Environmental Management Plan for the Breaching of the Fresh Water Supply Dam at the Faro Mine

Prepared for:

Deloitte & Touche Inc.
In their capacity as Interim Receiver for
Anvil Range Mining Corporation

Prepared by:

Gartner Lee Limited

Reference:
GLL 23025

Date:
August, 2003

Gartner Lee

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1. Introduction

This document provides guidance for protecting the environment during the Faro Freshwater Supply Dam Breaching Project and the associated draining of the reservoir. The document will provide a brief description of the approach to construction methods and sequencing, the associated environmental issues and details of mitigation and compensation plans and the monitoring requirements to ensure that environmental standards are met. An adaptive management plan is included in the program that will be used to ensure that any unexpected impacts to fish or fish habitat are addressed and appropriate mitigation or compensation measures are developed to offset them. The adaptive management approach is required as it will not be possible to fully assess the impact of restoring the stream channel within the reservoir until the reservoir is removed and inflows are provided a chance to re-establish a channel. The detailed baseline information, design, construction and environmental assessment can be found in "*Final Breach Design, Fresh Water Supply Dam, Faro Mine*"(SRK 2003a). Drawing 1 provides a layout of the Faro mine site with the freshwater supply dam and reservoir.

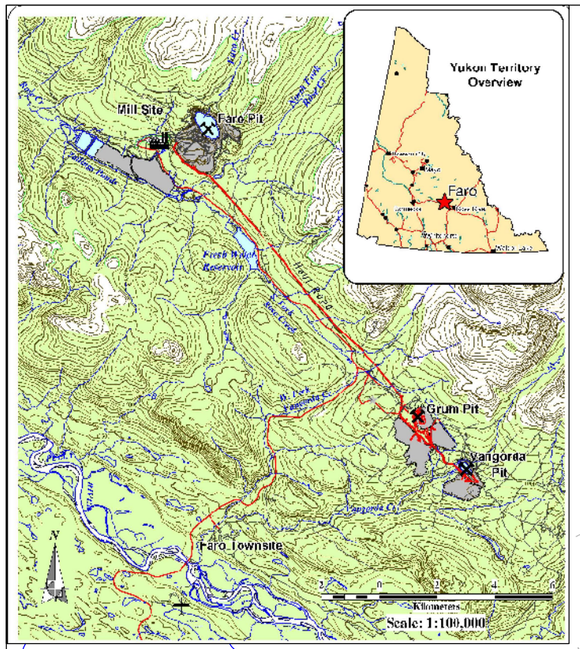
2. The Project

2.1 The Breach

The breach will be a notch excavated through the existing dam. The base of the notch will be 25.4 m wide and the sides will be armoured with rip rap leaving a 20 m wide flood plain through the dam. The flood plain has been sized to safely convey a 500-year return period flood. The notch design includes side slopes of 3H:1V provides slope stability to meet the required factor of safety. However, if additional piezometric data collected just prior to construction indicates that side slopes of 2.5H:1V will meet the required factor of safety for the conditions immediately post construction, the breach side slopes may be steepened.

Other aspects of the breach include the abandonment of the low-level pipe that currently passes water through the dam and the associated valve structure at the downstream end of the pipe. The upstream end of the pipe will be filled with grout and the end of the pipe capped with a steel plate. The valve house will be removed and the downstream end of the pipe covered by a slotted steel plate to facilitate ongoing drainage. Any exposed section of pipe will be covered by a 2 m thickness of soil.

Approximately 75,000 m^3 of material will be removed from the dam to create the breach. The material will be deposited into one of three proposed spoil areas which are generally located on Drawing 2. Some of the excavated material will be used to cover the exposed ends of the low-level pipe.



DRAWING INDEX:

Notes:

Base Map supplied by the Orthoshop, January 1991
North American Datum 1927
Contour Interval 100 m
Universal Transverse Mercator Projection
Map is a composite of 9 basemaps.

NOTE: SCALE HAS BEEN REDUCED BY 50%

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							C	ISSUED TO WATER BOARD	GWF	APR. 17/03
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REFERENCE DRAWINGS | REVISIONS | ISSUE AUTHORIZATION

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ENVIRONMENTAL MANAGEMENT PLAN

BGC Engineering Inc. AN APPLIED EARTH SCIENCES COMPANY

SRK Consulting Engineers and Scientists

DESIGNED BY: GWF	DRAWN BY: DC/JM
DATE: JAN. 2003	DATE: JAN. 2003
CHECKED BY: CCS	DISCIP. ENGR.
DATE: JAN. 2003	DATE:
PROJ. MGR:	PROJ. ENGR.
DATE	DATE

SRK PROJECT NUMBER: 1CD003.22

Deloitte & Touche Inc.

FRESH WATER SUPPLY DAM BREACH
ANVIL RANGE MINING COMPLEX, YT

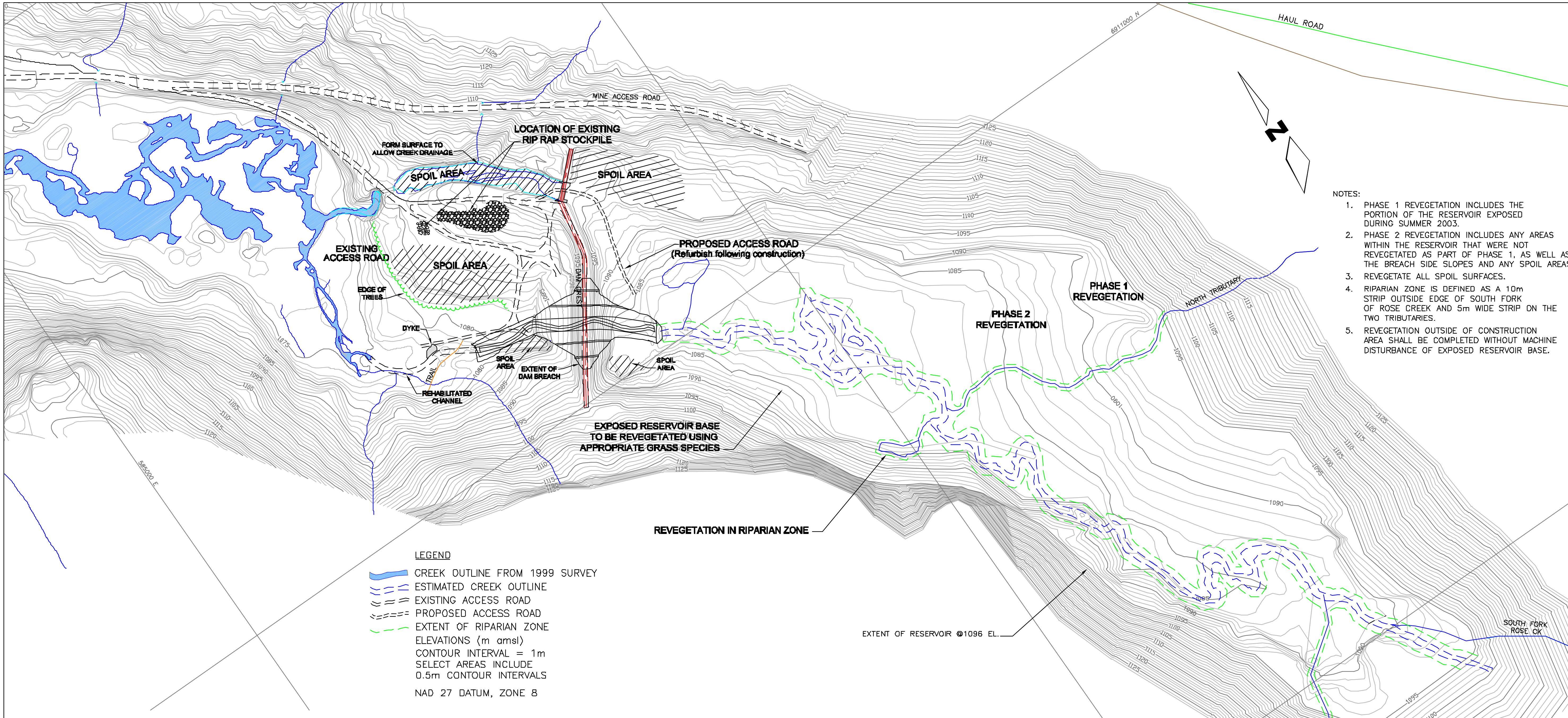
SCALE: 1:15,000 (0 200 400 600 800 1000)

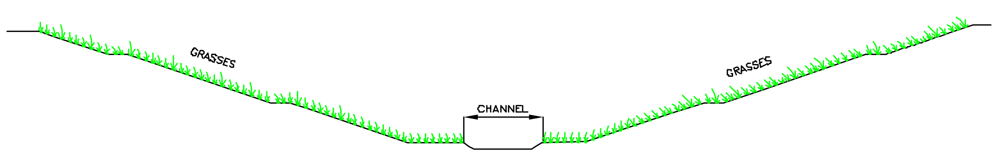
COVER SHEET

DRAWING NUMBER #1

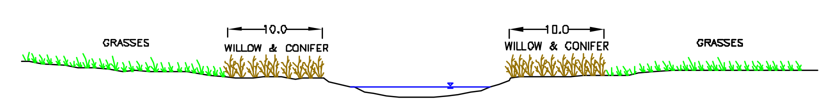
REV.

