailings pile decreased from 4.1 cm/y to 3.8 cm/y (-6%). Over this period the average direction of north lobe, upper slope movement changed 100 degrees, shifting from a predominantly east-northeast direction to a predominantly north-northwest direction.

The largest variations in horizontal movement rates between monitoring cycles, irrespective of direction, were observed at Monitoring Point No. BH-14 with a standard deviation of average movement rate of 7.6 cm/y. The largest variations between principal direction and the movement azimuths observed during monitoring cycle were observed at Monitoring Point Nos. 26-A and BH-14 with difference to principal direction averages of 69 degrees, and 76 degrees, respectively. The largest variation between principal direction and movement azimuths observed at all monitoring points occurred during the following monitoring cycles:

- July 2004 to September 2004 with a difference to principal direction average of 123 degrees and standard deviation of 37 degrees.
- July 2008 to July 2010 with a difference to principal direction average of 86 degrees and standard deviation of 71 degrees.
- September 2014 to September 2015 with a difference to principal direction average of 89 degrees and standard deviation of 25.

5.5.7 Triggers and Recommendations

The trigger for the Tailings Pile established in the 2014 LTMP report, along with the value observed in 2015, is presented in Table QQ; however, it is recommended that the trigger value is changed to include standard deviation (refer to recommendation TP-F below). The standard deviation should take into account potential survey error and movement variability.

Table QQ Tailings Pile (North Lobe, Upper Slope) Trigger Results

ID	Description	Trigger Value	2015 Value
TP-1	Average monitoring point horizontal movement rate - per slope section	Movement rate (cm/y) > than movement rate from previous monitoring cycle	-6%

The trigger value was not exceeded in 2015.

The monitoring recommendations relevant to the Tailings Pile are presented in Table RR.



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Table RR Tailings Pile Monitoring Recommendations

ID	Description	Implementation	Validity
TP-A (R104)	Visual inspection and survey of the Wolverine Creek tailings pile should be completed on a biennial basis	Inspection and survey of the north upper lobe completed in 2015 with full survey of tailings pile completed in 2014	Refer to recommendations TP-C and TP-D
TP-B (R104)	Complete geotechnical investigation and assessment of the north and south lobes of the Wolverine Creek tailings pile	Not completed	Valid - required to improve understanding of variance in average movement rates between north and south lobes; however this investigation is not considered urgent (i.e., not required in the next year) and can be completed prior to site wide remediation unless required sooner due to tailings slope acceleration
TP-C (2014)	Visual inspection of the Wolverine Creek tailings pile should be completed on an annual basis	Completed in 2015	Valid - practice should continue
TP-D (2014)	Survey of the Wolverine Creek tailings pile should be completed on a biennial basis	North upper lobe completed in 2015, full survey to be completed in 2016	Valid - practice should continue
TP-E (New)	Change TP-1 trigger value to: movement rate (cm/y) > movement rate from previous monitoring cycle plus standard deviation of all movement rates between 2003 and current year, exclusive of July to September 2010	Should be implemented as part of 2016 LTMP	Required to take into account survey error and movement variability

5.6 Snowshoe Pit

In 2014 it was recommended that monitoring points should be installed at the top of Snowshoe Pit (recommendation PP-B); however, Underhill indicated that gaining access to the top of the pit without an all-terrain vehicle would be impractical. Accessing this location on foot could take up to four hours. Furthermore, monitoring movement at the top of the pit would have limited applicability to site safety as the risk classifications associated with pit wall failure are considered minor. Consequently, only two monitoring points were established at the base of Snowshoe Pit.

The monitoring recommendation relevant to the Snowshoe Pit is presented in Table SS.



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Table SS Snowshoe Pit Monitoring Recommendations

ID	Description	Implementation	Validity
SP-A (New)	Do not establish monitoring points at the top of Snowshoe Pit	Not applicable	The top of the pit is not easily accessible and monitoring movement at these locations provides limited value
SP-B (New)	Visual inspection of the Snowshoe Pit should be completed on an annual basis with survey of the two monitoring pins at the bottom of the pit completed on a biennial basis	Inspection and establishment of the two monitoring pins completed in 2015	Valid - practice should continue



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6 Program Review

The following section contains a high-level review of the current practices used to undertake the program.

6.1 Site Inspection

Over the past two years, the site inspection has been conducted in August or September by two Professional Engineers licensed by the Association of Professional Engineers of Yukon (APEY), one specializing in hydrotechnical engineering and one specializing in geotechnical engineering (with a Professional Geologist included in 2014). It is recommended that at a minimum two Professional Engineers licensed by APEY inspect the site on an annual basis and that the inspection is conducted in August.

The site inspections comprised of a visual inspection of the site components listed in Section 1.1.1 and was conducted either by helicopter or light-duty truck.

Inspections conducted by helicopter can be completed in less than a day, with two days required to travel between Vancouver, BC and Dawson City, YT. All site components are accessible by helicopter, although the site access road can only be inspected via flyover, and the top of the pits are more easily accessible by helicopter. Helicopter flyovers also provide additional vantage points of key site components including the waste rock dump, tailings pile, and Clinton Creek channel.

Inspections conducted by light-duty truck can be completed in a day from Dawson City; however, additional travel time is required to mobilize from Dawson City to the site and from Whitehorse to Dawson City (as trucks with off-road capabilities can only be rented from Whitehorse). This could account for an additional 14 hours of travel time. All site components are accessible by truck; however, more time is required to access the tops of the pits.

Although the cost of a helicopter rental is high, it is offset by the reduced travel time and vehicle rental charges. It is recommended that future LTMP site inspections use this method of transport to facilitate more efficient site inspections including flyovers.

Prior to embarking to site, all HSE planning documents were forwarded to AAM for review. It is recommended that this practice continues and that submission of HSE planning documents is included as a deliverable in the Scope of Work to confirm they comply with AAM and site protocols.

6.2 Site Survey

Currently, Underhill is hired by the consultant that undertakes the LTMP as a subcontractor to conduct field survey services. Their scope of work includes topographic survey of selected site components (based on whether it is a large or small LTMP) and providing survey data (including a compilation of survey coordinates and an AutoCAD drawing of all survey points and features) to the consultant. This practice is effective for surveying ground features that either occupy a small footprint (e.g., drop structures) or are linear (e.g., the Clinton Creek channel). Larger more complex features (e.g., the waste rock dump) cannot be economically surveyed in their entirety and the movement of these features is typified by the movement of discrete monitoring points spread throughout the feature.



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Digital elevation models (DEMs) of the waste rock dump and tailings pile could facilitate the estimation of global soil movement vectors (i.e., the movement magnitude and direction of large blocks of soil rather than discrete points). However, DEMs are limited by the resolution (i.e., the distance between DEM points) of the technology used to survey the feature. It should be noted that the development of a DEM would not eliminate the requirement for physical survey of the drop structures, Clinton Creek channel, Wolverine Creek channel, Wolverine ponds, or Hudgeon Lake outlet.

A summary of potential survey methods (along with achievable resolution, pros, and cons) are provided in Table TT.

Table TT DEM Survey Methods

Method	Resolution / Horizontal Accuracy	Pros	Cons
Ground survey using RTK equipment	Resolution: N/A – survey consists of breaklines and spot elevations Accuracy: +/- 1 cm	<ul style="list-style-type: none"> High accuracy 	<ul style="list-style-type: none"> Labour intensive process Relies on points chosen by surveyor rather than consistent grid No orthophoto
LiDAR	Resolution: 20 cm or greater Accuracy: +/- 2.5 cm	<ul style="list-style-type: none"> Can penetrate vegetation 	<ul style="list-style-type: none"> Specialized equipment required GPS base station required at site Highest cost No orthophoto
Aerial photogrammetry (including unmanned aerial vehicle)	10 cm (high-resolution) Accuracy: +/- 10 cm	<ul style="list-style-type: none"> Lower cost than LiDAR 	<ul style="list-style-type: none"> Lighting dependent Survey of ground control points (GCPs) required (typically 100 points) Less accurate than LiDAR Cannot penetrate vegetation
Satellite photogrammetry	50 cm (based on GeoEye-1 satellite) Accuracy: +/- 30 cm	<ul style="list-style-type: none"> Automated process Low annual costs 	<ul style="list-style-type: none"> Survey of GCPs required Low resolution High up front cost Low accuracy



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Based on current technological capabilities, the available methods to develop DEMs are either not cost-effective or lack sufficient resolution and accuracy (i.e., the achievable resolution/accuracy are greater than the average annual movement rates observed). It is recommended that AAM continue to employ ground survey methods to monitor discrete points spread throughout the waste rock dump and tailings pile. AAM should consider aerial or satellite photogrammetry once these technologies have advanced to the point that they can achieve resolutions and accuracies approaching 2 cm.

The practice of engaging Underhill as a subcontractor can pose challenges to the consultant completing the LTMP. As there is no AAM staff at the site, the consultant becomes Prime Contractor while its personnel, including subcontractors, are on site and is responsible for ensuring that HSE protocols are adhered to and, as such, must maintain a representative at the site. Given that the inspection lasts one day and survey can last up to five days, there is insufficient overlap to ensure that consultant personnel is at site for the duration of the survey. It is recommended that AAM hire Underhill (or another surveyor) directly as this would eliminate as much as four days of field time by the consultant as the surveyor would become Prime Contractor and no site representative from the consultant would be required.

6.3 Site Components

It is recommended that the site components listed in Section 1.1.1 continue to be inspected on an annual basis. No additional site components were identified that require ongoing inspection. On a biennial basis, starting in 2016, the following site components should be surveyed as part of the large LTMP survey:

- Closed portion of access road adjacent to Clinton Creek (including baseline, cracks, and edge of embankment);
- Hudgeon Lake outlet (including boom abutments, rock armouring, and cross-sections);
- Drop structures (including monitoring points and cross-sections);
- Clinton Creek channel (including alignment and profile between Hudgeon Lake outlet and confluence with Wolverine Creek channel as well as cross-sections A through F);
- Clinton Creek waste rock dump monitoring points;
- Wolverine Creek channel (including alignment and profile between Wolverine ponds and confluence with Clinton Creek channel as well as cross-sections G through L);
- Wolverine Creek tailings pile monitoring points; and
- Snowshoe Pit monitoring points.

On a biennial basis starting in 2017, the following site components should be surveyed as part of the small LTMP survey:

- Closed portion of access road adjacent to Clinton Creek (including baseline, cracks, and edge of embankment);
- Drop structures (including monitoring points and cross-sections); and
- Clinton Creek channel (including alignment and profile from Hudgeon Lake outlet to 100 m downstream of Ford Crossing No. 1).



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2015 Survey Results

7 Conclusions and Recommendations

7.1 Conclusions

The conclusions presented in the following sections are based on observations made during the site inspection and results of the analyses of the survey data.

7.1.1 Clinton Creek Access Road

The closed portion of the Clinton Creek access road continues to move north due to the movement of the waste rock while the embankment adjacent to the road is failing due to slope instability caused by erosion at the slope toe. This portion of the access road should be regularly inspected for signs of increased tension cracking and surveyed on an annual basis to monitor the stability of the slope (based on loss of embankment material) and the movement of the baseline.

The 16 m portion of the embankment at which the maximum horizontal offset south of 2.1 m was observed between 2012 and 2014 expanded laterally (i.e., parallel to the baseline) to a length of 25 m (refer to Figure 1003, Appendix 1). Although the top of the embankment slope adjacent to the closed portion of the access road continues to fail into Clinton Creek, none of the four triggers associated with the closed portion of the access road were triggered in 2015.

7.1.2 Gabion Drop Structures

Repairs to DS4 were completed in 2015 consisting primarily of the regrading of the channel to a shallower slope and the installation of an articulated concrete revetment mat to armour the channel. Minor repairs to DS1, DS2, and DS3 were completed concurrently, including the removal of vegetation, replacement of gabion mesh, replenishment of gabion rock, and the placement of additional mesh.

Increased horizontal movement rates were observed at DS2 and DS3; however, this may be a result of the construction activity completed at DS4 in 2015. No triggers associated with the drop structures were exceeded in 2015. All drop structures should continue to be inspected and surveyed on an annual basis.

7.1.3 Clinton Creek Channel

Downcutting of the Clinton Creek channel decreased between the periods of August 2012 to September 2014 and September 2014 to September 2015, while deposition was observed to have increased significantly, particularly downstream of the drop structure transition zone (Sta. 0+200 to Sta. 0+420). No triggers associated with the Clinton Creek channel were exceeded in 2015.

The channel should continue to be inspected on an annual basis between the Hudgeon Lake Outlet and confluence with Wolverine Creek. The channel profile and centreline should continue to be surveyed annually from the Hudgeon Lake outlet and just downstream of Ford Crossing No. 1, with survey extending to the confluence with Wolverine Creek on a biennial basis. Cross-sections of the channel at pre-determined locations should continue to be surveyed on a biennial basis.



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7.1.4 Clinton Creek Waste Rock Dump

Average horizontal movement rates observed through the waste rock dump upper slope increased by 36% between the periods 2012-2014 and 2014-2015, resulting in trigger WR-1 being exceeded. While an increase of 30% is the threshold for undertaking a geotechnical investigation, the rate of increase of 1.1 cm/y is less than the ±1.4 cm average horizontal precision reported for the waste rock dump upper slope monitoring points and the variability of the data set was significant (refer to Section 5.4.6). Also, Figure H and Figure K show substantial variation in the movement rates. Therefore, the acceleration is not considered significant, and it is not recommended that a geotechnical investigation is undertaken in 2016. The waste rock upper slope monitoring points should be surveyed as planned in 2016.

The waste rock dump should continue to be inspected on an annual basis and surveyed on a biennial basis. The use of satellite photogrammetry should be considered for future LTMP surveys as it would permit the collection of movement measurements across the entire waste rock dump rather than at discrete locations (refer to Section 5.4.7). Alternatively, the waste rock dump should continue to be surveyed using remote GPS receivers on a biennial basis.

7.1.5 Wolverine Creek Tailings Pile

Average horizontal movement rates observed through the tailings pile north lobe, upper slope decreased by 6% between the periods 2012–2014 and 2014–2015. The trigger associated with the tailings pile was not exceeded in 2015.

The tailings pile should continue to be inspected on an annual basis. The use of satellite photogrammetry should be considered for future LTMP surveys as it would permit the collection of movement measurements across the entirety of the tailings pile rather than at discrete locations. Alternatively, the tailings pile should continue to be surveyed using remote GPS receivers on a biennial basis.

7.2 Recommendations

Recommendations included in the site observations summary (Section 2.2) are compiled in Table UU.

Table UU Compilation of Site Observation Recommendations

ID	Description	Result
SO-1	At DS-1 Minor vegetation (e.g., grasses and tree saplings) observed above water line and large piece of woody debris located at the drawdown weir	Tree saplings and debris were removed by Sidhu
SO-2	At DS-2 Minor vegetation observed above water line	Tree saplings was removed by Sidhu
SO-3	At DS-3 Minor vegetation observed above water line	Tree saplings was removed by Sidhu
SO-4	At DS-4 Minor vegetation observed above water line	Tree saplings was removed by Sidhu
SO-5	Perched boulder observed above access road northeast of Porcupine Pit	As public access to this location is restricted, removal of the boulder is not recommended at this time
SO-6	Wolverine Creek culverts at confluence with Clinton Creek were slightly obstructed by debris	Debris removed by Sidhu



Government of Yukon Energy, Mines and Resources – Assessment and Abandoned Mines Clinton Creek Long-Term Monitoring Program

2015 Survey Results

The new monitoring recommendations included in this report are compiled in Table VV.

Table VV Compilation of New Monitoring Recommendations

ID	Description	Rationale
AR-E	Re-survey depth gauge at Ford Crossing No. 1 as part of 2016 LTMP to re-establish elevation	Required to determine whether ford crossing can be safely used based on water depth
DS-H	Re-establish drop structure Monitoring Point Nos. 1,461 to 1,465.	Required to monitor movement at DS3 and DS4
DS-I	Change DS-3 trigger value to a change of drop structure width greater than 1.0 m	DS-2 downstream at trigger threshold and appears to be in stable condition
CC-H	The upper creek (Sta. 0+200 to Sta. 0+680) and mid-creek (Sta. 0+680 to Sta. 0+913) portions of the channel should be surveyed annually, with the lower creek (Sta. 0+913 to confluence with Wolverine Creek) portion of the channel surveyed on a biennial basis	Lower creek is stable compared to upper and mid-creek portions of channel and does not require annual survey
WR-D	Satellite photogrammetry could be used to measure movement rates through the waste rock dump	Improve the coverage of movement measurements
WR-E	Excluded monitoring point BH-4 Cable from future LTMPs	BH-4 Cable cannot be surveyed consistently as it is not considered to be stable (i.e., it consists of a flexible cable rather than a piece of rebar driven into the ground)
WR-F	Change WR-1 trigger value to: movement rate (cm/y) > movement rate from previous monitoring cycle plus standard deviation of all movement rates between 2003 and current year, exclusive of July to September 2010	Required to take into account survey error and movement variability
TP-E	Satellite photogrammetry could be used to measure movement rates through the tailings pile	Improve the coverage of movement measurements
TP-F	Change TP-1 trigger value to: movement rate (cm/y) > movement rate from previous monitoring cycle plus standard deviation of all movement rates between 2003 and current year, exclusive of July to September 2010	Required to take into account survey error and movement variability
SP-A	Do not establish monitoring points at the top of Snowshoe Pit	The top of the pit is not easily accessible and monitoring movement at these locations provides limited value
SP-B	Visual inspection of the Snowshoe Pit should be completed on an annual basis with survey of the two monitoring pins at the bottom of the pit completed on a biennial basis	Inspection and establishment of the two monitoring pins completed in 2015



**Government of Yukon Energy, Mines and Resources – Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program**

2015 Survey Results

8 References

R21 UMA Engineering (2003). Environmental Liability Report.

R22 UMA Engineering (2006). Long-Term Performance Monitoring Results 2005.

R51 AECOM (2011). Long-Term Performance Monitoring 2010.

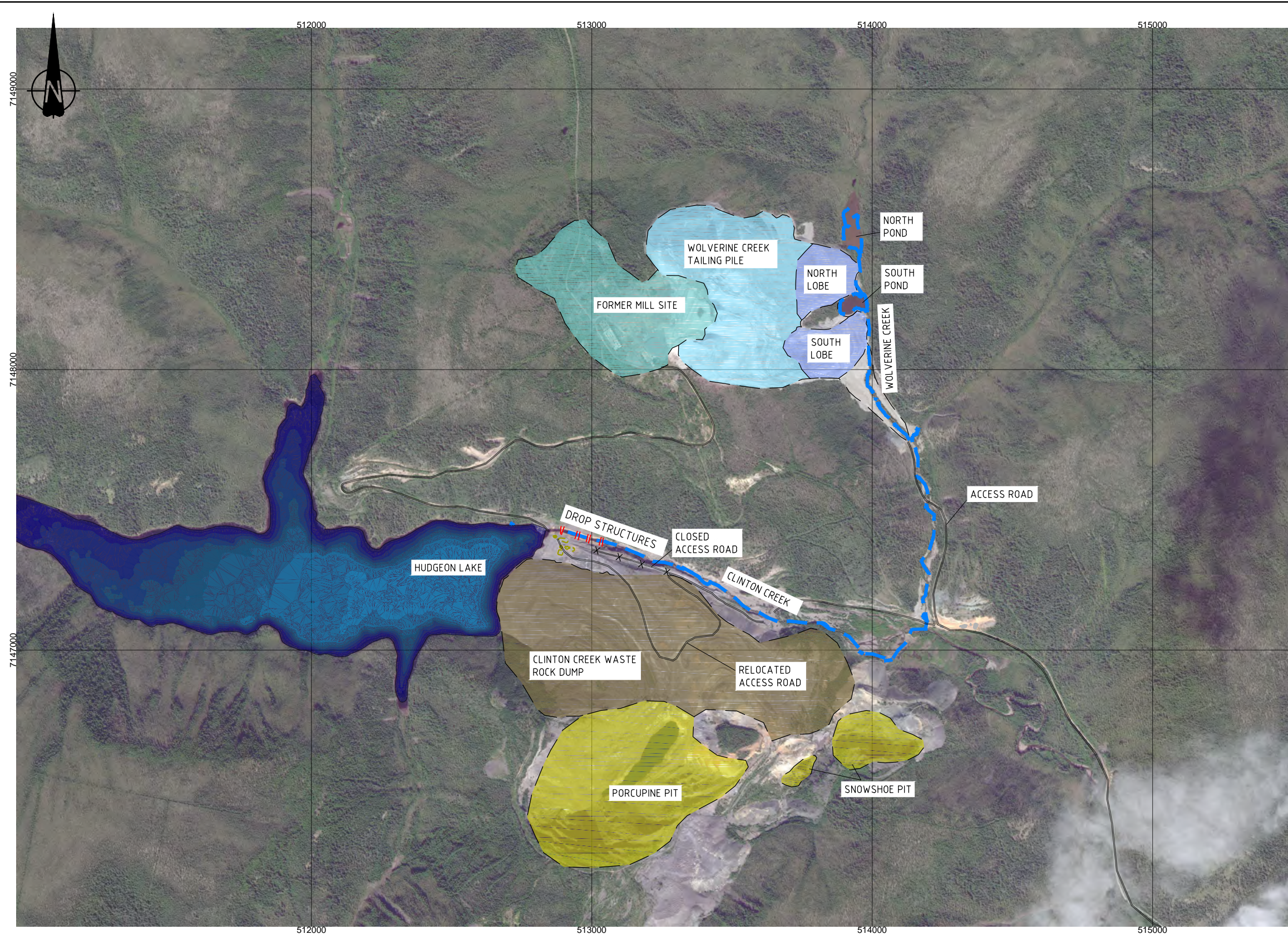
R94 AECOM (2011). Emergency Drop Structure Repairs Construction Activity Report 2011.

R104 Associated Engineering (2013). Long Term Performance Monitoring 2012.

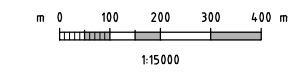
WorleyParsons (2014). Clinton Creek Long-Term Monitoring Program - 2014 Survey Results.

Appendix 1

Figures



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- LEGEND**
- FORMER MILL SITE
 - WOLVERINE CREEK TAILING PILE
 - NORTH AND SOUTH LOBE - TAILINGS PILE
 - CLINTON CREEK WASTE ROCK DUMP
 - PORCUPINE AND SNOWSHOE PIT DUMP AND WASTE ROCK DUMPS
 - HUDGEON LAKE

NOTES:
1. DIMENSIONS AND ELEVATIONS ARE IN METRES.

