# GOVERNMENT OF YUKON

# CLINTON CREEK CHANNEL STABILIZATION (STAGE 3) CONSTRUCTION REPORT

**Prepared for:**
**Government of Yukon**

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**Attention: Mr. Hugh Copland, P.Eng., P.Geo.**

**Reference Former Clinton Creek Asbestos Mine – Clinton Creek Channel Stabilization (Stage 3) - Construction Report**

Enclosed are eight copies of our construction report summarizing the channel stabilization works completed in the summer of 2004 at the former Clinton Creek Asbestos Mine. The work undertaken between July 11 and September 4, 2004 includes constructing the third and fourth drop structures downstream of the Hudgeon Lake outlet. These repairs constitute the third and final stage of the planned channel stabilization work undertaken to mitigate the concerns related to a breach of the waste rock blockage which forms the Hudgeon Lake outlet. Some maintenance of the channel stabilization works is expected, particularly after the 2005 spring freshet event.

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

Yours truly,

**UMA ENGINEERING LTD.**

Tom Wingrove, P.Eng.
Regional Vice President
GR/dh

Larry Bielus, M.Sc.
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# 1 INTRODUCTION

This report summarizes the channel stabilization work completed in the summer of 2004 at the former Clinton Creek Asbestos Mine in the Yukon Territory. This was the third and final stage of the planned Clinton Creek channel stabilization work within the first 200 metres of the channel downstream of Hudgeon Lake. The work was undertaken to help mitigate the downstream hazards associated with a sudden breach of the Hudgeon Lake outlet.

The design of the channel stabilization works included the installation of four gabion drop structures within the first 200 metres of the channel downstream of the lake outlet. In the fall of 2002, the first stage of these repairs was undertaken, which included the construction of Drop Structure #1 and re-grading of the Hudgeon Lake outlet (UMA 2003a). The second stage was undertaken in the summer of 2003 (UMA 2003b) during which Drop Structure #2 was completed. Wet weather in early September and the late fall weather at the end of September precluded construction of the remaining two drop structures in 2003. The last two structures were constructed in 2004.

# 2 HISTORICAL SUMMARY

The former Clinton Creek Asbestos Mine is located about 100 km northwest of Dawson City in the Yukon Territory, 9 km upstream of the confluence of Clinton Creek and the Forty Mile River. The mine consists of three open pits (Porcupine, Creek and Snowshoe), two waste rock dumps (Porcupine Creek and Clinton Creek) along the south side of Clinton Creek, and a tailings pile on the west side of Wolverine Creek (Figure 2-1). From 1968 until depletion of economic reserves in 1978, the Cassiar Mining Corporation extracted approximately 12 million tonnes of serpentine ore from the bedrock.