FILE NAME: F:\Deloitte...touche\dead drawings-Faro\faro FWSD\Figure 1.dwg





TYPICAL REVEGETATION IN PROPOSED BREACH ZONE



TYPICAL REVEGETATION IN RIPARIAN ZONE

NOTE: SCALE HAS BEEN REDUCED BY 50%

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FRESH WATER SUPPLY DAM BREACH
ANVIL RANGE MINING COMPLEX, YT

SCALE: 1:3000
0 50 100 150 200 250 metres

CONSTRUCTION AREA AND REVEGETATION PLAN

DRAWING NUMBER #2
REV.

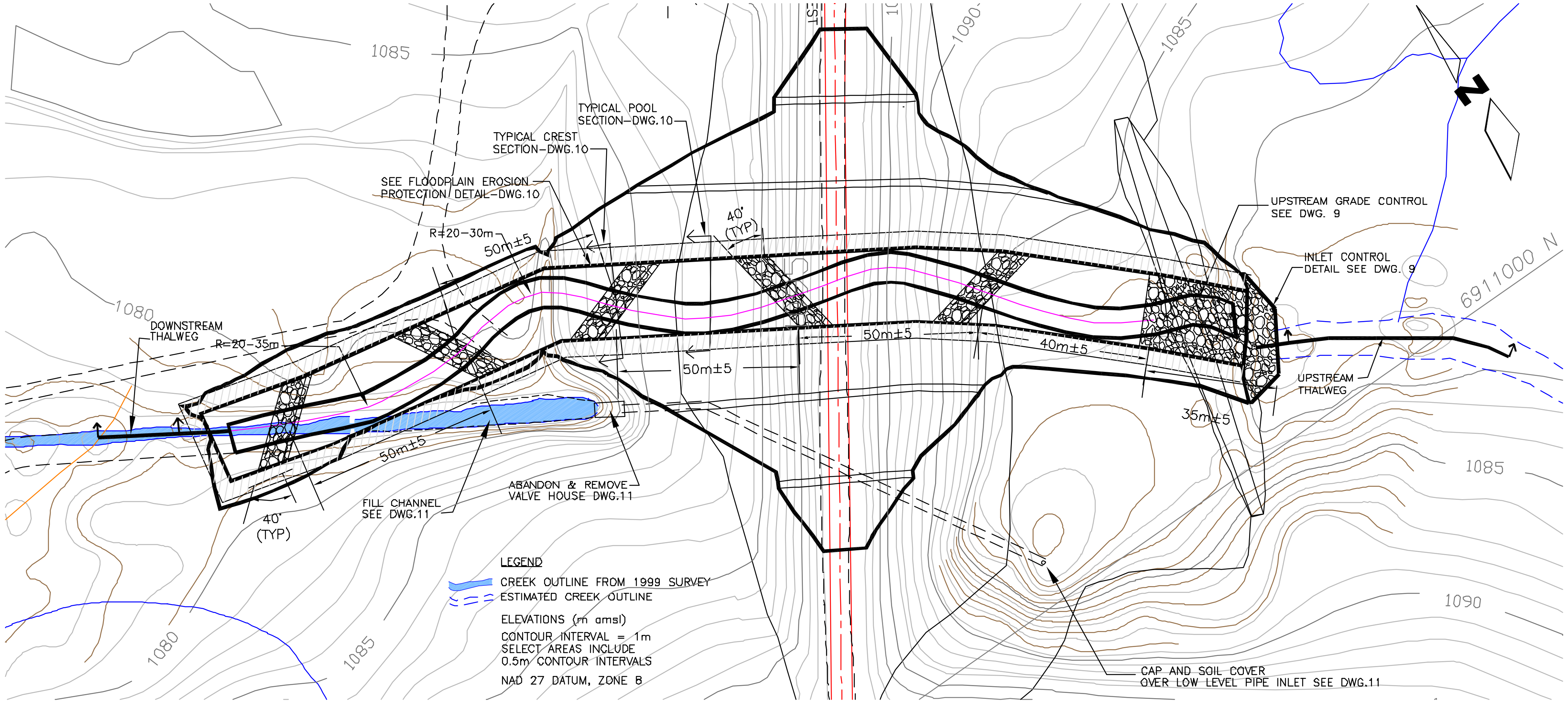
2.2 Stream Channel through the Breach

A sinuous 8 m wide channel of pool/riffle character will be constructed in the flood plain through the breach. The purpose of this channel is to recreate fish habitat characteristics that were likely present in the area prior to the formation of the dam. The overall design grade is 1% with riffle and pool as the general hydraulic condition providing habitat and passage for arctic grayling. The channel is designed to contain the normal flood (2 year return period of 5.6 m^3/s) as bank full flow in the channel. Larger floods will overtop the channel, however velocities of water passing through the breach will allow for fish passage during 10-year return period floods. During estimated winter base flows of 0.08 to 0.12 m^3/s it is expected that the pools will be able to provide over-winter refugia for fish. The design channel includes a depth of 0.3 m over the riffles and approximately one meter deep pools. The constructed riffles would be spaced approximately every 50 m and the pools would make up about 50 to 75% of the channel length. General details of the channel design is provided in Drawing 3. The channel through the breach will be constructed under the supervision of a qualified stream restoration engineer.

2.3 Channel Restoration - Downstream of the Dam

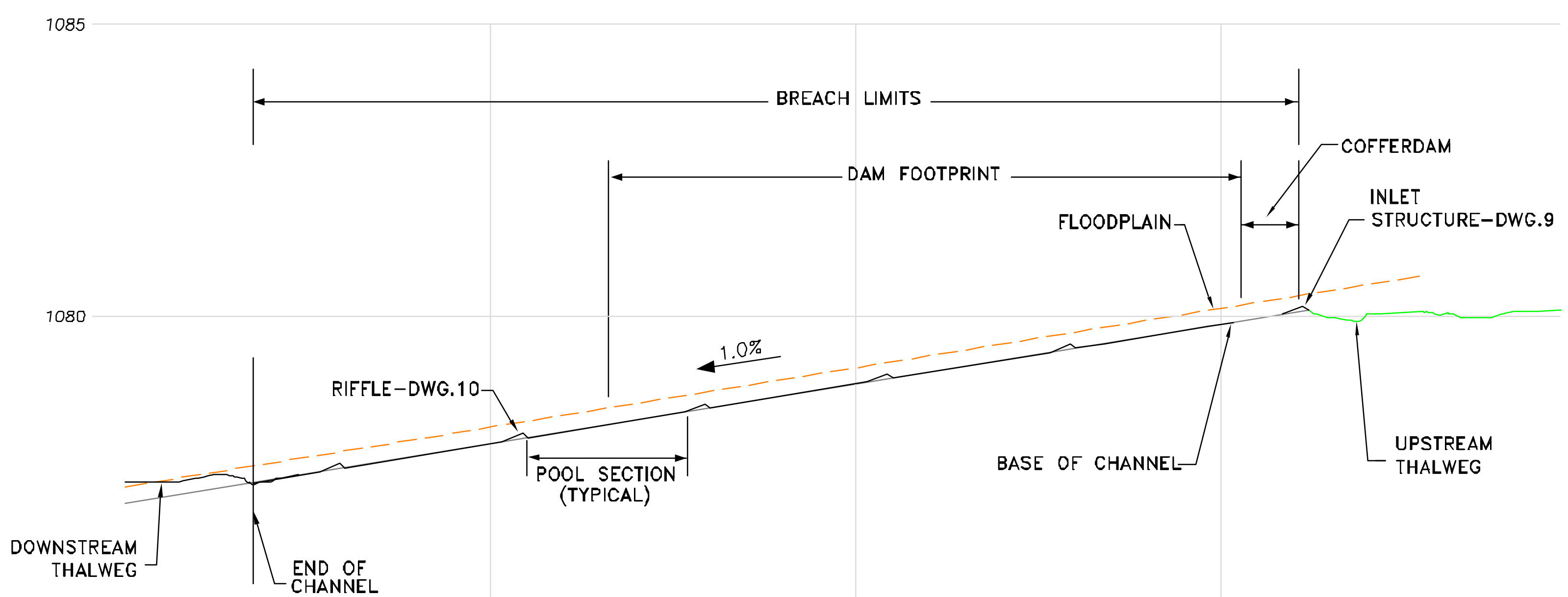
When the dam was built a low-level outlet was incorporated into the dam and used to convey water through the dam to allow extraction of water for use in the milling process and to maintain a minimum flow in Rose Creek. The channel that conveyed the water into the unaltered section of the South Fork of Rose Creek below the dam, was designed to carry flows of less than 1 m^3/s. Drawing 4 shows the general layout of the existing reservoir and low-level pipe. Once the dam is breached this channel will have to carry normal freshet flows that will reach 5.6 m^3/s and higher. The increased flows that the channel will have to handle once the dam has been breached could potentially cause erosion and downstream sedimentation.

