Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

Project Description

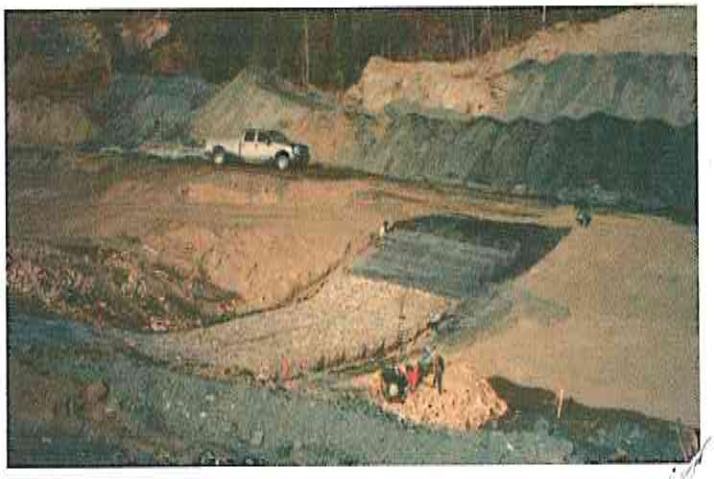
For

Abandoned Clinton Creek Asbestos Mine Creek Channel Stabilization

Stage 2

DRAFT

Prepared by:
Indian and Northern Affairs Canada
Northern Affairs Program, Yukon Region
Waste Management Program
May 2003



Canada

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APPENDICES

1.0 Introduction

1.1 OBJECTIVES

Under the direction of the Project Manager, Yukon Government – Energy, Mines and Resources the DIAND Waste Management Program is proposing the continuation of channel stabilization at the abandoned Clinton Creek Asbestos Mine. The stabilization of the creek channel will be achieved by constructing additional *gabion weirs* [1] below the outflow of Hudgeon Lake, a reservoir created by a massive slope failure of waste rock in 1974.

Concerns with respect to the physical conditions at the site have existed since the closure of mine operations in 1978 and the site and creek channel have been monitored by DIAND Water Resources on a regular basis. Recent investigations (Royal Roads University, 1999; UMA, 1999 and 2000) have confirmed the observations by DIAND Water Resources that continuing down-cutting of the Clinton Creek channel and erosion of the unstable waste rock may cause the waste rock dam to fail. A sudden breach of the landslide dam and subsequent flooding could expose individuals, property and the downstream environment to various degrees of risk.

The physical instability and environmental issues at the Clinton Creek Mine have been discussed with the Department of Fisheries and Oceans, Yukon Salmon Committee, Tr'on Dëk Hwëch'in, DIAND Land and Water Resources and other stakeholders. The consensus of these consultations was that the stabilization of the outflow channel near the reservoir is a priority to reduce the immediate threat of a breach. The construction of several gabion structures presents a cost-effective solution (UMA, 2002). To remediate 350 metres of the Clinton Creek channel downstream of the outlet, approximately six gabion structures will have to be constructed (drop structure no.1 was built in 2002) and waste rock slopes along the creek channel will have to be graded.

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1 *Gabion Structures* are arrays of rock-filled baskets of wire mesh, designed to reduce and disperse the destructive force of fast flowing water.

1.2 BACKGROUND

The abandoned Clinton Creek asbestos mine is located about 100 km northwest of Dawson City, Yukon, 9 km upstream of the confluence of Clinton Creek and the Forty Mile River. The mine site is accessible from Dawson City via the Top of the World Highway, the Clinton Creek road, and an access road from the former Clinton Creek town site. From 1968 to 1978, the Cassiar Asbestos Corporation Ltd. extracted approximately 12 million tonnes of serpentine ore from the bedrock and produced 60 million tonnes of waste rock and 10 million tonnes of tailings. Ore was taken from open pits located on the south side of Clinton Creek and transported via a cable tramway to the mill site on a ridge on the north side of the Clinton Creek valley. The asbestos fibre was then transported by truck to Cassiar, B.C. for further processing. Waste rock and tailings were deposited on valley slopes near the open pits and the mill respectively. The affected mine site area consists of three open pits (Porcupine, Creek and Snowshoe), two waste rock dumps (Porcupine and Clinton Creek) and a tailings pile on the west side of Porcupine creek **(Figure 1)**.

A significant slope failure of the Clinton Creek Dump occurred in 1974, blocking the natural drainage of Clinton Creek and creating a land slide dam and a reservoir now referred to as Hudgeon Lake. The surface area of Hudgeon Lake has been estimated at 115 ha, the maximum depth at 27 m, and the volume at 12 million cubic metres of water (Royal Roads University, 1999). Waste rock placement and instabilities also blocked the natural drainage of Porcupine Creek, creating a small reservoir upstream. The tailings deposited near the mill site also failed and two lobes created partial and intermittent blockage of Wolverine Creek. Both Porcupine and Wolverine creeks are tributaries to Clinton Creek.

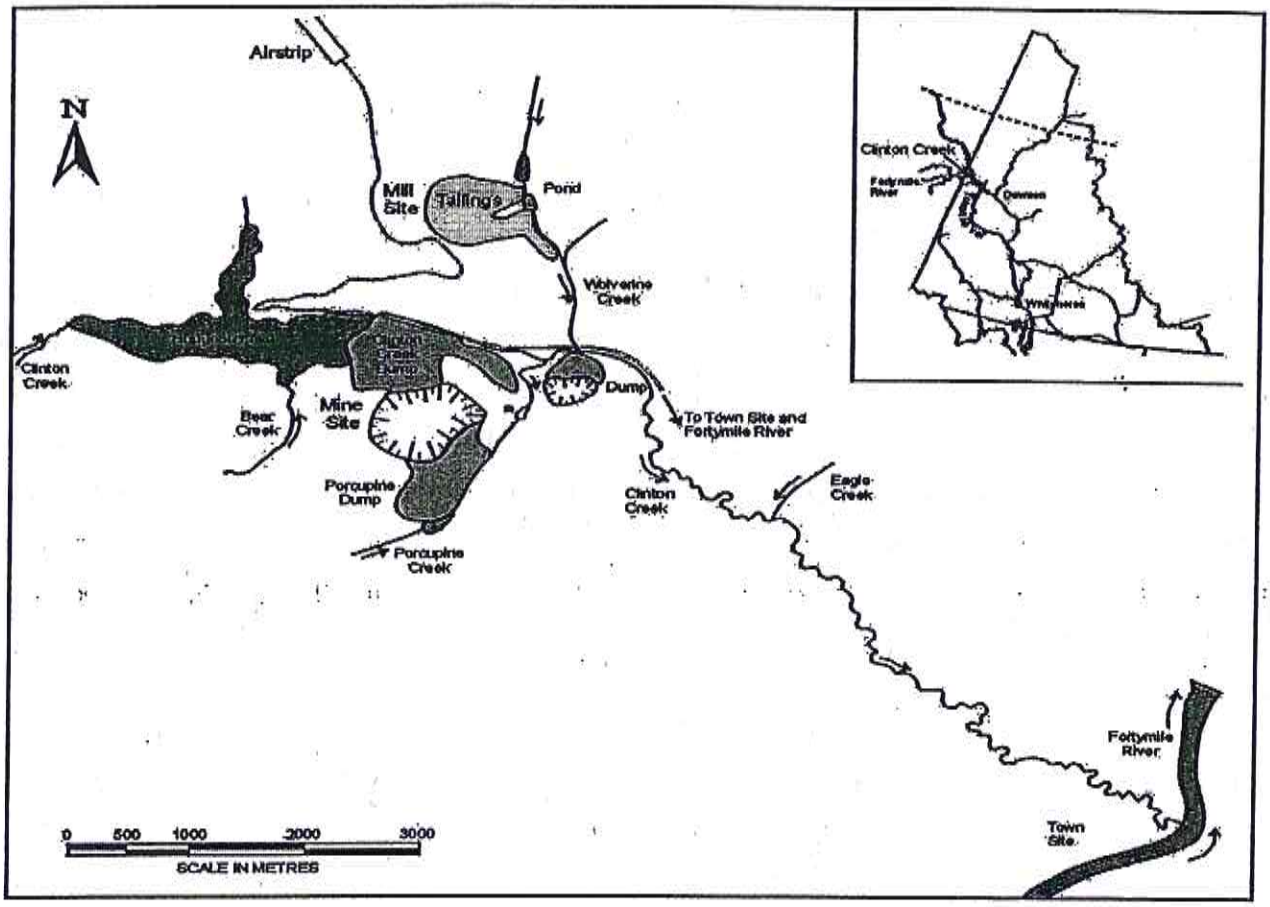


Figure 1: Location Plan (Royal Roads University, 1999)

During 1998/99, DIAND Waste Management initiated an extensive environmental review and a risk assessment (Royal Roads University, 1999 and UMA, 2000). The studies concluded that existing and future conditions at the abandoned Clinton Creek Asbestos Mine have the potential to expose individuals, property and the environment to various degrees of risk associated with downstream flooding, channel sedimentation and chronic redistribution of eroded waste rock and tailings. These risks can be broadly placed into public safety and ecological and health risk categories as presented by DIAND Waste Management and UMA Engineering Ltd. at a public information session in Dawson City, Yukon in 2001:

Public Safety

In terms of public safety, the level of risk downstream of the mine site has been categorized as high, medium or low based on the severity of flooding in each zone. The inherent risk to humans and the potential for loss-of-life is dependent upon the likelihood of exposure (occupancy) within these zones. The potential for loss-of-life is greatest immediately downstream of the mine site in the area potentially inundated by a breach of the waste rock pile, or within the Wolverine Creek valley in the event of a breach of tailings blockage. Farther downstream along Clinton Creek, the risks are reduced, as the high water levels will be confined to the creek valley below the road where human exposure is less likely. The risk is considered low at the next most likely downstream area of occupancy in the vicinity of the Clinton Creek Town-site where the valley widens considerably.

Ecological and Health Risks

Aquatic life and mammals downstream of the mine site are potentially at risk from the redistribution of eroded waste rock and tailings. The largest risk is believed to be from a sudden breach of the waste rock dam resulting in fisheries and habitat loss through downstream smothering and flooding. The impact of asbestos fibres in water on aquatic life has not been ascertained and is not well researched. Available literature does suggest however, that water-borne asbestos has little if any toxicity to aquatic organisms or mammals through the ingestion of water. Chronic risks from the mobilization and release of dissolved metals or other substances to the water appear to be unlikely.
Human health risks associated with possible inhalation of asbestos fibres during occasional site visits have not been quantified although it has been recognized that a crust formed on the surface of the tailings has reduced air-borne transmission of fibres.

Actions by DIAND Waste Management to date have included the direct notification of all known stakeholders and some media coverage. Warning signs are installed at key highway and access road locations to notify travellers and other users in the area of the potential hazard. As the lead agency, DIAND Waste Management has actively worked with other government departments and consultants to investigate possible mitigation methods, which led to the construction of the first drop structure and

modification work at the outlet of Hudgeon Lake in 2002. The first phase of stream channel stabilization was successfully undertaken in the fall of 2002 at the Hudgeon Lake outlet. The work was completed under a Contribution Agreement between DIAND and the Tr'on Dëk Hwëch'in First Nation with the use of local work force and sub-contractors. Site supervision was provided by UMA Engineering and DIAND Waste Management.

1.3 Waste Rock Movement

The instability of the Clinton Creek waste rock dump has been recognized while the mine was still in operation and records of waste rock movement exist from 1976 until 1986. Routine site inspections and waste rock movement monitoring carried out in 1999, 2000 and 2001 have indicated that the Clinton Creek waste rock dump has still not reached equilibrium conditions (GEO-Engineering Ltd., 2000). Horizontal movements over time are summarized in **Figure 2.**

Over the two year period from July 1999 to June 2001, annual horizontal movements ranging from one to eleven centimetres, or an average annual rate of seven centimetres were observed. Over the same time period, the average rate of vertical settlement appears to be in the order of seven centimetres. The movements confirm previous observations that waste rock pile movements are small (in comparison to movements prior to 1986) and may be referred to as creep movements.

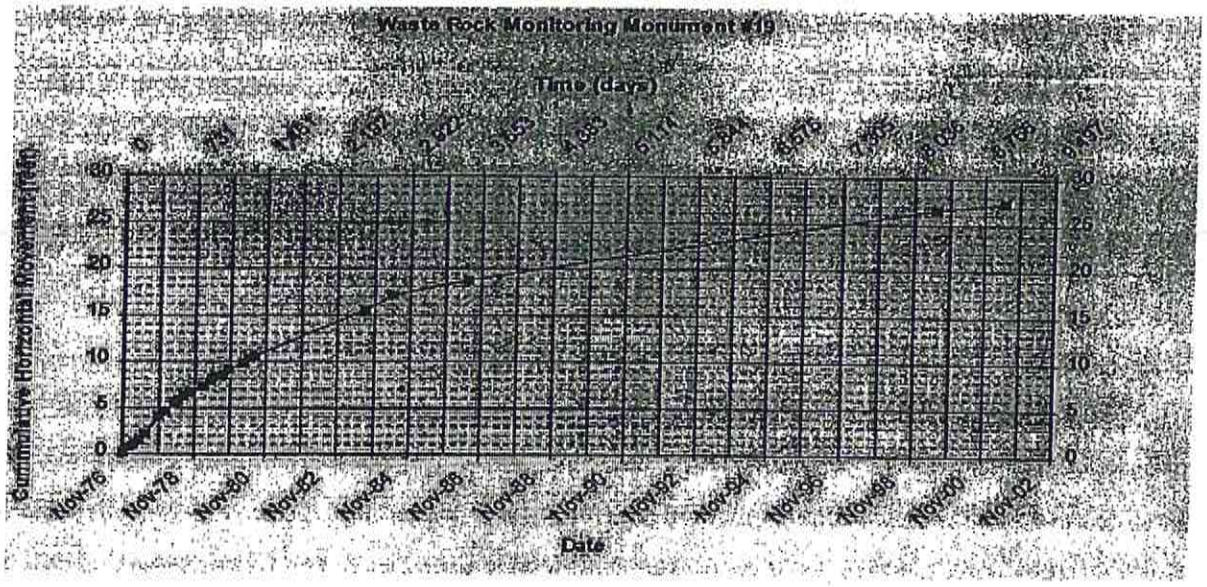


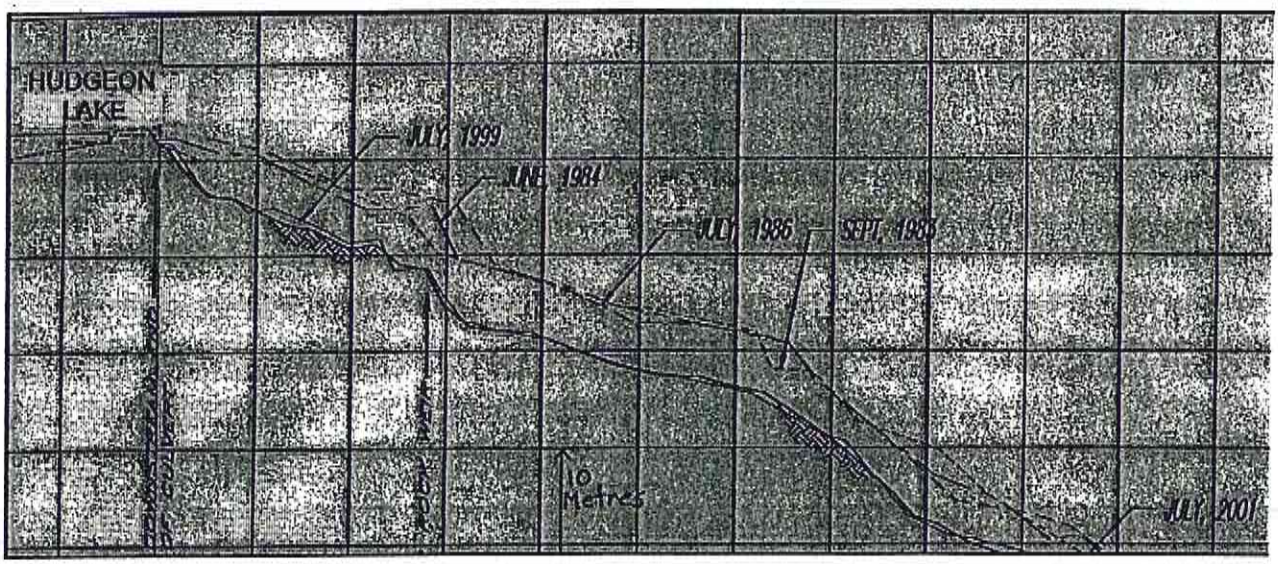
Figure 2: Waste Rock Dump Movements (UMA Engineering Ltd., 2002)

Channel stabilization measures must accommodate anticipated creep movements. The stabilization of the waste rock may however, be deferred until the channel stabilization is complete and additional data for waste rock movement becomes available.

Because the channel stabilization works involve partial infilling of the existing channel, it is possible that the observed horizontal creep movements may be reduced or possibly halted (UMA, 2002).

1.4 Creek Channel

It is believed that the most immediate concern with respect of the potential for a catastrophic breach of the waste rock is the integrity (stability) of the existing creek channel at the Hudgeon Lake outlet. Comparing creek channel profiles in 1986, 1999 and 2001, it is clear that continued channel erosion is deepening



(down-cutting) the channel a distance of about 500 m from just downstream of the outlet (**Figure 3**).

Figure 3: Clinton Creek Channel Profiles (modified from UMA Engineering Ltd., 2002)

The existing channel through the waste rock dump is approximately 800 m long and up to 18 m below the existing road near the middle of the waste rock dump. Side slopes on the waste rock are generally at or

steeper than one horizontal to one vertical (1H:1V). The creek has cut its way into the bedrock consisting of clay shale (argillite) from about 350 m downstream of the outlet to the lower reaches of the channel through the waste rock. The waste rock is generally a well graded material consisting of silt, sand, gravel, cobbles and occasional boulders.

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 the flow of the creek. In most instances, this material is quickly overtopped and transported and deposited downstream. As the down-cutting gradually retrogresses towards the outlet however, conditions may quickly develop where normal flow and /or an overtopping event could trigger a full scale breach of the waste rock. The consequences of a breach and rapid draining of Hudgeon Lake are discussed in UMA's Risk Assessment Report (UMA, 2000).