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	Oneway		
WORLEYPARSONS PROJECT No		307071-01056	

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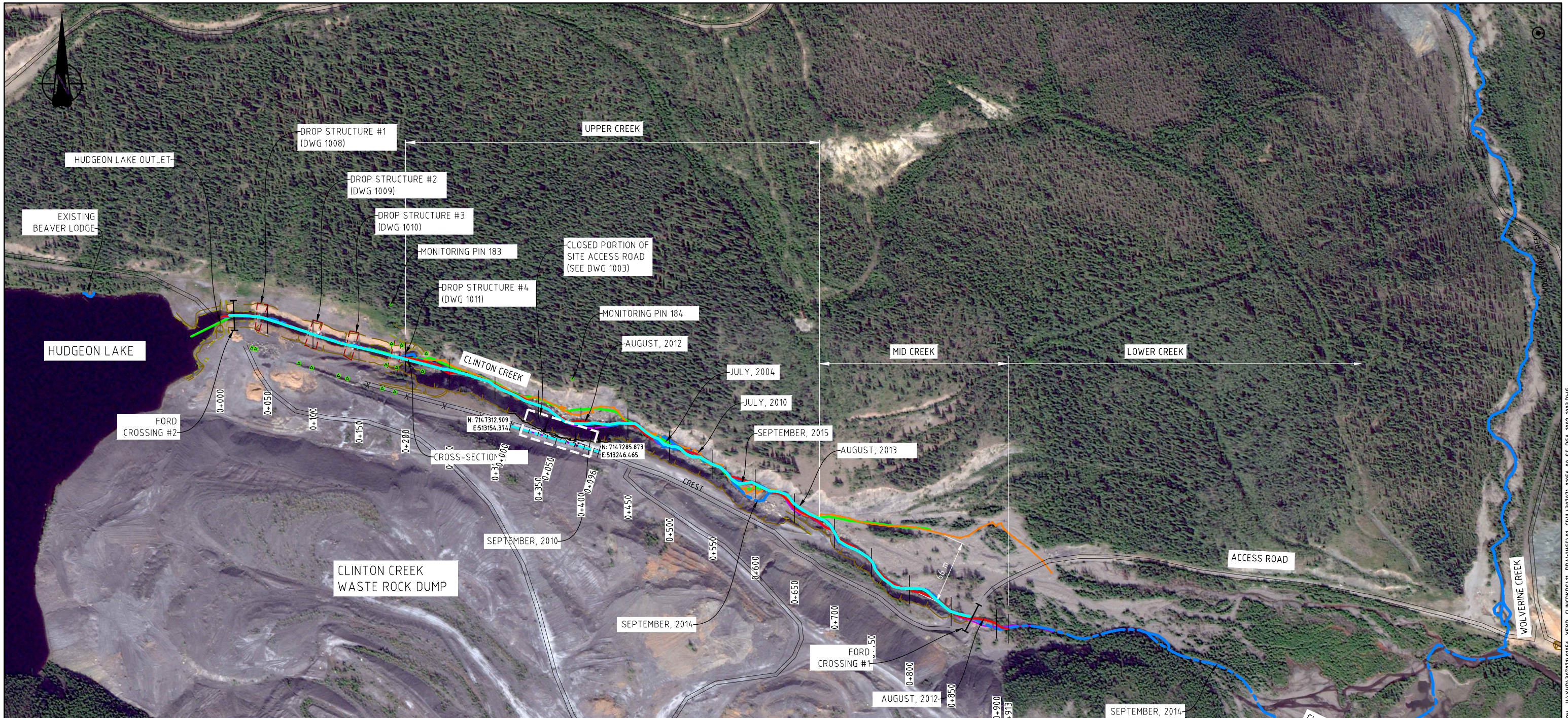
Yukon
Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

WorleyParsons
RESOURCES IN MOTION

CLINTON CREEK SITE
LONG TERM MONITORING PROGRAM (2015)
OVERALL SITE PLAN

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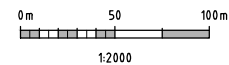
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 SAVE DATE & TIME: 10/11/2015 12:53:18 PM



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- CREEK CENTERLINE JULY 2010
- 2015 SURVEYED TOP OF CREEK EMBANKMENT
- + MONITORING PIN
- RECOMMENDED FUTURE MONITORING POINTS
- CREEK CENTERLINE SEPTEMBER 2015
- CREEK CENTERLINE SEPTEMBER 2014
- CREEK CENTERLINE AUGUST 2012
- CREEK CENTERLINE SEPTEMBER 2010
- ACCESS ROAD
- CLOSED ACCESS ROAD

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NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. STATIONING IS BASED ON 2012 CREEK CENTERLINE.
3. OFFSETS ARE SHOWN RELATIVE TO 2014 AND 2004 CENTER LINES.

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ENGINEERING AND PERMIT STAMPS (As Required)

Oneway

WORLEYPARSONS PROJECT No
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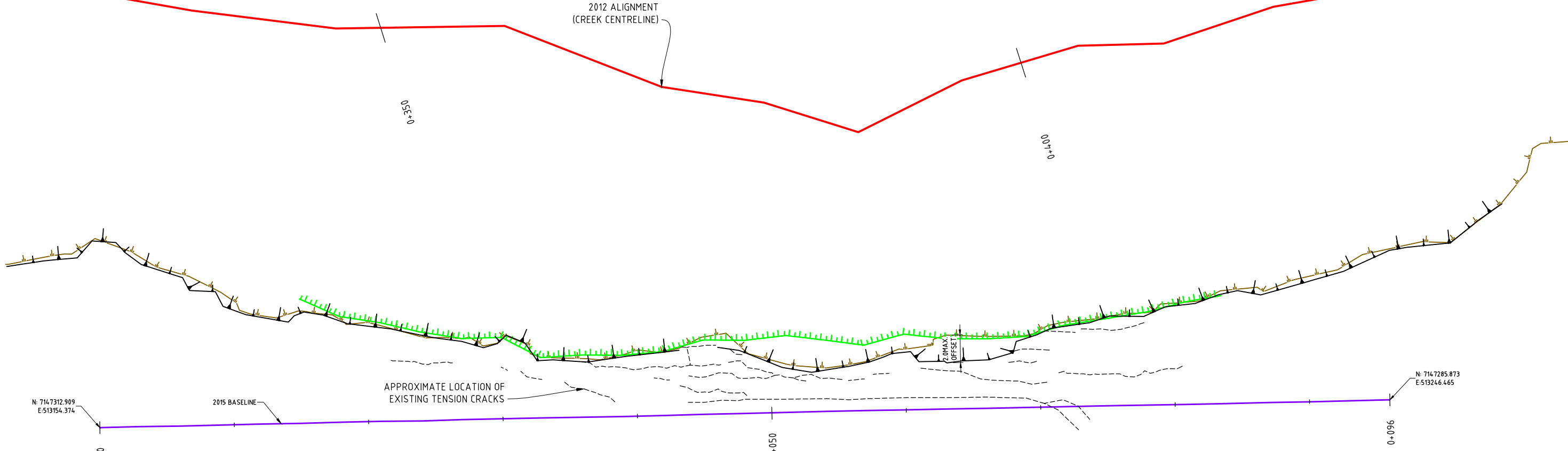
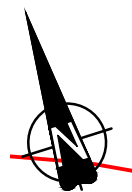
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RESOURCES IN MOTION

CLINTON CREEK SITE
LONG TERM MONITORING PROGRAM (2015)
CLINTON CREEK PLAN

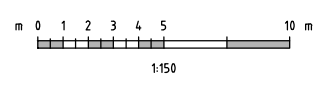
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2015 TENSION CRACKS PLAN
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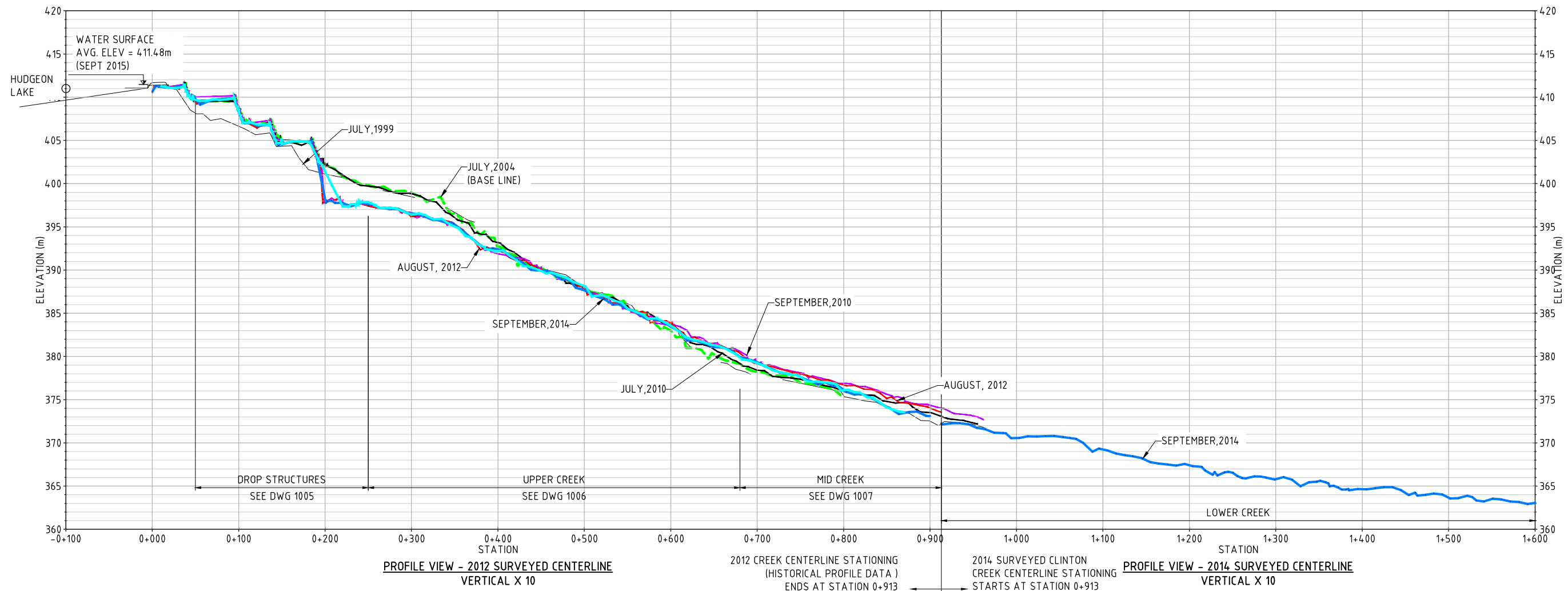
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- 2015 TENSION CRACKS
 - 2015 TOP OF BANK
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 - 2012 TOP OF BANK

- NOTES:**
1. DIMENSIONS AND ELEVATIONS ARE IN METRES.

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			<p>WORLEYPARSONS PROJECT No 307071-01056</p>	<p>DRG No 307071-01056-00-SS-DGA-1003</p>	<p>REV 0</p>

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PROFILE VIEW - 2012 SURVEYED CENTERLINE VERTICAL X 10
 2012 CREEK CENTERLINE STATIONING (HISTORICAL PROFILE DATA) ENDS AT STATION 0+913
 2014 SURVEYED CLINTON CREEK CENTERLINE STATIONING STARTS AT STATION 0+913
 PROFILE VIEW - 2014 SURVEYED CENTERLINE VERTICAL X 10

LEGEND

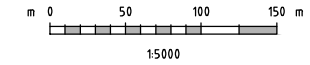
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	PROFILE JULY 2010
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	PROFILE SEPTEMBER 2014
	PROFILE SEPTEMBER 2015

- NOTES:**
- DIMENSIONS AND ELEVATIONS ARE IN METRES.
 - STATIONING BETWEEN STA. -0+150 TO SA 0+913 IS BASED ON 2012 REFERENCE LINE.
 - PROFILES OF THE CHANNEL FROM MONITORING SURVEYS COMPLETED IN 1983, 1984, 2001, 2006, 2007, 2008, AND 2011 ARE NOT SHOWN FOR THE SAKE OF CLARITY.

STATION	NORTHING	EASTING
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0+750	7,147,204	513,613

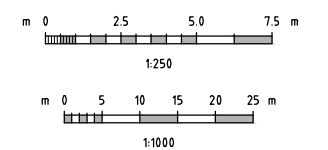
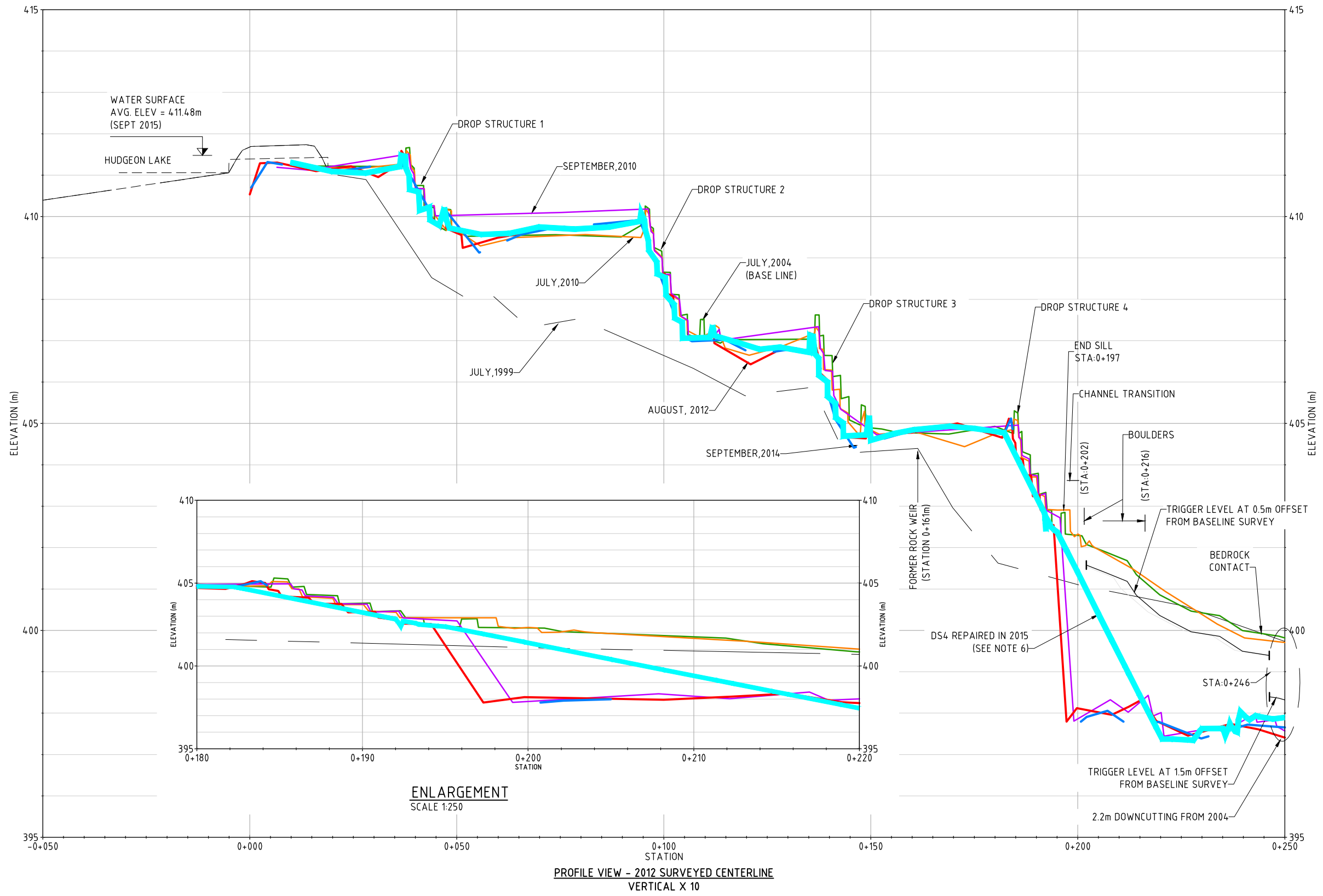
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												 Department of Energy, Mines and Resources Assessment and Abandoned Mines		DRG No	307071-01056-00-SS-DGA-1004	REV		
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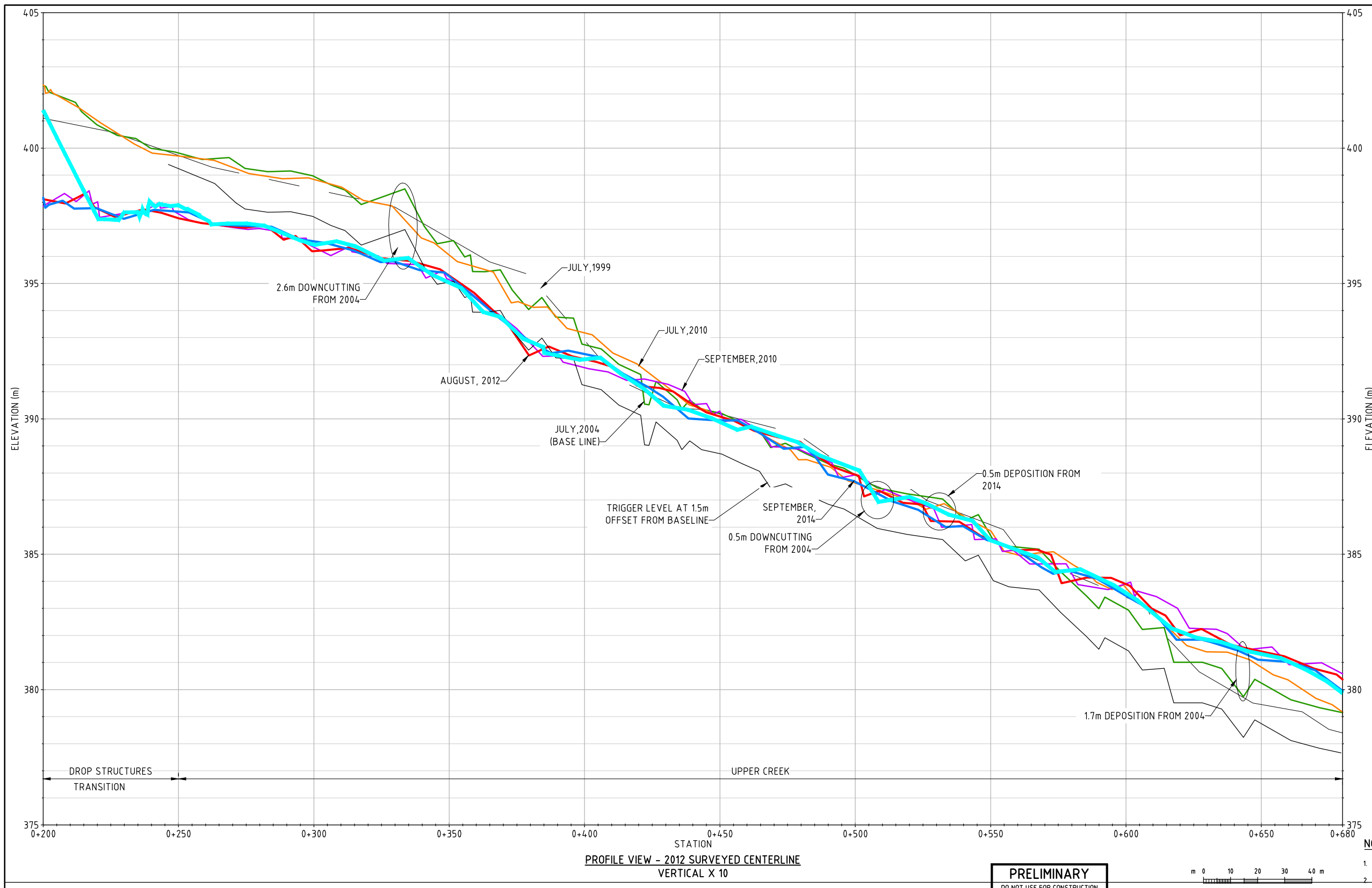
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	PROFILE SEPTEMBER 2015

- NOTES:**
- DIMENSIONS AND ELEVATIONS ARE IN METRES.
 - STATIONING IS BASED ON 2012 CREEK CENTER LINE WITH THE START OF THE CENTERLINE AT STATION 0+000.
 - PROFILES OF THE CHANNEL FROM MONITORING SURVEYS COMPLETED IN 1983, 1984, 2001, 2006, 2007, 2008, AND 2011 ARE NOT SHOWN FOR THE SAKE OF CLARIFY.
 - DOWNCUTTING / DEPOSITION LABELS ARE SHOWN RELATIVE TO THE 2004 PROFILE.
 - THE CHANNEL SECTION BETWEEN STA 0+190 AND 0+201 COULD NOT BE SURVEYED IN 2014 AS IT COULD NOT BE SAFELY ACCESSED.
 - REPAIRS TO DROP STRUCTURE 4, INCLUDING THE INSTALLATION OF AN ARTICULATED CONCRETE BLOCK DROP CHUTE, ALTERED THE CHANNEL PROFILE.

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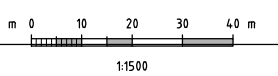


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Green line	PROFILE 2004 (BASELINE FOR LONG TERM MONITORING)
Orange line	PROFILE JULY 2010
Purple line	PROFILE SEPTEMBER 2010
Red line	PROFILE AUGUST 2012
Blue line	PROFILE SEPTEMBER 2014
Cyan line	PROFILE SEPTEMBER 2015

- NOTES:**
- DIMENSIONS AND ELEVATIONS ARE IN METRES.
 - STATIONING IS BASED ON 2012 CREEK CENTER LINE.
 - PROFILES OF THE CHANNEL FROM MONITORING SURVEYS COMPLETED IN 1983, 1984, 2001, 2006, 2007, 2008, AND 2011 ARE NOT SHOWN FOR THE SAKE OF CLARIFY.