Because this channel has been established for over 30 years, the preferred approach to restoration is to minimize instream work and the leave the channel in its existing state. With the upgrade to the valve on the low-level pipe the valve is currently discharging just over 2 m^3/s into the channel with no evidence of erosion or other flow problems downstream. Rather than engineer and construct a channel below the dam, an adaptive approach will be taken that would initially allow the stream to re-work the channel. The new channel through the breach will discharge directly into the existing channel downstream of the dam. The downstream channel will be monitored during the freshet flows in the spring of 2004. If significant erosion and flooding occurs a plan will be developed to provide the appropriate channel dimensions and stability elements. These alterations will be made during the low flow conditions in the summer or fall of 2004. If there are no significant problems during the 2004 freshet the channel will be left as it is.



RIFFLE STRUCTURE STARTING AT UPSTREAM END	ELEVATION OF RIFFLE CREST (EXCLUDING THE SLOPE TO THE RIFFLE CENTRE)
INLET STRUCTURE	1080.50
RIFFLE	1079.92
RIFFLE	1079.32
RIFFLE	1078.72
RIFFLE	1078.12
RIFFLE	1077.50

NOTE: DETAILED COORDINATES TO BE PROVIDED PRIOR TO CONSTRUCTION



HORIZONTAL SCALE – 1:1000
VERTICAL SCALE – x2

NOTE: SCALE HAS BEEN REDUCED BY 50%

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DATE	DATE

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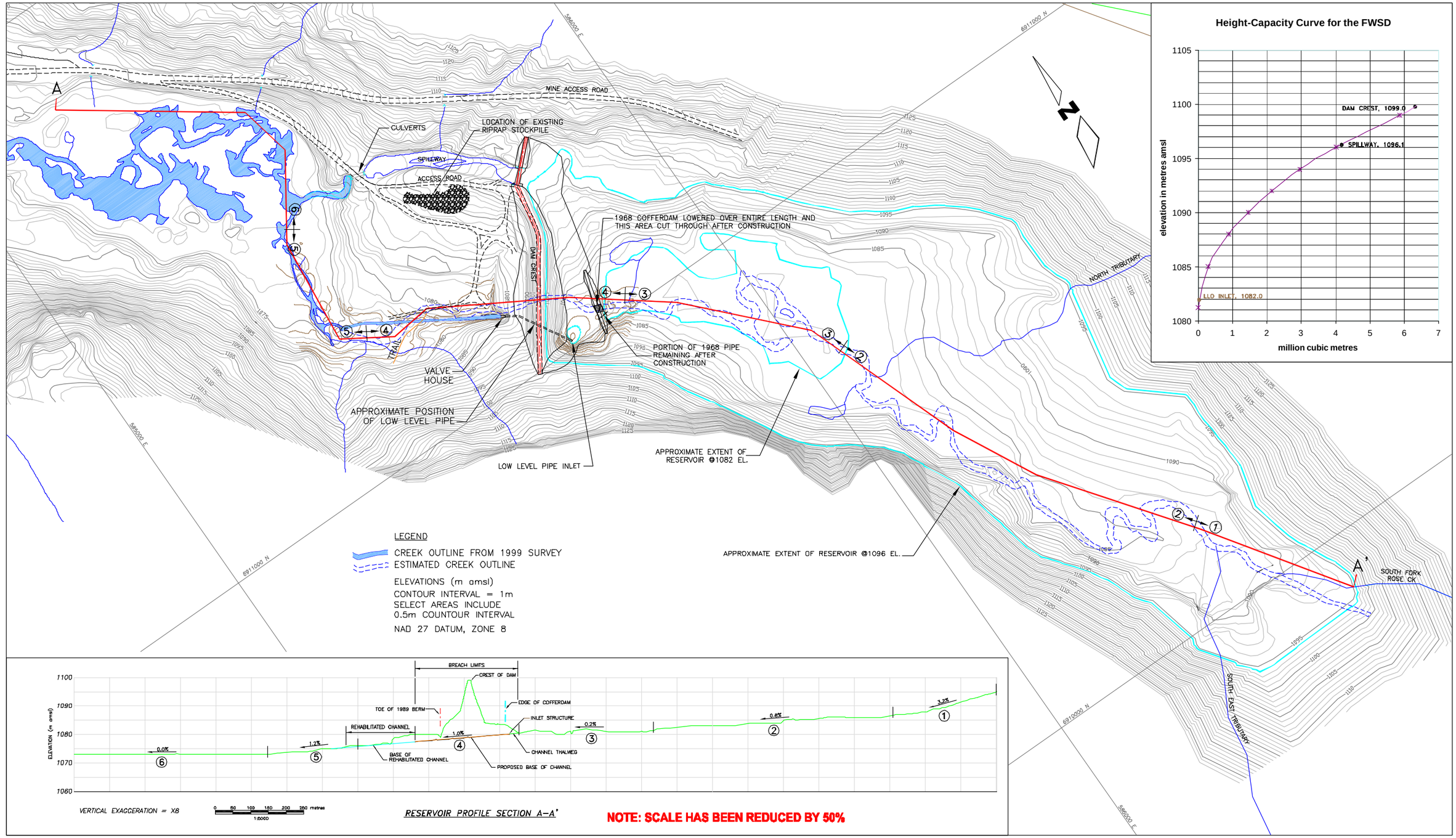
Deloitte & Touche Inc.

FRESH WATER SUPPLY DAM BREACH
ANVIL RANGE MINING COMPLEX, YT

SCALE: 1:750 — 0 10 20 30 40 50 Metres

FWSD BREACH PLAN AND PROFILE

DRAWING NUMBER: #3
REV.



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FRESH WATER SUPPLY DAM BREACH
ANVIL RANGE MINING COMPLEX, YT

SCALE: 1:3000
0 50 100 150 200 250 metres

RESERVOIR SITE PLAN

DRAWING NUMBER #4

REV.

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2.4 Water Management

2.4.1 Reservoir drawdown

During the spring and summer months of 2003, the reservoir will be held at 1090 m amsl or less (down to 1088 m amsl) when practical. Upgrades to the valve on the low-level outlet now allow the valve to safely pass flows up to 2.3 m^3/s. Due to the low snow pack this year, the freshet inflows to the reservoir were less than normal. This should, therefore, facilitate keeping the reservoir level at or near 1090 m amsl, providing there are no significant rain events.

There are three constraints on reservoir drawdown:

- Rate of inflows and the low-level pipe's capacity to match or exceed the inflows to the reservoir.
- Dam safety. If drawn down too rapidly, it could cause failure on the upstream face of the dam
- The fish salvage program. Removing fish from the reservoir is anticipated to take place when the reservoir levels are around 1086 m to provide enough depth to operate fish capture gear without getting fouled by woody debris on the bottom of the reservoir.