1.5 Land Tenure

The abandoned Clinton Creek Mine Site is on private property with the land title under Cassiar Asbestos (Lot 102, Group 1101). **Figure 4** shows the approximate extent of the property in relation to Hudgeon Lake and the proposed construction area.

Placer claims at the confluence of Wolverine Creek and Clinton Creek have expired and no renewals have been filed with the Dawson mining recorder as of June 27, 2002.

Throughout the property there are a number of quartz claims, mostly held by the Cassiar Mining Corporation. At this time however, there are no mining or exploration activities taking place in the area.

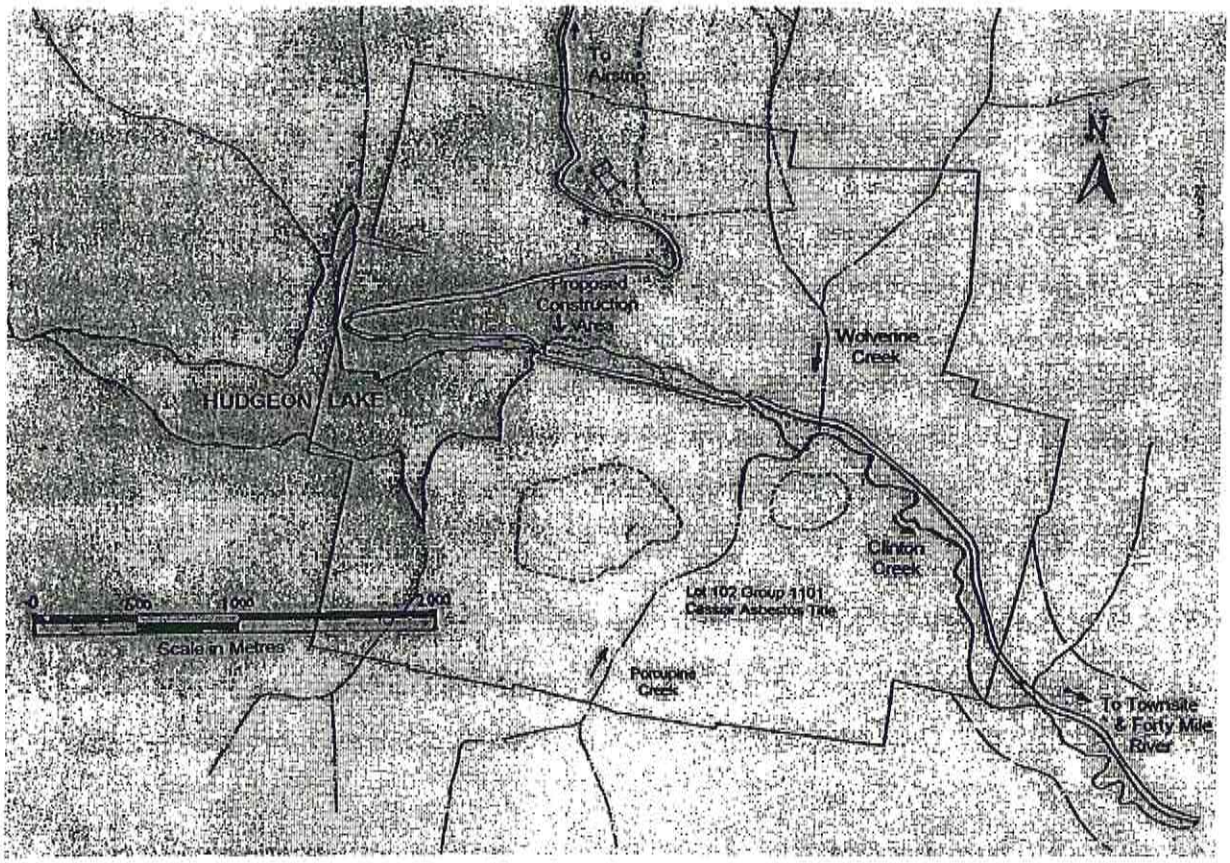


Figure 4: Property line of Lot 102 and location of proposed construction area (DIAND Waste Management, 2002).

2.0 Channel Design

2.1 Hydrology

Based on a regional hydrology study (UMA, 2000), the 100- and 200- year frequency floods for Clinton Creek were estimated from regional unit discharges. The 100- and 200-year floods were plotted in a log-normal graph from which the 50- and 25-floods were estimated by interpolation. The drainage area and estimated discharges are shown in **Table 1.**

Parameter	Clinton Creek
Drainage Area (km^2)	117
25-year flood (m^3/s)	28.9
50-year flood (m^3/s)	33.8
100-year flood (m^3/s)	39.0
200-year flood (m^3/s)	44.5

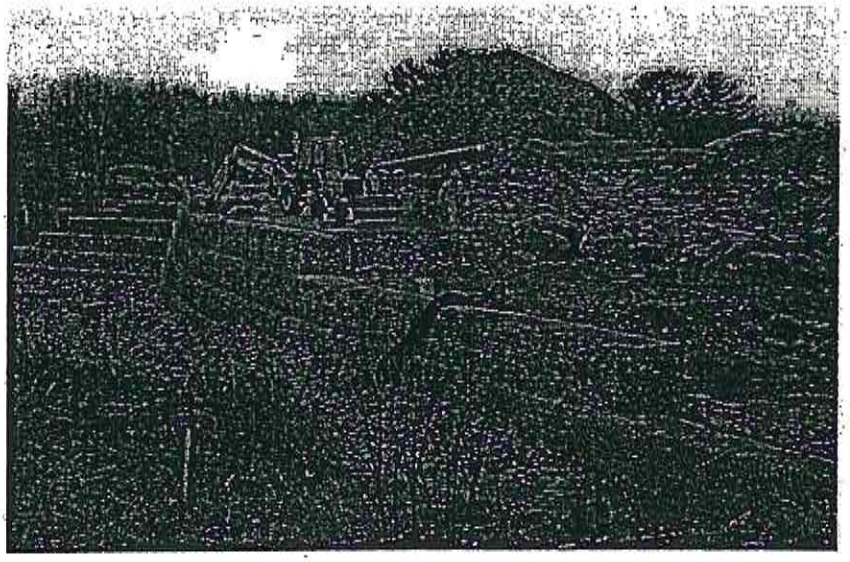
Table 1: Drainage Area and Discharges for Clinton Creek

To maintain minimum flow from Hudgeon Lake during the construction period, a low-flow estimate for the month of August was obtained from DIAND Water Resources. A water level gauge has been in operation at several locations along Clinton Creek since 1978. The mean unit runoff from Hudgeon Lake for the three lowest flow days for August was calculated based on eight years of data and a lake drainage area of 126.2 km^2. The minimum mean flow amounts to **0.199 m^3/s.**

DIAND Waste Management suggests maintaining the minimum flow from Hudgeon Lake through pumping or siphoning past the construction area in order to maintain aquatic habitats in the downstream portions of Clinton Creek. A rock weir will have to be constructed below the construction area where water from the lake will re-enter the creek channel, in order to avoid erosion and an increase of sedimentation.

2.2 Gabion Weirs

The recommended channel stabilization work involves flattening of the channel grade through the use of gabion drop structures (see **Photograph 1**). Gabion structures are preferred over rigid structures because of their flexibility that allows them to undergo deformation while remaining structurally sound, which is an important consideration given the observed creep movements of the waste rock. Gabion structures are simple to construct with conventional construction equipment, using material available at the mine site. The only materials requiring transportation over a long distance are the gabion baskets and geotextile.



Photograph 1: Gabion Structure

The drop structures at Clinton Creek are to be constructed from 0.5 x 1.0 x 3.0 m gabion baskets placed empty on geotextile, above gravel bedding. The baskets are tied together with wire and machine filled with cobbles. The gabions are placed as steps, which provide energy dissipation between each step as the water travels through the structure. The weir at the top of a structure creates a constriction that reduces the water surface draw-down immediately upstream to control the channel flow velocity along that length of channel. An end sill prevents a floor jet during high discharges (see **Figures 5a** and **5b**).

As the weir and end sill are made of gabions, a part of the channel flow will pass through the gabions rather than over them. As a result, neither the weir nor the end sill will cause any significant ponding of water. In fact, during low flows, the water surface may be below the top of the gabions i.e. between the cobbles. Because there will be a small flow of water through the gabions most of the time, it is important that the gabions sit on a geotextile and gravel bedding layer to prevent the loss of fine grained material below the baskets. Some sand and gravel will be washed through the channel, in particular during spring runoff. The finer material will become trapped between the cobbles in the gabion baskets further stabilizing the structure.

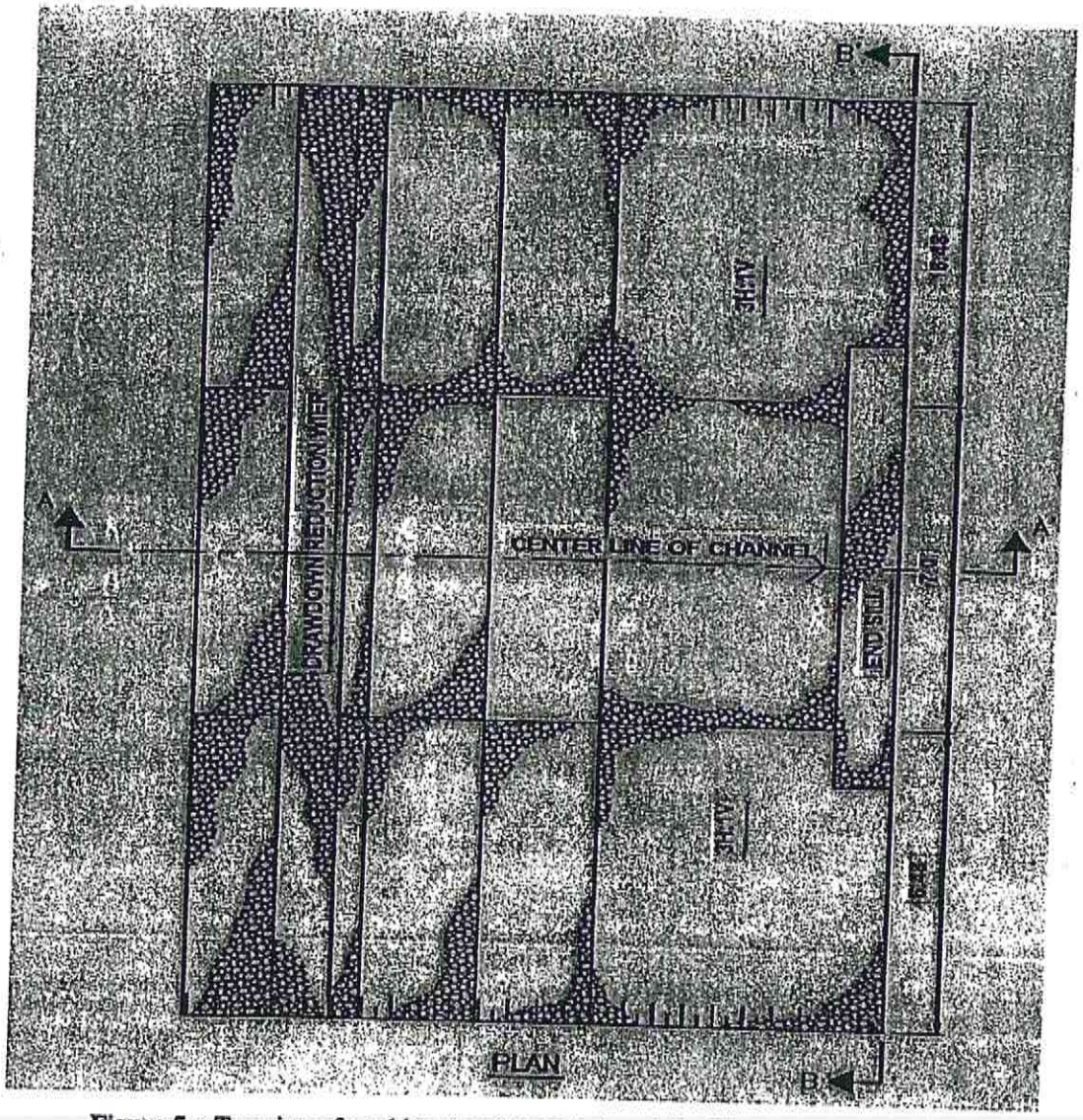


Figure 5a: Top view of a gabion structure as designed for Clinton Creek (UMA, 2002)

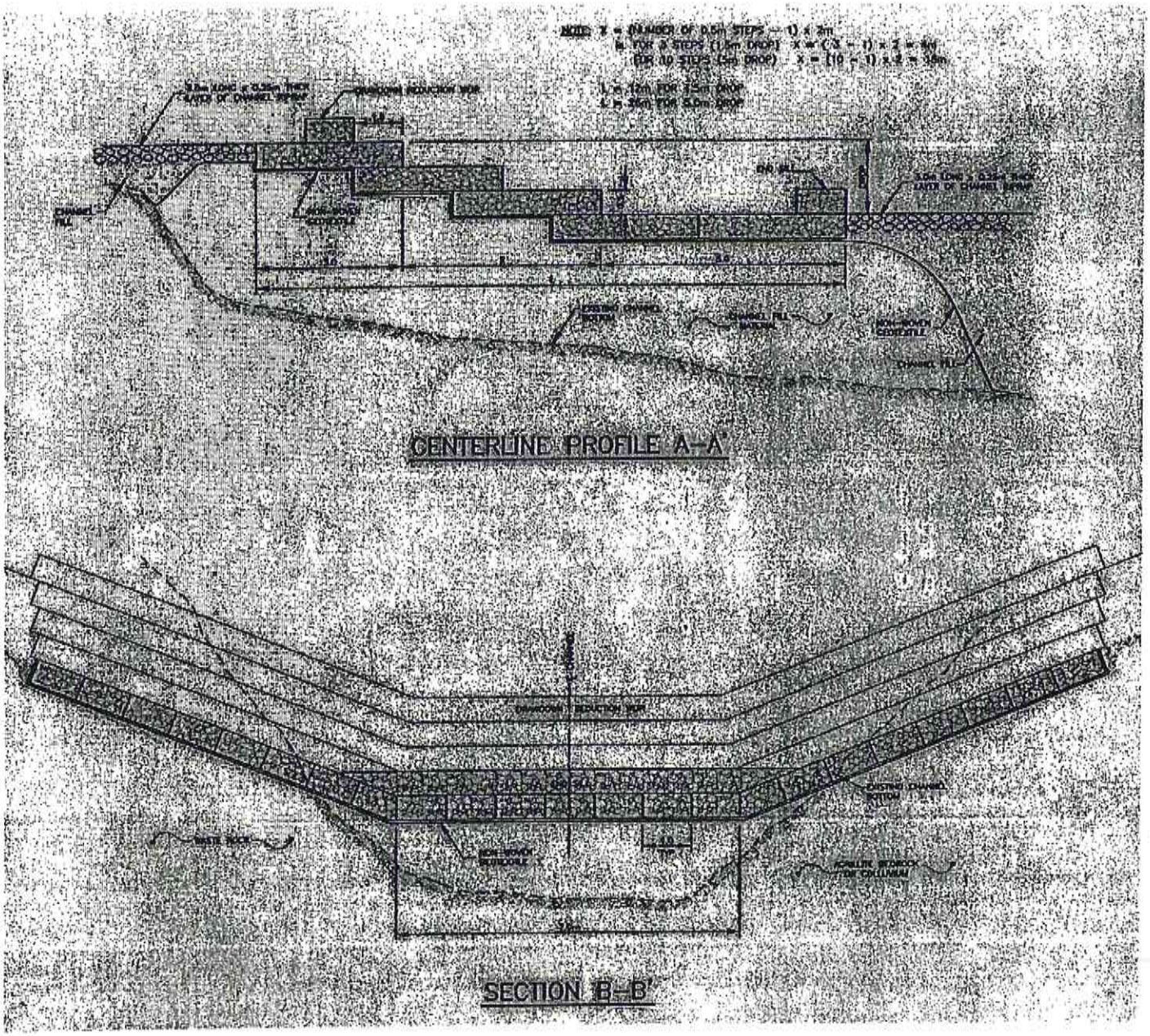


Figure 5b: Profiles of gabion structure as designed for Clinton Creek (UMA, 2002)

2.3 Channel Capacity

The estimated 25-year flood (28.9 m^3/s) was used for the design of the channel stabilization works for the waste rock pile. However, the discharge of the 25-year flood at the Hudgeon Lake outlet will be smaller due to the flood attenuation caused by Hudgeon Lake, resulting in a higher level of protection. Based on the design discharge and 3H:1V side slopes, the new channel geometry will have a bed width of 7.0 m and depth of flow of 2.0 m for a profile grade of 0.00101 m/m. With the dimensions of the individual gabion baskets used for the grade control structures, the freeboard at the control structures will be approximately 0.2 m or sufficient to confine a 50-year flood within an armoured control section.

3.0 Stabilization of Lake Outlet

3.1 Construction Events 2002

The construction of the first gabion structure and re-shaping of the lake outlet took place between August 28 and October 4, 2002. The general construction events required to complete the work included:

- improve road (site access) from the bridge over the Fortymile River to the mine site;
- production of gabion fill material;
- construction of a diversion pipe to route the flow from Hudgeon Lake around the work area;
- construction of a cofferdam across the outlet at Hudgeon Lake;
- fish salvage from remaining ponds in the creek channel;
- creek channel preparation which included removal of the two culverts from the lake outlet, removal of debris and vegetation from the channel and moving some boulders to facilitate construction of the gabion drop structure(s);

- backfilling, compacting and shaping the creek channel to the design grades;
- construction of gabion drop structures;
- re-grading of the outlet from Hudgeon Lake and installing a gabion mat and ford crossing;
- restoring flow over the lake outlet and into Clinton Creek and removal of diversion pipe;
- site restoration.

Due to the potential for airborne asbestos fibres to be present during construction, a Health and Safety Plan was developed to minimize the exposure of the people on-site to airborne asbestos fibres until the test results from air quality samples were available. The test results indicated that the levels of airborne fibres were well below the allowable limit of 0.5 fibres per ml (or: 0.5 f/cc) for an 8 hour exposure period.

A Letter of Advice was provided by the Department of Fisheries and Oceans approving the proposed work. The advice given required that the work be conducted in a manner to minimize the release of sediment to downstream waters and that deleterious substances, and specifically lubricants, coolants and fuels be used, transferred and stored in such a manner that they are not and do not become deposited in fish bearing waters. In addition, the work had to be conducted in a manner to prevent harmful alteration, disruption or destruction of fish habitat.