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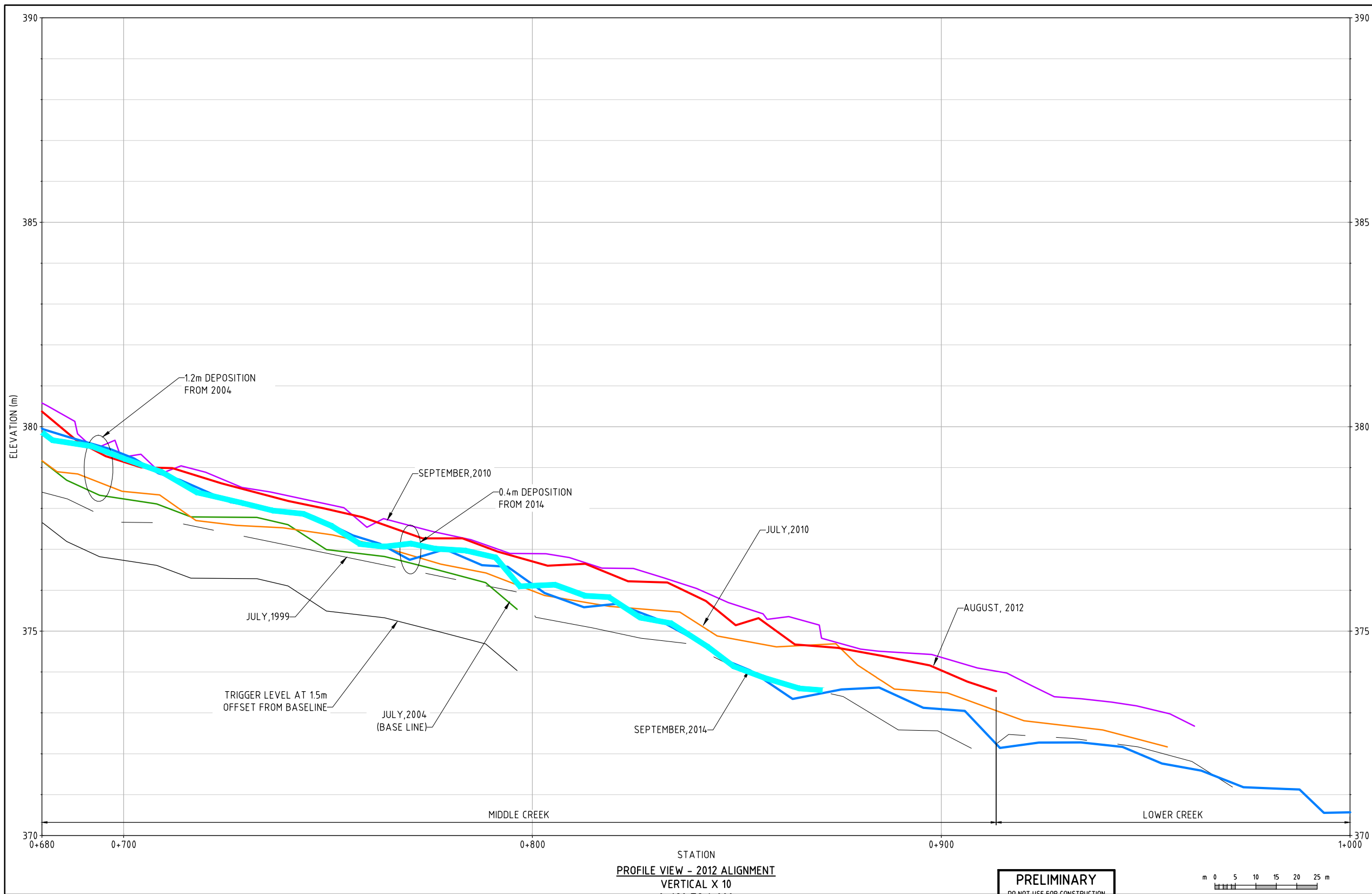
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CLINTON CREEK SITE
LONG TERM MONITORING PROGRAM (2015)
CLINTON CREEK CENTERLINE PROFILE
STA 0+200 TO STA 0+680

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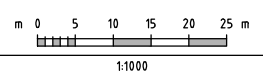


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	PROFILE AUGUST 2012
	PROFILE SEPTEMBER 2014
	PROFILE SEPTEMBER 2015

- NOTES:**
- DIMENSIONS AND ELEVATIONS ARE IN METRES.
 - STATIONING IS BASED ON 2012 CREEK CENTER LINE.
 - PROFILES OF THE CHANNEL FROM MONITORING SURVEYS COMPLETED IN 1983, 1984, 2001, 2006, 2007, 2008, AND 2011 ARE NOT SHOWN FOR THE SAKE OF CLARIFY.

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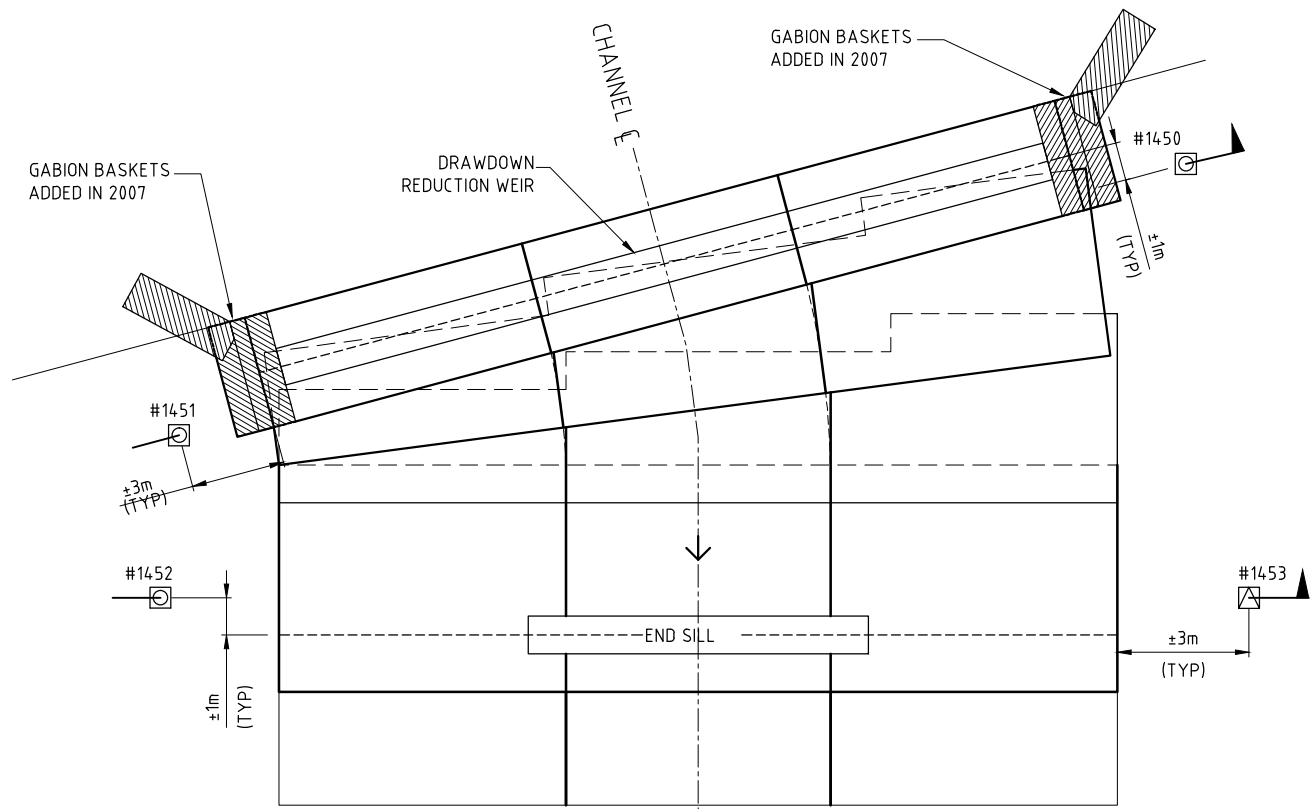
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WORLEYPARSONS PROJECT No
307071-01056

ENGINEERING AND PERMIT STAMPS (As Required)

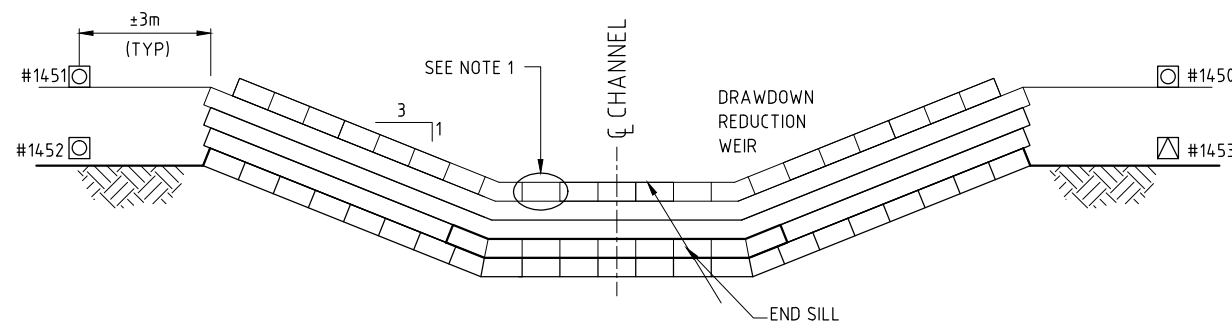
CUSTOMER
Yukon
Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines
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WorleyParsons
CLINTON CREEK SITE
LONG TERM MONITORING PROGRAM (2015)
CLINTON CREEK CENTERLINE PROFILE
STA 0+680 TO STA 0+1000
DRG No 307071-01056-00-SS-DGA-1007 REV 0

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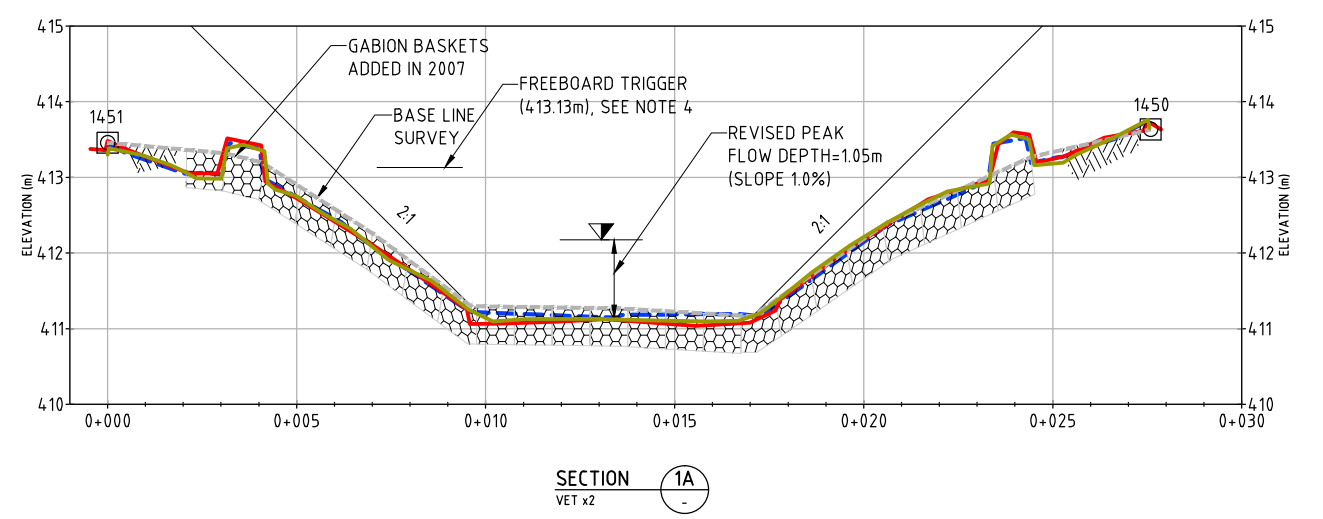
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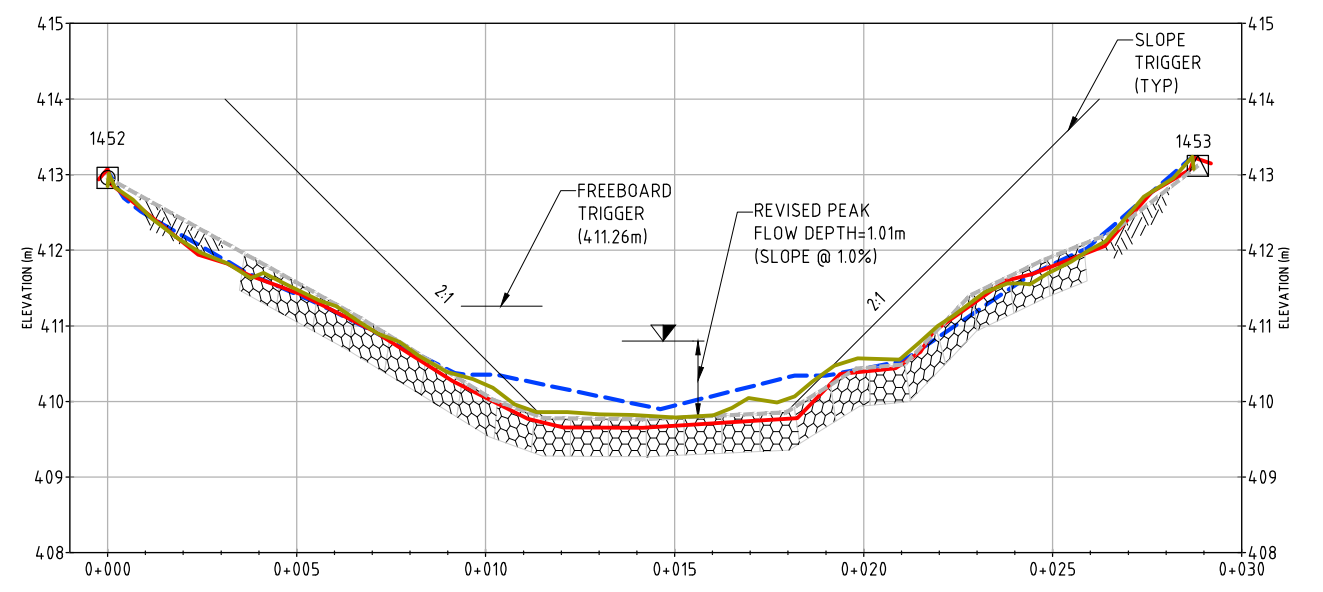
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SCALE: 1:200

- CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN) INSTALLED DURING 2006 SURVEY.
- CHANNEL CLOSURE MOVEMENT MONITOR INSTALLED IN 2012 (TYP.)

- NOTE 1: GABION FILL REMOVED FROM THIS CELL OF THE DRAWDOWN WEIR IN 2007 TO FACILITATE DRAWING DOWN HUDGON LAKE WATER LEVEL DURING LOW FLOW PERIODS.
- NOTE 2: REFER TO AECOM'S "FORMER CLINTON CREEK ASBESTOS MINE - EMERGENCY DROP STRUCTURE REPAIRS, CONSTRUCTION ACTIVITY REPORT, 2011" R94 FOR 2011 REPAIR DETAILS.
- NOTE 3: FREE BOARD TRIGGER SHOWN AT 300mm BELOW GABION BASKETS (REFER 2014 RECOMMENDATION DS-F).
- NOTE 4: FREEBOARD TRIGGER MEASURED FROM TOP OF BASKETS ADDED IN 2007.

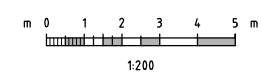


SECTION 1A
VERT x2



SECTION 1B
VERT x2

PRELIMINARY
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Last Saved: Nov. 10/15 12:43pm



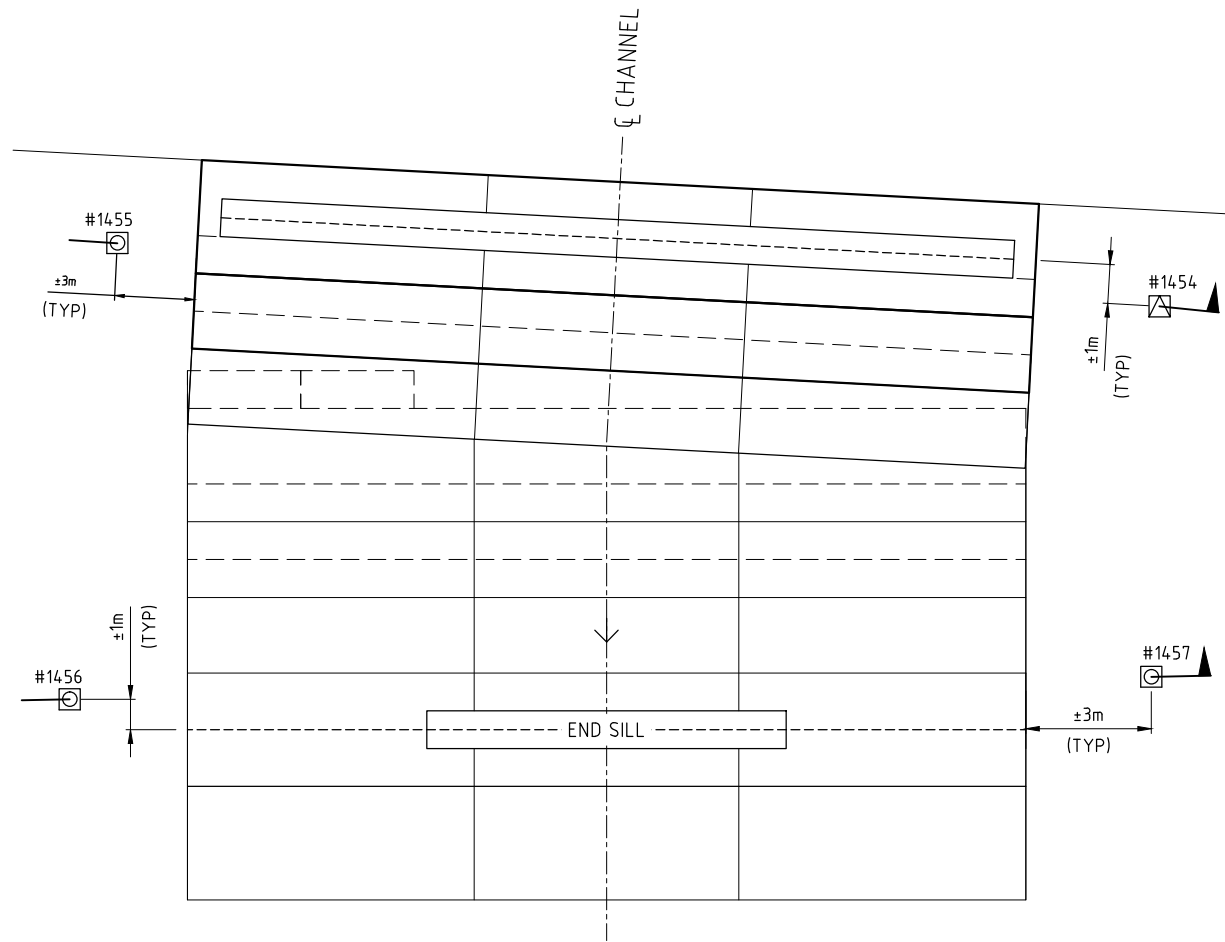
- LEGEND**
- BASELINE SURVEY (2006)
 - SURVEY (AUGUST 2012)
 - SURVEY (SEPTEMBER 2014)
 - SURVEY (AUGUST 2015)

- NOTES:**
- DIMENSIONS AND ELEVATIONS ARE IN METRES.

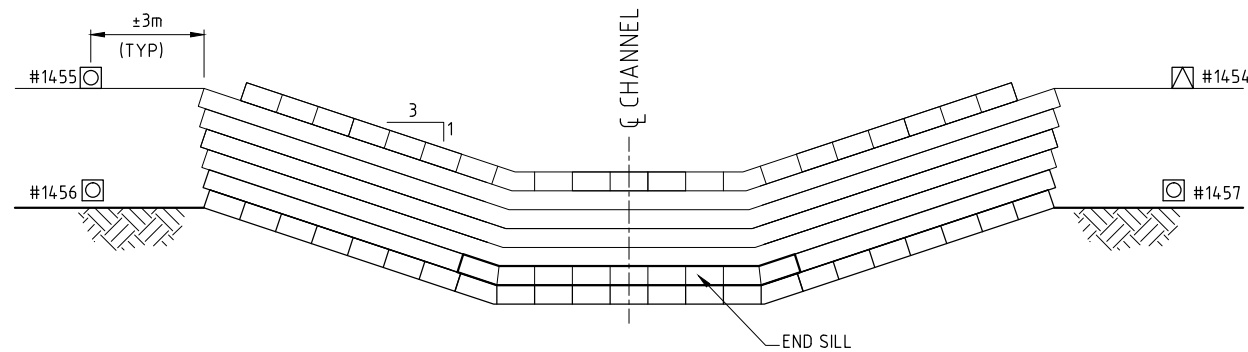
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A	10-NOV-15	ISSUED FOR CLIENT REVIEW	AAL	-	JSG	AJT	LRM	-		

D SHEET	SCALE	AS SHOWN	ENGINEERING AND PERMIT STAMPS (As Required)	CUSTOMER
				 Department of Energy, Mines and Resources Assessment and Abandoned Mines
WORLEYPARSONS PROJECT No			307071-01056	 CLINTON CREEK SITE LONG TERM MONITORING PROGRAM (2015) 2014 - DROP STRUCTURE #1 MONITORING SECTIONS
DRG No	307071-01056-00-SS-DGA-1008			REV 0

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 USER NAME: jake.gentiles
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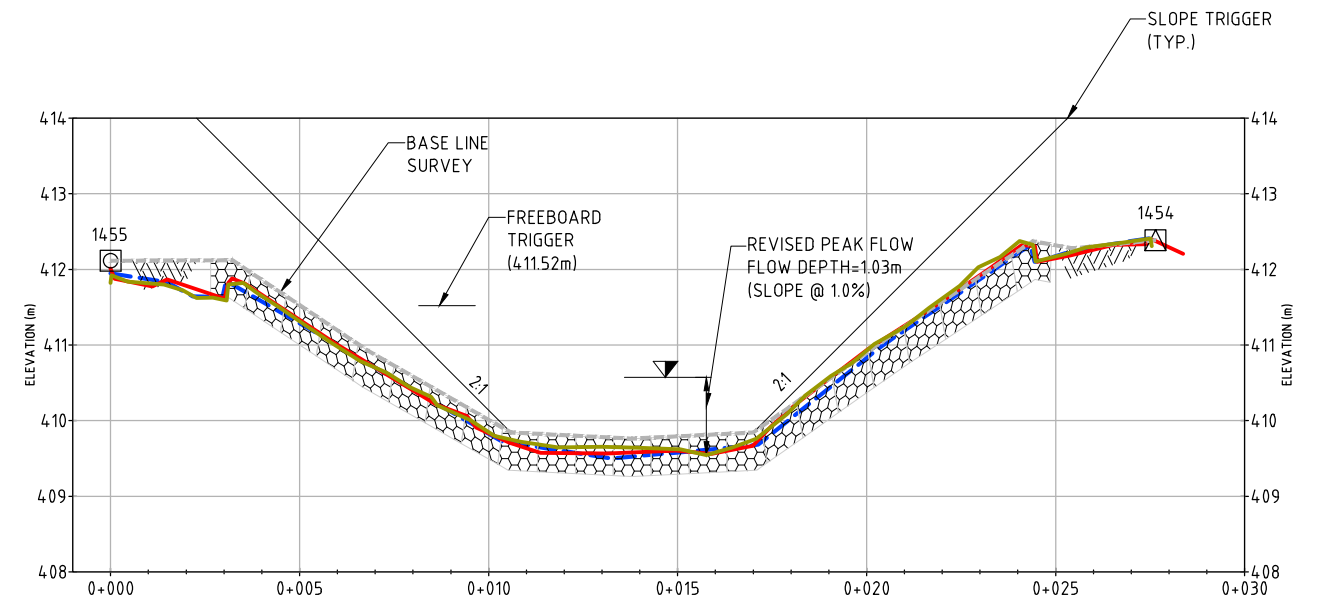
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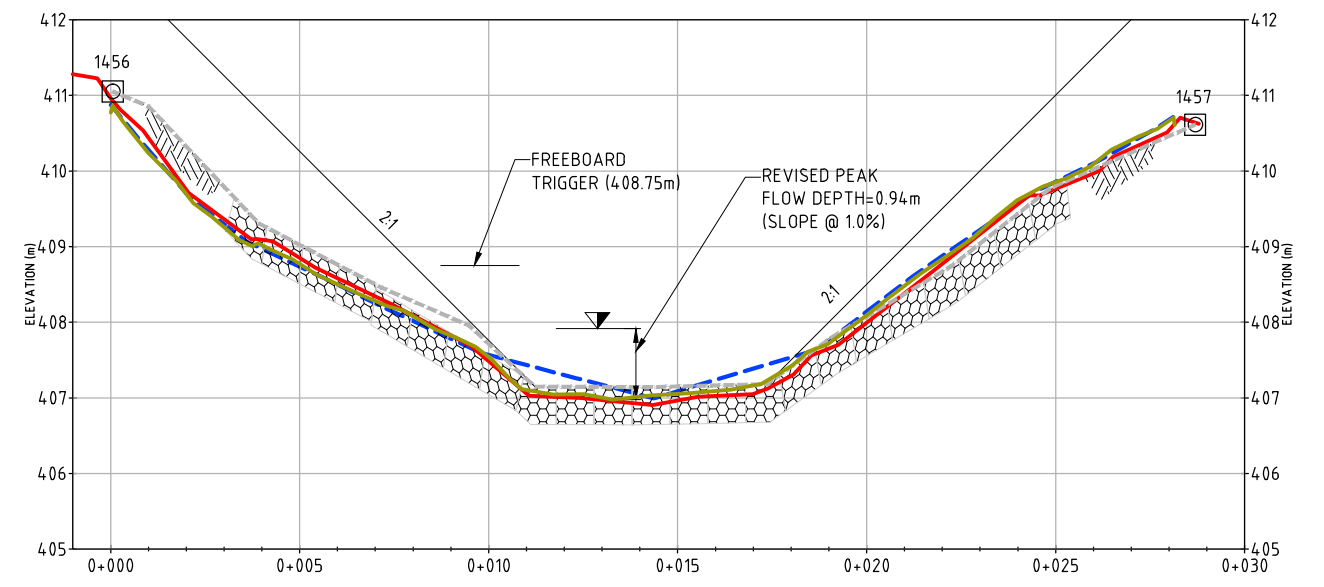
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SCALE: 1:200

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NOTE 2: FREE BOARD TRIGGER SHOWN AT 300mm BELOW GABION BASKETS (REFER 2014 RECOMMENDATION DS-F).