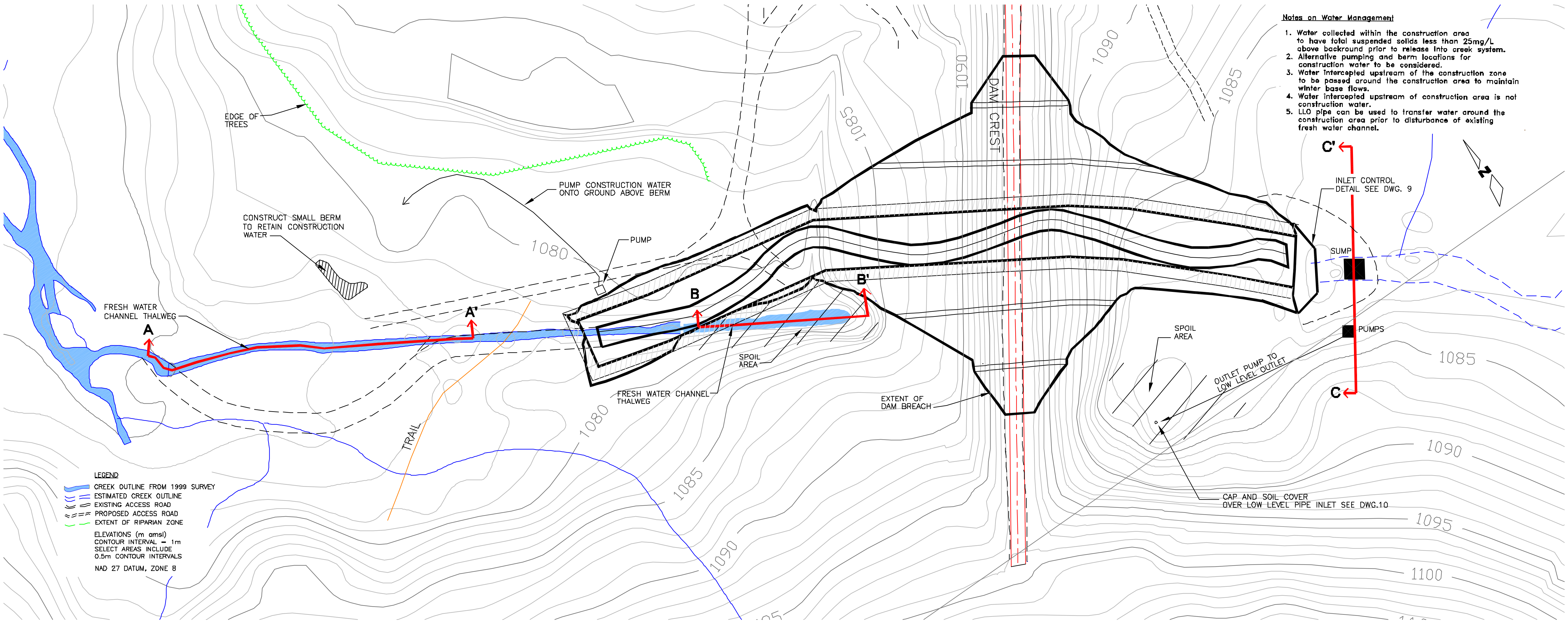
Under normal weather conditions, the reservoir will be down to the 1082 m level by mid to late October. Below 1082 m, pumps will have to be used to remove the final 50,000 m^3 of water from the reservoir and to discharge the anticipated inflows at that time of year.

2.4.2 Water Management During Construction

Surface water and groundwater will be managed throughout construction. Water management has two components; diverting winter base flows in Rose Creek past the construction area and collecting surface or groundwater that flows into the work site. Therefore, there will be two types of water during construction: creek water and construction water. Creek water will be diverted around the construction site in a manner that will provide continuous passage of flow from above the cofferdam to the freshwater channel below the work site. Construction water will be collected to ensure that waters with elevated sediment levels do not get released in to the South Fork of Rose Creek.

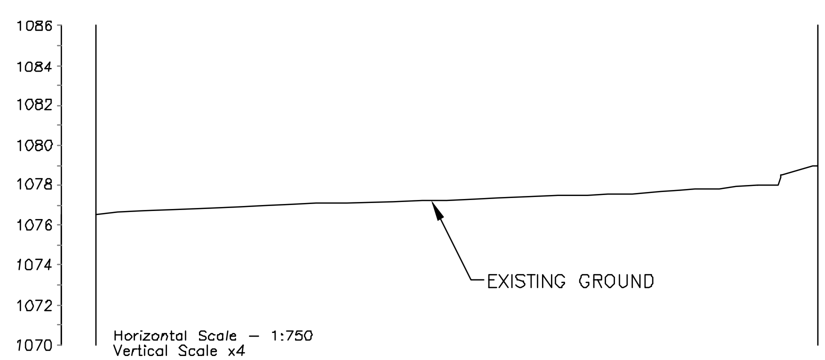
In order to capture and pump the winter base flow in the South Fork of Rose Creek, a sump will be excavated within the old channel just upstream of the cofferdam (Drawing 5) Digging the sump will temporarily cause high TSS within the disturbed area of the sump construction. The excavation of the sump will be done in a manner that will minimize the release of sediment downstream. The suggested procedure might include:

- Deploy a silt curtain across the reservoir or around the sump construction area to contain the turbid water
- Pumps fitted with appropriate fish screens would extract water from an area outside the sediment curtain and discharge creek flow into the low-level pipe.

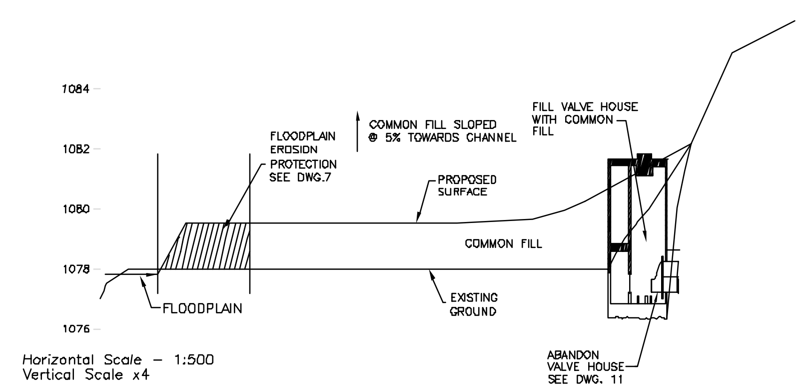


Notes on Water Management

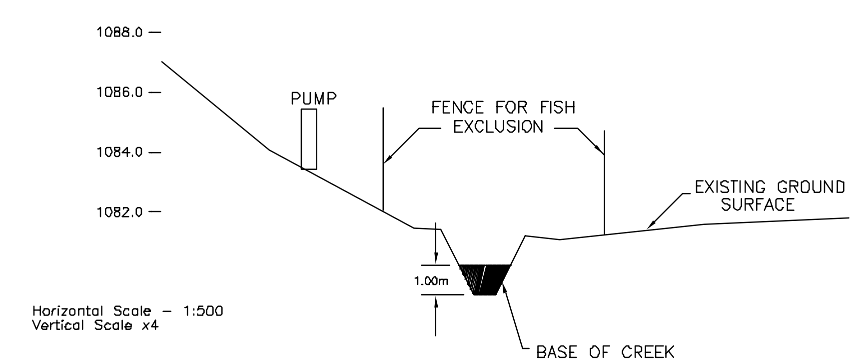
1. Water collected within the construction area to have total suspended solids less than 25mg/L above backround prior to release into creek system.
2. Alternative pumping and berm locations for construction water to be considered.
3. Water intercepted upstream of the construction zone to be passed around the construction area to maintain winter base flows.
4. Water intercepted upstream of construction area is not construction water.
5. LLO pipe can be used to transfer water around the construction area prior to disturbance of existing fresh water channel.



PROFILE A–A' – FRESH WATER CHANNEL THALWEG



PROFILE B – B' – FRESH WATER CHANNEL NEAR VALVE HOUSE



SECTION C–C' – SUMP DETAIL

NOTE: SCALE HAS BEEN REDUCED BY 50%

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Deloitte & Touche Inc.

FRESH WATER SUPPLY DAM BREACH
ANVIL RANGE MINING COMPLEX, YT

SCALE: 1:750 — 0 10 20 30 40 50 metres

WATER MANAGEMENT

DRAWING NUMBER: #5 — REV.

FILE NAME: F:\Deloitte_touche\Acad drawings-Faro\faro FWSD\Figure12.dwg

- Leave the curtain in place until the sediment levels drop to background levels.
- Move pump intakes into the sump area once sediment levels have decreased.
- Avoid cutting off the flow of water downstream of the dam.

Throughout the construction period, it is anticipated that the reservoir will be frozen and snow covered, with little likelihood of generating sediment. However, the water collecting in the sump may be affected by sediment generated as the creek restores itself within its former channel and potentially by moving sediment collected in the former channel. The recent sediment investigation (SRK 2003b) indicated that approximately 3,700 to 5,000 m^3 of sediment have accumulated in the reservoir and that the creek location was discernable, which indicates that the effects are likely to be minimal. Despite steps to minimize the erosion potential, such as the seeding program (section 3.1), some sediment will inevitably be mobilized, primarily during the first post-construction freshet in 2004. As noted in the design report (SRK 2003a), data from other decommissioning projects indicates that 20 to 30% of the total sediment could be mobilized during the first freshet. If this were applied to the FWS Reservoir, there could be a sediment load of 80 to 330 mg/L in the south fork of Rose Creek immediately below the breach depending on factors such as snow pack, temperature and rainfall.