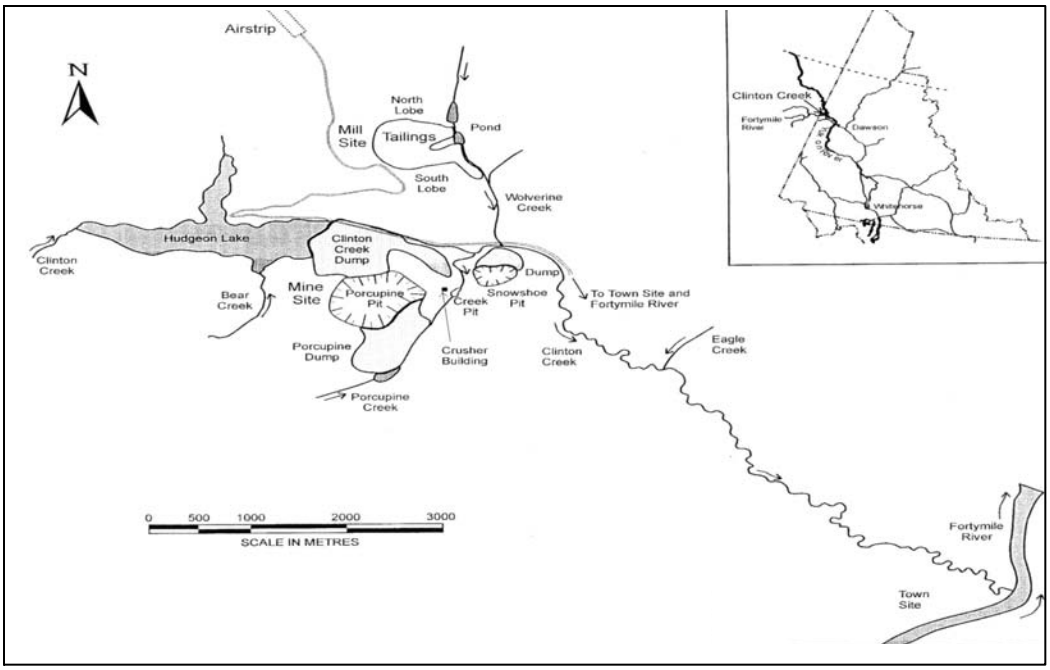


**Figure 2-1) Abandoned Clinton Creek Asbestos Mine Site**

Over 60 million tonnes of waste rock from the open pits was deposited over the south slope of the Clinton Creek valley at a location referred to as the Clinton Creek waste rock dump. The ore was transported by an aerial tramway to the mill located on a ridge along the west side of Wolverine Creek, a tributary of Clinton Creek. Over the same period of time, about 10 million tonnes of asbestos tailings from the milling operation were deposited over the west slope of the

Wolverine Creek valley (Wolverine Creek tailings piles). Since closure of the asbestos mine, concerns have been raised with respect to the physical condition of the site, in particular downstream hazards associated with breaching of the Hudgeon Lake outlet and channel blockages resulting from landslides of the Clinton Creek waste rock dump and Wolverine Creek tailings piles.

With respect to the potential for a breach of the waste rock, the most immediate concern is the integrity (stability) of the existing creek channel at the Hudgeon Lake outlet. Profiles of the creek channel from 1986, 1999 and 2001, showed that continued channel erosion was deepening (down-cutting) the channel from just downstream of the outlet to about 500m downstream of the outlet. As down-cutting continues, the toe of the waste rock pile is undercut and localized slope instabilities develop. The unstable waste rock slumps into the channel and temporarily blocks creek flow. In most instances, this material is quickly overtopped and transported downstream and deposited in the Clinton Creek channel downstream of the mine. As the down-cutting gradually retrogresses towards the outlet, conditions may quickly develop where normal flow and/or an overtopping event could trigger a full scale breach of the waste rock at the Hudgeon Lake outlet. The consequences of a breach and rapid draining of Hudgeon Lake are discussed in UMA's Risk Assessment Report (UMA 2000).

# 3 CHANNEL STABILIZATION (Stage 3)

## *3.1 Introduction*

The objective of Stage 3 was to complete the remainder of the planned creek stabilization work in the 2004 construction season (i.e. construct Drop Structures 3 and 4). Construction was again undertaken by Hän Construction Ltd. from Dawson City, Yukon. Hän Construction Ltd. is owned by Chief Isaac Inc., which is a business unit of the Tr'ondëk Hwëch'in First Nation. The work was completed under a contract between the Government of Yukon – Energy, Mines and Resources (GY-EMR) and the Tr'ondëk Hwëch'in First Nation. Resident inspection services were provided by UMA Engineering.

The potential for airborne asbestos fibres to be present during construction was determined to be low risk based on the air monitoring results completed during the first two stages of the work. This is mainly due to the lack of asbestos fibres in this area of the mine site. A Health and Safety Plan (Appendix A) was developed for the creek stabilization work and the demolition work that was also completed in 2004. Air monitoring test results from the Stage 1 and 2 channel stabilization work indicated that the levels of airborne fibres were well below the allowable limit of 0.5 fibres per ml for an 8-hour exposure period. Air monitoring completed in 2004 as part of an overall air quality testing program confirmed that the levels of airborne asbestos are below the allowable limit of 0.5 fibres per ml for an 8-hour exposure period. The results of the 2004 air monitoring program have been provided in a separate report to the Government of Yukon, a summary of the test results is provided in Appendix B.

The specifications for this work are included in Appendix A. A copy of the original Letter of Advice provided by the Department of Fisheries and Oceans (DFO) approving the proposed work and the 2004 Land Use Permit issued to the Government of Yukon is included in Appendix C.

## 3.2 Construction Activities

General Construction activities included:

- Installation of a cofferdam at the Hudgeon Lake outlet (Photograph 3-1),
- Fish salvage from the cofferdam down to Wolverine Creek (Photograph 3-2),
- Preparation of the drop structure foundation which included removing boulders and deleterious materials from the creek channel and sub-cutting, backfilling and shaping the creek channel to the design grades (Photographs 3-3, 3-4, 3-8 and 3-9),
- Construction of two gabion drop structures (Photographs 3-5, 3-6 and 3-10 to 3-13),
- Backfilling the channel between the drop structures (Photograph 3-7),
- Restoring flow through the lake outlet into Clinton Creek (Photographs 3-13 & 3-14) and,
- General site grading and restoration (Photograph 3-15).