3.2 CONSTRUCTION CHALLENGES

The greatest challenge was how to divert the flow from Hudgeon Lake around the work area in the creek channel while maintaining a minimum flow of 0.2 m^3 per second in Clinton Creek downstream of the work area. A diversion pipe was constructed to overcome this challenge. The diversion consisted of 180 metres of 600 mm diameter culvert pipe laid in a trench that was graded at a slope of 1.5 percent.

The capacity of this pipe was significantly lower than the original Hudgeon Lake outlet capacity. The problems associated with the difference in capacity are related to the level of the lake and allowable lake storage. With regard to lake storage and lake level, it was not desirable to raise the lake level significantly above normal water levels due to the increased potential for seepage and/or piping to occur downstream of the outlet. Compounding this problem was the need for storage volume while the construction work was underway that is, it would not be desirable to have to let water run through a partially completed channel because the lake level was getting too high. These problems were avoided by drawing down Hudgeon Lake before building the cofferdam. This was largely achieved by cleaning out the inlet side of the two culverts located in the original lake outlet. A maximum allowable water level was chosen based on the high water mark visible along the lake shoreline. A 400 mm diameter overflow pipe fitted with a valve was also installed in the cofferdam that could be used to increase the flow out of the lake, if required.

Subsequent to installing the cofferdam and running the diversion pipe, the level of the lake increased at a rate of about 4 cm/day early in the project but decreased to about 1 cm/day near the latter part of September. During the construction period there was never a need to let water flow through the overflow pipe. The performance of the diversion pipe was more than adequate although there were some minor issues with leakage from the culvert couplers. The water leaking from the couplers was prevented from flowing along the trench by installing three check dams in the trench where leakage was the greatest. No more problems were encountered with the diversion pipe after installing the check dams.

Another problem encountered was seepage from the toe of the waste rock pile at the lower level of the drop structure. This problem was overcome by building a granular blanket drain under the floor of the lower level of the drop structure.

Photograph 1: Completed drop structure at outlet of Hudgeon Lake (UMA, 2002)

3.3 Specifications for Channel Stabilization (Stage 2)

The draft version of specifications for stage 2 of the Clinton Creek channel stabilization are attached as **Appendix A**. Materials and speciality tools information can be found in **Appendix C**.

4.0 References

GEO-Engineering (M.S.T.) Ltd. 2000. *Abandoned Clinton Creek Asbestos Mine - Report on June and July 2000 Site Inspections.*Calgary, AB.

Royal Roads University. 1999. *An Environmental Review of the Clinton Creek Abandoned Asbestos Mine. Yukon, Canada.* Royal Roads University - Applied Research Division. Victoria, BC.

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UMA Engineering Ltd. 2002. *Abandoned Clinton Creek Asbestos Mine - Environmental Liability Report.* UMA Engineering Ltd., Winnipeg, Manitoba.

UMA Engineering Ltd. 2002. *Abandoned Clinton Creek Asbestos Mine - Channel Stabilization / Specifications and Drawings.* (July, 2002). UMA Engineering Ltd., Winnipeg, Manitoba.

APPENDIX A

SPECIFICATIONS FOR CLINTON CREEK

CHANNEL STABILIZATION

(Stage 2)

DRAFT

INDIAN AND NORTHERN AFFAIRS CANADA

SPECIFICATIONS

FOR

CLINTON CREEK CHANNEL STABILIZATION (Stage 2)

AT THE

**ABANDONED CLINTON CREEK MINE SITE,
YUKON TERRITORY**

May, 2003

UMA ENGINEERING LTD.
ENGINEERS AND PLANNERS

1479 Buffalo Place
Winnipeg, Manitoba
R3T 1L7

TABLE OF CONTENTS

Material Suppliers

The list of material suppliers we intend to use on the Work is as follows:

Material	Supplier
Geotextile	
Gabion Baskets	
Cofferdam	
Diversion Pipe	
Culverts for main road	
Other:	

Labour and Equipment Rate Schedule

The rates for the labour and equipment we intend to use on the Work is as follows:

Labour/Equipment	Hourly Rate ($ per hour)	Standby Rate (if applicable) ($ per day)

Schedule of Work

FOR: CLINTON CREEK CHANNEL STABILIZATION (Stage 2),

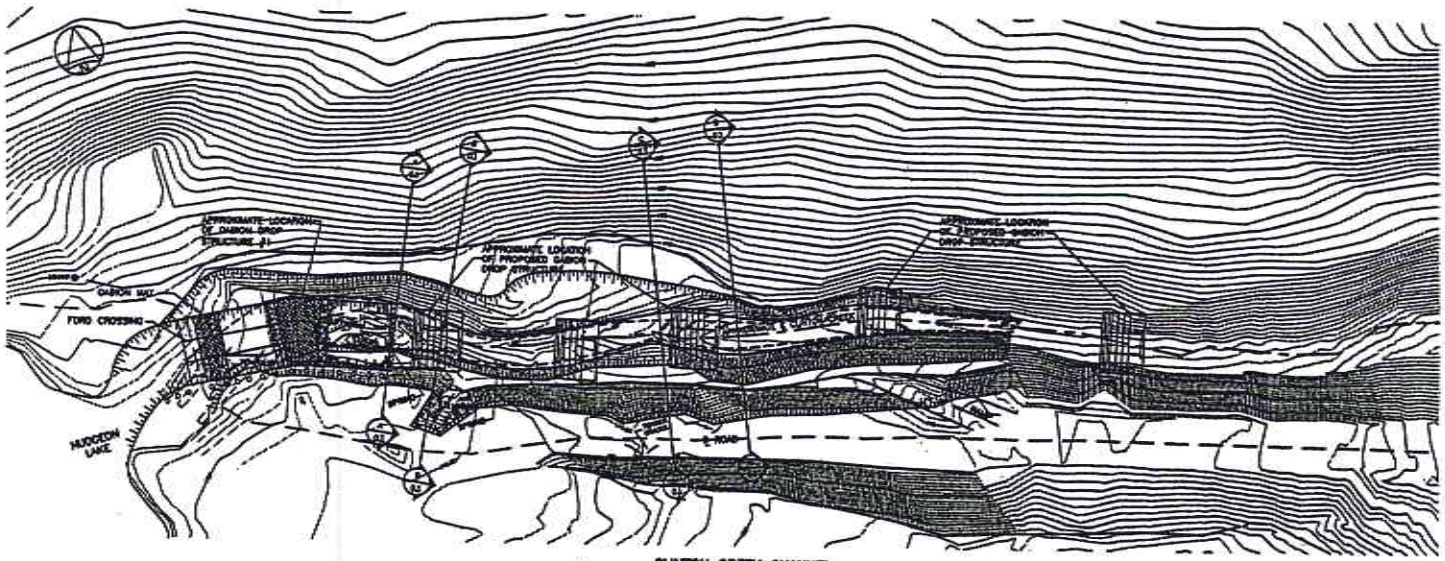
ABANDONED CLINTON CREEK MINE SITE, YUKON TERRITORY

Items of Work	Percentage of Work Completed				
	Start Date 0%	25%	50%	75%	Completion 100%
1) Mob / Site Preparation					
2) Material Processing					
3) Lake Diversion/Siphon					
4) Channel Grading					
5) Gabion Drop Structure #2					
6) Gabion Drop Structure #3					
7) Gabion Drop Structure #4					
8) Gabion Drop Structure #5					
9) Gabion Drop Structure #6					
10) Waste rock side slope grading					
11) Site Cleanup / demob					

CONTRACTOR'S PROPOSED COMMENCEMENT DATE _____ 20

Estimated Material Quantities

Item	Description	Quantity			Unit
		Total Required	Leftover from 2002	New	
1.	Gabion baskets (0.5m x 1.0m x 3.0m)	900	370	530	# of baskets
2.	Gabion baskets (0.3m x 1.0m x 3.0m)	40	0	40	# of baskets
3.	Non-woven geotextile	4180	1672	2508	square metres
4.	Gabion fill	1600	0	1600	cubic metres
5.	Channel rip rap	1000	0	1000	cubic metres
6.	Channel fill	1600	0	1600	cubic metres
7.	Waste rock pile - side slope grading	9000	0	9000	cubic metres
8.	Spenax Pneumatic Staple guns (purchased)	2	0	2	Per gun
9.	Culvert pipe (600mm ID)	+/- 250	0	+/- 250	Lineal metres
10.	Culvert pipe (200mm ID)	60	0	60	Lineal metres



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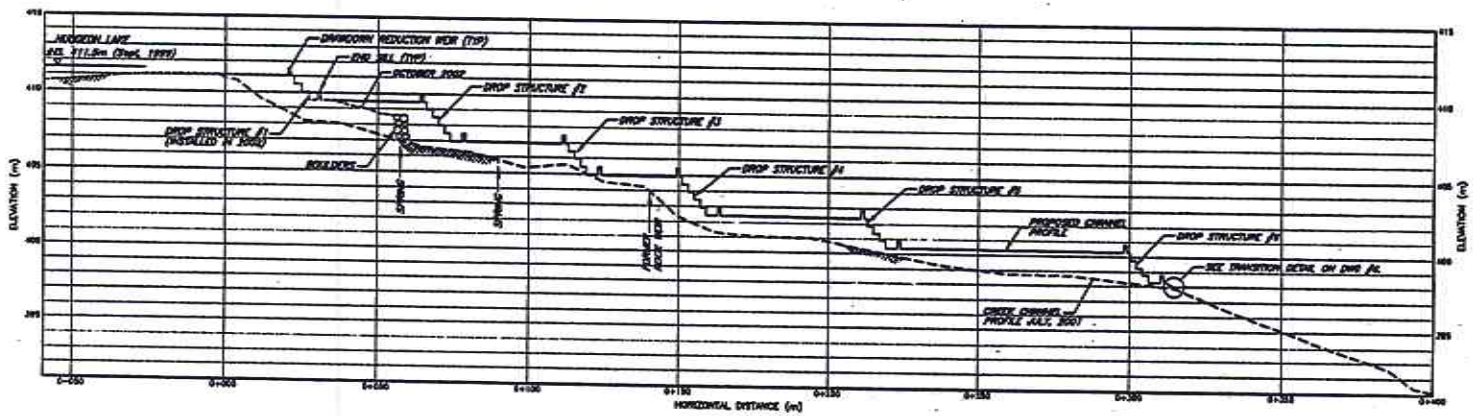


CLINTON CREEK CHANNEL PROFILE

VER. SCALE 1:100
HOR. SCALE 1:750

NOTE: FINAL LOCATION OF THE DROP STRUCTURES WILL BE DETERMINED DURING CONSTRUCTION.

HALF SIZE REDUCTION

NAD 83 UTM Zone 7
Photography Date: September 1999

REV.	DESCRIPTION	DRN.	APP.	DATE

VER. HOR.

UMA Engineering Ltd.
• Consulting • Engineering • Construction • Management Services

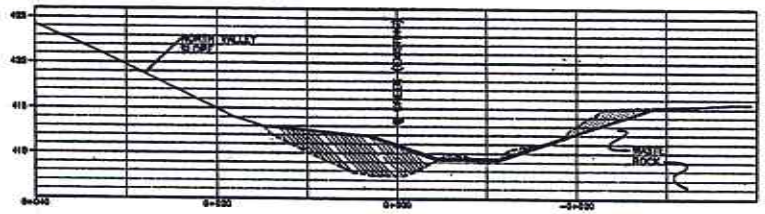
APPROVED BY		MAY, 2003 DATE	
DRAWN BY	LJV	DESIGNED BY	GR/TA
CHECKED BY	GR	CHECKED BY	KWS
SCALE	AS NOTED	JOB No.	0440-044-00-01

INDIAN AND NORTHERN AFFAIRS CANADA

ABANDONED CLINTON CREEK ASBESTOS MINE
CLINTON CREEK CHANNEL STABILIZATION - STAGE 2

PLAN AND PROFILE

DWG. No. 02 | REV. -



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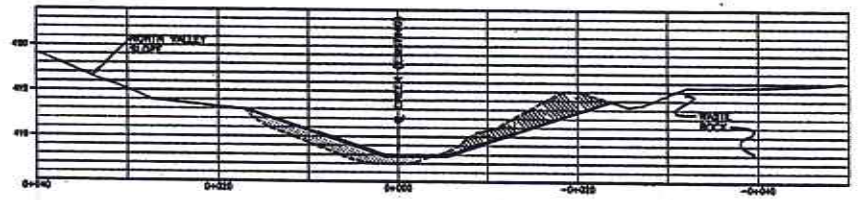

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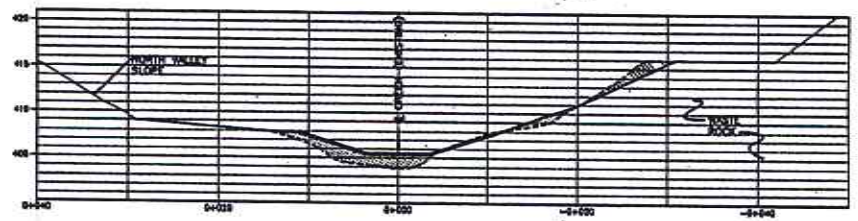

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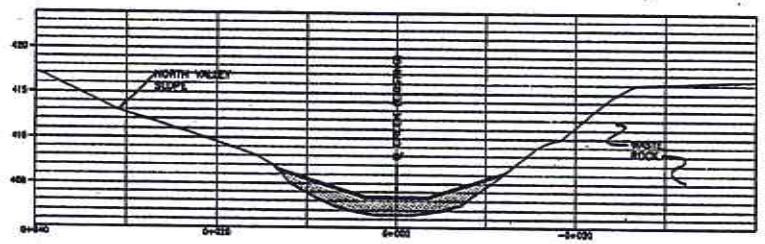

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LEGEND
- CUT MATERIAL
- COMPACTED FILL
- STABILIZED CHANNEL SECTION

HALF SIZE REDUCTION

NO.	DESCRIPTION	DRN.	APP.	DATE

UMA Engineering Ltd.

APPROVED BY — DATE: MAY, 2002

DRAWN BY:	LAV	REVIEWED BY:	GR/TM
CHECKED BY:	GR	ORIGINED BY:	KKS
SCALE:	AS NOTED	JOB No.	4440-044-00-01

INDIAN AND NORTHERN AFFAIRS CANADA

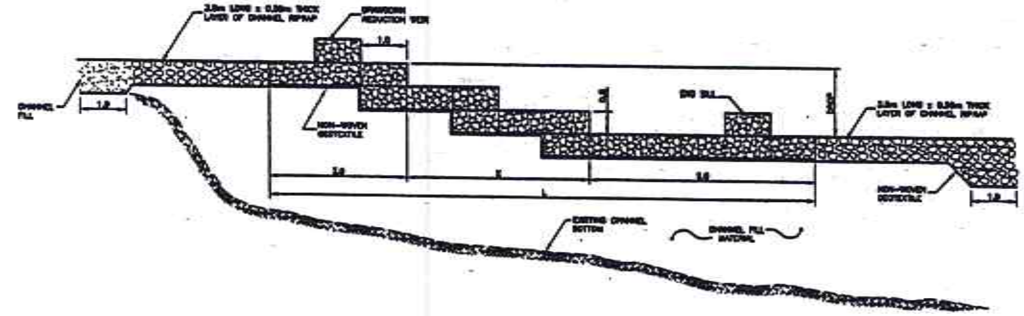
ABANDONED CLINTON CREEK ASBESTOS MINE
CLINTON CREEK CHANNEL STABILIZATION - STAGE 2

CROSS SECTIONS

DWG. No. 03 — REV. No. -

NOTE: X = (NUMBER OF 0.5m STEPS − 1) x 2m
ie. FOR 3 STEPS (1.5m DROP) X = (3 − 1) x 2 = 4m
FOR 10 STEPS (5m DROP) X = (10 − 1) x 2 = 18m

DROP STRUCTURES	DROP (m)	L (m)	No. of BASKETS
	1.5	12	125
#3, #5, #6	2.0	14	148
#2, #4	2.5	16	171
	3.0	18	194
	3.5	20	217



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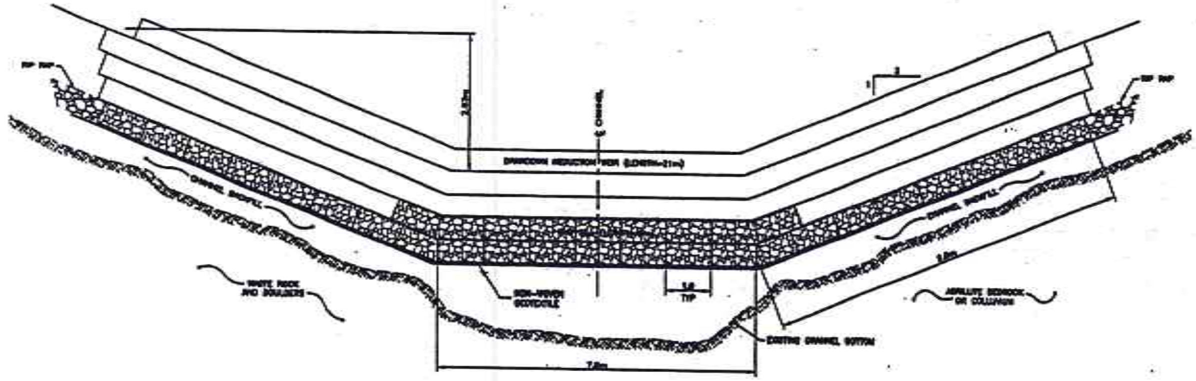

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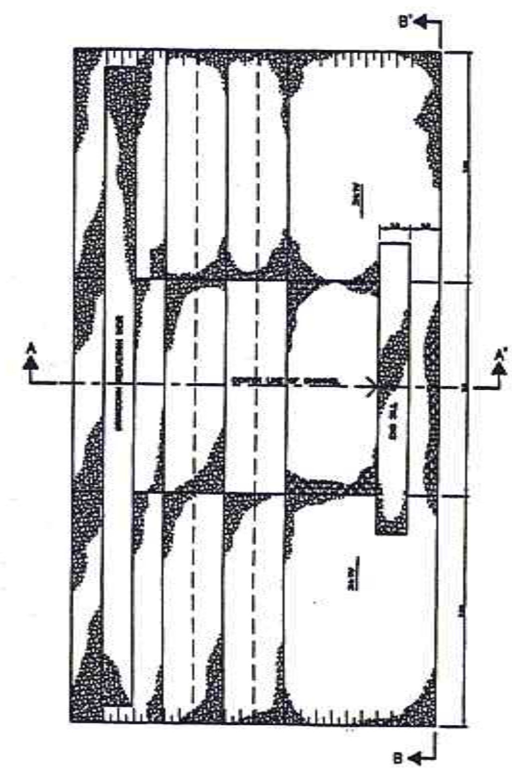


PLAN
1:75

HALF SIZE REDUCTION

METRIC

UMA Engineering Ltd.