The volume of creek water that can be expected throughout the construction period is outlined in Table 1. Sufficient pumping capacity will be available to handle the expected inflows. In the event of a pump failure, standby pumps will be available on 24-hour notice. The original cofferdam will be used to contain flows above the work area with sufficient capacity to hold the anticipated volume of water that would accumulate over the 24hour period.

Table 1. Estimated Monthly Inflow to the FWS Dam Reservoir in m^3/s

Month	Estimated Monthly Flow (m^3/s), Year of Estimate			
	Average (1968)[1]	Minimum (2003)[1]	Average (2003)[1]	Maximum (2003)[1]
January	0.113	0.08	0.16	0.22
February	0.085	0.06	0.14	0.20
March	0.085	0.06	0.13	0.18
April	0.113	0.11	0.16	0.18
May	1.42	0.94	1.38	1.91
June	2.92	0.94	1.96	2.92
July	1.49	0.64	1.01	1.25
August	0.906	0.59	0.96	1.48
September	0.736	0.53	0.97	1.72
October	0.595	0.39	0.61	1.23
November	0.269	0.22	0.29	0.37
December	0.198	0.12	0.20	0.25

[1]Average (1968) refers to the values established by Parsons in 1968. The 2003 values are based on more recent data, as reported in the 2003 design report.

Pumping of the water from the sump to the downstream receiving environment will require pumping around the downstream construction area and discharging the water into the natural downstream channel.

While the low-level pipe is in place water will pumped directly into the pipe. If the low-level pipe is to be decommissioned before water can be allowed to flow down the new channel through the breach, the creek water will be transferred downstream of the construction area by pumping water into an open flume or through a series of pipes laid through the breach.

Water that collects within the disturbed construction area is construction water. This water will be pumped and discharged onto a vegetated area upslope of a temporary holding area which will be built using a temporary berm on the north side of the existing fresh water channel (Drawing 5). As the construction water runs across the vegetated ground surface, it is anticipated that the sediment content will decrease significantly before it reaches the holding area. Any water that collects behind the berm will be pumped into the creek provided that it meets the discharge criteria for TSS. Alternative methods of clearing the sediment from the construction water will be examined as part of final construction planning.

The water management will vary as the construction proceeds in various stages, likely in accordance with the sequence outlined below. However, efficiencies on the construction side will be sought from the contractor provided they are able to meet the environmental requirements.

- Perform bulk excavation of the notch. The excavation will not extend to the position of the inlet structure. Water will be pumped through the LLO and into the existing fresh water channel.
- Perform installation of the channel erosion protection and formation of the stream channel through the breach. Water will be pumped through the LLO and into the existing channel.
- Abandon the LLO and complete excavation of the upstream portion of channel and install inlet control. Water will be pumped into a flume/pipe which will outlet into the channel below the dam or the channel through the breach, if construction activities have been completed in that section of the channel. The timing of the abandonment of the LLO is uncertain but will likely occur in conjunction with completion of the installation of the erosion protection. Whenever the LLO is abandoned, water will be pumped directly into a flume/pipe system around the active construction area.

3. Environmental Issues and Mitigation

The components of this project that have environmental consequences include:

- Pre construction which includes dewatering of the reservoir, and the disposition of the fish population currently in the reservoir and the exposure of unvegetated soils
- Construction activities which includes reconstructing the stream channel through the breach, the exclusion of fish from the construction area and control of erosion and the release of sediment into the South Fork of Rose Creek

- Post Construction which includes the revegation of the reservoir, reestablishment of the riparian and other aspects of fish habitat along the re-established stream channel.

The direct effect of the project on the environment is associated with the drawdown and exposure of unvegetated areas within the reservoir and the potential alteration of fish habitat because of the work within the footprint of the dam and immediately downstream of the dam. We have assumed that the section of the South Fork of Rose Creek above the dam will naturally find the original channel as the water levels drop. During the bathymetric survey conducted in August 2002 and additional sampling in February 2003, the original creek channel was evident and it shows up on the hydroacoustic tracings of the reservoir bottom. Indications are that sediment accumulations have been minimal and there is a high likelihood that re-establishment of the old creeks channels will occur. The water levels in the reservoir have been maintained at about the 1090 m amsl through the spring and early summer of 2003 and the south fork of rose creek does appear to have re-formed in its former location between elevation 1096 and 1090 m amsl.

3.1 Reservoir Dewatering and Erosion Control

The reservoir water level will be kept as close to 1090 as possible through freshet, however, it will likely temporarily rise above this level due to freshet or rain events and may not return to 1090 until inflows drop, despite efforts by site staff. Ideally water levels will be lowered to approximately 1087 m to provide storage if summer rains exceed the capacity of the LLO to keep the reservoir at 1090 and to also expedite drawdown for construction, once approved. Exposure of unvegetated slopes because of the reduced reservoir levels provides the potential for erosion and sedimentation. A proactive approach to stabilizing the bare soils will be implemented to minimize erosion and potential sedimentation into the South Fork of Rose Creek. A two-phased re-vegetation program of the reservoir is proposed:

Phase 1. Broadcast seeding of the exposed soils between 1096 and 1090 m amsl. This will take place during the 2003 growing season. Arctic Alpine Seed Ltd. has developed a specific seeding plan for this component that is provided in Appendix A. It is anticipated that this seeding program will contribute to erosion control during the 2004 freshet. Even though the grasses die off over winter, this planting will provide root structure to reduce erosion during spring snowmelt and rains in the spring of 2004. Over the summer, the erosion potential for areas between 1090 and the water level just prior to permanent snow cover will be assessed and seed applied where necessary. This seed would then be in place under the snow and available to germinate early in the spring right after snow melt.

Phase 2. Spring 2004 seeding after snow melts. This seeding will focus the areas of the reservoir base that were not seeded during the first phase of revegetation. This may include the reapplication of seeds in areas seeded in Phase 1 where there is low germination or seed has been washed away be rain or snow melt or eaten by wildlife. Specific attention will be paid to the riparian zones of the mainstem and tributary streams. The revegetation will also extend to the construction zone and the spoil areas. The

seed mixture and methods used for the Phase 2 revegetation will be similar to that used for the 2003 program (Appendix A)

The riparian zone will include revegetation with grass, willow and spruce (or white fir) plantings. The willow and spruce will be planted in a 10 m wide zone (extending 10 m from the edge of the bank) adjacent to the South Fork of Rose Creek and a 5 m wide zone adjacent to the smaller tributaries, as shown in Drawing 2.

Planting of white spruce or alpine fir as part of the Phase 2 revegetation will be performed within the riparian zones of the stream channels within the reservoir. The actual areas to be planted will be determined throughout the summer of 2004, after snow melt. The areas selected will be those where stumps indicate the presence of these trees prior to reservoir formation. Preliminary plans for planting trees include the use of larger planting stock to ensure the trees have a good chance of survival amongst the grass and sedge that will be established through seeding. Planted trees will be fertilized with an appropriate starter mix to accelerate root establishment as the nutrient condition of the soils within the reservoir are likely depleted through years of saturation. The anticipated planting density will be equivalent to 800 stems per hectare.

Based on the estimated alignment of the original channel the riparian area to be rehabilitated with willow stakes is approximately 2,400 m long and 20 m wide, for a total area of 48,000 m^2. Willow stakes should be generally placed on 1 m centres with up to 48,000 stakes being required. However willow and tree densities will be adjusted in areas where both are planted. Willow stakes should be collected while the plants are still dormant (i.e. late winter or early spring before leaves start to form). This plan will be refined and a final rehabilitation plan developed after a site survey that will be carried out once the reservoir is dewatered. This will likely take place in the spring of 2004 after snow melt but could be done in the fall of 2003 if water levels are low enough prior to snow accumulation.

3.2 Fish Salvage

3.2.1 Introduction

There are three components to fish salvage for this project:

- The removal of fish from the reservoir as the water levels in the reservoir drop
- Salvage of fish stranded in pools that become cutoff from the main body of water as the reservoir level drops, and
- Salvage of fish from the construction area.

One of the main concerns of the reservoir dewatering is for the fish population that currently exists in the reservoir. The stream habitat that will be left once the reservoir is dewatered will not have the capacity to support the number of fish that would be left behind. Fisheries and Oceans Canada (DFO) and the Yukon

Territorial Government (YTG) provided a guideline document for the salvage of fish from the reservoir and the following program is based on that document.