- ☒ CHANNEL CLOSURE MOVEMENT MONITOR INSTALLED IN 2012 (TYP.)
- ☒ CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN) INSTALLED DURING 2006 SURVEY.

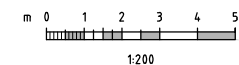


SECTION 2A
VERT x2



SECTION 2B
VERT x2

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Nov. 10/15 12:43pm



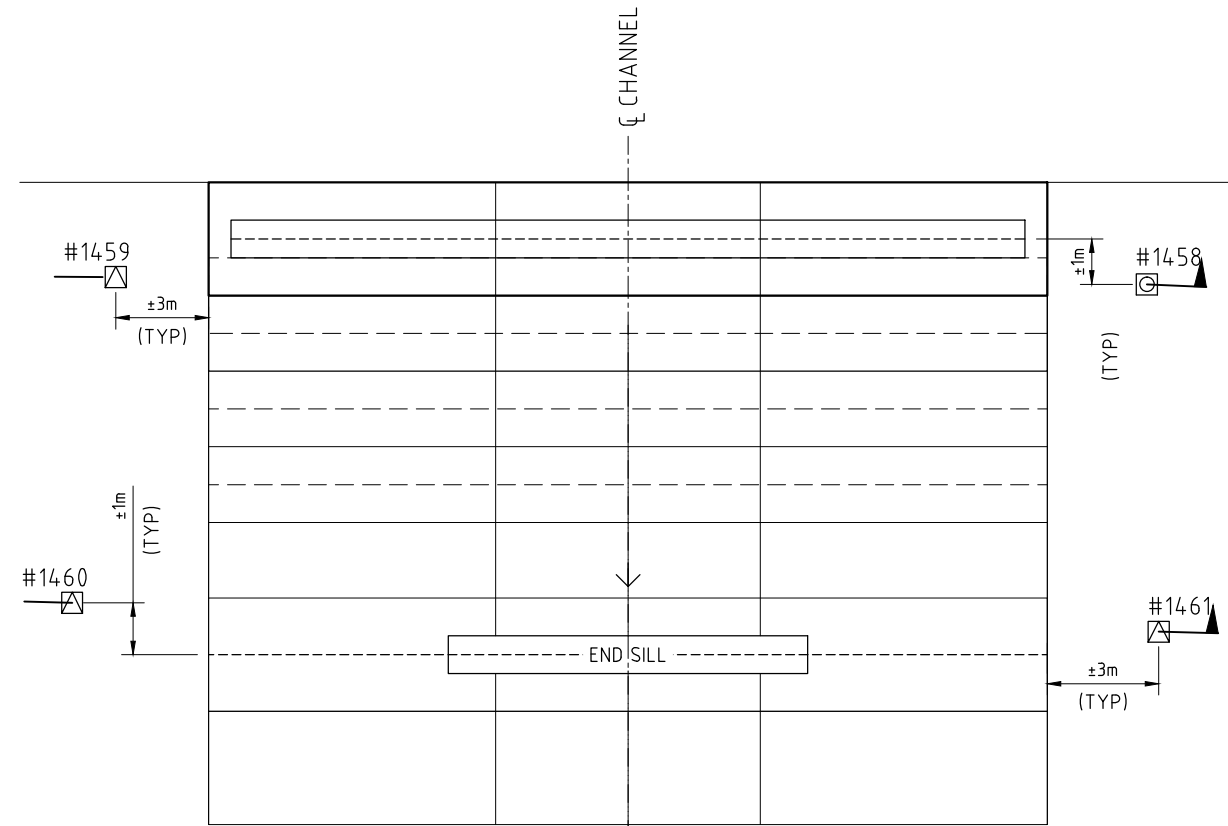
- LEGEND**
- BASELINE SURVEY (2006)
 - SURVEY (AUGUST 2012)
 - SURVEY (SEPTEMBER 2014)
 - SURVEY (AUGUST 2015)

NOTES:

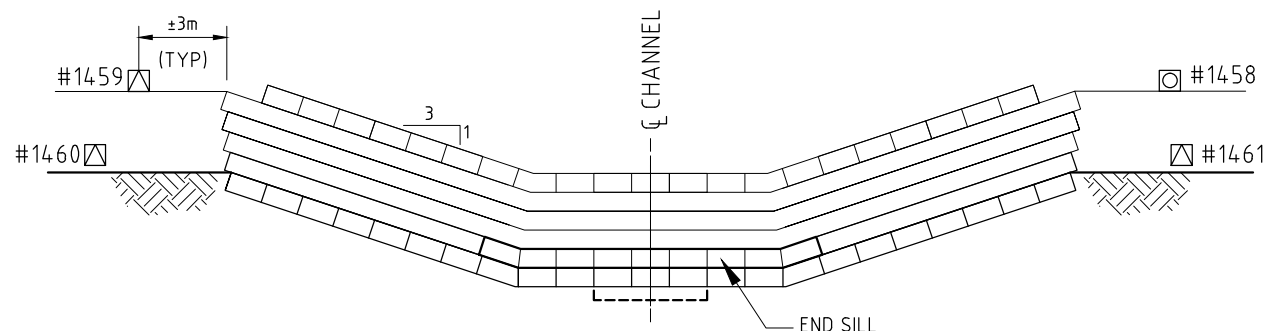
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D SHEET	SCALE	AS SHOWN	ENGINEERING AND PERMIT STAMPS (As Required)	CUSTOMER
			Oneway	Yukon Government Department of Energy, Mines and Resources Assessment and Abandoned Mines
WORLEYPARSONS PROJECT No			CLINTON CREEK SITE LONG TERM MONITORING PROGRAM (2015) 2014 - DROP STRUCTURE #2	
307071-01056			DRG No	REV
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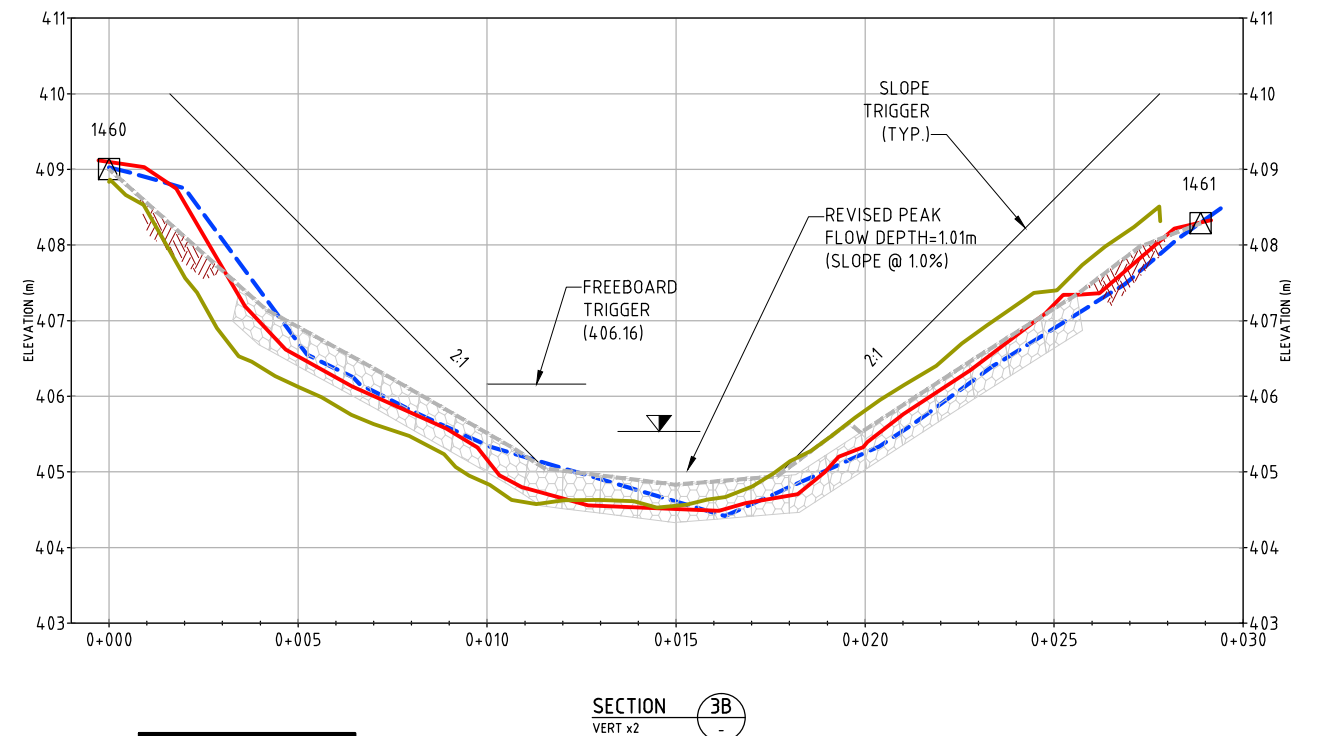
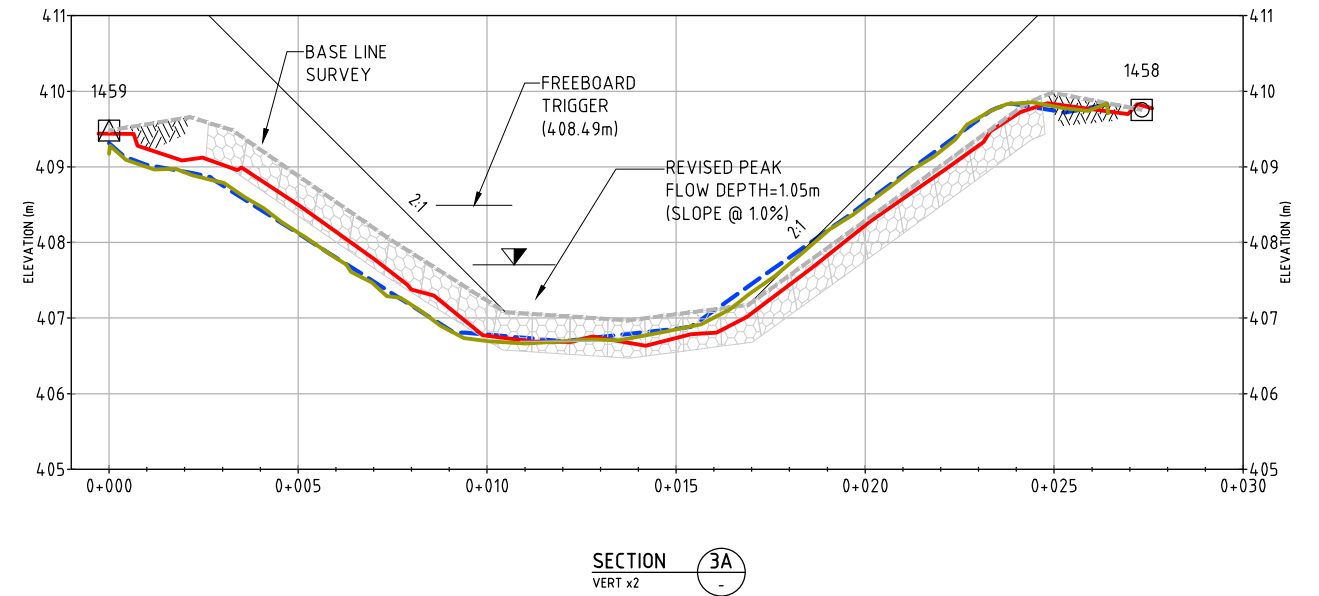
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SCALE: 1:200



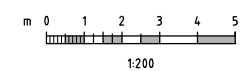
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SCALE: 1:200

NOTE 1: REFER TO AECOM'S "FORMER CLINTON CREEK ASBESTOS MINE - EMERGENCY DROP STRUCTURE REPAIRS, CONSTRUCTION ACTIVITY REPORT, 2011" FOR 2011 REPAIR DETAILS.
NOTE 2: FREE BOARD TRIGGER SHOWN AT 300mm BELOW GABION BASKETS (REFER 2014 RECOMMENDATION DS-F).
NOTE 3: MONITORING POINT NO. 1460 RE-ESTABLISHED IN 2015.

- ☒ CHANNEL CLOSURE MOVEMENT MONITOR INSTALLED IN 2012 (TYP.)
- ☐ CHANNEL CLOSURE MOVEMENT MONITOR (19mm Ø STEEL PIN) INSTALLED DURING 2006 SURVEY.



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LEGEND

- BASELINE SURVEY (2006)
- SURVEY (AUGUST 2012)
- SURVEY (SEPTEMBER 2014)
- SURVEY (AUGUST 2015)

NOTES:

- 1. DIMENSIONS AND ELEVATIONS ARE IN METRES.

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
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WORLEYPARSONS PROJECT No			
307071-01056			

CUSTOMER

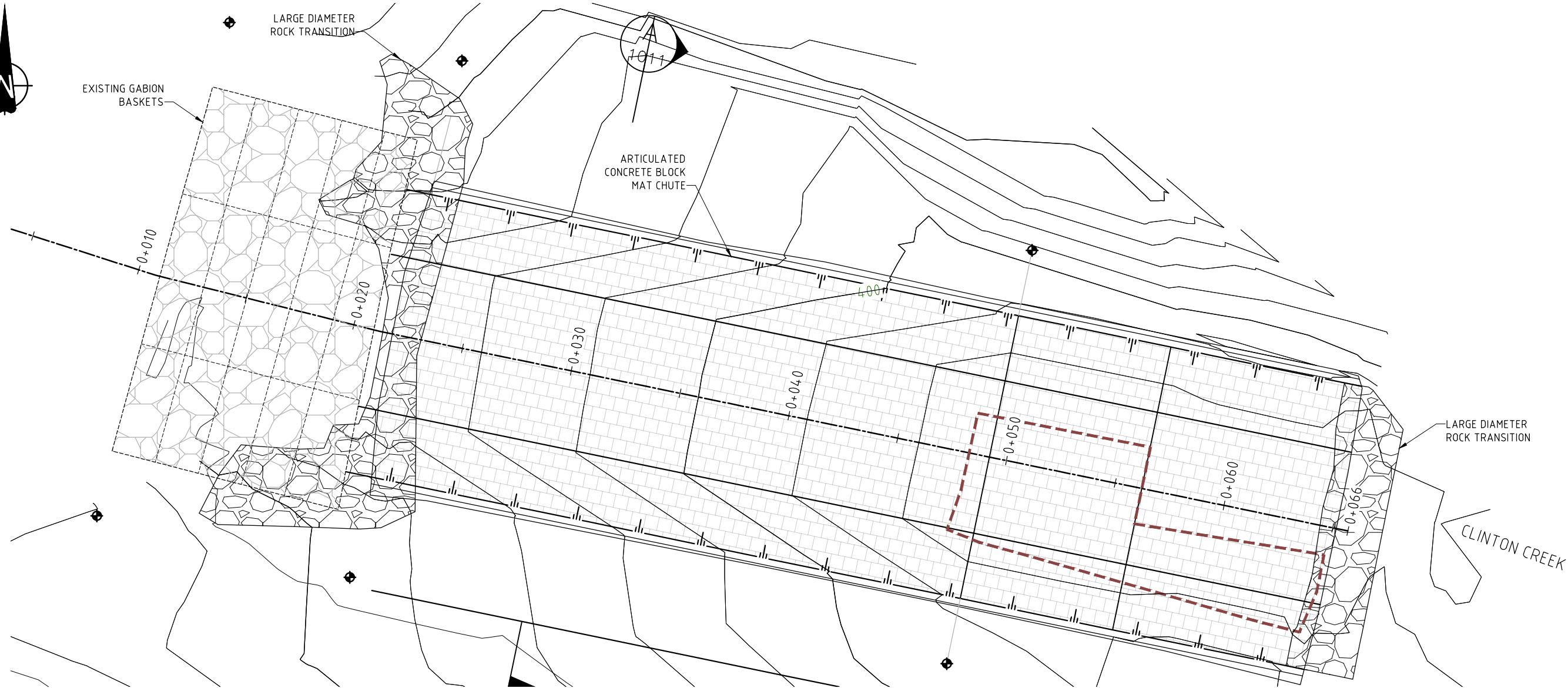
Government
Department of Energy, Mines and Resources
Assessment and Abandoned Mines

"This drawing is prepared for the use of the contractual customer of WorleyParsons Canada Services Ltd. and WorleyParsons Canada Services Ltd. assumes no liability to any other party for any representations contained in this drawing."

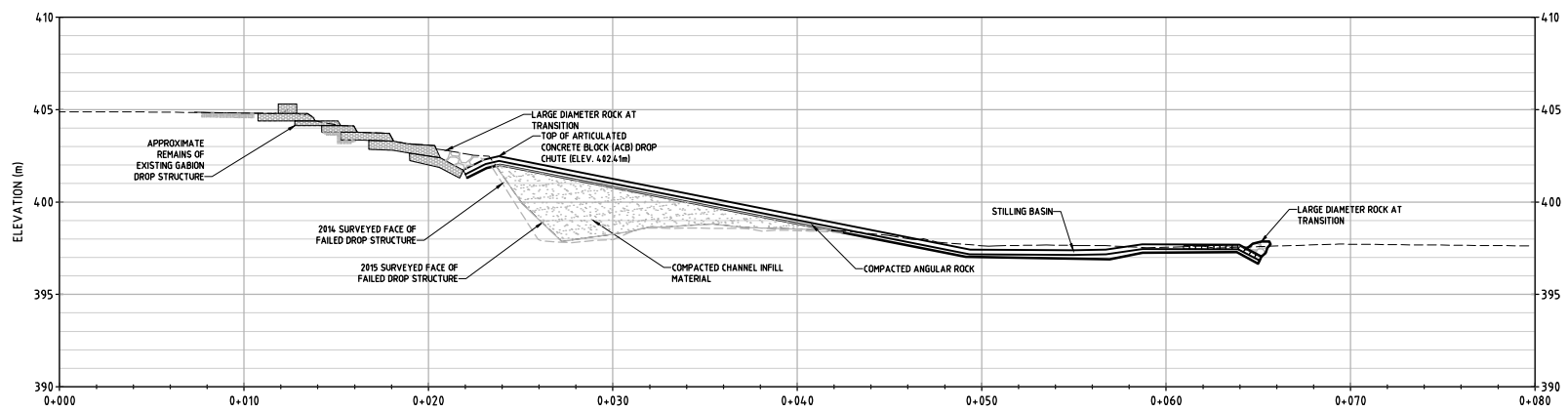
CLINTON CREEK SITE
LONG TERM MONITORING PROGRAM (2015)
2014-DROP STRUCTURE #3

DRG No 307071-01056-00-SS-DGA-1010

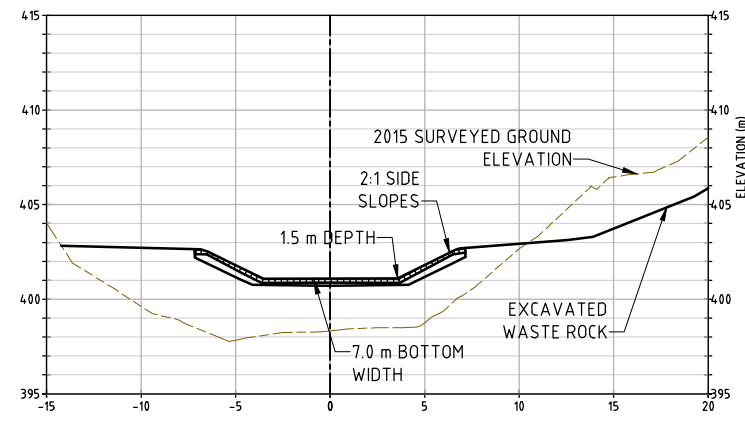
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DROP STRUCTURE #4 PLAN VIEW
SCALE: 1:1000

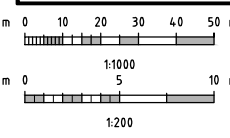


DROP STRUCTURE #4 PROFILE
SCALE: 1:200



SECTION A-A
SCALE: 1:200

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Dec. 22/15 11:03am



- LEGEND**
- BOTTOM OF CHUTE CROSS-SECTION
 - TOP OF CHUTE CROSS-SECTION
 - ◆ APPROXIMATE LOCATIONS OF FUTURE MONITORING POINTS

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
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D SHEET SCALE AS SHOWN

Oneway

ENGINEERING AND PERMIT STAMPS (As Required)