MAY, 2002

LJY

GR/SA

GS

KMS

AS NOTED

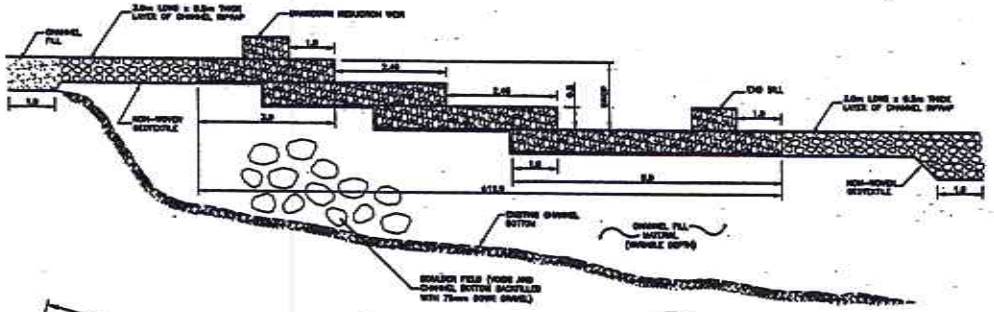
4440-044-00-01

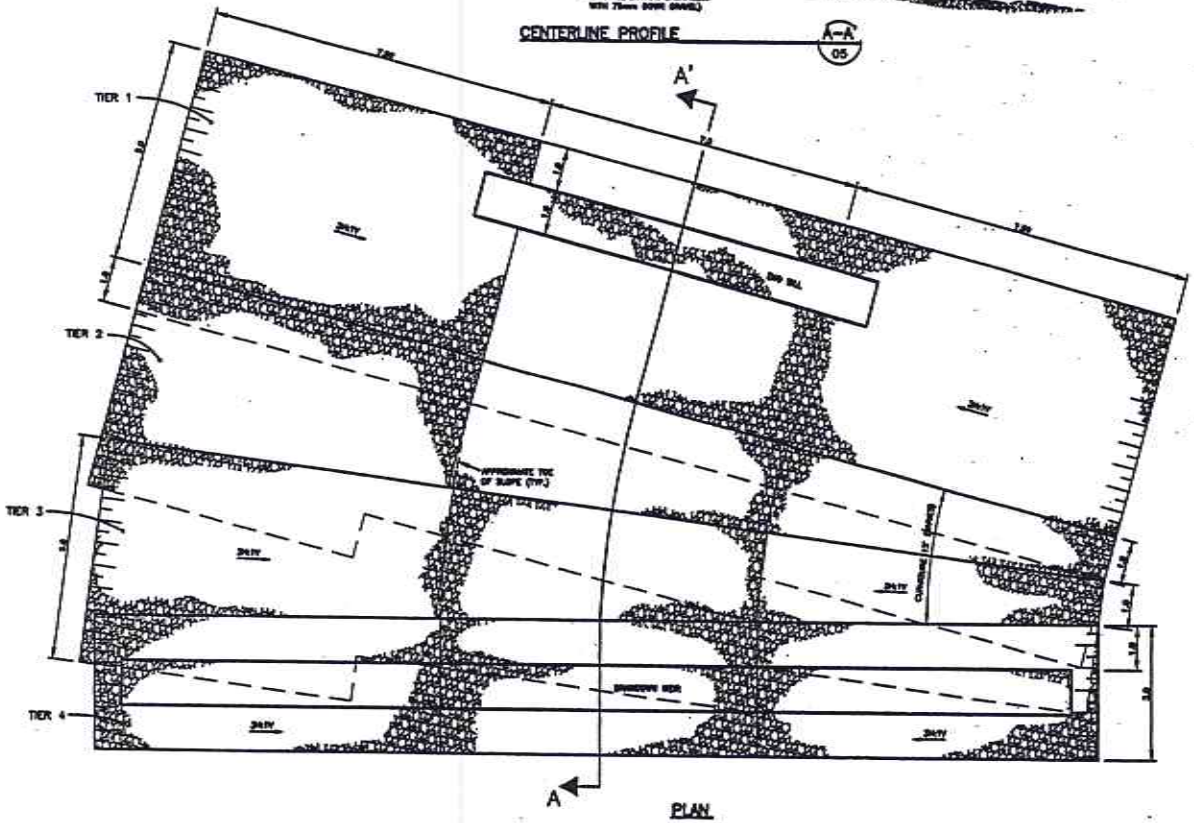
INDIAN AND NORTHERN AFFAIRS CANADA

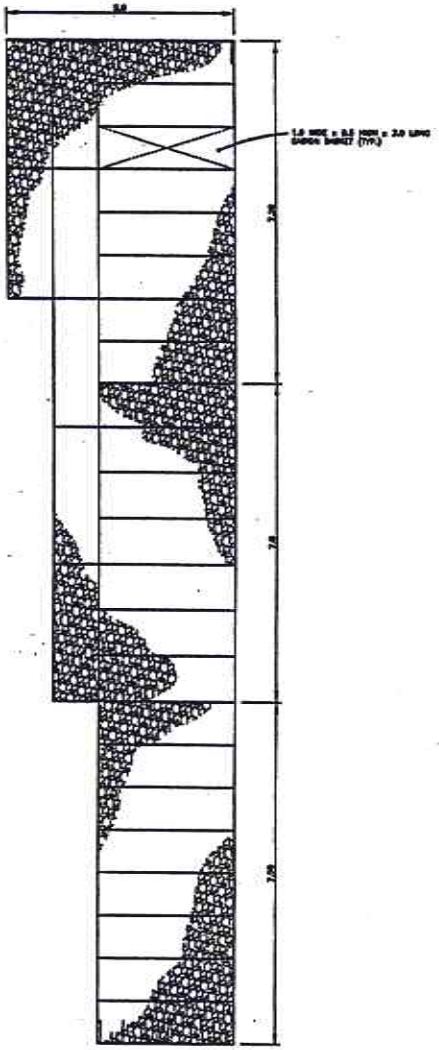
ABANDONED CLINTON CREEK ASBESTOS MINE
CLINTON CREEK CHANNEL STABILIZATION - STAGE 2

STRAIGHT DROP STRUCTURE DETAILS

04 | -







HALF SIZE REDUCTION

METRIC
WHEN DIMENSIONS ARE IN MILLIMETRES
DIMENSIONS IN METRES INDICATE METRES

NO.	DESCRIPTION	BY	APP.	DATE

UMA Engineering Ltd.

MAY, 2003
DATE

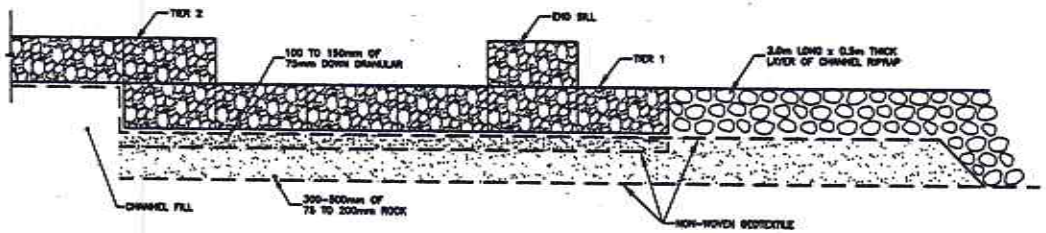
DRAWN BY	LAV	DESIGNED BY	GR/RA
CHECKED BY	GR	CHECKED BY	KMS
SCALE	1:50	JOB No.	4440-044-00-01

INDIAN AND NORTHERN AFFAIRS CANADA

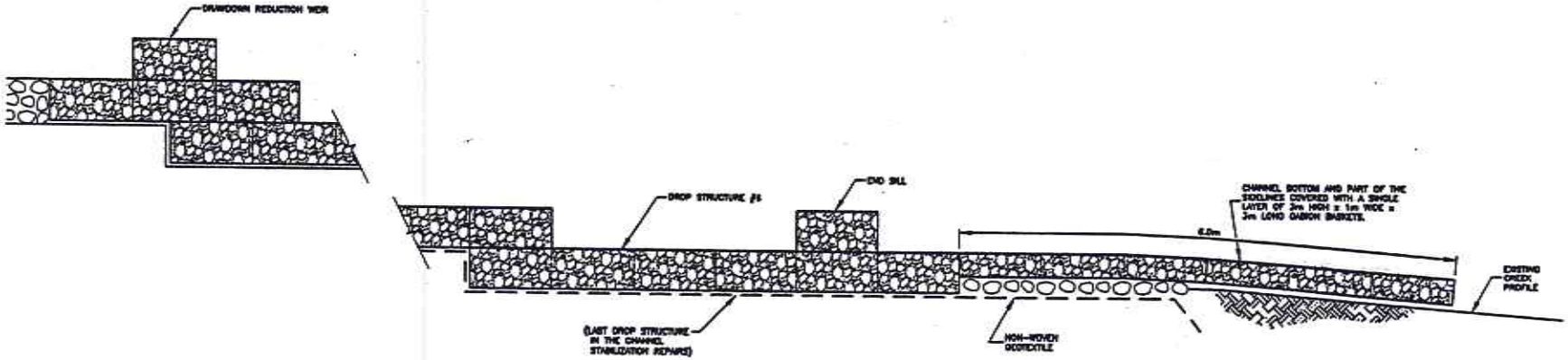
ABANDONED CLINTON CREEK ASBESTOS MINE
CLINTON CREEK CHANNEL STABILIZATION - STAGE 2

CURVED DROP STRUCTURE DETAILS

DWG. No. 05 REV. -



DETAIL OF BLANKET DRAIN



CHANNEL TRANSITION DETAIL

HALF SIZE REDUCTION

METRIC
UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN MILLIMETRES
ELEVATIONS AND DIMENSIONS ARE IN METRES

NO.	DESCRIPTION	BY	APP.	DATE

UMA Engineering Ltd.
• Consulting • Engineering • Construction • Management Services

APPROVED BY: DATE: MAY, 2003

DRAWN BY:	LJV	DESIGNED BY:	CP/TH
CHECKED BY:	DR	ENGINEER OF RECORD:	KMS
SCALE:	1:25	JOB No.	6440-044-00-01

INDIAN AND NORTHERN AFFAIRS CANADA

ABANDONED CLINTON CREEK ASBESTOS MINE
CLINTON CREEK CHANNEL STABILIZATION - STAGE 2

DETAILS

DWG. No. 06 REV. -

SP:1 CLINTON CREEK CHANNEL STABILIZATION

This Specification covers all aspects of the channel stabilization work.

1.1 General Information

The purpose of the work is to mitigate the potential for a breach of the outlet from Hudgeon lake which could result in flash flooding in the Clinton Creek Valley downstream of the mine site. The work involves stabilization of the Hudgeon Lake outlet (completed in 2002) and the Clinton Creek channel downstream of the lake outlet.

1.2 Description of Work

The intent of the work is to stabilize up to 350 lineal metres of the Clinton Creek channel downstream of the Hudgeon lake outlet. Downstream of the lake outlet, approximately six gabion drop structures will be constructed (Drop Structure No. 1 was built in 2002) to flatten the grade of the channel, which will reduce the erosion potential. The drop structures will serve as grade control points and will be constructed using PVC coated gabion baskets filled with clean rock. The existing channel will be filled and shaped as required to construct the drop structures. Downstream of the stabilized area of the channel. the waste rock side slopes will be flattened to reduce sloughing.

The work in the channel shall be constructed under zero flow conditions. A minimum flow of 0.2 m^3/second from Hudgeon Lake shall be diverted around the work area. The work should proceed in a manner that flow can be temporarily increased or re-instated into the channel to account for increased flows from the lake resulting from precipitation events. The water elevation in Hudgeon Lake must be maintained between elevation 411.0 and 412.2 metres.

1.3 Laws and Regulations, Health and Safety Plan

All activities shall be conducted in accordance with all applicable Federal, Territorial, and local laws and regulations. Indian and Northern Affairs – Canada (DIAND) – Waste Management Program, Yukon Region, is identified as the Project Authority, and is conducting this work under the authority of the Yukon Waters Act. DIAND authorizes its designated agents, contractors, employees etc. to access the site and implement the described construction works and other activities directly associated with this project. The Contractor shall be responsible for conducting the work in accordance with all labour laws, Workers Compensation and any and all other applicable regulations.

A Health and Safety Plan for the Work has been developed and is included in Appendix A for the Contractors use.

1.4 Materials and Specialty Tools

The Contractor shall be responsible for supplying all materials and specialty tools. It is expected that delivery of the gabion baskets and geotextile will likely take about 10 to 14 days.

Any diversion pipe/siphon materials, cofferdam materials and any un-used geotextile, gabions and specialty tools (i.e. Spenax staple guns) purchased for this work shall remain the property of the Owner and between construction seasons the materials and tools shall be stored in Dawson City at a location defined by the Owner (INAC).

1.4.1 Handling and Storage of Materials

All material shall be handled, stored, and/or stockpiled in a careful and workmanlike manner.

1.4.2 Approval

Materials supplied under this Specification shall be subject to inspection by the Engineer. A representative sample of all granular materials will be submitted to the Engineer prior to placement.

1.4.3 Geotextile

The geotextile shall be a non-woven ARMTEC 350 or an approved equal.

1.4.4 Gabion Baskets

The gabion baskets shall be manufactured by Maccaferri Canada Ltd. and shall be made of PVC coated, galvanized wire. The size of the gabion baskets for the drop structures shall be 0.5m x 1.0m x 3.0m. The size of the gabion baskets used at the transition section at the downstream end of Drop Structure No. 6 shall be 0.3m x 1.0m x 3.0m. Stainless steel SPENAX rings shall be used to assemble the baskets and drop structures. Technical data for the gabion baskets and the stainless steel rings has been included in Appendix B.

1.4.5 Specialty Tools For Gabion Assembly

Two new SPENAX SC-50T pneumatic guns and one new manual SPENAX tool shall be purchased for use on the job. These guns can only be purchased directly from Maccaferri Canada. Technical data for the SPENAX guns has been included in Appendix B.

Each pneumatic SPENAX gun shall have a dedicated air compressor capable of producing 15 CFM and maintaining a constant operating pressure between 90 and 100 psi.

1.4.6 Diversion Pipe

If used, the diversion pipe shall have a minimum 600mm ID and equivalent to the BOSS 2000 HDPE pipe with bell and spigot water tight ends manufactured by the Big 'O' Pipe Company, or approved equal. Technical data for the HDPE pipe has been included in Appendix B.

1.4.7 Culverts

Culverts used for cross-drainage at various locations (approximately 10 locations) along the mine access road shall be 200mm ID and equivalent to the BOSS 2000 HDPE pipe with regular ends manufactured by the Big 'O' Pipe Company, or approved equal.

1.4.8 Sand bags

A minimum of 100 burlap sandbags (approx. 50 pounds when filled) will be on-hand for use as needed.

1.4.9 Channel Fill

Channel fill material shall be unfrozen, well graded with a maximum size of 150mm and free of asbestos and deleterious material (i.e. wood, organics). Locally available materials such as the argillite waste rock and/or a combination of argillite and colluvium will be acceptable. The undersize material from the production of gabion fill shall be used as select channel fill where directed by the Engineer.

1.4.10 Channel Rip Rap and Gabion Fill

The channel rip-rap and gabion fill materials shall consist of hard, dense, durable rock fragments free from cracks, seams, or other defects that would tend to increase their susceptibility to destruction by water and frost.

The channel rip rap and gabion fill shall conform to the following gradation:

Equivalent Stone Diameter		**Gradation Limits Percent Passing by Weight**
Metric Sieve (mm)	U.S. Standard	
200	8 inch	100
150	6 inch	60
75	3 inch	0-10

1.5 Construction Requirements

1.5.1 Construction Sequencing

The work shall be completed in a sequence mutually agreed upon by the Contractor, the Engineer and the Owner, except that a minimum flow rate of 0.2 m^3/sec from Hudgeon Lake must be diverted around the work area before the cofferdam is installed and any earth work in the channel is initiated. Immediately following installation of the cofferdam, a fish salvage operation will be conducted in the creek channel between the cofferdam and the diversion pipe outlet. No work in the channel will be permitted until the fish salvage operation is complete.

The timing for installation of the cofferdam will determined on-site based on the level of Hudgeon Lake. The cofferdam shall not be installed unless the Contractor is ready to begin working in the channel immediately following the fish salvage operation.

1.5.2 Preparation of Work Areas

The Contractor shall prepare the work areas as necessary to complete the specified work. Work platforms or benches may be prepared on the south side and north side of the Clinton Creek channel, if required. Spoil material from this operation that meets the specifications for channel fill may be used as channel fill.

1.5.3 Hudgeon Lake Cofferdam and Flow Diversion

The Contractor shall be responsible for the design and construction of a cofferdam and flow diversion. The flow diversion system shall be capable of handling a minimum flow of 0.2 m^3/sec from Hudgeon Lake which shall be diverted around the work area. The cofferdam and diversion pipe construction shall be reviewed at the pre-construction meeting. Charts showing diversion pipe capacities, Clinton Creek hydrographs are included in Appendix D

The cofferdam shall have a minimum freeboard of 600mm and be suitable to hold back the water in Hudgeon Lake up to a maximum elevation of 412.2m (the elevation of the lake outlet is 411.0m). Sediment generation shall be minimized during installation and removal of the cofferdam.

The level of Hudgeon Lake will be monitored daily. It is expected that a work window of 14 to 21 days can be achieved by allowing the lake level to naturally drain down to about 200mm above the lake outlet, (Elevation 411.2m) before installing the cofferdam. The work window available will depend on the number and intensity of precipitation events in the drainage basin upstream of the lake outlet. Should the lake level reach an elevation of 412.2m before the channel stabilization works are completed, it may be necessary to temporarily re-instate flow in the channel to draw the lake down.