The objectives of the program are:

- Salvage a predefined number of fish (by species and size) and relocate them into appropriate habitats within Rose Creek to maintain genetic diversity of fish species within the watershed.
- Collect biological data on the fish population in the reservoir including:
  - An estimate of the fish population through a mark – recapture program
  - Data related to productivity of the reservoir.
- Ensure beneficial use of the fish if excessive mortalities occur during the salvage program

This section is based on the information available at the time of writing. The DFO/YTG guidelines require that a final salvage program be provided that includes detail of personnel function/responsibility, the equipment to be used, locations for sampling and fish release. This section will be updated as we obtain this information. Current efforts are underway to locate the necessary sampling gear, transport equipment and finalize the field team. This information will be provided as it becomes available. Also, in support of this fish removal program an application to transfer live fish will be submitted to the Yukon Introductions and Transfer Committee.

The reservoir could contain a significant number of grayling. An estimate of the population in the reservoir can be made using a basic productivity model by Downing *et al*. (1990) which was developed to estimate lake productivity based on the largest size class of fish and the total phosphate in a water body. Gartner Lee (2002) collected water samples from the reservoir which contained 0.0025 mg/L (average) of total phosphate in the reservoir and the largest size class of grayling at 320 mm. Therefore, the Downing *et al*. model provided an estimated number of grayling in the reservoir ranging from 3,000 to 4,500 fish.

3.2.2 Removal of fish from the reservoir

3.2.2.1 Initial Fish Tagging

The primary purpose of this component is to help track the progress of the fish transfer and removal. This component consists of a capture and marking phase of 100 to 200 arctic grayling that have a fork length of 250 mm or greater. The fish will be tagged with numbered floy tags (or other suitable tags). Each fish will be measured, weighed, tagged and released into a holding tank. The fish will be observed for one hour and then released back into the reservoir.

Once the 200 fish are tagged and released, fish capture will be suspended for two to three days. This will allow the marked fish to re-integrate with the main population. Once the actual transfer and removal program is initiated as described below, the marked fish that are recaptured will be recorded. As the fish removal proceeds the reduction or lack of tagged fish captured will be used as indication the removal of fish from the reservoir is nearing completion. Because the overall salvage program will result in the

removal of a significant portion of the population, the overall ratio of marked to unmarked fish can also be used to generate an estimate of the total population of fish. A caution regarding the marked fish is that fish that are handled for marking can change their behaviour for several days to two weeks resulting in initially low capture rates of marked fish.

3.2.2.2 Capture and Out Planting

A survey of the south and north forks and the mainstem of Rose Creek will be conducted prior to release of fish. The purpose of the survey will be to determine the distribution and abundance of adult grayling in the study area. Previous fish sampling has indicated that larger grayling are located in the pools and other deeper water areas and are difficult to capture through electrofishing. Therefore, a snorkel survey will be used to collect information on the distribution of species and numbers of fish by size class. An initial analysis of this information will be used to determine if there are sections of suitable adult grayling habitat that appear to be under stocked. Any under stocked areas will be identified as the sites for out planting fish from the reservoir. Other criteria used to determine out planting sites include having a suitable distribution of sites along the creek and accessibility by truck and/or a short walk. The number of fish released at each location will depend on the observed density of fish at that location during the snorkel survey and the number of sites chosen. Out planting sites will be marked on the ground and on maps, photographed and habitat data recorded.

Initially the capture and out planting will focus on relocating adult grayling, burbot and slimy sculpins. A minimum of 100 adult grayling that are judged to be in good condition will be tagged and released into the out planting sites. Approximately 10 fish will be released per site but this will depend on the number of sites identified. All grayling to be out planted will be weighed and measured and marked with a floy tag similar to the ones used to mark the fish during the initial marking period.

The capture program will target the live capture of 100 slimy sculpins which will be released at the out planting sites. Length data of all fish caught and released will be recorded. All of the first 100 fish will be out planted.

Burbot are also present in the reservoir. The fish salvage guidelines did not specify a target number of fish to be captured live, however, any fish that are caught will be measured (total length) and released at the out planting sites. In all cases field notes will record the number of fish released at each out planting site.

Fish caught for tagging and release will be anaesthetized using alkaseltzer or clove oil (clove oil is preferred) and weighed, measured and tagged. After handling the fish will be released into a holding facility and their recovery monitored for one hour. Fish that appear healthy will be transported by pick-up truck in aerated tanks to the out planting sites. Buckets will be used to transfer the fish from the truck to the creek.

Details of transporting the fish include:

- Keeping fish in holding tank until ready for transport
- Filling transport containers with cool water form the reservoir just prior to transporting the fish.
- A dissolved oxygen (DO) meter and thermometer will be on hand to monitor temperature and DO
- During hot weather, the capture and transport of fish will be done in early morning or late afternoon to avoid high temperatures
- Provide tarps to keep direct sun light off holding tank and transport tank

Temperature conditions during the salvage and out planting operations will be monitored closely to limit heat related stress on the fish. Ideal temperatures during the salvage will be air temperatures that do not exceed 20º C and water temperatures in the reservoir that do not exceed 15º C. To minimize this risk the salvage will not start until after August 15th. Particular attention will be paid to the temperature in the transfer tank which would ideally should be cooler than the temperature of the receiving water. If weather conditions are such that the water temperatures can not be controlled the fish salvage and transport will be suspended until temperatures drop.

3.2.2.3 Biological Sampling

The guidelines provided by DFO/YTG have specified that once the above targets for out planting are met then fish are to be caught and preserved for biological analysis. Specifically:

- Arctic Grayling. A total of 500 fish with a minimum of 50 fish in each size class (5cm increments, 0 – 5 cm, 6 – 10, 11 – 15, 16 – 20, 21 – 25, 26 – 30, 31+)
- Slimy sculpins, up to 500
- Burbot, a up to 500.

Depending on the rate of capture, fishing techniques may be altered to catch the fish for the biological sampling program. A gang of gill nets of various mesh sizes could be used to facilitate the capture of fish in the various size classes. Since live capture is not required, the gill nets would be set for longer periods of time starting with 1 – 2 hour sets around dusk or dawn. Overnight sets would only be considered if several shorter sets result in only small captures of fish.

All fish collected for this biological sampling will be weighed, measured and tagged for future cross referencing with any other analysis that may be carried out on the fish. Additional information on the capture date, time location, gear type will be recorded and the fish will be packaged and frozen for delivery to the Yukon Territorial Government for further analysis.

There is the potential for there to be higher mortality of fish than required to meet the biological sampling program needs. A contingency plan will be developed with input from local stakeholders, YTG and DFO for dealing with these excess fish. The goal will be to find a beneficial use for all mortalities and to release as many live fish back into Rose Creek and possibly the Pelly River as practical.

In order to provide YTG with information required to assess the productivity of the reservoir, additional limnological data will be collected at the time of the biological fish sampling. This will include:

- Secchi reading
- Dissolved oxygen and temperature profiles
- Collection of water samples from the surface, mid-depth and just above the bottom for analysis of general water quality parameters including total and dissolved metals, nitrogens, phosphorus, total suspended solids, pH (field and lab), specific conductivity, and sulphate, total organic carbon, chlorophyll a.

3.2.2.4 Final Fish Out

Preliminary estimates of the maximum number of grayling that could be in the reservoir is 3,000 to 4,500. If this is the case then significantly more fish will be present than have been targeted for out planting and biological sampling (i.e. 600 grayling). If catch per unit effort and the preliminary mark recapture population estimates indicates that significant numbers of fish remain in the reservoir, DFO and YTG will be contacted and a decision for dealing with the remaining fish will be made. The preliminary plan is to revert to the live capture of fish and out plant these fish into the Pelly River near the town of Faro. As with the other out planting, relevant data will be recorded and a portion of the arctic grayling will be tagged.

3.2.2.5 Fish Capture Methods

The proposed methods of fish capture include trap nets, minnow traps, beach seining, electrofishing and gill nets. The fish in the reservoir generally fit three categories.

1. The arctic grayling are more pelagic and are likely found throughout the reservoir depending on size, water temperature, time of day, etc. Trap nets are likely the most effective method for the live capture of grayling.
2. Sculpins and burbot tend to be associated with the bottom and may not be so easily captured. Sinking gill nets, beach seines and minnow traps may be more effective methods for these species.
3. Juveniles of all species are likely to be associated with shoreline habitats where minnow traps, beach seines and electrofishing may be effective.

The preferred method for larger arctic grayling (over 150 mm) is trap netting. Two trap nets (if available) will be deployed and left to fish for 12 to 24 hours. The guidelines for trap net deployment include locating the trap box in water that is as at least as deep as the box and in water no deeper than 1.5 times the height of the trap box. However, conditions of use and catch efficiency are affected by a variety of factors and the field biologist will make on site decisions on where the traps will be located. Depending on capture rates, trap nets will be moved every two days to maximize the opportunity for catching fish. We anticipate that the salvage work will take place when the reservoir is at an elevation of 1085 to 1087

m and the main basin of the reservoir will be over 3 m deep. The use of the trap nets will be focused on the west end where water will be deepest.