WORLEYPARSONS PROJECT No
307071-01056

CUSTOMER

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

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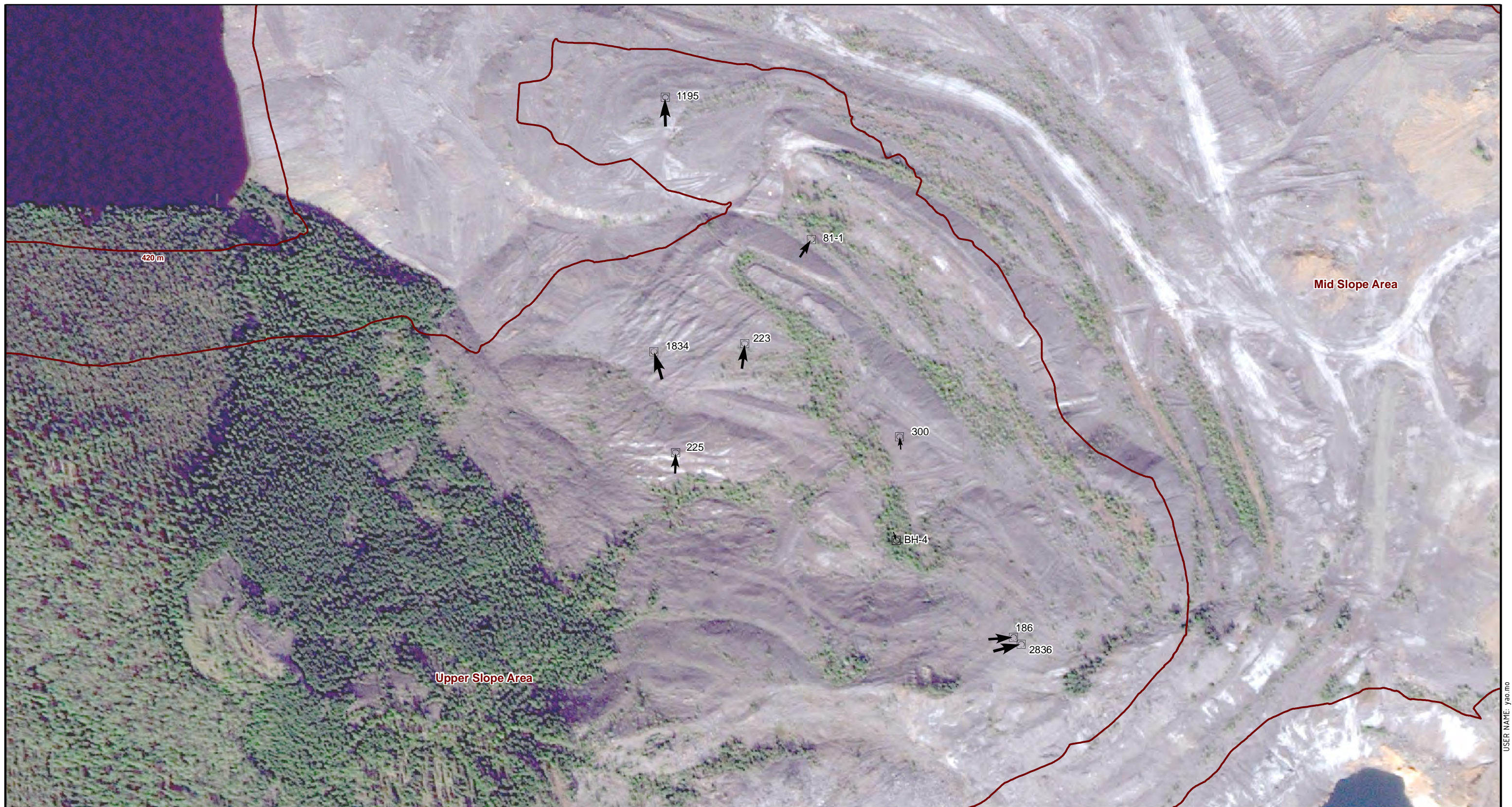
WorleyParsons

CLINTON CREEK SITE
LONG TERM MONITORING PROGRAM (2015)
DROP STRUCTURE #4

DRG No
307071-01056-00-SS-DGA-1011

REV
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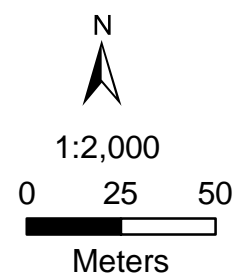


Legend

- 2015 Survey Locations
- Slope Zone Boundary
- Upper Slope: Elevation > 450 m
- Mid Slope: 420 m < Elevation < 450 m
- Lower Slope: Elevation < 420 m

Monitoring Station Movement (cm)

- 5
- 15
- 25
- >30



B SHEET	SCALE: SHOWN	CUSTOMER
Oneway to zero harm		
Date: 23/12/2015		
Drawn By: Y.M.		
Edited By: T.B.		
App'd By: J.G.		

WorleyParsons
resources & energy

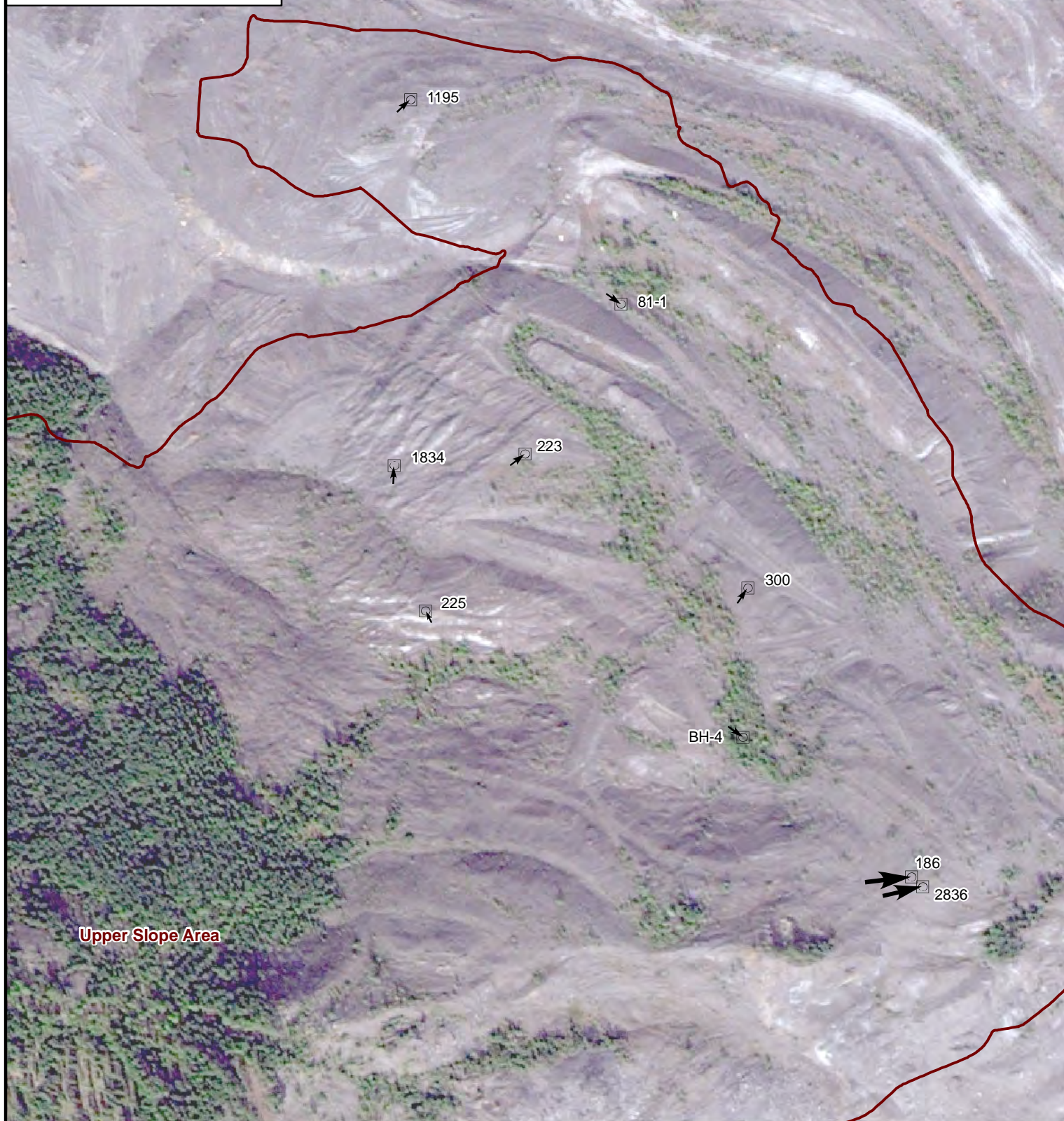
Clinton Creek Site
Long Term Monitoring Program (2015)
Clinton Creek Waste Rock Dump – Upper Slope
Movement from 2003 – 2015

"This drawing is prepared for the use of our customer as specified in the accompanying report. WorleyParsons Canada Ltd. assumes no liability to any other party for any representations contained in this drawing."

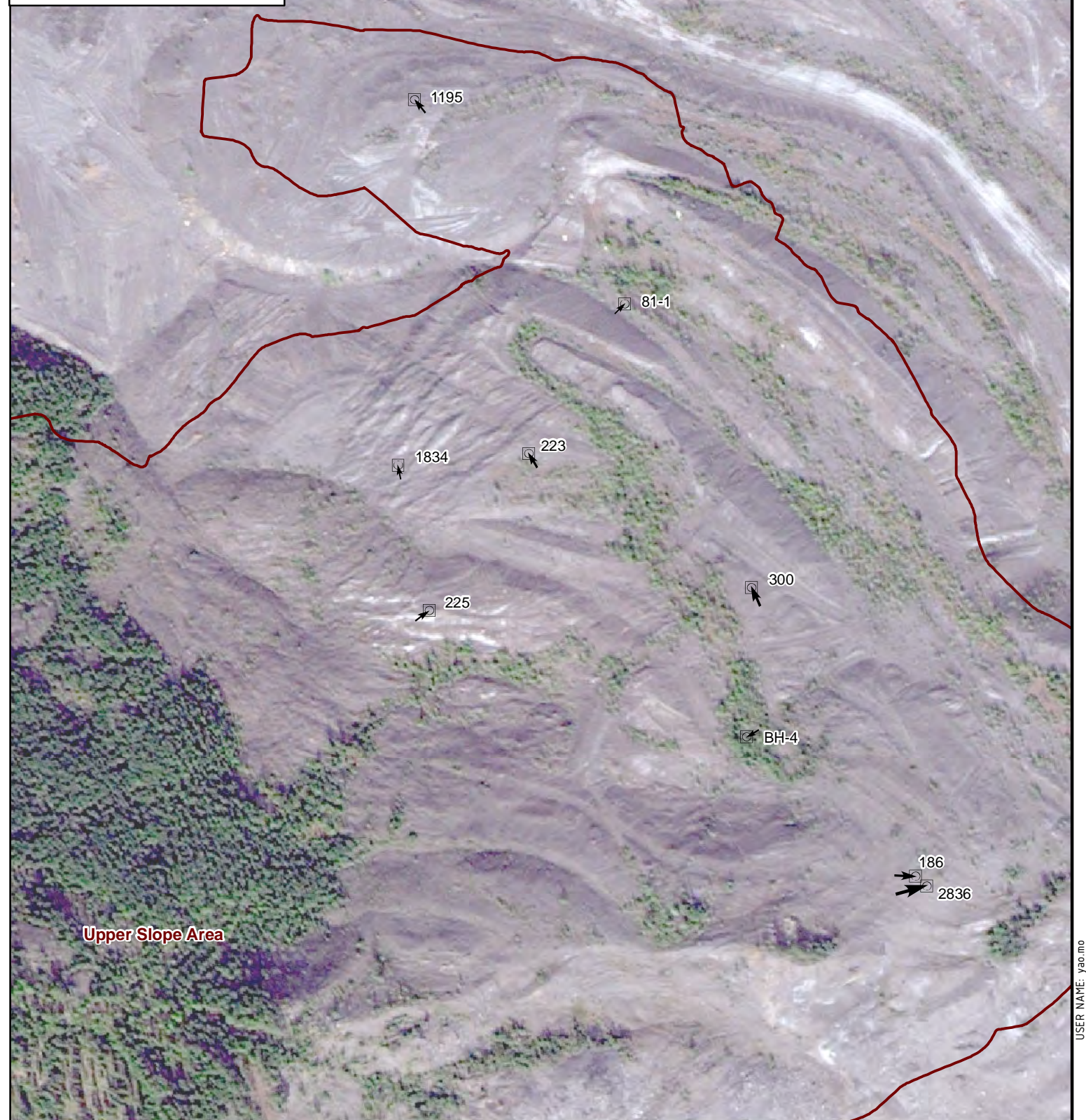
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 ISSUING OFFICE: Burnaby GIS
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Movements 2012 - 2014



Movements 2014 - 2015

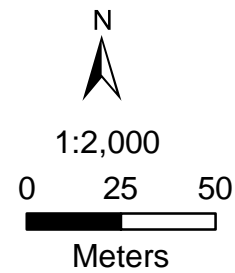


Legend

- Survey Location
- Slope Zone Boundary
- Upper Slope: Elevation > 450 m
- Mid Slope: 420 m < Elevation < 450 m
- Lower Slope: Elevation < 420 m

Monitoring Station Movement (cm)

- 2
- 6
- 10
- > 15



B SHEET	SCALE: SHOWN	CUSTOMER
Oneway to zero harm		
Date:	23/12/2015	
Drawn By:	Y.M.	
Edited By:	T.B.	
App'd By:	J.G.	

 resources & energy		
Clinton Creek Site Long Term Monitoring Program (2015) Clinton Creek Waste Rock Dump – Upper Slope Incremental Movements 2012 – 2015		

"This drawing is prepared for the use of our customer as specified in the accompanying report. WorleyParsons Canada Ltd. assumes no liability to any other party for any representations contained in this drawing."

WORLEYPARSONS PROJECT No:	FIG No:	REV
307071-01009	1013	0

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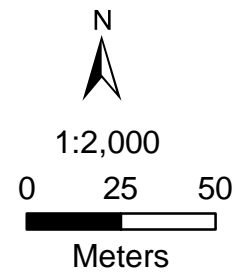


Legend

- Survey Location
- Slope Zone Boundary
- Upper Slope: Elevation > 530 m
- Mid Slope: 425 m < Elevation < 530 m
- Lower Slope: Elevation < 425 m

Monitoring Station Movement (cm)

- < 15
- 25
- 30
- >30



B SHEET	SCALE: SHOWN	CUSTOMER
Oneway to zero harm		
Date:	23/12/2015	
Drawn By:	Y.M.	
Edited By:	T.B.	
App'd By:	J.G.	

"This drawing is prepared for the use of our customer as specified in the accompanying report. WorleyParsons Canada Ltd. assumes no liability to any other party for any representations contained in this drawing."

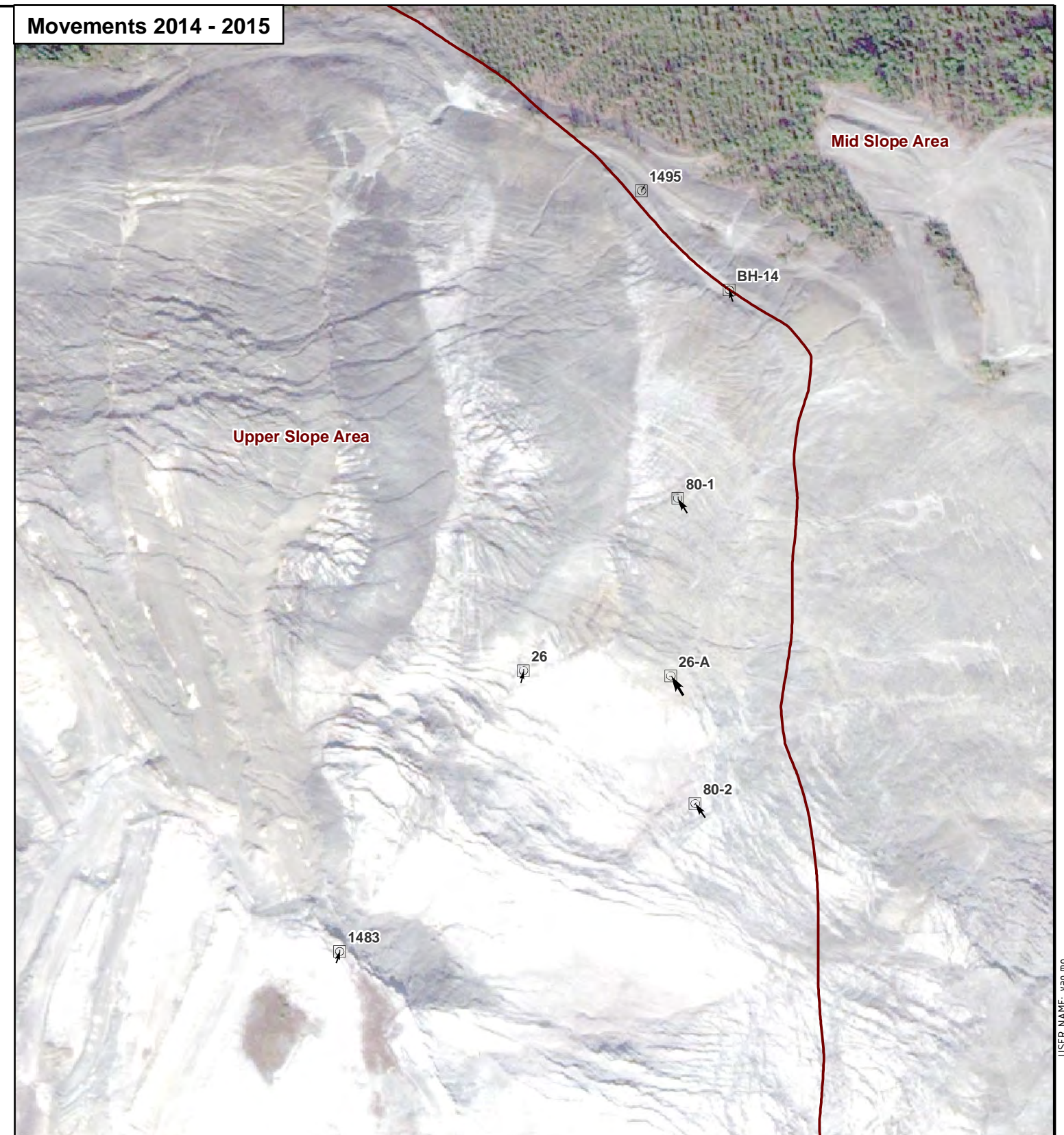
Clinton Creek Site Long Term Monitoring Program (2015) Wolverine Creek Tailings Pile - Upper Slope Movement from 2003 - 2015		
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ISSUING OFFICE: Burnaby GIS
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Movements 2012 - 2014



Movements 2014 - 2015

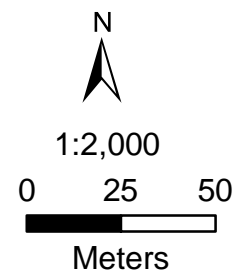


Legend

- Survey Location
- Slope Zone Boundary
- Upper Slope: Elevation > 530 m
- Mid Slope: 425 m < Elevation < 530 m
- Lower Slope: Elevation < 425 m

Monitoring Station Movement (cm)

- < 4
- 8
- 10
- >10



B SHEET	SCALE: SHOWN	CUSTOMER
Oneway to zero harm		Yukon Government
Date:	23/12/2015	
Drawn By:	Y.M.	
Edited By:	T.B.	
App'd By:	J.G.	

 resources & energy		
Clinton Creek Site Long Term Monitoring Program (2015) Wolverine Creek Tailings Pile - Upper Slope Incremental Movements 2012 - 2015		
WORLEYPARSONS PROJECT No:	FIG No:	REV
307071-01009	1015	0

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Appendix 2

Site Photographs



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**

1 Site Access Roads



Photo 1: Access road low spot between Fortymile Bridge and site gate looking east.



Photo 2: Access road washboarding between Fortymile Bridge and site gate looking northeast.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 3: Site access gate looking east.



Photo 4: Downstream side of Ford Crossing No. 1 temporary infrastructure looking northwest.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 5: Upstream side of Ford Crossing No. 1 temporary infrastructure looking north.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 6: Access road west of Ford Crossing No. 1 looking east.



Photo 7: Ford Crossing No. 2 displaced gabion mesh looking east.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 8: Ford Crossing No. 2 with temporary berm (photo taken September 2, 2015)



Photo 9: Access road between Ford Crossing No. 2 and former Mill Site looking east.



2 Closed Portion of Access Road



Photo 10: Closed portion of access road embankment looking west.



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Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 11: Closed portion of access road embankment looking east.



Photo 12: Closed portion of access road top of bank looking east.



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Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 13: Closed portion of access road top of bank looking west.



Photo 14: Closed portion of access road top of bank looking west.



3 Hudgeon Lake Outlet



Photo 15: Hudgeon Lake Outlet looking northwest.



Photo 16: Hudgeon Lake north abutment looking north.



Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines Clinton Creek Long-Term Monitoring Program

2015 Survey Results

Appendix 2 - Site Photographs



Photo 17: Hudgeon Lake south abutment looking northeast.



Photo 18: Hudgeon Lake beaver den looking northwest.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 19: Hudgeon Lake remote lake level gauge.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 20: Hudgeon Lake Booms looking southwest.



4 Drop Structures



Photo 21: All drop structures looking northwest.



Photo 22: Drop Structure No. 1 looking northwest.



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Clinton Creek Long-Term Monitoring Program
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Photo 23: Drop Structure No. 2 looking northwest.



Photo 24: Drop Structure No. 2 downstream pool looking east.



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Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 25: Drop Structure No. 2 unknown substance in downstream pool looking southeast.



Photo 26: Drop Structure No. 3 looking southwest.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 27: Repaired drop structure gabion basket looking southwest.



Photo 28: Drop Structure No. 4 transition to revetment chute looking west.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 29: Drop Structure No. 4 transition to revetment chute looking southwest.



Photo 30: Drop Structure No. 4 revetment chute looking east.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 31: Additional mesh installed at Drop Structure No. 4.



5 Clinton Creek Channel



Photo 32: Clinton Creek Channel looking northeast.



Photo 33: Clinton Creek Channel looking northeast.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 34: Clinton Creek Channel looking northeast.



Photo 35: Trees across Clinton Creek Channel looking northeast.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 36: Lower Clinton Creek Channel looking east.



Photo 37: Minor slope erosion at Lower Clinton Creek Channel looking northwest.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 38: Lower Clinton Creek Channel at Ford Crossing No. 1 looking northwest.



Photo 39: Lower Clinton Creek Channel at Ford Crossing No. 1 looking northeast.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 40: Stream gauge at Ford Crossing No. 1 looking north.



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Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 41: Clinton Creek Channel confluence with Wolverine Creek looking southwest.



6 Clinton Creek Waste Rock Pile



Photo 42: Clinton Creek Waste Rock Pile slope erosion near Ford Crossing No. 1 looking south.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results
Appendix 2 - Site Photographs**



Photo 43: Clinton Creek Waste Rock Pile slope erosion near Ford Crossing No. 1 looking southeast.



**Government of Yukon Energy, Mines and Resources - Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
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Photo 44: Clinton Creek Waste Rock Pile slope erosion near Ford Crossing No. 1 looking south.