1.5.4 Channel Excavation, Backfilling and Grading

Prior to initiating excavation or backfill activities clear the channel of any debris including trees and other deleterious material. Large boulders shall be moved aside for later use as channel armouring.

Within the channel stabilization area, excavate and backfill the channel as directed by the Engineer. Channel side slopes shall be re-graded as shown on the Drawings.

Excavated waste rock material can be used as channel fill provided the material meets the requirements of SP:1.4.9.

The backfill shall be placed in lifts not exceeding 300mm and then compacted. The required level of compactive effort based on the number of passes of the compaction equipment will be determined in the field.

Downstream of the channel stabilization area, the waste rock side slopes shall be flattened to approximately 1H:1V or as directed by the Engineer.

1.5.5 Gabion Drop Structure Construction

The location of the gabion drop structures on the Drawings is approximate. Final locations will be determined in the field based on survey data and constructability issues. In general, the drop structures will be constructed in a rectangular/straight shape however, some of the structures may need to be constructed with a curve. Details for both straight and curved structures are shown on the Drawings.

(1) Preparation of Drop Structure Base

Where the gabions are placed in a cut area, level any ridges left from excavation and fill in the low spots. Compact the surface until the finished surface is smooth, level and conforms to the design grades.

Where the gabions are placed in a fill area, place the channel fill material in lifts not exceeding 300mm. Compact the fill in accordance with SP: 1.5.4. The finished grade shall be smooth, level and conform to the design grades.

Where seepage is encountered from the base or sides of the existing creek channel, construct a granular drainage blanket below the base of the gabions as directed by the Engineer. A detail of a granular drainage blanket is shown on the Drawings.

Place the geotextile on the finished base as shown on the Drawings and in the manner described under SP:1.5.6 Geotextile Placement.

(2) Drop Structure Assembly

Assembly of the gabion baskets shall be done in accordance with the manufacturer's installation instructions (Appendix B). The gabion baskets shall be assembled, connected and closed using stainless steel rings. The stainless steel rings shall be installed at 100 to 150mm spacing. Where the stainless steel

rings can not be used the baskets shall be tied together using the PVC coated assembly wire provided with the baskets.

For each tier of the drop structure, start by assembling and placing the gabion baskets on the completed base. Install the lowest row of gabion baskets on the side slopes before starting the placement of gabion fill in the baskets on the base. Complete filling and closing of the gabion baskets on the structure floor before placing the remaining baskets on the side slopes. Fill and close the gabions on the side slopes. Before placing the baskets for the next highest tier, pull the geotextile up so it covers the vertical upstream side of the gabion baskets.

(3) Transition From Stabilized Channel to Existing Channel

A transition from the stabilized channel to the existing channel will be required at the downstream end of Drop Structure No. 6. The channel bottom and part of the side slopes will be lined with 0.3metre high gabion baskets over a length of 6 metres, as shown on the Drawings.

1.5.6 Geotextile Placement

Geotextile placement shall be as follows:

(i) Place the geotextile by unrolling onto the prepared surface and retain in position with weights or pins.
(ii) Place geotextile smooth and free of folds, wrinkles, and creases.
(iii) Place geotextile perpendicular to the channel alignment (seams perpendicular to flow).
(iv) Overlap seams a minimum of 1m wide. The geotextile panels shall be placed in an upstream direction so that the upstream panel overlaps the downstream panel at the location of the seam.
(v) Protect installed geotextile from displacement and damage until, during, and after placement of the overlying gabion baskets or rip-rap.
(vi) Repair rips or tears with a patch to cover a minimum of 1 metre on each side of the rip or tear.
(vii) The geotextile shall be anchored at the upstream and downstream ends of the drop structures as shown on the Drawings. The geotextile at the top of the channel slopes shall be laid flat on the side slope for a distance of approximately 1m past the gabions and covered with channel rip rap, as shown on the Drawings.

1.5.7 Placement of Channel Rip-Rap

Channel rip-rap material shall be placed at the upstream and downstream ends of each drop structure as shown on the Drawings and in a manner that the underlying geotextile is not disturbed or damaged. Place additional channel rip rap as directed by the Engineer.

1.5.8 Cofferdam Removal

Remove cofferdam to restore natural creek flow once the channel stabilization work has been completed. The cofferdam shall be removed such that the water is released slowly to minimize erosion and sediment load. The diversion pipe shall remain in operation during removal of the cofferdam.

1.6 Quality Control

1.6.1 Inspection

Workmanship and materials furnished under this Specification are subject to inspection by the Engineer including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineer reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

1.6.2 Access

The Engineer shall be afforded full access for the inspection of materials, both at the site of Work and any borrow site used for the supply of materials, to determine whether the material is being supplied in accordance with this Specification.

1.6.3 Materials

Materials supplied under this Specification shall be subject to approval by the Engineer in accordance with SP:1.4.2 – Approval.

1.6.4 Corrective Action

The Contractor shall at his own expense, correct such work or replace such materials found to be defective under this Specification.

1.7 Method of Measurement and Basis of Payment

1.7.1 Method of Measurement

All labour and equipment work shall be measured on an hourly basis. Time shall commence when equipment and/or labour begins working each day and cease when work is stopped for the day. Time taken during this period for lunch and/or supper breaks will not be counted.

Standby time shall only be paid for equipment that is in regular use on the job site at the standby rate provided by the Contractor. Where equipment is not required for extended periods of time, the equipment may be de-mobilized from the site and re-mobilized at a later date alternatively, the equipment may be left on site but not receive any standby payment. Payment of standby time shall be approved by the Engineer.

Verification of the materials and specialty tools delivered to site will be made prior to payment.

1.7.2 Basis of Payment

All labour and equipment work shall be paid for at the hourly rates provided by the Contractor, measured as specified herein, which price shall be payment in full for performing all operations herein described and all other items incidental to the work included in this Specification.

The rates for equipment shall include but not be limited to all costs incurred for operation, supervision, maintenance, overhead, wages, accommodation, Worker's Compensation, fuel, lubricants, repairs, insurance, permits and profit.

The rates for labour shall include but not be limited to wages, supervision, accommodation, overhead, Worker's Compensation, fuel, lubricants, repairs, insurance, permits and profit.

Material costs shall be paid for at the invoiced cost, including transportation. Any additional charges added to cover overhead and all other indirect costs shall be pre-approved by the Owner.

Specialty tools purchased shall be paid for at the invoiced cost. Any additional charges added to cover overhead and all other indirect costs shall be pre-approved by the Owner.

APPENDIX B

HEALTH AND SAFETY PLAN

CLINTON CREEK PROJECT
OCCUPATIONAL AND ENVIRONMENTAL HEALTH AND SAFETY ISSUES AND EMERGENCY RESPONSE PLAN

Introduction

The purpose of the work is to mitigate the potential for a breach of the outlet from Hudgeon lake which could result in flash flooding in the Clinton Creek Valley downstream of the mine site. The work involves stabilization of the outlet and the Clinton Creek channel downstream of the outlet. The outlet and a short portion of the channel was stabilized in 2002. The material forming the channel may contain some asbestos fibres that could become airborne during construction activities.

The Health and Safety Program is designed to anticipate, recognize, evaluate, and control adverse environmental conditions and physical hazards that may result in injury, impairment, or the exposure to toxic substances. The Emergency Response Plan provides a response to minimise the impact of an accidental release of substances that may affect the well-being of workers, and the local environment.

Location

The Clinton Creek Asbestos Mine is located 100 km northwest of Dawson City in the Yukon Territory. The location is at 64^0 22' 23" N and 140^0 42' 50" W adjacent to Clinton Creek approximately 9 km upstream of its confluence with the Forty Mile River. Porcupine and Wolverine Creeks are local tributaries of Clinton Creek. The project site is located at a failed waste rock deposit on the north-facing slope of the Clinton Creek valley. The failure created a landslide dam now referred to as Hudgeon Lake. The waste rock channel stabilization work will occur along Clinton Creek for a distance of approximately 350 metres downstream from the outlet of Hudgeon Lake.

Abbreviations

The following abbreviations and definitions are used in this document:

1. ANSI American National Standards Institute. Publishes consensus standards on a wide variety of subjects, including safety equipment, procedures, etc.
2. CEPA Canadian Environmental Protection Act
3. CSA Canadian Standards Association, the national consensus standards association for Canada is roughly the Canadian equivalent of ANSI in the US

4. DIAND Department of Indian Affairs and Northern Development
5. ERP Emergency Response Plan
6. HEPA High Efficiency Particulate Air filter. At least 99.97% efficient in the filtration of air borne particles 0.3 microns in diameter or greater
7. MSDS Material Safety Data Sheet provided by chemical manufacturers
8. MSHA Mine Safety and Health Administration, an agency of the US Department of Labour
9. NIOSH National Institute for Occupational Safety & Health. An arm of the US Centres for Disease Control, it does research and suggests guidelines for exposure control, but is not a regulatory agency
10. OSHA Occupational Safety & Health Administration, a part of the US Department of Labour, it regulates many job safety issues, including chemical handling and storage; also Occupational Safety & Health Act, the US Federal legislation which created OSHA (the Administration) and NIOSH
11. RMO Resource Management Officer
12. TDGA Transport of Dangerous Goods Act
13. WHMIS Workplace Hazardous Materials Information System. This program is legislated by the Canadian government, which requires, among other things, the creation and availability of material safety data sheets

Time Table (tentative)

June 1 to October 4, 2003.

Communication

A satellite phone will be available on site for communication and emergency calls.

Hazard Identification

1. Asbestos Hazards - inhalation of asbestos fibres by workers resulting from disturbance of the waste rock during excavation and backfilling activities.
2. Chemical Hazards - fuels used on site
3. Explosion or Fire - ignition of explosive or flammable liquids

4. Physical Hazards - mechanical equipment, sharp objects
   - increased risk of injury to personnel when wearing protective gear (if required) that may impair agility, stamina, hearing, and vision
   - electric shock when using power equipment in wet location or using poorly grounded tools
5. Wildlife - moderate risk (bears)

General Health and Safety Measures

1. All work will be conducted, as a minimum, in strict compliance to all applicable laws, ordinances, rules, regulations and orders and general practices for the safety of persons or property. The applicable requirements include any general safety rules and regulations of Yukon Workers' Compensation Health and Safety Board, WHMIS and Occupational Health and Safety legislation.
2. The Environmental Monitor / Safety Training Supervisor will be responsible for the Health and Safety legislation.
3. If deemed necessary, the Contractor shall provide wildlife monitors, acceptable to the Engineer, equipped with firearms to protect the safety of all workers including the Engineer, and Engineer's support staff during site operations.
4. Prior to the start of the work, all team members will participate in a mandatory safety briefing session to become familiar with all aspects of the Safety Program and Emergency Response Plan. Specific instructions on actions to be taken in case of safety violations, accidents, personal injury and emergencies will be provided.
5. Prior to commencement of specific work activities, all team members will be briefed on the following safety issues:
   a. safety equipment and use
   b. clearing, excavation and backfilling operations
   c. contaminants on site
   d. emergency measures in case of an accident or fire
6. A "buddy system" will also be used as a protective measure in particularly hazardous situations so that team members can keep watch on one another to provide quick aid if needed.
7. Contacts for emergency will include the DIAND project authority, the RCMP detachment and the nursing station in Dawson City, Yukon, and the Yukon Fuel and Oil Spills Report Line.

Waste Rock Excavation and Backfilling

1. The potential consequences of planned construction activities, such as excavating and backfilling, at the site will be considered prior to each action. Personnel assigned to work around the operating equipment will have the appropriate safety training.
2. Any persons within 800 metres of the work site while waste rock is being handled shall take necessary precautions to prevent exposure to airborne asbestos fibres.

Site Safety Meetings and Inspections

To ensure that the Site Safety Plan is being followed, the Safety Officer will conduct a safety meeting prior to initiating each site activity and at the beginning of each workday.

The purpose of the meetings is to:

- describe assigned tasks and their potential hazards;
- co-ordinate activities;
- identify methods and precautions to prevent injuries;
- plan for emergencies;
- describe any changes to the Site Safety Plan;
- get worker feedback on conditions affecting safety and health;
- get worker feedback on how well the Site Safety Plan is working.

The Site Safety Officer will also conduct frequent inspections of site conditions, facilities, equipment and activities. The Site Safety Officer and personnel will be responsible for inspecting the condition of their personal protective equipment and ensuring its operational condition.

First Aid

First Aid will be administered on site by the Environmental Monitor / Safety and Training Supervisor. According to the Yukon Workers' Compensation Health and Safety Board (1992), Class "A" hazards were identified for the Clinton Creek Channel Stabilization Project. The requirements for First Aid made available on site are met by an attendant with a Standard First Aid certificate, a # 2 Unit First Aid Kit (St. Johns Standard), a stretcher, and

three emergency blankets. In addition to the basic requirements, a spinal board, cervical collars and a Scott Air Pack will also be on site. In case of an accident, a casualty will be transported to Dawson City, Yukon or depending on weather conditions, to the nearest nursing station via rotor wing. Emergency phone numbers are provided in the ERP. Every incident requiring First Aid will be recorded in an accident report.

Fires

The fire safety program includes fire prevention, fire protection and fire fighting.

1. As a preventative measure there will be no fires or burning of rubbish at the work site.
2. A person discovering a fire will report the incident to the Project Superintendent.
3. Fire extinguishers will be located on site and in each supervisor's vehicle.
4. Smoking will not be permitted in hazardous areas and care will be exercised in the use of smoking materials in non-restricted areas.
5. The current National Fire Code of Canada shall govern the handling, storage and use of flammable liquids such as gasoline. Flammable liquids such as gasoline will be stored in approved safety cans.
6. Disposal of flammable liquids will be in accordance with all applicable environmental regulations.

Personal Protective Equipment

1. Workers will use protection appropriate to the potential type and level of exposure. The protective equipment will meet CSA, ANSI, and NIOSH standards and guidelines.
2. Team members will be made aware that the equipment alone does not eliminate the hazard. If the equipment fails, exposure will occur, as such, hazard awareness will be a paramount component of the field program.
3. All equipment will be properly fitted and maintained in a clean and serviceable condition.
4. If at any time during the project the protective equipment is damaged, then the team member will remove, dispose and replace the damaged item.
5. Before entering asbestos work area, instruct workers and visitors in use of respirators, dress, and all aspects of work procedures and protective measures. Instruction shall be provided by Competent Person as defined by Occupational Health and Safety Act.
6. **Respirators:** When working in areas where asbestos fibres are present, workers shall wear non-powered half-face respirators with high efficiency (HEPA) cartridge filters. Provide approved respirators to visitors. Replace filters daily or test according to

manufacturer's specifications and replace as indicated. Respirators shall be acceptable to Occupational Health Branch of Ministry of Labour. Provide instruction to users in use of respirators, including qualitative fit testing. No user shall wear facial hair, which affects seal between respirator and face. Maintain respirators in proper functioning and clean condition, or remove from Site.

7. **Protective Clothing:** Provide workers and visitors with full body disposable coveralls with integral hoods. Once coveralls are worn in asbestos work area, treat as asbestos contaminated waste and dispose of appropriately. Workers and visitors shall also wear other protective apparel as required by construction regulations (e.g. safety boots, hard hats, gloves, etc.).
8. Persons leaving asbestos work area(s) shall remove gross contamination from clothing. Clean respirator to ensure that visible contamination is removed.

Environmental Monitoring/Sampling

1. The employer shall ensure any required medical examinations are completed in accordance with the Yukon Health and Safety Act.
2. Air samples may be taken from commencement of work until completion in asbestos work area(s) with NIOSH 7400 procedures, or with Fibrous Aerosol Monitor.
3. Co-operate in collection of air samples, including requiring workers to wear sampling pumps for up to half shift periods. Workers shall exercise care not to damage air sampling equipment.
4. An MSA Escort Elf portable sampling pump is used to draw air through a 25 mm, 0.8 um pore size, cellulose ester filter at a constant flow rate for a sufficient period of time to collect a representative sample of air for personnel in the work area. The air sample(s) are then retrieved and sent to a qualified laboratory for analysis by Phase Contrast Microscopy (PCM).
5. If air monitoring shows airborne fibre levels exceed 10X the time-weighted average exposure criteria (TWAEC) of 0.1 fibres per cubic metre of air (f/cc) for personal exposure, then workers will be required to use powered air purifying respirators (PAPRs) with full-face piece and HEPA filters.
6. All sampling results will be kept on site and made available to workers for their review.

Head Protection

Head protection against impact blows will be provided when required in the form of a protective hat with a liner, which will be able to resist penetration and absorb the shock of a blow. The hat will meet CSA standard Z94.1.

Foot Protection

For protection against falling or rolling objects, sharp objects, wet, slippery surfaces workers will use appropriate insulated safety shoes or boots. Safety shoes will be sturdy, have an impact-resistant toe and meet CSA Standard Z195 or ANSI standards. In case of an emergency spill, team members responding will wear protective boot covers.

Eye and Face Protection

When required, protection will be based on the kind and degree of hazard present. Available equipment will include goggles, safety glasses, and face shield. The eye protectors will meet the requirements of CSA Z94.3 or ANSI standards.

Ear Protection

To avoid exposure to high noise levels disposable phone earplugs or earmuffs will be made available.

Respiratory Protection

It is anticipated that exposure to harmful concentrations of air contaminants may result from temporary or emergency conditions. In such a scenario, the exposed team members will wear protective respiratory equipment to prevent breathing air contaminated with harmful dusts (including asbestos), fumes, gases and vapours. The selection of protective respirators equipment will be made according to the guidance of NIOSH or MSHA or ANSI Practices for Respiratory Protection and will include Air Purifying Respirator with HEPA cartridge and chemical cartridge.

Arm and Hand Protection

Absorption of chemicals, cuts and burns are examples of hazards associated with arm and hand injuries. Insulated rubber gloves and leather gloves will be provided for protection from these hazards. These gloves will conform to CSA and ANSI standards.

EMERGENCY RESPONSE PLAN

This Emergency Response Plan (ERP) includes actions to be taken to reduce the impact of spillage for release of, or substantial threats of release of hazardous materials and non-aqueous phase liquids from barrels and other containers encountered during drilling and test pit excavation. A list of emergency contacts, including those for medical emergencies and emergency reporting are given below.