Beach seines could be effective collecting shore based species/lifestages. Beach seining requires access to beach areas free of boulders or medium to large size woody debris and a uniform bottom. If these types of beach areas are not available then electroshocking, minnow traps and possibly small mesh gillnets will be used. Backpack electroshockers can be used to capture fish along the shore areas targeting areas of habitat complexity where juveniles are likely to be present.

Gill nets can target a wide range of fish sizes and may be effective for the different needs of this project. If gillnets are used for the live capture phases, the sets will be restricted to short periods starting with 20 minute sets. Mesh size will depend on the size of fish being targeted. Generally, a 1.5" stretch mesh will be used to start but as sampling progresses, mesh sizes may be altered to depending on the success of the initial mesh. The focus will be to minimize mortality during the capture phase except in the case where these nets are used to capture the fish for the biological sampling phase. Both sinking and floating gill nets of various mesh sizes ranging from 25 to 89 mm will be available.

3.2.3 Follow up monitoring of Out Planted Fish

The out planting sites on Rose Creek will be surveyed after the out planting has been completed and prior to the on set of winter conditions in 2003. A snorkel survey will be used to collect the same information as was collected prior to the out planting. The location of any tagged arctic grayling that are observed will be recorded.

During the early summer of 2004 another snorkel survey will be conducted of Rose Creek. Additional survey work will take place in the reservoir area and upstream to the culverts that create a barrier to fish movement. The upstream survey will focus on determining the extent of fish use in the constructed channels, the re-established stream channel in the reservoir and the presence of tagged fish above the reservoir. The accessible portions of the other tributary streams that currently flow into the reservoir will also be surveyed for tagged fish. This monitoring program will be carried out in conjunction with the monitoring of habitat that is provided later in this report.

3.2.4 Fish Salvage During Drawdown and Prior to Construction

It is likely that the majority of the fish will be removed from the reservoir before the reservoir reaches low levels (i.e. below 1082 m). However, the nature of fish collection suggests that not all the fish will be removed, therefore, there will have to be some monitoring during the final drawdown to check for potential stranding areas and stranded fish. DFO/YTG will be notified of any fish stranding and a decision taken as to what to do with those fish.

At this time, it is anticipated that drawn down could be complete before the accumulation of snow and ice. Therefore, monitoring of fish use in the vicinity of the construction area will be carried out. The initial plan is to establish some form of fish barrier on the south fork of Rose Creek upstream of the proposed location of the intakes for the pumps that will be used to remove the final volume of water from the reservoir. After the barrier is put in place, minnow trapping and electrofishing will be used to remove fish from the stream channel below the barrier. Fish caught during this salvage operation will be placed back into the stream upstream of the barrier.

3.3 Fish Habitat Restoration

An important component of this project is the re-establishment of the original fish habitat in the South Fork of Rose Creek. Details of the re-establishment of the stream channel through the breach is described in section 2.2 and the adaptive management approach to the channel immediately downstream of the breach is described in section 2.3. The other aspects of the habitat restoration is bringing the stream channels above the dam back into production after being at the bottom of the reservoir for over 30 years. The current plan for work in this area (approximately 2530 m of stream channel) is focused on re-establishing fish passage to Reach 4 of the South Fork of Rose Creek and re-establishing riparian vegetation as quickly as possible.

- Streams will be assessed for blockages that may have formed as a result of the reservoir and the creation of deltas over the past 30 years. A survey of the stream will be conducted in the spring of 2004 and if necessary a plan developed to remove the blockages if they were formed as a result of the reservoir.
- Revegetating this area is an important component of the fish habitat restoration and has been described in section 3.1. The seeding for erosion control will be augmented by riparian planting and will include willow staking and conifer planting in a 10 m wide strip on either side of the South Fork of Rose Creek and a 5 m wide strip either side of the tributary streams. A final rehabilitation plan will be developed after a field reconnaissance once the reservoir is drained. This will likely take place after snow melt in the spring of 2004 but could be done prior to snow in the fall of 2003 if the water levels are low enough. The purpose will be to identify areas where trees grew previously based on the presence of stumps and assess soil conditions. Initial plans anticipate that these riparian areas will be re-planted with spruce or alpine fir at a density of 800 stems per ha. Other areas will be planted with willow stakes at a density of 10,000 per ha.

The work on the entire length of stream habitat affected by the dam and reservoir is designed to re-establish the form and function of the habitat in this section of the South Fork of Rose Creek to a condition similar to the system prior to the construction of the dam.

However, there is some uncertainty with how well the upstream creek section will become reestablished in the original stream channel. It is expected, based on the 1948 air photos, that some sections the creek will have a very low gradient and high sinuosity, which provides the possibility for the stream flow to cut

a new channel. This could result in the formation of sections of unstable channel. However, preliminary indications suggest that the water will likely find the old stream channel. This will be a focus of follow up monitoring in the spring/summer of 2004.

3.4 Fish Habitat Compensation Program

The compensation activities incorporated into the project currently include:

- planting of willows and conifers along the stream channels to establish riparian habitat
- evaluating and implementing a plan to restore the original creek channel immediately downstream of the channel that will be constructed through the breach.

An adaptive management approach will be taken to further evaluate the fish and fish habitat conditions in Rose Creek such as the assessment and removal of any barriers to fish movement that were created as a result of the presence of the reservoir. If surveys in the spring/summer of 2004 indicate that there are ongoing residual impacts within the aquatic or terrestrial habitats because of this project, compensation plans will be developed for approval from the agencies.

4. Construction Effects and Mitigation

4.1 General

The potential environmental issues of the construction phase include:

- Loss of control of water upstream of the construction site
- Water management and sediment control within the construction areas.
- Accidents and malfunctions associated with heavy equipment working near fish habitat.
- Disruption of riparian habitat.
- The development of spoil area(s).

The construction is scheduled to take place over the winter months when there is very little water flow. Therefore, the potential for erosion and sedimentation is very low during construction. This will be further minimized through diverting any stream flow that collects upstream of the existing cofferdam around the construction area. Hydrologic projections estimate that the flow in the South Fork of Rose Creek between December and March is approximately 0.11 m^3/s, which can be easily managed by pumping. The hydrologic assessment also indicates that the risk of a flood event during the construction period is near negligible.

The greatest source of erodible material in the construction area is the material used to construct impervious core of the dam which extends out to the downstream edge of the cofferdam. Drainage collection and sediment control measures will include pumping water out of the construction area, as necessary. The water will be pumped to a closed system to the north of the fresh water channel, as described in Section 2.4.

The contractor will be responsible for installing and maintaining the mitigation measures described in this report that are required for the construction phase and any additional measures that may be required during the course of the construction to minimize any unanticipated negative environmental consequences that may arise during the construction phase of this project.

4.2 Water Management

The water management program has been described in section 2.4. The plan will ensure that there is a continuous flow of water into the South Fork of Rose Creek below the work site. Execution of the water management plan will have to be done in a way that ensures that water stays under the ice. Once water begins to flow over the ice it is very difficult to get it back into the channel until the ice melts. This could impact fish habitat downstream of the project if it occurs.

It is anticipated that the small quantities of water that get into the construction area will be pumped to an upland area where it will be allowed to seep into the snow or vegetation. A berm will be built downslope of the discharge point to collect any pumped water that stays on the surface. Any water collecting behind the berm will be pumped back to the creek, provided it meets the Canadian Council of Ministers of the Environment (CCME 2002) guidelines for suspended sediment. The pumps will be appropriately sized to handle the expected water quantities. Fish screens will not be required on these pumps, as fish will not be able to get into the construction area, and fish will be salvaged from the construction area before construction begins. Sufficient storage capacity will be provided upstream of the cofferdam to contain flows in the South Fork of Rose Creek in the event that pumps break down and a replacement pump has to be brought in from Whitehorse (24 hours).

4.3 Fuel Handling and Accidents and Malfunctions

Accidents and malfunctions provide the greatest risk to water quality and sediment contamination. Any accident or malfunction with the potential with environmental consequences will be immediately reported to the site supervisor and the environmental monitor. If the Environmental Monitor determines that a work stoppage is required to minimize further environmental impact, such an order will be issued immediately. The appropriate authorities will also be informed as soon as practical. Section 6.2.6 summarizes the potential accidents and malfunctions. The most critical malfunction would be the breakdown of the pumps used to pass the water in the South Fork of Rose Creek around the work site. A

suitably sized back-up pump will be on site to minimize the risk of this event happening. Delay in completing the project due to equipment failure should not result in a delay that would end up with a partially completed breach at the start of freshet. The proposed dewatering plans anticipate that it will be possible to start excavating the breach of the dam in November 2003, which will allow ample time to complete the breach even if additional equipment needs to be brought on site to cover for broken equipment.