The work completed during each week of the project is briefly described below and in the Weekly Project Reports included in Appendix D. Table 3-1 summarizes the approximate number of working days for each drop structure. Table 3-2 summarizes the construction materials used and remaining at the completion of the work. Selected photographs have been included in this report (Photographs 3-1 to 3-15) and a complete set of digital photographs has been also been appended on a Compact Disc. The record drawings for the work are included in Appendix E. For completeness, the record drawings for all four drop structures have been included.

**Table 3-1) Working Days**

| Work Task | Time (days) |
|---|---|
| Drop Structure #3 Construction | 16 |
| Drop Structure #4 Construction | 17 |
| **Total Days** | **33** |

**Table 3-2) Construction Material Inventory**

| Item | Quantity Delivered | | Quantity Used | *Quantity Remaining |
|---|---|---|---|---|
| | 2003 Stock | New | | |
| Gabion Baskets<br>n x 0.5m – PVC coated | 683 | 0 | 551 | 132 |
| Gabion Baskets<br>3m x 1m x 0.3m – PVC coated | 40 | 0 | 30 | 10 |
| Non-Woven Geotextile<br>(ARMTEC 350) 418 $m^2$ per roll | 14 | 0 | 11 | 3 |
| Pneumatic Staple Guns (used for assembling baskets) | 2 | 0 | 2 | 2 |
| Manual Staple Gun | 1 | 0 | 1 | 1 |
| Stainless Steel Rings | 30 | 15 | 35 | 10 |
| HDPE culvert pipe (6m x 0.2m) | 6 | 0 | 0 | 6 |
| HDPE culvert pipe couplers | 4 | 0 | 0 | 4 |
| Gabion Fill ($m^3$) | 1,500 | 0 | 1,175 | 325 |
| 75mm down gravel fill ($m^3$) | 1,000 | 0 | 625 | 375 |
| 200mm over rip rap ($m^3$) | 200 | 100 | 150 | 150 |

*Note: The geotextile, culverts and gabion staples have been stored at Gillespie Equipment Rentals in Dawson City, YT. The staple guns are stored at Hän Construction Ltd.

Week 1 (Report 01 – week ending July 17)

The construction camp was setup by the first week of June and the equipment was mobilized to site in early July. The construction equipment mobilized to site included a D7 Caterpillar bulldozer, a 966C Caterpillar loader, a 320L Caterpillar excavator, a tandem dump truck and a self-propelled vibratory drum compactor. Work completed during the first week of work included installing the cofferdam, fish salvage, topping off some baskets in Drop Structure #2 and preparation of the foundation for Drop Structure #3.

Week 2 (Report 02 – week ending July 24)

The first two tiers of Drop Structure #3 were installed over 5 working days. Work was stopped for two days due to wet weather and site conditions.

Week 3 (Report 03 – week ending July 31)

The final three tiers of gabion baskets were installed to complete Drop Structure #3 and the channel between Drop Structures 2 and 3 was backfilled. The cofferdam was removed on July 30 as the lake was rising due to the precipitation events. The creek stabilization work was halted to allow Hudgeon Lake to drawdown.

Weeks 4 and 5 (Reports 04 & 05 – weeks ending August 7 & 14)

The majority of the work completed during these two weeks was related to the demolition activities scheduled for the summer of 2004. Work related to the creek stabilization included hauling oversize rock from the quarry to the work site and pre-assembling gabion baskets.

Week 6 (Report 06 – week ending August 21)

Work completed during the sixth week included installing the cofferdam, fish salvage and preparation of the foundation for Drop Structure #4.

Week 7 (Report 07 – week ending August 28)

Work completed during the seventh week included installation of Tiers 1 and 2 for Drop Structure #4.

Week 8 (Report 08 – week ending September 4)

The remaining four tiers of gabion baskets were installed to complete Drop Structure #4, the channel between Drop Structures 3 and 4 was backfilled and channel armouring at the downstream end of the drop structure was installed. The cofferdam was removed on September 4.