Project Management:

Brett Hartshorne (INAC)	(867) 667-3268
HAN Construction Ltd.	(867) 993-5520
Gil Robinson (UMA Engineering)	on-site
Yukon Fuel and oil Spills Report Line:	(867) 667-7244
Dawson City, Community Nursing Station:	(867) 993-4444
Ambulance: Dawson City, Yukon	(867) 993-4444 or 1-800-661-0408
Trans North Helicopters	(867) 993-5494 or 668-2177
Fireweed Helicopters	(867) 993-5700
Resource Management Officer (RMO):	
Todd Pilgrim	(867) 993-5468
RCMP Dawson City, Yukon:	(867) 993-5555 or 667-5555

INCIDENT: HAZARDOUS MATERIAL OR NONAQUEOUS PHASE LIQUID SPILL

The response measures include:

1. Contain spill source and prevent from spreading.
2. Air monitor for explosive or toxic gases. If a hazardous condition is found, the appropriate protective equipment will be used.
3. Mobilize spill control kit. The kit will include:
    - Personal protective equipment
    - Recovery drum
    - Absorbent material
    - Hand shovel
    - Small pail for scooping up liquid
    - Plastic sheeting
4. Recover spill and contaminated material and place in recovery drum.
5. Ensure spill is secure.
6. Implement a decontamination procedure before any employee or equipment leaves the area of potential hazardous exposure.
7. Transport recovery drum to temporary storage area. A polyethylene drop sheet will be secured to the ground at the temporary storage area
8. The sorting, packaging, transportation and disposal of all hazardous materials and waste encountered will be in accordance to all applicable regulations including the TDGA and CEPA.
9. Prepare spill report.
10. Call the Yukon Fuel and Oil Spill Report Line.

INCIDENT: SERIOUS INJURY

1. Call for help.
2. Assess hazards at the site; if necessary make area safe.
3. Initial First Aid.
4. Evacuate casualty to the nursing station in Dawson City, Yukon
5. Prepare report.

INCIDENT: FIRES

1. A person discovering a fire will report the incident to the Project Manger.
2. Fire suppression equipment will be made available. If a fire is not promptly extinguished, the RMO in Dawson City, Yukon will be notified immediately.

APPENDIX C

MATERIALS AND SPECIALTY TOOLS INFORMATION

MACCAFERRI

ENVIRONMENTAL SOLUTIONS

Update: 01/2002

Maccaferri Canada Ltd. reserves the right to amend product specifications without notice and specifiers are requested to check as to the validity of the specifications they are using.

PRODUCT TECHNICAL DATA SHEET

Gabions – PVC Coating

PVC COATED GABIONS

Gabions are baskets made of 8x10 hexagonal double twisted woven wire mesh, as per ASTM A975-97 (Figures 1 and 2). Gabions are filled with stones at the project site to form flexible, permeable, monolithic structures such as retaining walls, channel linings, and weirs for erosion control projects.

The wire used in the manufacture of the gabion is heavily zinc coated soft temper steel. A PVC coating is then applied to provide added protection for use in polluted environments where soils or water are acidic; in salt or fresh water, or wherever the risk of corrosion is present. The PVC coating has a nominal thickness of 0.50 mm. The standard specifications of mesh-wire are shown in Table 1.

The gabion is divided into cells by means of diaphragms positioned at approximately 1 metre centres (Figure 1). In order to reinforce the structure, all mesh panel edges are selvedged with a wire having a greater diameter.

Dimensions and sizes of PVC coated gabions are shown in Table 2.

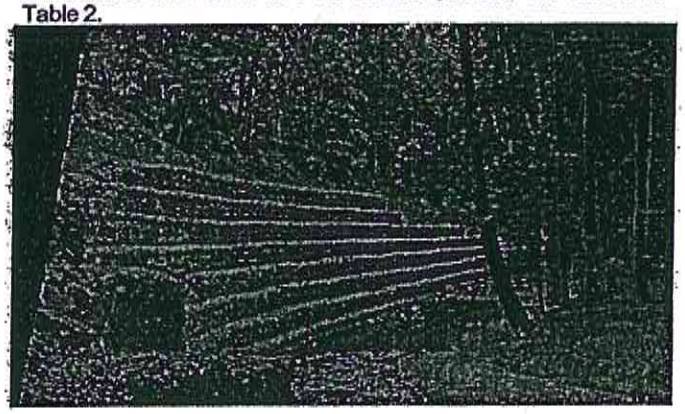


Figure 1

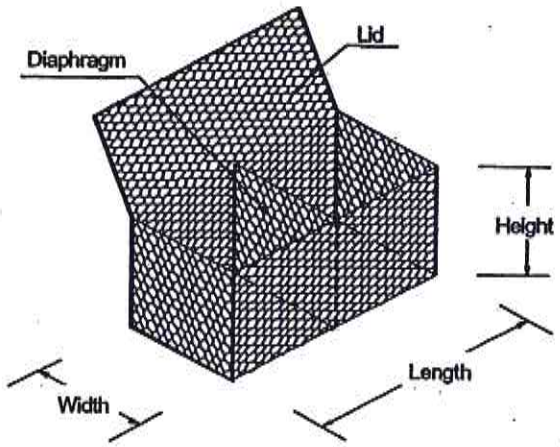


Figure 2

MESH TOLERANCE
The tolerance on the opening of mesh "D" being the distance between the axis of twist, is according to ASTM A975-97

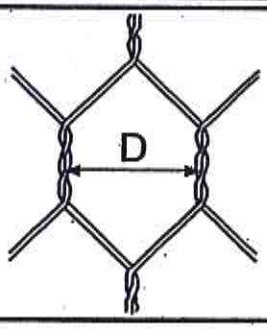


TABLE 1—STANDARD MESH-WIRE

Type	D (mm)	Tolerance	Internal Wire Diameter (mm)	External Wire Diameter (mm)
8x10/Zn + PVC	83	+/- 10%	2.70	3.70

WIRE

All tests on wire must be performed prior to manufacturing the mesh. Wire tolerances (shown in Table 3) are in accordance with ASTM A641-97.

1. Tensile strength: both the wire used for the manufacture of gabions and the lacing wire shall have a tensile strength of 38-48 kg/mm^2 according to ASTM A641-97.
2. Elongation: shall not be less than 12%, in accordance with ASTM A370-92. The test must be carried out on a sample at least 30 cm long.
3. Zinc coating: minimum quantities of zinc shown in Table 3 meet he requirements of ASTM A641-97, Class III soft temper coating.
4. Adhesion of zinc: the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641-97.

PVC COATING CHARACTERISTICS

The technical characteristics and the resistance of the PVC to aging meet the relevant standards. The main values for the PVC material are as follows:

Specific gravity: 1.30-1.35 kg/dm^3, in accordance with ASTM D792 Table 1;
Hardness: between 50 and 60 Shore D, according to ASTM D 2240;
Tensile strength: not less than 20.6 MPa, according to ASTM D412-92;
Modulus of elasticity: not less than 18.6 MPa, in accordance with ASTM D412-92;
Abrasion resistance: the percentage of the weight loss shall be less than 12%, according to ASTM D1242-92.

...continued on page 2

PVC COATING CHARACTERISTICS, Continued

Creeping corrosion: maximum penetration of corrosion of the wire from a square cut end shall be 25 mm when the specimen has been immersed for 2,000 hrs in a 5% solution HCl (hydrochloric acid 12 Be).

The accelerated aging tests are:

Salt spray test: test period 3,000 hours, test method ASTM B117-94;

Exposure to UV rays: test period 3,000 hours at 63°C, test method ASTM D1499-92a and ASTM G23-93 apparatus Type E;

Brittleness temperature: no higher than - 9°C, or lower temperature when specified by the purchaser, when tested in accordance with ASTM D746.

The properties after aging tests shall be as follows:

Appearance of coated mesh: no cracking, stripping or air bubbles, and no appreciable variation in color;

Specific Gravity: variations shall not exceed 6%;

Hardness: variations shall not exceed 10%;

Tensile strength: variations shall not exceed 25%;

Modulus of elasticity: variations shall not exceed 25%;

Abrasion resistance: variations shall not exceed 10%;

Brittleness temperature: shall not exceed +18°C.

TABLE 2—GABION SIZES (8x10 mesh)

Length (m)	Width (m)	Height (m)	Number of Cells	Capacity (m^3)
2	1	1	2	2
3	1	1	3	3
4	1	1	4	4
2	1	0.5	2	1
3	1	0.5	3	1.5
4	1	0.5	4	2
2	1	0.3	2	0.6
3	1	0.3	3	0.9
4	1	0.3	4	1.2

Tolerances of +/- 5% of the length, width and height of the gabions shall be permitted.
All sizes and dimensions are nominal.

TABLE 3—WIRE		Lacing Wire*	Mesh Wire	Selvedge Wire
PVC Mesh Diameter	Φ (mm)	2.20	2.70	3.40
Wire Tolerance	(+/-) Φ (mm)	0.10	0.10	0.10
Minimum Quantity of Zinc	(g/m^2)	213	244	260

* Lacing wire is supplied at a percentage of the gabion weight.

ASSEMBLY AND INSTALLATION

Gabions are delivered on site unassembled in a collapsed form. Once the units are unfolded, the corners and diaphragms are bound together using either lacing wire (see Figure 3) or stainless steel rings (see Figure 4) that are provided with the units. The lacing must be performed as described in the Product Installation Guide to insure proper strength and function of the gabions. Rings must be closed (see Figure 5) and there must be one ring in every mesh opening, the spacing should not exceed 150 mm as shown in Figure 4.

Upon proper lacing of the gabions, they are filled with stone that is between 100 and 200 mm in diameter. The stones shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure. The placement of stone on all visible faces shall be hand placed for appearance purposes. Before binding the lids down it is important to check the stone filling at the corners to insure proper shape.

For further information on the assembly and installation of gabions, please consult the Products Installation Guide.

Figure 3— Lacing

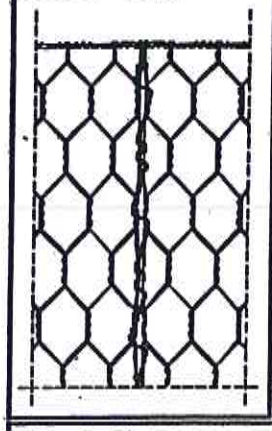


Figure 4—Rings

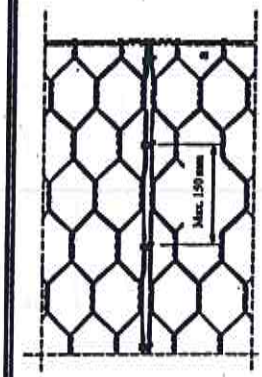


Figure 5—Rings

Quantity Request: When requesting a quote, please specify:
- size of units (length x width x height, see Figure 1)
- type of mesh,
- type of coating

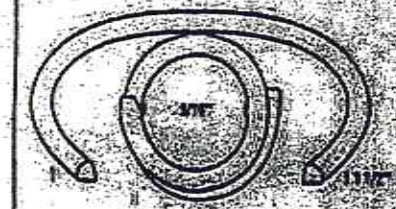
Example: 100 gabions, 2m x 1m x 1m - 8x10 mesh - PVC coated

MACCAFERRI
ENVIRONMENTAL SOLUTIONS
Website : www.maccaferri-canada.com

MACCAFERRI CANADA LTD.
515 Waydom Drive, R.R. #1
Ayr, Ontario, N0B 1E0
Tel: (519) 623-9990 Fax: (519) 623-1309
Email: hq@maccaferri-canada.com

SC50T - 125-Rings Magazine 9/16" Closure Very Large Bag Closure C Ring Closing Tool

Click to Enlarge



Features and Benefits

- Air driven
- Large 1-1/2" opening
- MTCKA3 touch trip, bag guide kit
- MTCKA50 foot valve, bag guide kit

Product Details

Weight 19.3 lbs, 6.49 kilos

Magazine Capacity 125

Approx Purchase Price = $2,500 + taxes + freight

Warranty

Work Safely with Tools, Wear Safety Glasses.

RING11SS40 - 1,600-Pack 1-1/2" Sharp Point 11-Gauge Stainless Steel C-Ring

SPENAX™

Click to Enlarge

Features and Benefits

Product Details

Fastener Gauge	11
Fits Bostitch Tools	SC50T, SC50HP
Point Style	Sharp Point
Quantity Per Item Pack	1,600
Closure Size	9/16" to 5/8", 14.3mm to 15.9mm
Material	Stainless Steel
Qty Case Per Skid	96
Qty Pack Per Case	1
Ring Size	1-1/2"
Ring Type	C

Warranty

Work Safely With Tools, Wear Safety Glasses

BOSS HDPE PIPE

Design and Performance Advantages for Engineers

Product Description

High density polyethylene (HDPE) BOSS pipe is a proven performer in the municipal, industrial and forestry pipe markets. Engineered for gravity flow systems, a wide range of BOSS pipe designs are available to meet specific standard and project requirements:

BOSS POLY-TITE, CSA certified leak-tight sanitary and storm sewer pipe, intended for the most demanding municipal applications.

BOSS 2000, CSA certified storm sewer system, used as storm sewers, perforated stormwater management systems, landfill leachate collection, and industrial liquid collection systems.

BOSS 1000, corrugated culvert/storm sewer has a single wall corrugated interior which offers excellent flexibility and economy.

Subdrain Tubing, provides a highly cost effective and efficient solution to the management of subsurface ground water.

Strength

The corrugated exterior provides this product with its inherent minimum pipe stiffness of 320 kPa or 210 kPa. The smooth inner wall provides longitudinal stiffness which enables alignment and grade to be maintained in the trench during installation.

Impact Resistance

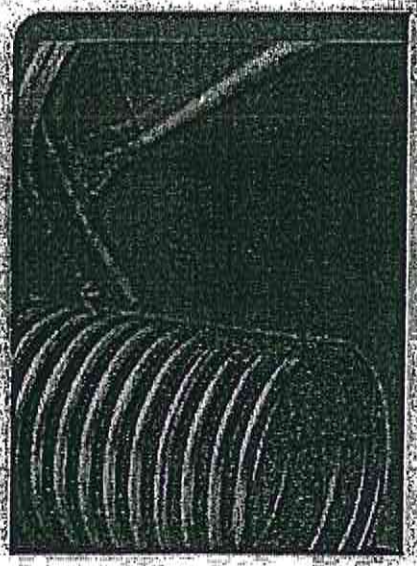
BOSS pipes take the knocks and bumps of handling, moving and installation with ease. The combination of non-brittle HDPE and its unique corrugated exterior makes BOSS pipe capable of sustaining impact in both warm weather usage and cold weather installations.

Weather Resistance

BOSS pipe contains a minimum of 2% carbon black additive to protect the product from ultraviolet light. This gives BOSS pipe maximum weather resistance in applications where continuous exposure to the elements is expected.

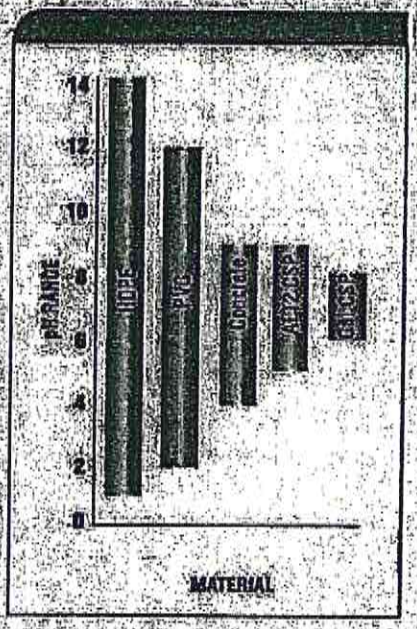
Chemical, pH and Abrasion Resistance

HDPE material provides excellent resistance to both acidic and alkaline environments. The high density polyethylene used in the manufacture of BOSS product performs well under extreme chemical, acidic and abrasive conditions. BOSS pipe brings the gravity flow sewer market the same exceptional performance that HDPE has exhibited in other applications, remaining tough and resistant under conditions that would seriously damage pipe made of traditional materials.



Pipe Material and Recommended pH Range

The chemical resistance characteristics of HDPE give BOSS pipe excellent ratings from strong acids through all bases, pH 1.25 to 14.



Abrasion Resistance

Abrasion is the wearing away of a pipe material surface, caused by an abrasive bed load (gravel, rock or sharp stones) being carried by the flow. Tests indicate that HDPE pipe is highly resistant to abrasion. Although experiencing a slight increase in abrasive wear when installed in extreme acidic conditions, BOSS pipe provides significant advantages over traditional sewer pipe materials. The resistance of HDPE pipe to wear under abrasive conditions gives it a significant advantage over traditional pipe materials in both acidic and abrasive environments.

INSTALLATION GUIDELINES

The key to successful installation of BOSS pipe is the achievement of stable and permanent support through the selection and compaction of proper embedment materials. Complete guidelines and procedures can be found in CSA B182.11 "Recommended Practice for Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings."

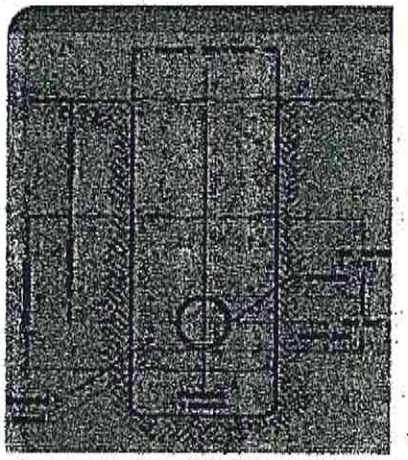
Foundation
The pipe must rest on a smooth, stable foundation, free of rocks and clumps.

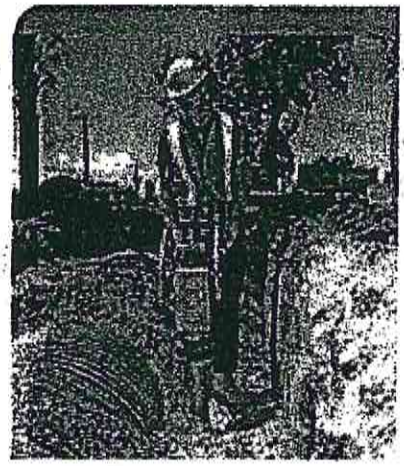
Bedding
Bedding should consist of compacted well graded granular material, levelled to the proper grade.

Haunching
Haunching should be the same material as bedding, placed and compacted in successive lifts of 150 mm, up to the springline of the pipe. Compact to 95% Standard Proctor Density.