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Photo 45: Clinton Creek Waste Rock Pile low spot near abandoned shovel looking northwest.



Photo 46: Clinton Creek Waste Rock Pile perched rock looking northwest.



7 Wolverine Creek Channel



Photo 47: Wolverine Creek culvert outlet at confluence with Clinton Creek looking northwest.



Photo 48: Wolverine Creek culvert inlet looking southeast.



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Photo 49: Wolverine Creek high flow culvert outlet looking north.



Photo 50: Wolverine Creek high flow culvert inlet looking south.



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Photo 51: Lower Wolverine Creek upstream of culvert looking north.



Photo 52: Wolverine Creek rock lined channel looking northwest.



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Photo 53: Wolverine Creek rock weir looking northeast.



Photo 54: Wolverine Creek rock weir looking east.



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Photo 55: Wolverine Creek rock weir looking northwest.



8 Wolverine Ponds



Photo 56: Wolverine Ponds from the Tailings Pile looking east.



Photo 57: South Wolverine Pond looking north.



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Photo 58: South Wolverine Pond outlet looking southeast.



Photo 59: South Wolverine Pond outlet looking northeast.



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Photo 60: Channel between Wolverine Ponds looking northwest.



Photo 61: Channel between Wolverine Ponds looking northeast.



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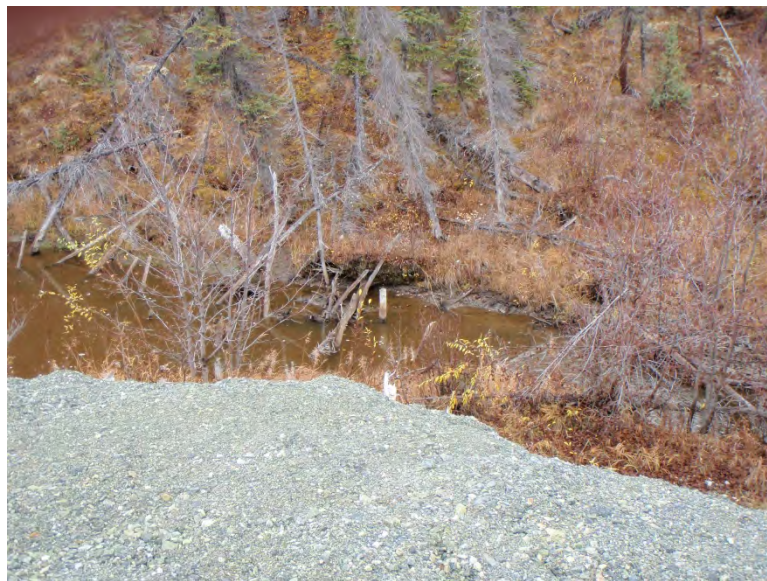


Photo 62: North Wolverine Pond outlet looking east.



9 Wolverine Creek Tailings Pile



Photo 63: Top of Wolverine Creek Tailings Pile north lobe looking northeast.



Photo 64: Top of Wolverine Creek Tailings Pile north lobe looking southeast.



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Photo 65: Top of Wolverine Creek Tailings Pile north lobe looking north.



Photo 66: Bottom of Wolverine Creek Tailings Pile north lobe looking southwest.



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Photo 67: Bottom of Wolverine Creek Tailings Pile south lobe looking west.



Photo 68: Bottom of Wolverine Creek Tailings Pile south lobe looking northwest.



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Photo 69: Bottom of Wolverine Creek Tailings Pile south lobe looking west.



Photo 70: Bottom of Wolverine Creek Tailings Pile south lobe looking south.



10 Porcupine Pit



Photo 71: Porcupine Pit looking west.



Photo 72: Porcupine Pit benches looking southwest.



11 Snowshoe Pit



Photo 73: Snowshoe Pit looking southeast.

Appendix 3

Compiled Survey Data

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM

SEPTEMBER 2015

UTM COORDINATES

NAD 83, Zone 7, 141° West



Advisian

WorleyParsons Group

CONTROL			
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT
1086	7147972.219	513176.710	590.955
1192	7147563.984	512278.758	441.231
2834	7148172.671	513447.756	606.786
2835	7147272.805	513147.046	432.648
3819	7147223.092	513111.927	441.839
3820	7147930.492	513981.157	402.884

CLINTON CREEK WASTE ROCK DUMP MOVEMENT MONITORING				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
2835	7147272.805	513147.046	432.648	Real Time Kinematic base for Markers shown below
1195	7147112.112	512899.527	456.348	Top of spike, Place Lathe
1834	7146973.870	512893.358	460.958	Rebar up 0.27 with tag Place lathe
81-1	7147034.850	512978.971	455.040	Large rebar 0.03 Dia. Up 1.43 with cone tripod, Tag and prism, leaning SW
223	7146978.298	512942.771	467.016	Steel rod up 0.38 with tag
225	7146918.916	512905.227	474.980	Rebar up 0.24, slight leaning North, place lathe
BH-4 ROD	7146871.259	513025.121	470.989	Steel rod up 0.38 with tag
BH-4 CABLE	7146871.366	513025.212	470.953	Ground shot on black cable
300	7146927.612	513026.959	468.845	Steel rod up 0.69, leaning North place lathe
186	7146818.506	513088.860	477.445	Steel rod up 0.66 with tag , Leaning North, place lathe
2836	7146814.776	513093.169	477.309	Top of rebar (control point) place lathe
MR 4411	7147103.569	513565.429	384.039	Place rod up 0.61 with tag 4411 place lathe (0+800)
MR 4410	7147152.249	513482.743	387.974	Place rod up 0.61 with tag 4410 place lathe (0+700)
MR 4412	7147068.525	513652.784	375.511	Place rod up 0.61 with tag 4412 place lathe (0+900)

Note: Coordinates are NAD 83 UTM grid, derived from a least squares adjustment of GPS observations holding values of stations 1192 and 1086 fixed in 3D.

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UTM COORDINATES

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Advisian

WorleyParsons Group

CONTROL				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
2835	7147272.790	513147.057	432.669	Real Time Kinematic base for Markers shown below

PORCUPINE PIT AREA MOVEMENT MONITORING			
	NORTHING	EASTING	ORTHOMETRIC HEIGHT
1839	7146861.379	513285.137	428.063
1838	7146491.908	513380.512	468.346
1837	7146502.925	513411.370	470.215
1830	7146523.822	513455.673	471.664
1832	7146537.079	513483.128	473.627
U1493	7146802.392	513576.561	452.526

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Advisian

WorleyParsons Group

CONTROL				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
2834	7148172.671	513447.756	606.786	RTK base for Wolverine Creek Tailing Pile Monitoring

WOLVERINE CREEK TAILING PILE				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
26	7148341.558	513483.729	574.834	Steel Rod with red tag and old prism , up 1.13,leaning
26-A	7148339.400	513540.633	557.507	steel Rod , with red tag , up 1.25 (cone tripod)
80-1	7148408.099	513543.374	555.249	Large Rebar, Diam. 0.03, up 1.03 with prism , leaning
80-2	7148290.108	513549.993	552.073	Large Rebar, Diam. 0.03, up 1.14 with prism , leaning
1483	7148233.078	513412.789	608.695	Steele Rod with blue tag illegible, up 0.50, leaning East
1495	7148526.793	513529.186	528.976	Steele Rod with blue tag , up 0.50, leaning East
BH-14	7148488.508	513563.091	530.315	Ground cable with lathe and Tag

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WorleyParsons Group

CONTROL				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
3819	7147223.092	513111.927	441.839	RTK base for Clinton Creek Centreline survey

Clinton Creek Centreline				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
7000	7147428.334	512861.138	411.311	CRKCL
7001	7147428.352	512871.090	411.090	CRKCL
7002	7147427.961	512879.250	411.050	CRKCL
7003	7147426.968	512887.509	411.207	CRKCL
7004	7147426.973	512887.861	411.482	CRKCL
7005	7147426.954	512888.731	411.456	CRKCL
7006	7147427.255	512888.978	411.179	CRKCL
7007	7147427.097	512889.767	410.988	CRKCL
7008	7147427.106	512889.891	410.652	CRKCL
7009	7147426.640	512892.056	410.595	CRKCL
7010	7147426.581	512892.270	410.148	CRKCL
7011	7147425.995	512894.518	410.227	CRKCL
7012	7147425.926	512894.660	409.915	CRKCL
7013	7147425.415	512896.816	409.785	CRKCL
7014	7147425.019	512897.995	410.219	CRKCL
7015	7147424.937	512898.509	409.897	CRKCL
7016	7147424.772	512899.152	409.724	CRKCL
7017	7147422.387	512906.440	409.567	CRKCL
7018	7147420.462	512912.992	409.592	CRKCL
7019	7147417.965	512919.747	409.746	CRKCL
7020	7147415.381	512927.749	409.696	CRKCL
7021	7147412.841	512935.741	409.744	CRKCL
7022	7147410.767	512942.955	409.883	CRKCL
7023	7147410.448	512943.156	410.090	CRKCL
7024	7147410.011	512943.858	409.915	CRKCL
7025	7147409.982	512944.034	409.690	CRKCL
7026	7147409.805	512944.815	409.419	CRKCL
7027	7147409.817	512944.901	409.181	CRKCL
7028	7147409.148	512946.692	408.903	CRKCL
7029	7147409.017	512946.748	408.613	CRKCL
7030	7147408.429	512948.567	408.527	CRKCL
7031	7147408.382	512948.754	408.095	CRKCL
7032	7147407.668	512950.573	407.875	CRKCL
7033	7147407.638	512950.724	407.542	CRKCL
7034	7147407.090	512952.452	407.450	CRKCL
7035	7147407.002	512952.550	407.060	CRKCL
7036	7147405.107	512958.811	407.079	CRKCL
7037	7147404.824	512959.453	407.372	CRKCL
7038	7147404.748	512959.886	407.122	CRKCL
7039	7147403.165	512964.797	406.969	CRKCL
7040	7147401.505	512970.300	406.791	CRKCL
7041	7147399.849	512974.916	406.843	CRKCL
7042	7147398.119	512981.762	406.720	CRKCL
7043	7147398.148	512982.027	407.135	CRKCL
7044	7147397.975	512982.774	407.110	CRKCL
7045	7147397.933	512983.002	406.678	CRKCL
7046	7147397.803	512983.988	406.577	CRKCL
7047	7147397.703	512984.090	406.158	CRKCL
7048	7147397.302	512986.018	406.003	CRKCL
7049	7147397.289	512986.085	405.654	CRKCL
7050	7147396.889	512987.910	405.488	CRKCL
7051	7147396.836	512987.994	405.138	CRKCL
7052	7147396.415	512989.761	405.010	CRKCL
7053	7147396.424	512989.816	404.693	CRKCL
7054	7147395.066	512995.111	404.722	CRKCL
7055	7147394.943	512995.888	405.186	CRKCL
7056	7147395.013	512996.265	404.594	CRKCL
7057	7147393.538	513001.555	404.755	CRKCL
7058	7147392.654	513006.279	404.848	CRKCL
7059	7147390.538	513014.682	404.932	CRKCL
7060	7147389.033	513020.581	404.876	CRKCL
7061	7147387.239	513027.460	404.777	CRKCL-Unable to get survey shots due to construction
7062	7147371.824	513085.413	397.789	CRKCL
7063	7147371.304	513091.884	397.577	CRKCL
7064	7147369.787	513097.132	397.347	CRKCL
7065	7147368.245	513102.470	397.181	CRKCL

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Advisian

WorleyParsons Group

7066	7147366.661	513108.277	397.215	CRKCL
Clinton Creek Centreline				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
7067	7147364.312	513115.029	397.214	CRKCL
7068	7147362.531	513121.233	397.132	CRKCL
7069	7147359.549	513131.101	396.702	CRKCL
7070	7147358.025	513133.494	396.589	CRKCL
7071	7147354.963	513137.590	396.426	CRKCL
7072	7147350.977	513144.898	396.556	CRKCL
7073	7147348.290	513151.438	396.370	CRKCL
7074	7147344.037	513160.949	395.848	CRKCL
7075	7147339.481	513168.563	395.941	CRKCL
7076	7147336.551	513177.183	395.319	CRKCL
7077	7147333.217	513187.386	394.831	CRKCL-Debri
7078	7147330.021	513194.540	393.944	CRKCL
7079	7147325.760	513199.411	393.763	CRKCL
7080	7147320.686	513206.179	392.963	CRKCL
7081	7147316.779	513212.339	392.652	CRKCL
7082	7147317.618	513213.274	392.438	CRKCL
7083	7147315.599	513218.239	392.337	CRKCL
7084	7147315.438	513226.054	392.185	CRKCL
7085	7147315.145	513232.989	392.257	CRKCL
7086	7147316.084	513241.111	391.660	CRKCL
7087	7147315.229	513249.454	391.112	CRKCL
7088	7147314.437	513256.745	390.485	CRKCL
7089	7147315.847	513265.582	390.340	CRKCL
7090	7147315.677	513273.677	390.019	CRKCL
7091	7147315.504	513283.867	389.594	CRKCL
7092	7147312.629	513288.191	389.714	CRKCL
7093	7147306.502	513295.250	389.410	CRKCL-Fallen tree
7094	7147302.322	513301.777	389.139	CRKCL
7095	7147299.174	513309.362	388.650	CRKCL
7096	7147293.956	513314.117	389.663	CRKCL
7097	7147291.787	513321.392	388.085	CRKCL
7098	7147290.798	513328.355	386.933	CRKCL
7099	7147288.575	513332.012	387.003	CRKCL
7100	7147283.428	513337.842	387.118	CRKCL
7101	7147280.884	513344.116	386.861	CRKCL
7102	7147280.306	513351.773	386.464	CRKCL
7103	7147275.884	513359.518	386.235	CRKCL
7104	7147272.629	513365.016	385.524	CRKCL
7105	7147269.929	513372.833	385.217	CRKCL
7106	7147263.653	513379.757	384.874	CRKCL
7107	7147258.003	513384.348	384.346	CRKCL
7108	7147252.274	513391.890	384.445	CRKCL- Creek breaks into 2 and reconnect at 7113
7109	7147254.408	513405.540	383.849	CRKCL
7110	7147250.366	513413.223	383.297	CRKCL
7113	7147245.166	513424.493	382.266	CRKCL
7114	7147244.532	513433.199	381.921	CRKCL
7115	7147240.948	513443.307	381.755	CRKCL
7116	7147232.510	513449.178	381.417	CRKCL
7117	7147226.048	513458.340	381.162	CRKCL
7118	7147220.912	513466.351	380.705	CRKCL
7119	7147217.882	513473.248	380.300	CRKCL-Small metal debri
7120	7147214.376	513481.504	379.669	CRKCL
7121	7147208.914	513487.783	379.523	CRKCL
7122	7147200.822	513492.677	379.214	CRKCL-Wood debri
7123	7147192.547	513497.262	378.893	CRKCL
7124	7147187.946	513505.045	378.394	CRKCL
7125	7147183.577	513514.929	378.132	CRKCL
7126	7147179.618	513521.248	377.948	CRKCL
7127	7147175.401	513527.616	377.866	CRKCL
7128	7147170.010	513532.156	377.571	CRKCL
7129	7147163.259	513534.622	377.131	CRKCL
7130	7147158.516	513538.371	377.067	CRKCL
7131	7147153.542	513542.741	377.140	CRKCL
7132	7147149.951	513547.815	377.015	CRKCL
7133	7147145.244	513554.196	376.971	CRKCL
7134	7147143.686	513561.506	376.800	CRKCL
7135	7147143.439	513567.652	376.095	CRKCL
7136	7147143.504	513576.454	376.133	CRKCL
7137	7147142.803	513584.471	375.863	CRKCL
7138	7147139.713	513589.548	375.832	CRKCL

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM

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UTM COORDINATES

NAD 83, Zone 7, 141° West



Advisian

WorleyParsons Group

7139	7147133.987	513595.551	375.328	CRKCL
7140	7147129.081	513601.342	375.191	CRKCL
Clinton Creek Centreline				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
7141	7147123.367	513608.208	374.615	CRKCL-large Metal Tanks debri
7142	7147119.525	513613.151	374.141	CRKCL
7143	7147117.045	513620.251	373.857	CRKCL
7144	7147115.289	513628.060	373.597	CRKCL
7145	7147113.981	513633.492	373.554	CRKCL-Culvert

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM

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UTM COORDINATES

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Advisian

WorleyParsons Group

CONTROL				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
3819	7147223.092	513111.927	441.839	RTK base for monitoring pins around Snowshoe Pit

Monitoring Pins Around Snowshoe Pit				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
4413	7146691.142	513852.804	391.798	Monitoring Rod up 0.66 with Tag and Lath
4414	7146722.856	513966.283	401.070	Monitoring Rod up 0.60 with Tag and Lath

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM

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UTM COORDINATES

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Advisian

WorleyParsons Group

CONTROL				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
2834	7148172.671	513447.756	606.786	RTK base for Wolverine Creek Tailing Pile Monitoring

GABION DROP STRUCTURE 1 US				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6035	7147441.272	512890.142	413.650	0G1450
6036	7147441.234	512890.136	413.760	TOP1450-Rebar ewith Tag up 0.11, Slight lean to
6037	7147440.296	512889.802	413.510	ROCK
6038	7147439.369	512890.088	413.307	ROCK
6039	7147438.990	512890.017	413.194	GABION
6040	7147438.236	512889.939	413.159	GABION
6041	7147438.090	512889.952	413.503	GABION
6042	7147437.610	512889.981	413.565	GABION
6043	7147437.124	512889.907	413.416	GABION
6044	7147437.052	512889.912	412.919	GABION
6045	7147435.940	512889.781	412.815	GABION
6046	7147435.088	512889.758	412.605	GABION
6047	7147434.342	512889.649	412.398	GABION
6048	7147433.369	512889.710	412.101	GABION
6049	7147432.369	512889.640	411.749	GABION
6050	7147431.519	512889.601	411.405	GABION
6051	7147430.981	512889.543	411.197	GABION
6052	7147430.413	512889.547	411.102	GABION
6053	7147429.529	512889.460	411.097	GABION
6054	7147428.209	512889.441	411.108	GABION
6055	7147426.547	512889.253	411.130	GABION
6056	7147424.777	512889.170	411.125	GABION
6057	7147423.933	512889.091	411.095	GABION
6058	7147423.297	512889.019	411.254	GABION
6059	7147422.326	512888.938	411.628	GABION
6060	7147421.192	512888.760	411.909	GABION
6061	7147420.192	512888.757	412.320	GABION
6062	7147419.497	512888.620	412.513	GABION
6063	7147418.742	512888.564	412.758	GABION
6064	7147418.202	512888.558	412.840	GABION
6065	7147418.013	512888.523	412.920	GABION
6066	7147417.916	512888.594	413.345	GABION
6067	7147417.366	512888.523	413.433	GABION
6068	7147416.927	512888.452	413.385	GABION
6069	7147416.781	512888.399	412.984	GABION
6070	7147416.124	512888.357	412.987	GABION
6071	7147415.754	512888.356	413.088	ROCK1
6072	7147415.439	512888.297	413.166	ROCK1
6073	7147414.708	512888.202	413.292	ROCK1
6074	7147413.818	512888.133	413.386	TOP1451-Rebar with tag , up 0.09
6075	7147413.789	512888.120	413.300	0G1451

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WorleyParsons Group

GABION DROP STRUCTURE 1 DS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6122	7147439.014	512901.504	413.075	OG1453
6121	7147438.975	512901.494	413.235	TOP1453-Rebar with tag, up 0.16 in ground crack but
6124	7147438.487	512901.351	412.953	OG
6125	7147437.765	512901.077	412.708	OG
6126	7147436.833	512900.690	412.120	OG
6120	7147436.331	512900.778	412.003	ROCK3
6119	7147435.890	512900.603	411.850	ROCK3
6118	7147435.283	512900.445	411.692	ROCK3
6117	7147434.840	512900.290	411.550	ROCK3
6116	7147434.660	512900.250	411.562	GABION
6115	7147434.283	512900.094	411.562	GABION
6114	7147433.721	512899.859	411.443	GABION
6113	7147432.963	512899.533	411.135	GABION
6112	7147432.579	512899.380	410.999	GABION
6111	7147432.096	512899.255	410.774	GABION
6110	7147431.613	512899.078	410.552	GABION
6109	7147430.593	512898.653	410.569	GABION
6108	7147430.018	512898.416	410.475	GABION
6107	7147429.482	512898.191	410.261	GABION
6106	7147429.044	512898.014	410.069	GABION
6105	7147428.627	512897.812	409.986	GABION
6104	7147427.945	512897.487	410.044	GABION
6103	7147427.534	512897.309	409.914	GABION
6102	7147427.090	512897.089	409.817	GABION
6101	7147426.155	512896.766	409.789	GABION
6100	7147425.084	512896.386	409.823	GABION
6099	7147424.234	512896.116	409.830	GABION
6098	7147423.453	512895.806	409.858	GABION
6097	7147422.636	512895.650	409.860	GABION
6096	7147422.082	512895.492	409.961	GABION
6095	7147421.540	512895.291	410.181	GABION
6094	7147421.050	512895.102	410.294	GABION
6093	7147420.383	512894.884	410.392	GABION
6092	7147419.685	512894.654	410.604	GABION
6091	7147419.203	512894.461	410.791	GABION
6090	7147418.697	512894.234	410.897	GABION
6089	7147418.256	512894.026	411.049	GABION
6088	7147417.664	512893.820	411.261	GABION
6087	7147417.263	512893.669	411.333	GABION
6086	7147416.412	512893.452	411.543	GABION
6085	7147415.830	512893.245	411.702	GABION
6084	7147415.521	512893.094	411.631	GABION
6083	7147414.959	512892.897	411.822	ROCK2
6082	7147414.255	512892.66	411.971	ROCK2
6081	7147413.687	512892.482	412.163	ROCK2
6080	7147413.045	512892.289	412.417	ROCK2
6079	7147412.591	512892.044	412.672	ROCK2
6078	7147412.097	512891.985	412.833	ROCK2
6077	7147411.939	512891.98	413.016	TOP1452-Rebar with tag, up 0.17
6076	7147411.913	512891.959	412.847	OG1452