## 3.3 Fish Salvage and Habitat

In accordance with the work plan and Letter of Advice provided by DFO in 2002 (Appendix C), a fish salvage operation was completed between the Hudgeon Lake outlet and Wolverine Creek. Removal of the cofferdam was undertaken in a manner to reduce sediment load. The bulk fuel storage tank was located in a pit lined with a geomembrane.

Two fish salvage operations were undertaken in 2004, each occurring after installation of the cofferdam. The fish salvage work was conducted on July 13 and August 19 to recover fish trapped in the creek channel between the cofferdam and the beaver dams just upstream from Wolverine Creek. Approximately 500 fish were salvaged during the July 13 operation and another 700 fish were salvaged during the August 19 operation. During the first few days following the fish salvage the creek was re-walked to recover fish missed during main salvage work. Fish passage back into creek channel upstream of the beaver dams was blocked both by the beaver dams and natural creek channel features. A report on the fish salvage operation has been prepared by Hugh Copland (GY) and has been included in Appendix F.

The sediment load generated during removal of the cofferdam was minimal because of the low lake level (400mm deep behind the dam) that allowed the majority of the cofferdam to be removed under zero flow conditions. Water flowing through the new outlet from Hudgeon Lake began to run clear within 20 to 30 minutes of restoring the flow. The sediment load in the creek channel was also reduced by the presence of beaver dams and marsh areas downstream of the waste rock pile.

## 3.4 Control of Water

The creek stabilization measures were constructed under zero flow conditions using Hudgeon Lake as a water storage basin during construction. To maximize the construction window the lake level was allowed to drop naturally to within about 300mm of the lake outlet invert elevation and then a cofferdam was constructed across the lake outlet using argillite waste rock material. Some seepage of water through the adjacent waste rock pile typically occurs and this was dealt with by installing a granular blanket drain below the base of the lower level of gabion baskets in each drop structure (Photographs 3-4 and 3-9).

Low precipitation amounts in June and most of July allowed Hudgeon Lake to drain naturally down to elevation 411.3m before installing the cofferdam on July 13. Between July 13 and July 21, the lake level remained very stable near elevation 411.3 m. Precipitation events in the latter 10 days of the month necessitated removal of the cofferdam after Drop Structure #3 was finished because the lake was rising at a rate that would not allow an adequate construction window for Drop Structure #4. The cofferdam was re-installed on August 19 for construction of the last drop structure. No significant rain events occurred during construction of Drop Structure #4 and the lake level only increased by about 180 mm before the cofferdam was removed. A summary of the lake levels observed during the creek stabilization work is included in Appendix G.

# 4 DROP STRUCTURE PERFORMANCE AND MAINTENANCE

## 4.1 Drop Structure Performance

Some settlement of Drop Structure #1 occurred during the spring freshet event in 2003. As described in the Stage 2 Construction Report (UMA 2003b), these movements are believed to be associated with the scour hole which formed at the downstream end of the structure during the spring 2003 freshet. This problem was alleviated in subsequent drop structures by adding a third row of baskets to the lower tier of each drop structure. Some localized scouring of gabion fill from the baskets has been observed following the first spring freshet event for each structure. The scouring typically occurs on the flat section of each tier of baskets and is related to the high flows (i.e. higher energy) of the spring freshet event which results in some consolidation and re-positioning of the gabion fill and the loss of some smaller gabion fill particles which are less than about 75mm in diameter. This problem is alleviated by opening the baskets which have been scoured out and topping them off with gabion fill that is at least 100mm in diameter.

Drop Structures 1 and 2 appear to have performed well over the last year. Drop Structure 1 does not appear to have undergone any significant movements since Drop Structure 2 was completed in 2003, which provides water level control at the downstream end of Drop Structure 1. Some scouring of gabion fill was observed in about 15 to 20 of the gabion baskets in Drop Structure 2, these baskets were opened and topped off.

## 4.2 Inspection, Maintenance and Monitoring

### 4.2.1 Inspection

Maintenance of the drop structures and channel armouring will be required to maintain the long term serviceability of the creek channel stabilization measures. Annual inspections of the channel stabilization works should be undertaken and any required maintenance should be completed promptly. Ideally the inspection would occur in late May to early June after the spring freshet event has passed.

Some maintenance will likely be required after the 2005 spring freshet event, particularly for the works completed in 2004. It is expected that some scouring of the gabion fill from Drop Structures 3 and 4 will occur and there may be some re-adjustment of the channel armouring installed at the downstream end of Drop Structure 4. This channel armouring provides a transition between the drop structures and the existing channel. The main function of the armouring is to prevent undermining of Drop Structure 4 so it is important to maintain its integrity.