Initial Backfill
Backfill should be the same material as for haunching, extending from the springline to 300 mm above crown of pipe. For pipe diameters less than 300 mm, this dimension may be reduced to one pipe diameter, but not less than 150 mm. Compact to 95% Standard Proctor Density.

Final Backfill
Select native materials may be used depending on the application. Do not place large rocks or clumps within 600 mm of pipe.





Minimum/Maximum Height of Cover

Nominal Diameter (mm)	Minimum Cover (m) CS-600[1] or HS-25[2]	Minimum Cover (m) E-80[3]	Maximum Cover (m) 320 kPa Pipe Stiffness[4]	Maximum Cover (m) 210 kPa Pipe Stiffness[4]
100	0.30	0.60	11.9	9.0
150	0.30	0.60	11.9	9.0
200	0.30	0.60	11.9	9.0
250	0.30	0.60	11.6	9.0
300	0.30	0.60	10.6	9.5
375	0.30	0.60	10.6	9.5
450	0.30	0.60	11.9	9.1
525	0.30	0.60	11.0	9.5
600	0.30	0.60	11.3	10.7
750	0.30	0.60	14.1	10.7
900	0.30	0.60	14.1	10.7

1. CS-600 is CSA CS-600 truck loading
2. HS-25 is AASHTO HS-25 truck loading
3. Cooper E-80 Railway Loading
4. Empirical evidence suggests that maximum cover shown above may be very conservative. Reference: "Performance of High Density Polyethylene Pipe Under High Fill" by Daniel Adams, Tennyson Mulvoi and Ernest Selig, Dep. of Civil Engineering, University of Massachusetts, April 1988

BOSS® 2000
Storm Sewer and Culvert Pipe

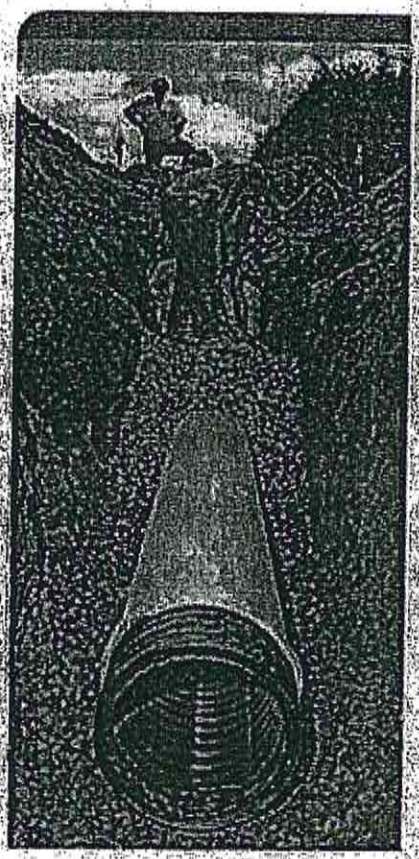
Application
BOSS 2000 incorporates the strength of a corrugated outer shell with a smooth inner wall to optimize hydraulics. BOSS 2000 is designed for general purpose storm drainage applications where the project requires a pipe with high crack resistance and is CSA certified to CSA B182.8. Typical applications include: municipal storm sewers, highway median drainage, perforated stormwater management systems, culverts and greenhouse applications.

Optimum Hydraulics
The smooth interior ensures optimum flow capacity for storm sewer applications. While test values for Manning's 'n' have been as low as 0.010, Engineers typically use 0.012 for design. As well, longer lengths and in-line fittings cause less disturbance to the flow than traditional pipe products.

Fittings and Accessories
BOSS 2000 storm sewer pipes come complete with a full range of available fittings. Both moulded fittings and adapters are available, as well as an extensive selection of made-to-order fabricated fittings to suit special project needs. Contact your local sales representative for a copy of the BOSS fittings catalogue.

Raw Material
High Molecular Weight High Density Polyethylene virgin resin compound certified by CSA will meet a minimum cell class of 324420C as defined in ASTM D3350. Additionally, BOSS 2000 will meet the more stringent requirements of a minimum crack resistance of 15% tensile yield stress for 24 hours as defined by CSA B182.8-02.

CSA Specification
CSA B182.8-02 Profile Polyethylene Storm Sewer and Drainage Pipe and Fittings.



Stocked lengths:	6 m
Custom lengths:	Available on special order
Stocked Stiffness:	320 kPa (100 mm to 900 mm) 210 kPa (250 mm to 900 mm)
Joining Systems:	*Soil tight* - External double bell "snap" coupler (100 mm - 200 mm), External "split" coupler (250 mm - 900 mm), *Water tight* - Ultra Stab 75® (100 mm - 900 mm)
Fitting Availability:	All BOSS 2000 fittings
Nominal Inside Diameter (mm):	100, 150, 200, 250, 300, 375, 450, 525, 600, 750, 900
Outside Diameter (mm):	120, 177, 234, 292, 361, 444, 540, 627, 726, 895, 1087
Applicable Standards:	CSA B182.8-02, BNQ 3624-120
Third Party Certification:	BNQ available where required Pipe, joining system and fittings are certified by CSA to CSA B182.8-02

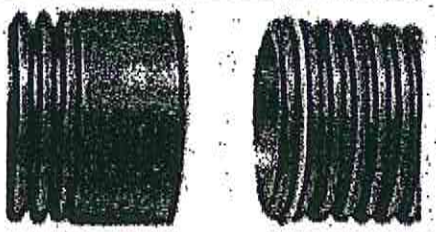
JOINING SYSTEMS

Water Tight – Ultra Stab 100® (CSA B182.6-02)

The joining systems incorporate a Styrene-Butadiene Rubber (SBR) gasket and are intended for watertight applications in which the system will keep the water in or out under normal gravity flow operating pressures. The joints are CSA certified to CSA B182.6-02 and have been laboratory tested to 100 kPa in accordance with ASTM Standard D3212. In special applications where hydro carbon contamination or other aggressive effluents are expected, resistant gaskets made from other rubber compounds can be specially ordered.

Ultra Stab 100® Coupler:
BOSS POLY-TITE
(100mm – 750mm)

The gasket is lubricated and the pipe is pushed in to the belled end to the orange seating mark. (Lubricant is supplied by Armtec)

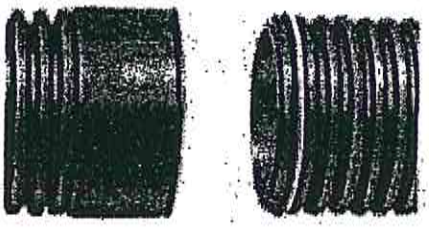


Water Tight – Ultra Stab 75® (CSA B182.8-02)

The couplers incorporate a SBR gasket and offer water tight joint integrity. They are intended for water tight applications in which the system will keep the water in or out under normal gravity flow operating pressures. The joints are CSA certified to CSA B182.8-02 and have been lab tested to 75 kPa in accordance with ASTM standard D3212.

Ultra-Stab 75® Coupler:
BOSS 2000
(100mm – 900mm),

The gasket is lubricated and the pipe is pushed in to the belled end to the orange seating mark. (Lubricant is supplied by Armtec)



Soil Tight

Nongasketed joining systems are soil tight and intended for backfill conditions that are not saturated with flowable fines. In these conditions, the pipe joints can simply be wrapped in a "SOCK" of geotextile. They offer a superior mechanical pull-a-part to that provided by bell and gasket systems.

A: External Split Coupler:
BOSS 2000 (250mm – 900mm),

(Annular) BOSS 1000
(750 - 900 mm)

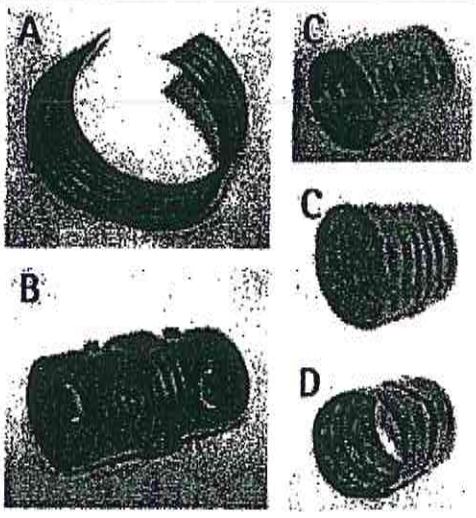
Subdrain tubing (50mm – 75mm, 200mm – 400mm)

B: Insert Coupling:
(Annular) BOSS 1000
(100mm),

Subdrain tubing
(100mm – 200mm)

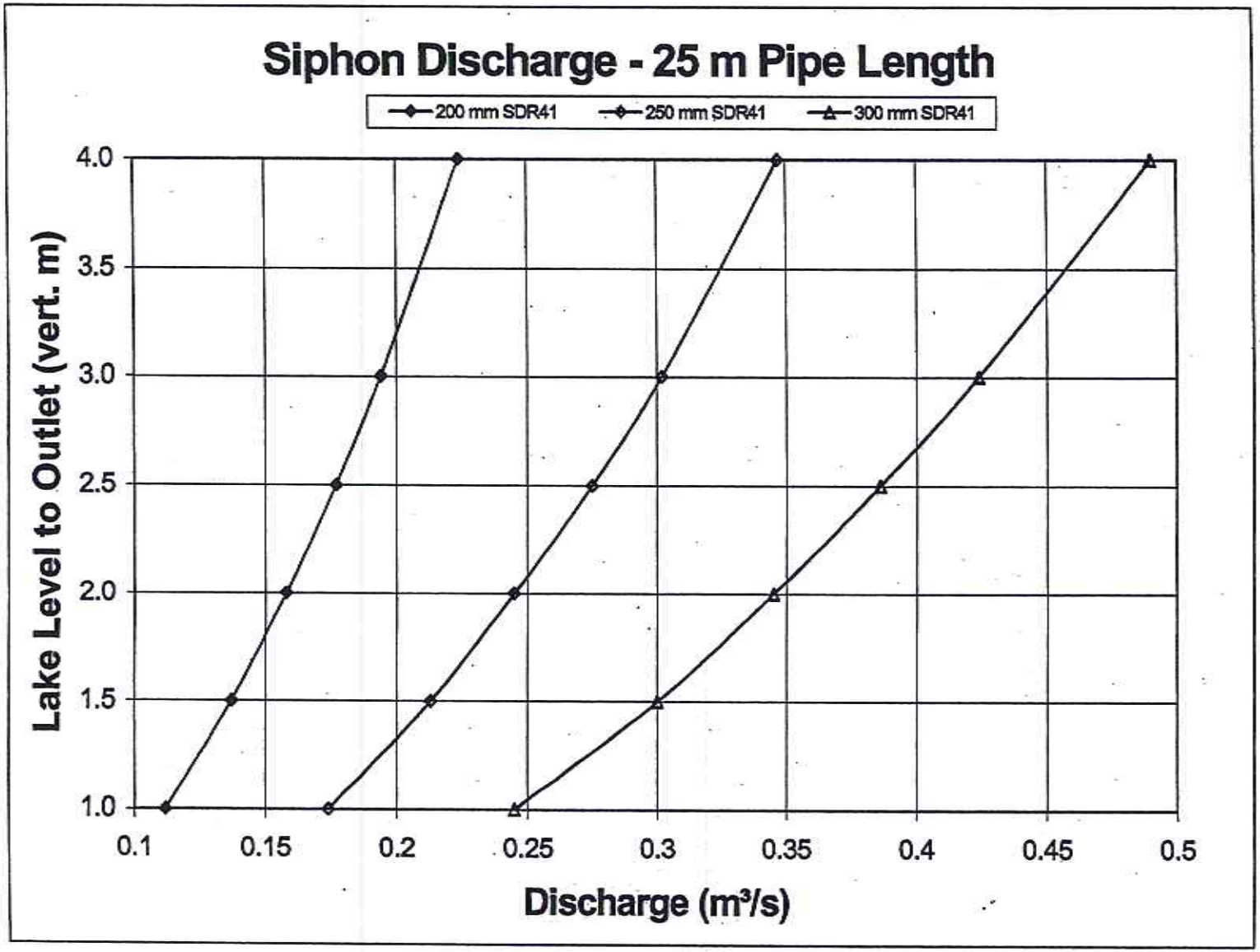
C: Screw on Coupler:
(Helical) BOSS 1000
(150mm – 600mm)

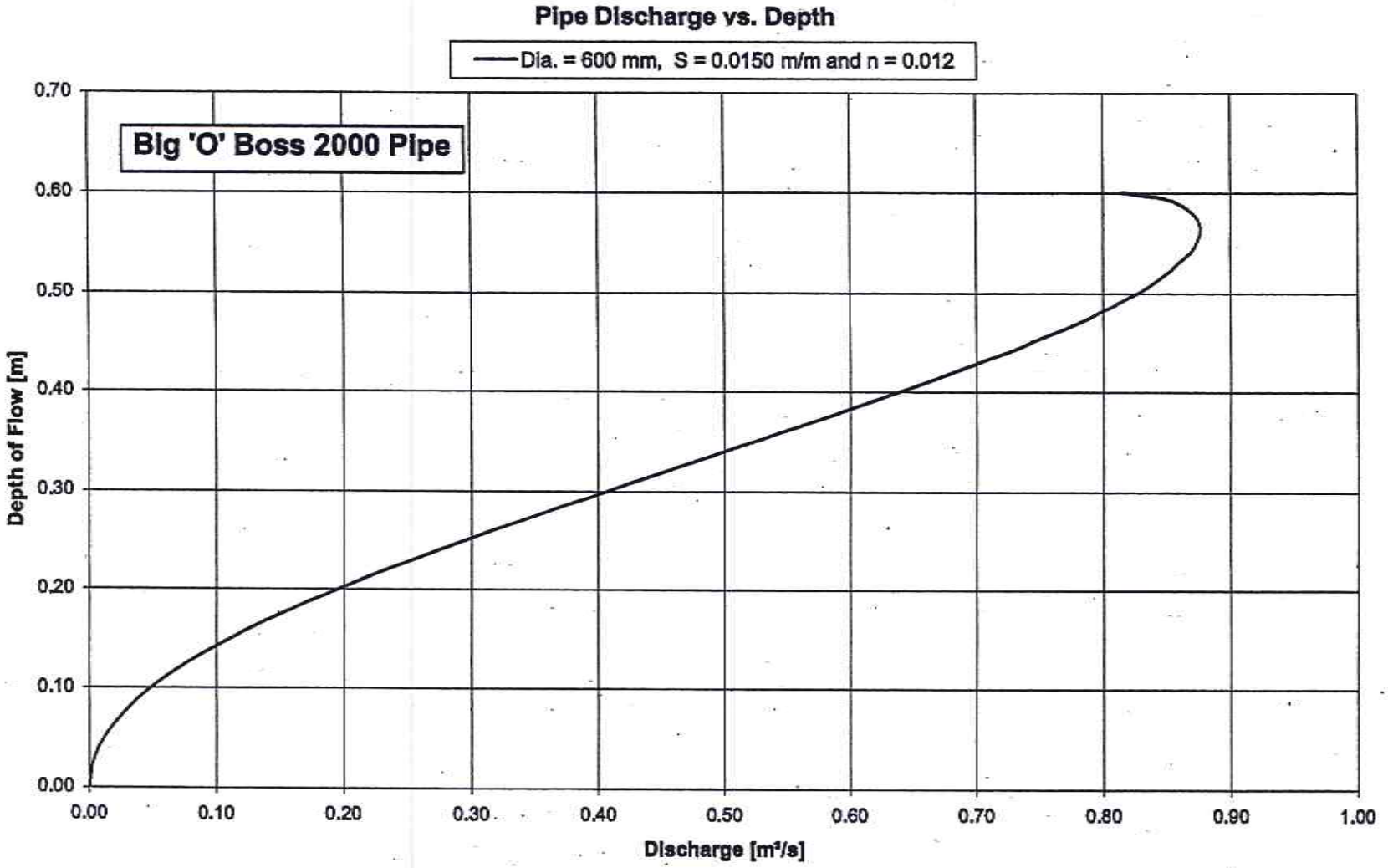
D: External Double Bell Snap:
BOSS 2000
(100mm - 200mm),