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GABION DROP STRUCTURE 2 US				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6127	7147423.209	512948.582	412.307	OG1454
6128	7147423.180	512948.562	412.411	TOP1454- Rebar with tag up 0.11
6129	7147422.454	512948.426	412.356	OG
6130	7147421.538	512948.115	412.292	OG
6131	7147421.049	512947.894	412.207	ROCK4
6133	7147420.307	512947.588	412.105	ROCK4
6132	7147420.272	512947.703	412.156	ROCK4
6134	7147420.248	512947.553	412.323	GABION
6135	7147419.921	512947.407	412.377	GABION
6136	7147419.428	512947.245	412.162	GABION
6137	7147418.883	512947.072	412.027	GABION
6138	7147418.411	512946.930	411.784	GABION
6139	7147417.639	512946.659	411.489	GABION
6140	7147417.046	512946.457	411.244	GABION
6141	7147416.255	512946.236	411.012	GABION
6142	7147415.688	512946.038	410.760	GABION
6143	7147415.163	512945.883	410.588	GABION
6144	7147414.513	512945.681	410.333	GABION
6145	7147414.054	512945.532	410.084	GABION
6146	7147413.257	512945.357	409.758	GABION
6147	7147412.630	512945.187	409.641	GABION
6148	7147411.986	512945.014	409.543	GABION
6149	7147411.335	512944.791	409.622	GABION
6150	7147410.258	512944.466	409.641	GABION
6151	7147409.373	512944.126	409.655	GABION
6152	7147408.273	512943.741	409.646	GABION
6153	7147407.326	512943.390	409.720	GABION
6154	7147406.690	512943.171	409.800	GABION
6155	7147406.099	512942.932	410.007	GABION
6156	7147405.271	512942.656	410.200	GABION
6157	7147405.110	512942.598	410.314	GABION
6158	7147404.560	512942.433	410.444	GABION
6159	7147403.986	512942.234	410.635	GABION
6160	7147403.319	512942.024	410.790	GABION
6161	7147402.637	512941.801	411.019	GABION
6162	7147401.953	512941.575	411.257	GABION
6163	7147401.288	512941.364	411.499	GABION
6164	7147400.727	512941.146	411.692	GABION
6165	7147400.397	512941.034	411.819	GABION
6166	7147400.017	512940.902	411.801	GABION
6167	7147399.983	512940.870	411.587	ROCK5
6168	7147399.636	512940.768	411.627	ROCK5
6169	7147399.252	512940.549	411.623	ROCK5
6170	7147398.904	512940.46	411.723	OG
6171	7147398.452	512940.224	411.8	OG
6172	7147397.493	512940.079	411.836	OG
6173	7147397.085	512939.944	411.924	TOP1455- Rebar with tag up 0.10 surrounding by bould
6174	7147397.066	512939.925	411.821	OG1455

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GABION DROP STRUCTURE 2 DS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6223	7147420.467	512958.007	410.609	OG1457
6222	7147420.438	512957.994	410.705	TOP1457-Rebar with tag, up 0.11, slight lean to Creek
6221	7147420.037	512957.793	410.557	OG
6220	7147419.580	512957.559	410.454	ROCK7
6219	7147418.880	512957.460	410.281	ROCK7
6218	7147418.332	512957.358	410.062	ROCK7
6217	7147417.678	512957.266	409.900	ROCK7
6216	7147417.077	512957.208	409.794	ROCK7
6215	7147416.785	512957.163	409.718	GABION
6214	7147416.392	512957.108	409.614	GABION
6213	7147415.842	512956.953	409.385	GABION
6212	7147415.261	512956.740	409.110	GABION
6211	7147414.784	512956.564	408.932	GABION
6210	7147413.951	512956.367	408.646	GABION
6209	7147413.099	512956.159	408.313	GABION
6208	7147412.484	512955.990	408.061	GABION
6207	7147411.565	512955.738	407.707	GABION
6206	7147411.045	512955.612	407.609	GABION
6205	7147410.655	512955.538	407.430	GABION
6204	7147409.868	512955.306	407.184	GABION
6203	7147409.087	512955.095	407.107	GABION
6202	7147408.036	512954.745	407.060	GABION
6201	7147407.039	512954.500	407.030	GABION
6200	7147406.069	512954.282	406.975	GABION
6199	7147405.335	512954.069	407.047	GABION
6198	7147404.550	512953.865	407.043	GABION
6197	7147403.733	512953.652	407.117	GABION
6196	7147403.419	512953.560	407.265	GABION
6195	7147402.984	512953.420	407.512	GABION
6194	7147402.573	512953.310	407.673	GABION
6193	7147402.116	512953.216	407.784	GABION
6192	7147401.533	512953.061	407.907	GABION
6191	7147400.721	512952.883	408.153	GABION
6190	7147400.308	512952.764	408.214	GABION
6189	7147399.685	512952.628	408.347	GABION
6188	7147399.136	512952.512	408.475	GABION
6187	7147398.508	512952.337	408.623	GABION
6186	7147397.861	512952.199	408.832	GABION
6185	7147397.270	512952.235	408.959	GABION
6184	7147396.946	512952.118	409.048	GABION
6183	7147396.785	512952.065	409.007	GABION
6182	7147396.443	512952.04	409.087	ROCK6
6181	7147395.73	512951.89	409.396	ROCK6
6180	7147395.253	512951.824	409.574	ROCK6
6179	7147394.808	512951.729	409.87	OG
6178	7147394.053	512951.702	410.239	OG
6177	7147393.422	512951.48	410.655	OG
6176	7147393.161	512951.354	410.861	TOP1456-Rebar with tag, up 0.12
6175	7147393.116	512951.346	410.774	OG1456

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GABION DROP STRUCTURE 3 US				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6224	7147412.123	512986.910	409.706	OG1458
6225	7147412.092	512986.896	409.836	TOP1458-Rebar with tag, up 0.12
6226	7147411.614	512986.756	409.738	OG
6227	7147411.046	512986.276	409.778	OG
6228	7147410.235	512986.163	409.855	OG
6229	7147409.579	512986.045	409.829	OG
6230	7147409.165	512985.943	409.741	GABION
6231	7147408.539	512985.854	409.558	GABION
6232	7147408.245	512985.758	409.359	GABION
6233	7147407.689	512985.617	409.134	GABION
6234	7147407.138	512985.537	408.965	GABION
6235	7147406.578	512985.407	408.741	GABION
6236	7147406.095	512985.292	408.559	GABION
6237	7147405.600	512985.164	408.364	GABION
6238	7147404.998	512985.041	408.175	GABION
6239	7147404.325	512984.893	407.872	GABION
6240	7147403.598	512984.687	407.557	GABION
6241	7147402.927	512984.561	407.319	GABION
6242	7147402.411	512984.462	407.111	GABION
6243	7147401.673	512984.328	406.915	GABION
6244	7147400.712	512984.036	406.814	GABION
6245	7147399.593	512983.676	406.705	GABION
6246	7147398.861	512983.485	406.720	GABION
6248	7147397.180	512983.119	406.665	GABION
6249	7147396.246	512982.871	406.694	GABION
6250	7147395.602	512982.752	406.737	GABION
6251	7147394.995	512982.592	406.899	GABION
6252	7147394.515	512982.475	407.086	GABION
6253	7147393.969	512982.353	407.268	GABION
6254	7147393.622	512982.256	407.289	GABION
6255	7147393.240	512982.134	407.471	GABION
6256	7147392.713	512981.971	407.610	GABION
6257	7147392.588	512981.943	407.710	GABION
6258	7147392.176	512981.793	407.847	GABION
6259	7147391.598	512981.610	408.056	GABION
6260	7147390.963	512981.453	408.266	GABION
6261	7147390.497	512981.326	408.453	GABION
6262	7147390.005	512981.196	408.602	GABION
6263	7147389.489	512981.009	408.788	GABION
6264	7147389.205	512980.933	408.821	GABION
6265	7147388.693	512980.737	408.889	OG
6266	7147388.273	512980.623	408.974	OG
6267	7147387.7	512980.573	408.965	OG
6268	7147386.967	512980.422	409.092	OG
6269	7147386.542	512980.38	409.278	TOP1459-Rebar with silver tag up 0.11
6270	7147386.52	512980.367	409.174	OG1459

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GABION DROP STRUCTURE 3 DS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6318	7147410.117	512995.883	408.313	OG1461
6317	7147410.091	512995.875	408.510	TOP1461-Rebar with tag, up 0.20
6316	7147409.445	512995.692	408.237	OG
6315	7147408.699	512995.547	407.981	OG
6314	7147408.100	512995.417	407.735	OG
6313	7147407.444	512995.305	407.400	OG
6312	7147406.866	512995.099	407.367	GABION
6311	7147406.183	512994.879	407.118	GABION
6310	7147405.679	512994.756	406.941	GABION
6309	7147405.032	512994.591	406.698	GABION
6308	7147404.377	512994.414	406.401	GABION
6307	7147403.542	512994.222	406.149	GABION
6306	7147402.921	512994.109	405.952	GABION
6305	7147402.277	512993.954	405.715	GABION
6304	7147401.642	512993.826	405.466	GABION
6303	7147401.141	512993.674	405.277	GABION
6302	7147400.610	512993.513	405.140	GABION
6301	7147400.212	512993.360	404.983	GABION
6300	7147399.647	512993.273	404.805	GABION
6299	7147398.939	512993.145	404.668	GABION
6298	7147398.478	512992.996	404.633	GABION
6297	7147397.956	512992.837	404.565	GABION
6296	7147397.177	512992.724	404.527	GABION
6295	7147396.595	512992.564	404.611	GABION
6294	7147395.708	512992.324	404.631	GABION
6293	7147394.805	512992.076	404.624	GABION
6292	7147394.092	512991.906	404.576	GABION
6291	7147393.452	512991.794	404.627	GABION
6290	7147392.921	512991.527	404.826	GABION
6289	7147392.395	512991.393	404.950	GABION
6288	7147392.055	512991.286	405.065	GABION
6287	7147391.764	512991.180	405.233	GABION
6286	7147390.872	512990.939	405.474	GABION
6285	7147389.973	512990.671	405.632	GABION
6284	7147389.391	512990.540	405.755	GABION
6283	7147388.636	512990.327	405.988	GABION
6282	7147388.054	512990.197	406.120	GABION
6281	7147387.439	512990.043	406.265	GABION
6280	7147386.842	512989.904	406.459	GABION
6279	7147386.503	512989.830	406.529	ROCK8
6278	7147385.927	512989.746	406.903	ROCK8
6277	7147385.417	512989.635	407.369	ROCK8
6276	7147385.109	512989.577	407.563	ROCK8
6275	7147384.518	512989.364	408.107	ROCK8
6274	7147384.076	512989.166	408.53	ROCK8
6273	7147383.612	512989.05	408.661	ROCK8
6272	7147383.214	512988.94	408.863	TOP1460-A-No rebar found, place new rebar with silver tag # and lathe
6271	7147383.191	512988.935	408.833	OG1460-A

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CONTROL				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
3819	7147223.092	513111.927	441.839	Base line and cracks on road

BASELINE				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6032	7147312.909	513154.374	415.331	Spike (NEW 2015)
6031	7147312.082	513157.252	415.365	Spike (NEW 2015)
6030	7147311.217	513160.124	415.422	Spike (NEW 2015)
6029	7147310.380	513163.007	415.506	Spike (NEW 2015)
6028	7147309.536	513165.888	415.489	Spike (NEW 2015)
5001	7147308.689	513168.756	415.439	Rebar
5002	7147307.846	513171.701	415.289	Spike
5003	7147307.020	513174.518	415.097	Spike
5004	7147306.141	513177.388	414.839	Spike
5005	7147305.335	513180.255	414.555	Spike
5006	7147304.475	513183.164	414.222	Spike
5007	7147303.630	513186.034	413.893	Spike
5008	7147302.775	513188.917	413.573	Spike
5009	7147301.920	513191.791	413.261	Spike
5010	7147301.078	513194.664	412.910	Spike
5011	7147300.259	513197.554	412.595	Spike
5012	7147299.413	513200.432	412.233	Spike
5013	7147298.576	513203.319	411.864	Spike
5014	7147297.752	513206.179	411.493	Spike
5015	7147296.896	513209.065	411.122	Spike
5016	7147296.042	513211.948	410.765	Spike
5017	7147295.197	513214.799	410.417	Spike
5018	7147294.349	513217.671	410.082	Spike
5019	7147293.501	513220.537	409.753	Spike
5020	7147292.650	513223.421	409.412	Spike
5021	7147291.799	513226.309	409.047	Spike
5022	7147290.951	513229.177	408.734	Spike
5000	7147290.088	513232.068	408.452	Rebar
6027	7147289.238	513234.934	408.128	Spike (NEW 2015)
6026	7147288.411	513237.815	407.861	Spike (NEW 2015)
6025	7147287.553	513240.696	407.582	Spike (NEW 2015)
6024	7147286.718	513243.573	407.364	Spike (NEW 2015)
6023	7147285.873	513246.465	407.113	Spike (NEW 2015)

TENSION CRACKS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6033	7147307.498	513182.353	414.732	UGL993-Found UGL control
6034	7147304.529	513189.144	413.840	UGL992-found UGL control
6324	7147297.251	513258.826	405.990	Top of steep slope
6325	7147296.650	513256.889	406.609	Top of steep slope
6326	7147295.636	513254.274	407.210	Top of steep slope
6327	7147296.479	513249.798	407.556	Top of steep slope
6328	7147296.026	513246.067	407.750	Top of steep slope
6329	7147296.108	513243.086	408.074	Top of steep slope
6330	7147296.219	513239.662	408.369	Top of steep slope
6331	7147297.041	513238.118	408.470	Top of steep slope
6332	7147297.175	513236.625	408.595	Top of steep slope
6333	7147297.088	513234.821	408.758	Top of steep slope
6334	7147297.520	513232.658	408.943	Top of steep slope
6335	7147297.317	513230.884	409.108	Top of steep slope
6336	7147298.123	513228.478	409.366	Top of steep slope
6337	7147298.095	513226.898	409.523	Top of steep slope
6338	7147298.569	513224.054	409.820	Top of steep slope
6339	7147298.424	513222.907	409.914	Top of steep slope
6340	7147298.418	513221.286	410.098	Top of steep slope
6341	7147297.690	513220.810	410.079	Top of steep slope
6342	7147297.738	513218.913	410.226	Top of steep slope
6343	7147298.249	513217.021	410.434	Top of steep slope
6344	7147298.455	513215.888	410.546	Top of steep slope

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TENSION CRACKS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6345	7147298.637	513215.730	410.557	Top of steep slope
6346	7147299.164	513213.930	410.775	Top of steep slope
6347	7147300.076	513213.562	410.892	Top of steep slope
6348	7147300.359	513212.156	411.042	Top of steep slope
6349	7147300.294	513211.584	411.119	Top of steep slope
6350	7147300.258	513210.477	411.217	Top of steep slope
6351	7147300.425	513208.812	411.415	Top of steep slope
6352	7147300.824	513206.093	411.722	Top of steep slope
6353	7147301.818	513204.137	412.017	Top of steep slope
6354	7147304.006	513201.440	412.504	Top of steep slope
6355	7147304.711	513199.974	412.703	Top of steep slope
6356	7147305.370	513197.178	413.047	Top of steep slope
6357	7147306.171	513193.084	413.527	Top of steep slope
6358	7147306.596	513190.420	413.787	Top of steep slope
6359	7147307.527	513188.037	414.098	Top of steep slope
6360	7147307.827	513186.891	414.228	Top of steep slope
6361	7147309.362	513186.420	414.367	Top of steep slope
6362	7147310.323	513185.273	414.532	Top of steep slope
6363	7147309.927	513184.444	414.606	Top of steep slope
6364	7147309.961	513183.362	414.695	Top of steep slope
6365	7147310.887	513181.973	414.86	Top of steep slope
6366	7147311.79	513180.049	415.036	Top of steep slope
6367	7147313.365	513177.228	415.201	Top of steep slope
6368	7147314.701	513174.28	415.452	Top of steep slope
6369	7147315.868	513172.742	415.652	Top of steep slope
6370	7147316.519	513171.445	415.384	Top of steep slope
6371	7147316.475	513170.667	415.434	Top of steep slope
6372	7147316.151	513170.108	415.491	Top of steep slope
6373	7147317.624	513167.286	415.616	Top of steep slope
6374	7147318.744	513165.832	415.342	Top of steep slope
6375	7147319.959	513165.618	415.215	Top of steep slope
6376	7147320.613	513163.814	415.253	Top of steep slope
6377	7147321.683	513163.609	415.269	Top of steep slope
6378	7147322.746	513162.109	415.378	Top of steep slope
6379	7147323.536	513160.979	415.473	Top of steep slope
6380	7147324.756	513160.1	415.142	Top of steep slope
6381	7147325.662	513159.68	414.844	Top of steep slope
6382	7147326.316	513158.026	414.956	Top of steep slope
6383	7147325.459	513156.583	415.331	Top of steep slope
6384	7147326.003	513154.117	415.815	Top of steep slope
6385	7147326.425	513151.396	415.934	Top of steep slope
6386	7147321.775	513156.336	415.661	CRACK Centre line
6387	7147321.719	513156.672	415.599	CRACK Centre line
6388	7147321.358	513157.008	415.574	CRACK Centre line
6389	7147320.971	513157.344	415.535	CRACK Centre line
6390	7147319.155	513159.407	415.528	CRACK Centre line
6391	7147314.559	513171.042	415.417	CRACK Centre line
6392	7147314.63	513170.879	415.517	CRACK Centre line
6393	7147314.351	513171.223	415.485	CRACK Centre line
6394	7147311.7	513175.237	415.4	CRACK Centre line
6395	7147311.716	513175.289	415.177	CRACK Centre line
6396	7147311.414	513176.149	415.318	CRACK Centre line
6397	7147311.063	513176.625	415.281	CRACK Centre line
6398	7147310.955	513177.006	415.161	CRACK Centre line
6399	7147310.671	513177.748	415.142	CRACK Centre line
6400	7147310.526	513178.055	415.01	CRACK Centre line
6401	7147310.533	513178.119	415.134	CRACK Centre line
6402	7147310.159	513178.681	415.064	CRACK Centre line
6403	7147310.002	513179.092	414.989	CRACK Centre line
6404	7147310.022	513179.435	415.035	CRACK Centre line
6405	7147309.902	513179.794	414.802	CRACK Centre line
6406	7147309.83	513180.151	414.897	CRACK Centre line
6407	7147309.749	513180.505	414.927	CRACK Centre line
6408	7147309.601	513180.712	414.842	CRACK Centre line
6409	7147309.581	513180.847	414.906	CRACK Centre line

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM

SEPTEMBER 2015

UTM COORDINATES

NAD 83, Zone 7, 141° West



Advisian

WorleyParsons Group

TENSION CRACKS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6410	7147308.187	513184.194	414.495	CRACK Centre line
6411	7147307.858	513184.554	414.154	CRACK Centre line
6412	7147307.769	513184.573	414.437	CRACK Centre line
6413	7147307.438	513185.488	414.299	CRACK Centre line
6414	7147306.912	513185.811	414.193	CRACK Centre line
6415	7147306.369	513186.809	414.086	CRACK Centre line
6416	7147305.662	513188.374	413.898	CRACK Centre line
6417	7147305.316	513188.596	413.745	CRACK Centre line
6418	7147305.155	513188.754	413.741	CRACK Centre line
6419	7147304.92	513189.208	413.732	CRACK Centre line
6420	7147304.761	513189.599	413.583	CRACK Centre line
6421	7147304.411	513190.065	413.614	CRACK Centre line
6422	7147304.2	513190.403	413.566	CRACK Centre line
6423	7147304.116	513190.475	413.436	CRACK Centre line
6424	7147304.019	513190.548	413.517	CRACK Centre line
6425	7147303.582	513191.241	413.438	CRACK Centre line
6426	7147303.173	513191.487	413.353	CRACK Centre line
6427	7147306.724	513190.039	413.76	CRACK Centre line
6428	7147306.468	513190.604	413.712	CRACK Centre line
6429	7147306.043	513190.911	413.573	CRACK Centre line
6430	7147305.974	513191.431	413.521	CRACK Centre line
6431	7147305.765	513191.749	413.497	CRACK Centre line
6432	7147305.697	513192.179	413.483	CRACK Centre line
6433	7147305.349	513192.973	413.363	CRACK Centre line
6434	7147305.006	513193.551	413.282	CRACK Centre line
6435	7147304.885	513194.22	413.172	CRACK Centre line
6436	7147304.863	513194.63	413.135	CRACK Centre line
6437	7147304.665	513195.363	412.9	CRACK Centre line
6438	7147304.54	513195.661	413.045	CRACK Centre line
6439	7147304.378	513195.919	413.016	CRACK Centre line
6440	7147304.367	513196.571	412.961	CRACK Centre line
6441	7147304.127	513196.971	412.819	CRACK Centre line
6442	7147304.068	513197.643	412.886	CRACK Centre line
6443	7147303.753	513198.421	412.559	CRACK Centre line
6444	7147303.605	513199.311	412.564	CRACK Centre line
6445	7147303.414	513199.695	412.413	CRACK Centre line
6446	7147303.401	513199.844	412.598	CRACK Centre line
6447	7147304.133	513197.69	412.903	CRACK Centre line
6448	7147304.737	513197.767	412.942	CRACK Centre line
6449	7147305.394	513197.827	412.858	CRACK Centre line
6450	7147305.531	513197.455	412.866	CRACK Centre line
6451	7147305.364	513198.116	412.878	CRACK Centre line
6452	7147305.201	513198.673	412.412	CRACK Centre line
6453	7147305.116	513199.148	412.804	CRACK Centre line
6454	7147304.882	513199.92	412.438	CRACK Centre line
6455	7147303.979	513194.807	413.145	CRACK Centre line
6456	7147303.776	513195.255	412.947	CRACK Centre line
6457	7147303.567	513195.589	412.897	CRACK Centre line
6458	7147303.477	513195.876	412.998	CRACK Centre line
6459	7147302.81	513196.485	412.913	CRACK Centre line
6460	7147302.664	513196.77	412.743	CRACK Centre line
6461	7147302.559	513196.929	412.81	CRACK Centre line
6462	7147301.942	513197.584	412.667	CRACK Centre line
6463	7147301.842	513198.116	412.592	CRACK Centre line
6464	7147301.704	513198.372	412.58	CRACK Centre line
6465	7147301.759	513199.132	412.496	CRACK Centre line
6466	7147301.591	513199.212	412.318	CRACK Centre line
6467	7147301.384	513199.46	412.241	CRACK Centre line
6468	7147301.196	513199.84	412.384	CRACK Centre line
6469	7147301.072	513200.24	412.321	CRACK Centre line
6470	7147300.916	513200.852	412.209	CRACK Centre line
6471	7147300.647	513200.986	412.208	CRACK Centre line
6472	7147303.338	513197.339	412.87	CRACK Centre line
6473	7147303.192	513197.589	412.738	CRACK Centre line
6474	7147302.965	513198.106	412.526	CRACK Centre line