### 4.2.2 Long-Term Maintenance

The long-term maintenance requirements presented in the Stage 2 Construction Report (UMA 2003b) are repeated here for completeness. The frequency of maintenance to the drop structures as a result of the environmental conditions that the gabions and the rock fill are exposed to and / or the potential movements of the waste rock pile across the stabilized portion of Clinton Creek has yet to be determined. The gabion baskets are coated with PVC to provide an additional layer of protection against damage to the galvanized wire during construction and also to provide additional protection against corrosion of the galvanized wire. Although there is no published information, the manufacturer of the baskets (Maccaferri Canada) indicated that they use a conservative design life of 35 years for the PVC coated galvanized wire baskets. They suggested that the baskets below the water line are at a lower risk to corrosion. Their experience has shown that the baskets do not undergo widespread corrosion, dependent on the environmental conditions of course, but localized corrosion problems may develop which can be repaired by placing a patch over the affected area. The patch is made up of the same material as the baskets with edges of the patch fastened to the existing baskets that are not showing signs of corrosion.

The rock for the gabion fill was selected because it was the best available material within the local area. However, over the long term the gabion fill material may be affected by freeze-thaw cycles that can break down the rock. It is not certain how resistant this rock will be to freeze-thaw cycles. There is also a possibility that ice wedges (referred to locally as 'glaciers') may form under the gabion baskets due to water seeping out from the waste rock pile. There were no signs of this effect observed at Drop Structure 1 in the winter of 2002/2003. Should this

phenomenon occur, it is anticipated that the flexibility of the gabion basket drop structures will accommodate the associated movements.

### 4.2.3 Movement Monitoring

The waste rock pile across the stabilized portion of the channel should be monitored to determine if the drop structures are being compressed (i.e. squeezed) laterally by creep movements of the waste rock pile. This can be accomplished by measuring across the drawdown weir of each drop structure, as shown on Drawing 01 in Appendix G. The initial (i.e. baseline) measurements for Drop Structures 1, 2, 3 and 4 are provided in Appendix G. Suspected movements of the waste rock pile based on the drop structure measurements can be checked by surveying the movement monitors located across the waste rock pile. Based on the waste rock monitoring to date it is believed that the waste rock movements are on the order of about 5 to 10cm per year and may be decreasing with time (UMA 2003). The waste rock movement monitoring program was expanded in 2003 and re-surveyed in 2004. A separate report has been prepared which includes a summary of the monitoring results.

Respectfully Submitted,

**UMA ENGINEERING LTD.**

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

# REFERENCES

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

UMA Engineering Ltd., 2003a. "Indian and Northern Affairs, Clinton Creek Channel Stabilization (Stage 1) Construction Report, – April 2003."

UMA Engineering Ltd., 2003b. "Government of Yukon, Clinton Creek Channel Stabilization (Stage 2) Construction Report, – December 2003."

**Photographs**

Photograph 3-1) Installing the cofferdam.

Photograph 3-2) Fish salvage operation.

Photograph 3-3) Preparing sub-grade for Drop Structure 3.

Photograph 3-4) Sub-grade prepared for Tier 1 of Drop Structure 3.

Photograph 3-5) Drop Structure 3: Tiers 1 to 4 installed.


Photograph 3-6) Placing gravel base for the last tier of baskets in Drop Structure 3.

Photograph 3-7) Backfilling channel upstream of Drop Structure 3.

Photograph 3-8) Access to Drop Structure 4 prepared.

Photograph 3-9) Blanket drain and base for Drop Structure 4 installed.

Photograph 3-10) Installing Tier 1 baskets for Drop Structure 4.

Photograph 3-11) Preparing base for Tier 3 baskets of Drop Structure 4.

Photograph 3-12) Drop Structure 3 and 4 completed.

Photograph 3-13) Channel flow re-instated following completion of Drop Structure 4.

Photograph 3-14) Downstream end of Drop Structure 4.

Photograph 3-15) Aerial view of completed channel stabilization works.

# Appendix A – Construction Specifications and Health and Safety Plan

# Appendix B – Air Monitoring Results

**Appendix C – Letter of Advice From DFO**

**and**

**Land Use Permit**

# Appendix D – Weekly Project Reports

**Appendix E – Record Drawings**

**Appendix F – Fish Salvage Report**

# Appendix G – Hudgeon Lake Levels
# and
# Drop Structure Monitoring