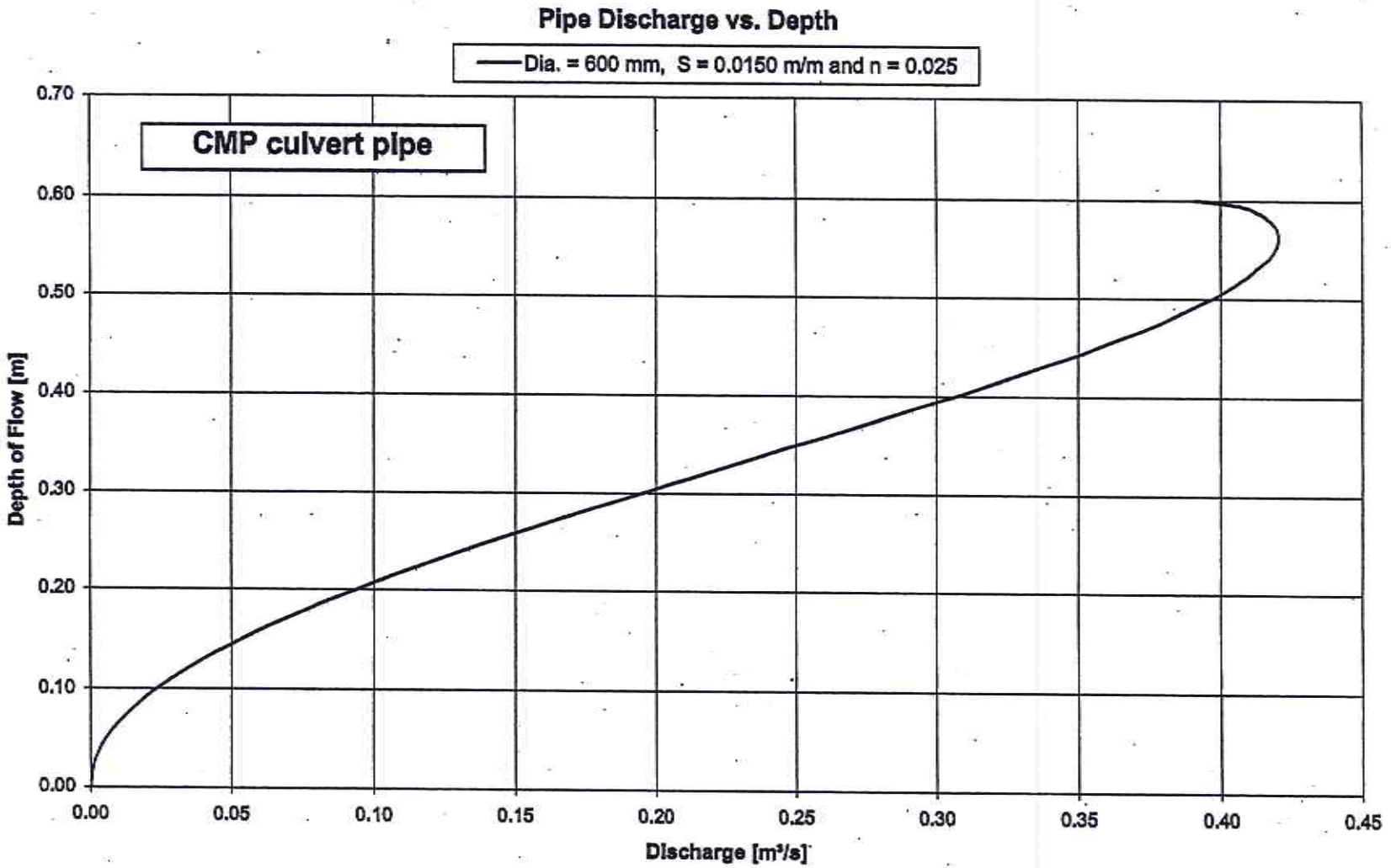


APPENDIX D

SIPHON AND GRAVITY PIPE FLOW CAPACITIES

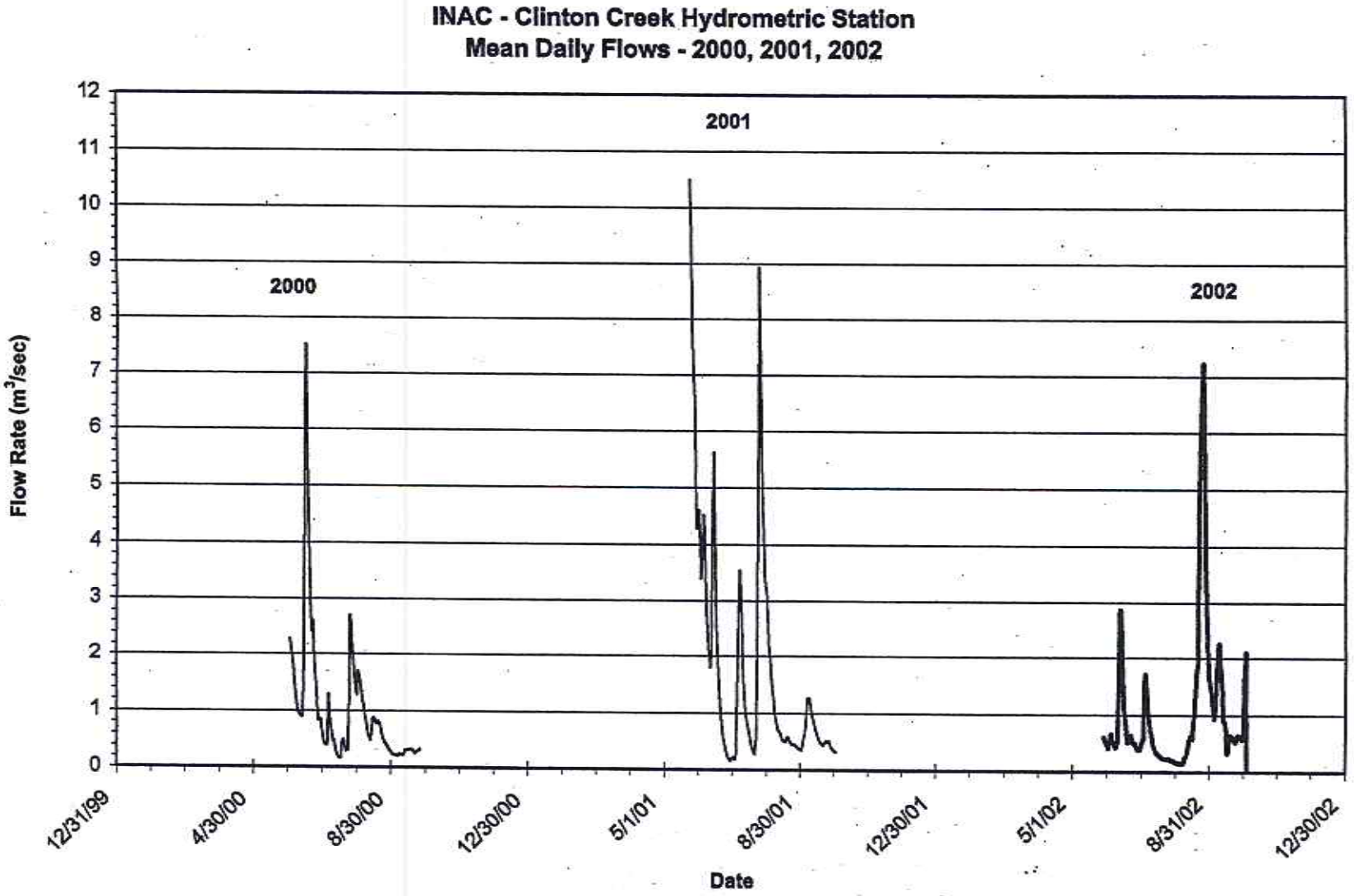

Siphon Discharge - 25 m Pipe Length
200 mm SDR41
250 mm SDR41
300 mm SDR41
Lake Level to Outlet (vert. m)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Discharge (m³/s)

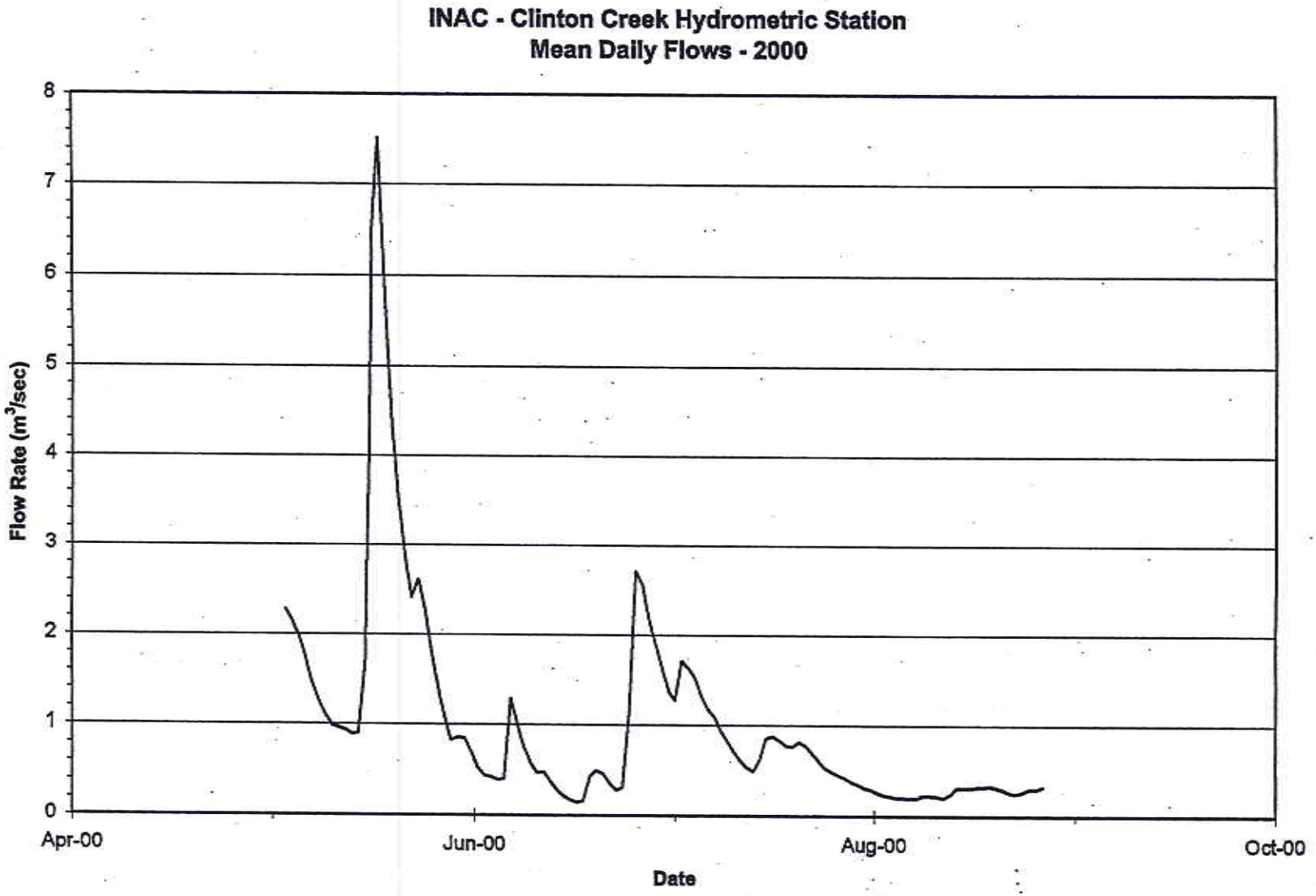

Pipe Discharge vs. Depth
Dia. = 600 mm, S = 0.0150 m/m and n = 0.012
Big 'O' Boss 2000 Pipe
Depth of Flow [m]
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Discharge [m³/s]

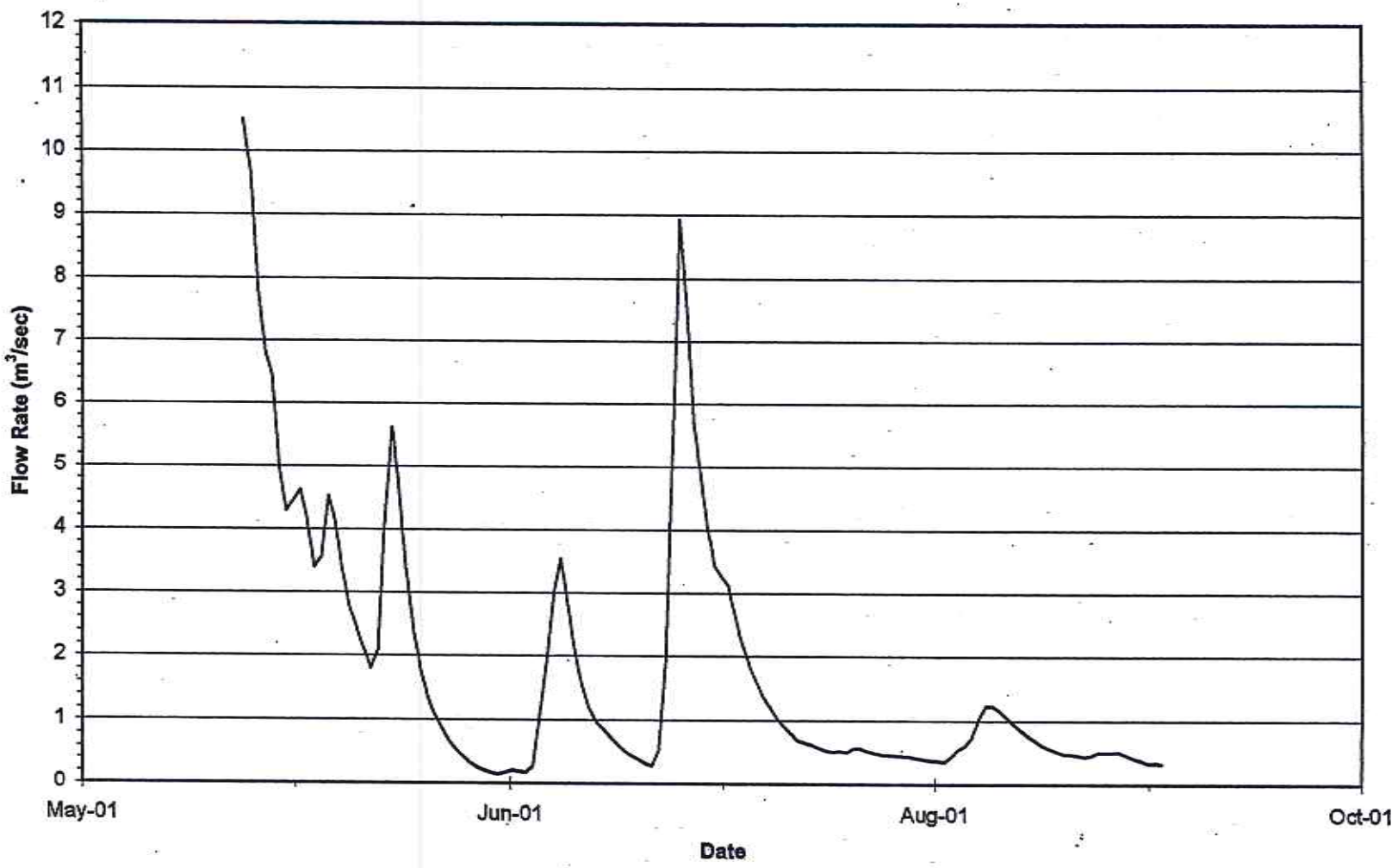

Pipe Discharge vs. Depth
Dia. = 600 mm, S = 0.0150 m/m and n = 0.025
CMP culvert pipe
Depth of Flow [m]
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
Discharge [m³/s]

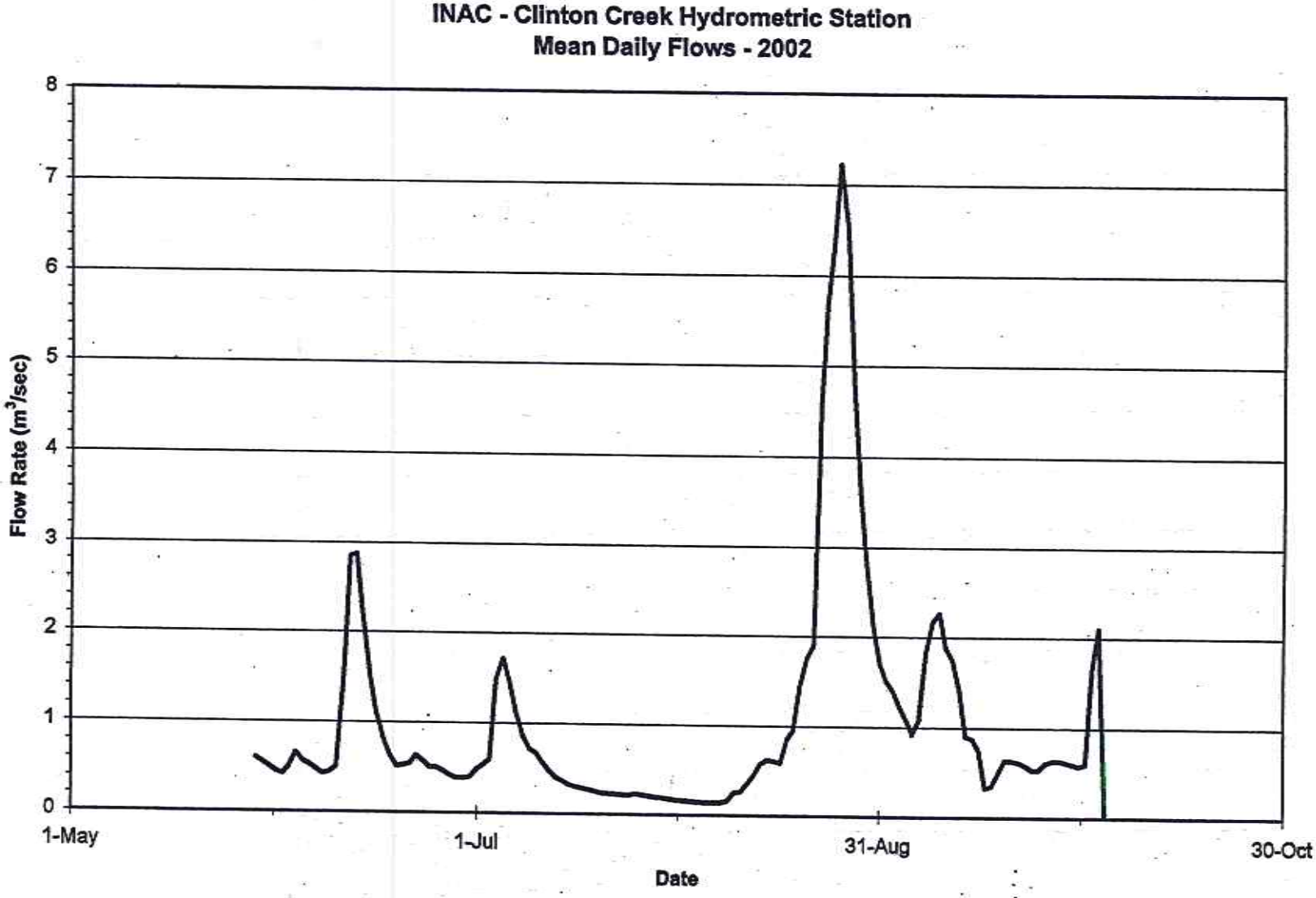
APPENDIX E

CLINTON CREEK HYDROGRAPHS


INAC - Clinton Creek Hydrometric Station
Mean Daily Flows - 2000, 2001, 2002
2000
2001
2002
Flow Rate (m3/sec)
0
1
2
3
4
5
6
7
8
9
10
11
12
12/31/99
4/30/00
8/30/00
12/30/00
5/1/01
8/30/01
12/30/01
5/1/02
8/31/02
12/30/02
Date


INAC - Clinton Creek Hydrometric Station
Mean Daily Flows - 2000
Flow Rate (m³/sec)
0
1
2
3
4
5
6
7
8
Apr-00
Jun-00
Aug-00
Oct-00
Date


INAC - Clinton Creek Hydrometric Station
Mean Daily Flows - 2001
Flow Rate (m3/sec)
0
1
2
3
4
5
6
7
8
9
10
11
12
May-01
Jun-01
Aug-01
Oct-01
Date


INAC - Clinton Creek Hydrometric Station
Mean Daily Flows - 2002
Flow Rate (m3/sec)
8
7
6
5
4
3
2
1
0
1-May
1-Jul
31-Aug
30-Oct
Date