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM

SEPTEMBER 2015

UTM COORDINATES

NAD 83, Zone 7, 141° West



Advisian

WorleyParsons Group

TENSION CRACKS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6475	7147302.892	513198.459	412.607	CRACK Centre line
6476	7147302.863	513199.519	412.477	CRACK Centre line
6477	7147302.538	513200.431	412.379	CRACK Centre line
6478	7147302.067	513200.759	412.256	CRACK Centre line
6479	7147301.923	513201.096	412.157	CRACK Centre line
6480	7147301.771	513201.756	412.16	CRACK Centre line
6481	7147301.681	513202.184	412.059	CRACK Centre line
6482	7147301.483	513202.527	411.885	CRACK Centre line
6483	7147301.397	513202.736	412.012	CRACK Centre line
6484	7147301.41	513203.027	412.029	CRACK Centre line
6485	7147301.414	513203.436	411.895	CRACK Centre line
6486	7147301.348	513203.808	411.729	CRACK Centre line
6487	7147301.113	513204.043	411.594	CRACK Centre line
6488	7147300.84	513204.71	411.809	CRACK Centre line
6489	7147300.557	513205.002	411.746	CRACK Centre line
6490	7147300.437	513205.256	411.647	CRACK Centre line
6491	7147300.316	513205.499	411.705	CRACK Centre line
6492	7147300.813	513205.323	411.727	CRACK Centre line
6493	7147300.678	513205.998	411.625	CRACK Centre line
6494	7147300.172	513206.6	411.515	CRACK Centre line
6495	7147300.035	513207.15	411.441	CRACK Centre line
6496	7147299.616	513208.115	411.359	CRACK Centre line
6497	7147299.41	513208.523	411.298	CRACK Centre line
6498	7147299.191	513209.572	411.067	CRACK Centre line
6499	7147299.153	513209.703	411.193	CRACK Centre line
6500	7147304.297	513200.826	412.04	CRACK Centre line
6501	7147303.802	513201.151	412.348	CRACK Centre line
6502	7147303.627	513201.562	412.382	CRACK Centre line
6503	7147303.394	513200.475	412.535	CRACK Centre line
6504	7147303.323	513201.088	412.387	CRACK Centre line
6505	7147303.222	513201.373	412.405	CRACK Centre line
6506	7147302.586	513201.706	412.319	CRACK Centre line
6507	7147302.226	513202.406	412.252	CRACK Centre line
6508	7147301.892	513202.891	412.14	CRACK Centre line
6509	7147301.677	513203.287	412.089	CRACK Centre line
6510	7147301.486	513196.691	412.748	CRACK Centre line
6511	7147301.115	513197.781	412.588	CRACK Centre line
6512	7147300.833	513199.157	412.424	CRACK Centre line
6513	7147300.457	513200.218	412.259	CRACK Centre line
6514	7147300.394	513200.819	412.212	CRACK Centre line
6515	7147299.492	513203.717	411.809	CRACK Centre line
6516	7147298.614	513206.563	411.371	CRACK Centre line
6517	7147298.047	513208.147	411.198	CRACK Centre line
6518	7147297.71	513209.492	411.058	CRACK Centre line
6519	7147296.886	513212.286	410.725	CRACK Centre line
6520	7147296.011	513215.049	410.377	CRACK Centre line
6521	7147295.076	513218.091	410.038	CRACK Centre line
6522	7147294.172	513220.738	409.728	CRACK Centre line
6523	7147293.401	513221.92	409.582	CRACK Centre line
6524	7147292.6	513222.763	409.456	CRACK Centre line
6525	7147290.767	513223.754	409.151	CRACK Centre line
6526	7147293.228	513223.316	409.417	CRACK Centre line
6527	7147292.457	513224.228	409.296	CRACK Centre line
6528	7147291.231	513224.792	409.121	CRACK Centre line
6529	7147299.283	513210.428	411.15	CRACK Centre line
6530	7147299.235	513210.756	411.094	CRACK Centre line
6531	7147299.021	513211.574	411.011	CRACK Centre line
6532	7147298.674	513213.934	410.751	CRACK Centre line
6533	7147298.243	513214.91	410.64	CRACK Centre line
6534	7147297.895	513215.711	410.507	CRACK Centre line
6535	7147297.529	513216.712	410.406	CRACK Centre line
6536	7147296.531	513217.956	410.24	CRACK Centre line
6537	7147296.249	513218.664	410.15	CRACK Centre line
6538	7147295.996	513219.337	409.953	CRACK Centre line
6539	7147295.529	513220.575	409.879	CRACK Centre line

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM

SEPTEMBER 2015

UTM COORDINATES

NAD 83, Zone 7, 141° West



Advisian

WorleyParsons Group

TENSION CRACKS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6540	7147295.034	513221.455	409.8	CRACK Centre line
6541	7147294.827	513222.581	409.677	CRACK Centre line
6542	7147297.07	513220.311	410.04	CRACK Centre line
6543	7147296.942	513221.111	409.967	CRACK Centre line
6544	7147296.702	513221.528	409.837	CRACK Centre line
6545	7147296.559	513221.877	409.856	CRACK Centre line
6546	7147296.533	513222.308	409.856	CRACK Centre line
6547	7147297.792	513220.905	410.029	CRACK Centre line
6548	7147297.749	513221.549	409.86	CRACK Centre line
6549	7147297.528	513222.196	409.876	CRACK Centre line
6550	7147297.352	513222.705	409.759	CRACK Centre line
6551	7147297.04	513223.467	409.776	CRACK Centre line
6552	7147298.477	513223.638	409.856	CRACK Centre line
6553	7147298.227	513224.326	409.58	CRACK Centre line
6554	7147297.977	513225.032	409.485	CRACK Centre line
6555	7147297.904	513225.282	409.652	CRACK Centre line
6556	7147297.715	513225.695	409.54	CRACK Centre line
6557	7147297.839	513226.195	409.401	CRACK Centre line
6558	7147297.764	513226.501	409.514	CRACK Centre line
6559	7147297.535	513227.004	409.309	CRACK Centre line
6560	7147297.392	513227.573	409.335	CRACK Centre line
6561	7147297.066	513228.293	408.821	CRACK Centre line
6562	7147296.943	513228.966	409.163	CRACK Centre line
6563	7147296.875	513229.646	408.985	CRACK Centre line
6564	7147296.85	513230.122	409.098	CRACK Centre line
6565	7147296.854	513230.422	408.917	CRACK Centre line
6566	7147296.848	513230.796	409.065	CRACK Centre line
6567	7147293.209	513234.887	408.493	CRACK Centre line
6568	7147293.173	513234.506	408.496	CRACK Centre line
6569	7147292.953	513233.819	408.541	CRACK Centre line
6570	7147292.745	513233.482	408.553	CRACK Centre line
6571	7147292.666	513233.072	408.562	CRACK Centre line
6572	7147292.907	513232.548	408.618	CRACK Centre line
6573	7147292.87	513232.13	408.651	CRACK Centre line
6574	7147293.086	513231.397	408.692	CRACK Centre line
6575	7147293.135	513230.851	408.756	CRACK Centre line
6576	7147293.1	513230.462	408.772	CRACK Centre line
6577	7147293.144	513230.12	408.848	CRACK Centre line
6578	7147293.453	513229.751	408.903	CRACK Centre line
6579	7147293.27	513229.407	408.906	CRACK Centre line
6580	7147293.222	513228.896	408.925	CRACK Centre line
6581	7147293.484	513228.274	409.045	CRACK Centre line
6582	7147293.781	513227.941	409.066	CRACK Centre line
6583	7147293.942	513227.364	409.116	CRACK Centre line
6584	7147294.273	513226.296	409.221	CRACK Centre line
6585	7147294.363	513226.109	409.261	CRACK Centre line
6586	7147294.363	513225.798	409.283	CRACK Centre line
6587	7147294.608	513225.379	409.346	CRACK Centre line
6588	7147294.706	513224.952	409.413	CRACK Centre line
6589	7147294.866	513224.66	409.494	CRACK Centre line
6590	7147295.024	513224.192	409.549	CRACK Centre line
6591	7147295.212	513224.006	409.576	CRACK Centre line
6592	7147295.231	513223.606	409.634	CRACK Centre line
6593	7147294.75	513238.86	408.351	CRACK Centre line
6594	7147294.824	513239.765	408.293	CRACK Centre line
6595	7147294.797	513240.934	408.232	CRACK Centre line
6596	7147294.585	513243.735	408.013	CRACK Centre line
6597	7147294.576	513244.324	407.966	CRACK Centre line
6598	7147294.478	513244.646	407.925	CRACK Centre line
6599	7147295.878	513245.153	407.811	CRACK Centre line
6600	7147295.823	513245.841	407.584	CRACK Centre line
6601	7147295.752	513246.294	407.735	CRACK Centre line
6602	7147295.743	513247.563	407.679	CRACK Centre line
6603	7147295.716	513247.973	407.51	CRACK Centre line
6604	7147295.911	513248.553	407.593	CRACK Centre line

CLINTON CREEK LONG TERM PERFORMANCE MONITORING PROGRAM

SEPTEMBER 2015

UTM COORDINATES

NAD 83, Zone 7, 141° West



Advisian

WorleyParsons Group

TENSION CRACKS				
POINT ID	NORTHING	EASTING	ORTHOMETRIC HEIGHT	COMMENT
6605	7147296.19	513249.24	407.383	CRACK Centre line
6606	7147296.11	513249.997	407.537	CRACK Centre line
6607	7147296.296	513251.116	407.26	CRACK Centre line
6608	7147294.2	513252.367	407.343	CRACK Centre line
6609	7147293.788	513253.58	407.237	CRACK Centre line
6610	7147293.649	513254.146	406.828	CRACK Centre line
6611	7147293.552	513254.376	407.164	CRACK Centre line
6612	7147293.336	513255.02	407.113	CRACK Centre line
6613	7147293.192	513255.749	407.069	CRACK Centre line

Appendix 4

Clinton Creek Trigger Summary



Government of Yukon Energy, Mines and Resources – Assessment and Abandoned Mines Clinton Creek Long-Term Monitoring Program 2015 Survey Results

Appendix 4 - Clinton Creek Trigger Summary

Table 1 Previously Reported Triggers

ID (Source Document)	Description	Trigger Value	2015 Value	Action	Status	Discussion
AR-1 (new)	Average horizontal movement of baseline from previous year	10 cm less the average reported accuracy of baseline shots	+0.09 cm/y	Develop mitigation plan	Not triggered	Horizontal accuracy of the baseline survey not to exceed ±5 cm
AR-2 (new)	Loss of embankment based on horizontal offset from previous year	1.0 m	0.35 m/y	Develop mitigation plan	Not triggered	---
AR-3 (new)	Total length of observed tension cracks	Increase by 20% from previous year	124 m	Develop mitigation plan	Not measured in 2014	Revisions to survey methodology required (refer to Recommendation AR-D)
AR-4 (new)	Average number of cracks observed perpendicular to each baseline pins	Increase by 20% from previous year	33% decrease	Develop mitigation plan	Not triggered	---
DS-1 (R22)	Change to drop structure geometry: steepened side slope	<2H:1V	2.7H:1V to 4.0H:1V	Develop mitigation plan for drop structures at which trigger has been exceeded	Not triggered	N/A
DS-2 (R22)	Change to drop structure geometry: minimum freeboard at design flow (R22)	<0.30 m	0.76 to 1.27 m	Develop mitigation plan for drop structures at which trigger has been exceeded	Not triggered	---



**Government of Yukon Energy, Mines and Resources – Assessment and Abandoned Mines
Clinton Creek Long-Term Monitoring Program
2015 Survey Results**

Appendix 4 - Clinton Creek Trigger Summary

ID (Source Document)	Description	Trigger Value	2015 Value	Action	Status	Discussion
DS-3 (R22)	Change to drop structure geometry: distance between monitoring points	>0.50 m	0.0 m to 0.5 m	Develop mitigation plan for drop structures at which trigger has been exceeded	Not triggered	Recommend that trigger value is changed to > 1.0 m per recommendation DS-I
DS-4 (R22)	Water flowing below the gabion baskets or undermining piping between DS1 and DS4	Visual evidence	---	Immediate appropriate repair prior to the end of the construction season	Not triggered	Repairs to drop structures completed in 2015 required diversion of creek; consequently, there was no flow to observe
DS-5 (R22)	Damage to gabion mesh	Visual evidence	---	Repair wire mesh and SPENAX rings as appropriate prior to the end of construction season	Repairs to all drop structures completed in 2015	---
DS-6 (new)	Change to cross-sectional end area since previous monitoring period	>10% RPC	-2.7 to +2.4%	Develop mitigation plan for drop structures at which trigger has been exceeded	Not triggered	---
CC-1 (R22)	Channel downcut over the 50 m channel segment downstream of DS4 to Sta. 0+250	>0.5 m (from 2006 baseline)	---	Begin planning for channel and waste rock stabilization	Triggered in 2010	Site-wide remediation planning is underway
CC-2 (R22)	Channel downcut over a measurable (>50 m) stretch of the channel downstream of Sta. 0+250	>1.5 m (from 2006 baseline)	---	Planning for channel and waste rock stabilization	Triggered in 2010	Site-wide remediation planning is underway



Government of Yukon Energy, Mines and Resources – Assessment and Abandoned Mines Clinton Creek Long-Term Monitoring Program 2015 Survey Results

Appendix 4 - Clinton Creek Trigger Summary

ID (Source Document)	Description	Trigger Value	2015 Value	Action	Status	Discussion
CC-3 (new)	Average channel deposition through upper/mid/lower creek section	>0.3 m from previous monitoring period	0.01 to 0.20 m (approx.)	Develop localized mitigation plan	Not triggered	---
CC-4 (new)	Mid-creek channel centerline shifts south, into the waste rock dump	>5 m (average) from previous monitoring period	-0.4 to 0.9 m south	Develop localized mitigation plan	Not triggered	---
WR-1 (new)	Average monitoring point horizontal movement rate – per slope section	Movement rate (cm/y) > than movement rate from previous cycle	Upper slope: +36%	<p>If movement rate increase is between 0 and 30%, monitoring points should be surveyed the following year.</p> <p>If movement rate increase is 30% or greater or if movement rate has increased over two consecutive years, begin planning for a geotechnical assessment (including drilling and modelling) to determine whether stabilization is required</p>	Triggered but potential for survey error and data variability have likely influenced the result, possibly resulting in a false exceedance	Geotechnical investigation should not be undertaken in 2016. Recommend trigger value is changed, per recommendation WR-F to: movement rate (cm/y) > movement rate from previous monitoring cycle plus standard deviation of all movement rates between 2003 and current year, exclusive of July to September 2010 rates



Government of Yukon Energy, Mines and Resources – Assessment and Abandoned Mines Clinton Creek Long-Term Monitoring Program 2015 Survey Results

Appendix 4 - Clinton Creek Trigger Summary

ID (Source Document)	Description	Trigger Value	2015 Value	Action	Status	Discussion
TP-1 (new)	Average monitoring point horizontal movement rate – per slope section	Movement rate (cm/y) > than movement rate from previous cycle	North Lobe, upper slope: -6%	<p>If movement rate increase is between 0 and 50%, monitoring points should be surveyed the following year.</p> <p>If movement rate increase is greater than 50% or if movement rate has increased over two consecutive years, begin planning for a geotechnical assessment (including drilling and modelling) to determine whether stabilization is required.</p>	Not triggered	Recommend trigger value is changed, per recommendation TP-F to: movement rate (cm/y) > movement rate from previous monitoring cycle plus standard deviation of all movement rates between 2003 and current year, exclusive of July to September 2010 rates

Appendix 5

Clinton Creek Monitoring Recommendations Summary



Government of Yukon Energy, Mines and Resources – Assessment and Abandoned Mines Clinton Creek Long-Term Monitoring Program 2015 Survey Results

Appendix 5 – Clinton Creek Monitoring Recommendations Summary

Table 1 Compilation of Recommendations

ID	Description	Implementation	Validity
AR-A (R51)	Monitor (i.e., inspect and survey) the tension cracks along the closed portion of the site access road on an annual basis.	Inspection and survey completed in 2015.	Valid – practice should continue.
AR-B (R104)	Install depth gauge at Clinton Creek Ford No. 1.	Completed – refer to recommendation AR-E below.	Requires re-establishment.
AR-C (new)	Extend the baseline to the north and south by 15 m.	Completed in 2015.	Completed.
AR-D (new)	Survey points recorded at the start, end, and changes in direction (greater than 30 deg.) of each tension crack.	Completed in 2015.	Valid – practice should continue.
AR-E (new)	Re-survey depth gauge at Ford Crossing No. 1 as part of 2016 LTMP to re-establish elevation.	To be implemented in 2016.	Required to determine whether ford crossing can be safely used based on water depth.
DS-A (R51)	Monitor (i.e., inspect and survey) drop structures on an annual basis.	Ongoing - inspection and survey of all drop structures completed in 2014 and 2015.	Valid – practice should continue.
DS-B (R104)	Undertake further geotechnical investigation and evaluation to provide a more in-depth discussion on possible causes for differing movement rates between the gabion monitors and waste rock dump monitors.	Not implemented.	Valid – should be completed prior to site-wide remediation.
DS-C (2014)	Install additional monitoring points along the waste rock dump toe aligned with the drop structures. A total of eight points should be installed with each point located 20 m south of the monitoring point on the south creek embankment.	Not completed due to construction activities. Should be implemented during 2016 LTMP survey.	Improve understanding of influence of waste rock movement on drop structures.



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Appendix 5 – Clinton Creek Monitoring Recommendations Summary

ID	Description	Implementation	Validity
DS-D (2014)	Establish new monitoring points and cross-section downstream of DS4 that can be safely accessed.	Not completed due to construction activities.	Not needed – DS4 repaired in 2015 requiring the re-establishment of new monitoring points (nos. 1462 to 1465) in 2016.
DS-E (2014)	Future survey should include the clear and explicit identification of break points (e.g., toe and top of embankment) through drop structure cross-sections and the edges of each course of gabion baskets along the drop structure centerline.	Implemented as part of 2015 survey.	To facilitate the measurement of drop structure cross-section parameters and the review of drop structure profiles.
DS-F (2014)	Change trigger DS-2 from <0.2 m freeboard to <0.3 m freeboard during conveyance of the 50-year peak flow and adopt revised design flows shown on Figure Nos. 1009 to 1012, Appendix 1.	Included on 2015 LTMP drawings.	To reflect revised peak flow depth and current hydraulic design practices.
DS-G (2014)	Change trigger DS3 to measure the drop structure width between the upstream and downstream monitoring points rather than at the upstream drawdown weir and between the downstream monitoring points.	Completed in 2015.	Only DS1 was installed with a drawdown weir.
DS-H (new)	Re-establish drop structure monitoring point Nos. 1462 to 1465.	To be implemented in 2016.	Require to monitor movement at DS4.
DS-I (new)	Change DS-3 trigger value to a change of drop structure width greater than 1.0 m.	To be implemented in 2016.	DS-2 downstream at trigger threshold and appears to be in stable condition.
CC-A (R51)	Environmental assessment to determine the impacts of stabilization measures at Clinton Creek Channel.	Not completed.	Valid – should be completed prior to site-wide remediation.
CC-B (R51)	Inspect and survey the Clinton Creek channel on an annual basis.	Inspection of channel up to confluence with Wolverine Creek and survey of upper and mid-creek portions of channel completed in 2015.	Refer to recommendation CC-H below.



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Appendix 5 – Clinton Creek Monitoring Recommendations Summary

ID	Description	Implementation	Validity
CC-C (R104)	Survey of cross-sections A-E along Clinton Creek should be completed on a biennial basis.	Should be completed as part of 2016 LTMP.	Valid – practice should continue.
CC-D (R104)	Install additional monitoring pins adjacent to where Clinton Creek has relocated closer to the waste rock area.	Completed in 2015.	Valid – refer to recommendation CC-G below.
CC-E (R104)	Complete geotechnical investigation of Clinton Creek waste rock dump.	Not completed.	Valid – should be completed prior to site wide remediation.
CC-F (2014)	Survey of Cross-Section F along Clinton Creek should be completed on a biennial basis.	Should be completed in subsequent LTMPs.	Survey required to compare cross-section to previous years and identify geomorphological/topographical changes.
CC-G (2014)	AAM should consider installing monitoring pins along south slope of Clinton Creek near Station Nos. 0+700, 0+800, and 0+900.	Completed in 2015.	Completed.
CC-H (New)	The upper creek (Sta. 0+200 to Sta. 0+680) and mid-creek (Sta. 0+680 to Sta. 0+913) portions of the channel should be surveyed annually, with the lower creek (Sta. 0+913 to confluence with Wolverine Creek) portion of the channel surveyed on a biennial basis.	Survey of upper creek and portion of mid-creek surveyed in 2015, upper, mid-, and lower creek portions should be surveyed as part of 2016 LTMP.	Lower creek is stable compared to upper and mid-creek portions of channel and does not require annual survey.
WR-A (R51)	Visual inspection of the waste rock dump should be completed on an annual basis with survey completed on a biennial basis.	Inspection and survey completed in 2015.	Valid – practice should continue.
WR-B (R104)	Trigger level for waste rock monitors should be further investigated and implemented.	Included in 2014 report.	Completed.
WR-C (2014)	Survey upper slope monitoring points in 2015 and compare to 2014 data.	Completed in 2015.	Completed.



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Appendix 5 – Clinton Creek Monitoring Recommendations Summary

ID	Description	Implementation	Validity
WR-F (New)	Excluded monitoring point BH-4 Cable from future LTMPs.	Should be implemented as part of 2016 LTMP.	BH-4 Cable cannot be surveyed consistently as it is not considered to be stable (i.e., it consists of a flexible cable rather than a piece of rebar driven into the ground).
WR-G (New)	Change WR-1 trigger value to: movement rate (cm/y) > movement rate from previous monitoring cycle plus standard deviation of all movement rates between 2003 and current year, exclusive of July to September 2010.	Should be implemented as part of 2016 LTMP.	Required to take into account survey error and movement variability.
TP-A (R104)	Visual inspection and survey of the Wolverine Creek tailings pile should be completed on a biennial basis.	Inspection and survey of the north upper lobe completed in 2015 with full survey of tailings pile completed in 2014.	Valid – but clarification required, refer to recommendations TP-C and TP-D below.
TP-B (R104)	Complete geotechnical investigation and assessment of the north and south lobes of the Wolverine Creek tailings pile.	Not completed.	Valid – required to improve understanding of variance in average movement rates between north and south lobes; however this investigation is not considered urgent (i.e., required within the next year) and can be completed prior to site wide remediation unless required sooner due to tailings slope acceleration (see above).
TP-C (2014)	Visual inspection of the Wolverine Creek tailings pile should be completed on an annual basis.	Completed in 2015.	Required to identify visible tension cracks and slumping to determine if further investigation is required in that year.



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Appendix 5 – Clinton Creek Monitoring Recommendations Summary

ID	Description	Implementation	Validity
TP-D (2014)	Survey of the Wolverine Creek tailings pile should be completed on a biennial basis.	North upper lobe completed in 2015, full survey to be completed in 2016.	Required to monitor movement rates through the tailings pile.
TP-E (New)	Change TP-1 trigger value to: movement rate (cm/y) > movement rate from previous monitoring cycle plus standard deviation of all movement rates between 2003 and current year, exclusive of July to September 2010.	Should be implemented as part of 2016 LTMP.	Required to take into account survey error and movement variability.
SP-A (New)	Do not establish monitoring points at the top of Snowshoe Pit.	Not applicable.	The top of the pit is not easily accessible and monitoring movement at these locations provides limited value.
SP-B (New)	Visual inspection of the Snowshoe Pit should be completed on an annual basis with survey of the two monitoring pins at the bottom of the pit completed on a biennial basis.	Inspection and establishment of the two monitoring pins completed in 2015.	Valid - practice should continue.