Refueling will be confined to a designated site adjacent to the access road on the downstream side of the dam located a minimum of 100 m from any watercourse. The area will be set up so that any fuel spill remains contained in the area. Bulk fuel storage will be at the mine site and a truck designed for fuel transfer will be used to refuel equipment at the designated refueling spot. A fully equipped spill kit will be on site at the refueling site and each piece of heavy equipment will have an appropriately equipped spill kit on board. The drainage collection features would also serve to contain any significant fuel spill that might occur during the construction phase. Any soils contaminated by a fuel spill will be collected and properly disposed of in a manner acceptable to the Environmental Monitor and any applicable regulations. The operators will be educated and aware of the requirements of the workplan and how to react in the event of a spill. In order to reduce the risk and the impact of spills:

1) The contractor will provide an oil spill response plan.
2) Biodegradable/environmentally friendly hydraulic fluid will be used on all equipment (i.e. loaders, excavators and dozers) using hydraulics within the creek channel below the high water level. An exception to this condition may be necessary depending on the air temperatures during construction and the temperature operating range of the biodegradable hydraulic fluid.
3) All machinery employed for in-stream work will be steam cleaned prior to arrival at the site.
4) All machinery employed will be inspected for leaks or worn hoses, fittings and all repairs will be made prior to access onto the site.
5) Oil sorbent sheets and/or containers will be placed under leaking vehicles and equipment immediately upon discovery.
6) Place oil sorbent sheets and/or containers under vehicles and equipment parked in high risk areas (i.e., adjacent to watercourses) for longer than 2 hours or immediately under any vehicle or equipment that is leaking.
7) Refueling areas will be enclosed so that any spills can be contained and easily cleaned up and prevent oil and fuel from entering the water. Maintenance of refueling areas (such as removal of rainwater) must be carried out such that no oil and fuel enters the environment. After the project is completed, any contaminated soils within the refueling area must be removed and disposed of properly.
8) To minimize the release of grease to the environment, excavators will not sit in water that is deep enough to cause the rotational table to be below the water level.

9) All clean-up materials and equipment, including sorbent pads, and leak proof waste containers, will be readily available on site in the quantities required for the type of equipment being used. The contractor is required to develop an appropriate list of equipment and materials that will be available at the work site.

10) Waste containers will be labeled appropriately and stored in a secure location, protected from weather until removal and disposal can be arranged.

11) Any waste oil or materials will be removed from the site as soon as possible in accordance with applicable Waste Management Standards, Transportation of Dangerous Good requirements and Special Waste Regulations.

12) In the event of a spill, 200L containment drums will be used to temporarily store material for shipment off site for disposal.

13) Fuel storage areas will be supplied with:
    - 2 open-top type, leak-proof, empty 45 gal drums with sealable lids
    - 2 packages (400 sheets) of absorbent pads (polypropylene – oil only)
    - 2 polypropylene sorbent socks (3"x 4' – oil only)
    - 1 polypropylene sorbent sock (3"x 10' – oil only)
    - 1 bag treated oil only cellulose particulate
    - 1 roll poly plastic sheet 110'x 6'x 6 mil thickness
    - 1 neoprene drain cover
    - 6 poly disposal bags and ties (45 gal drum size, 6 mil)
    - 2 pair nitrite gloves (large)
    - 1 rake
    - 1 shovel
    - 1 utility knife
    - blank labels / indelible maker
    - oil sorbent sheets and/or containers will be placed under leaking vehicles and equipment immediately upon discovery

4.4 Riparian Areas

The majority of the work will take place in close proximity to the dam and there is no need to clear riparian vegetation. When the work areas are laid out the environmental monitor will be onsite to ensure that access roads, lay down areas and spoil sites are located to avoid the loss of any riparian vegetation. Section 3.3 addresses the rehabilitation of the riparian areas within the footprint of the reservoir.

4.5 Spoil Areas

Three spoil areas have been identified (Drawing 2). Prior to freshet, appropriate erosion and sediment control measures will be implemented to ensure that sediment laden water from the spoil area does not

enter any watercourses. The spoil pile will revegetated as part of the Phase 2 revegetation in spring/summer 2004. Depending on the results of post-construction monitoring, a granular berm may be placed at the downstream toe of the spoil pile to contain sediment from erosion of the spoil pile surface.

5. Environmental Monitoring

5.1 General

It is assumed that the field team responsible for the execution of the environmental monitoring will comprise a Resident Engineer, Site Supervisor (Contractor), and Environmental Monitor (Monitor).

The Resident Engineer will be on-site daily during all construction work related to the breach. The Resident Engineer will be responsible for day to day environmental monitoring (during active construction) and ensuring the works are performed in accordance with the EMP.

The Monitor is not expected to be on-site daily throughout the construction period. However, the Monitor will be on-site daily during project startup, the construction of the sump, and construction of the inlet structure for the channel. The Monitor will also be on site on an as needed basis, depending on the nature of the work being undertaken and discussions between the Monitor and the Resident Engineer. As noted above, when the Monitor is not on site, the Resident Engineer will be responsible for the execution of the EMP and environmental monitoring. The Monitor will conduct a site visit prior to the commencement of the construction phase of the project, during any shut-down stages of the project, and as required during any of the key stages of the project. More details on the schedule of the Monitor will be provided as the final construction schedule is developed. The Monitor will have the authority to order the shutdown of the operation if environmental protection is compromised (i.e. water quality criteria are exceeded, a fuel spill occurs, etc).

5.2 Responsibilities

The Resident Engineer, Construction Manager, the Contractor's Site Supervisor, and Environmental Monitor for each component of the work are responsible for ensuring that the EMP has been reviewed and understood by all personnel, including sub-contractors, involved with the project. Environmental issues will be covered in pre-job and on-site meetings with the crews to ensure that environmental risks have been identified and adequately addressed. Any subcontractors will be issued a copy of the EMP and will be required to sign a "Contractor Orientation Record" form. The contractor will ensure that all staff is familiar with the relevant components of the EMP. Any changes to the work plan shall be brought to the attention of the Site Supervisor and Environmental Monitor so that the EMP can be amended and agencies contacted, if necessary.

Prior to the start of the construction project, the reporting structure for the environmental monitoring will be clearly identified. The Environmental Monitor will report issues of concern directly to the site supervisor who will coordinate any corrective action with equipment operators. The Environmental Monitor will work closely with the Resident Engineer and Contractor's senior site representative to review project schedules and issues of concern and to anticipate environmental issues ahead of time so that contingency plans are in place to ensure good environmental stewardship throughout the project.

5.3 Monitoring

Monitoring will be required before, during and after construction. Many of the aspects that must be monitored have been identified earlier and include:

- Monitoring fish left in the reservoir to check for stranding. This will be particularly important during the final stages of dewatering the reservoir.
- Set up of construction area including laydown areas, fueling site, establishment of drainage and sediment control measures for construction
- Initial monitoring of construction activities to ensure appropriate environmental protocols are followed such as refueling and emergency preparedness.
- Advise on layout of stream channel features, especially the section below the dam. Daily monitoring during the construction of the stream channel through the breach and any compensation habitat required.
- Monitor water discharge from construction area and stream restoration work areas for turbidity
- Monitor downstream pools in Reach 2 of the South Fork of Rose Creek for turbidity and dissolved oxygen during all construction phases
- Be on site during initial snow melt to evaluate turbidity levels and assess the need for additional practical sediment control to minimize sedimentation of streams (i.e. locate and stabilize or isolate sources of erosion)
- Monitor seeding success in early spring and determine the need for additional seeding.

5.4 Monitoring Total Suspended Sediment and Turbidity

Monitoring of water quality will focus on total suspended sediment (TSS). There is a lab at the mine that can be used to measure the TSS concentration in water on a daily basis. Samples for TSS will be collected on a routine basis and turbidity measurements (NTUs) taken at the time of sampling. The TSS and turbidity data will be used to generate a relationship between TSS and turbidity so that an immediate, approximate assessment of TSS levels based on the turbidity reading can be made if required. Therefore,

a properly calibrated turbidity meter will be onsite prior to and during the construction phase. The criteria that will be used for TSS is the CCME (2002) aquatic life guidelines which stipulate that the maximum induced TSS level in the receiving wares is 25 mg/L above background. If background levels are greater than 250 mg/L then the maximum increase is 10% of the background level.

Prior to the start of construction, TSS levels will be measured upstream and downstream of the reservoir. The upstream site will be established in a pool at least 0.7 m deep located just downstream of the culvert on the mine access road on the south fork of Rose Creek. The downstream site will be located in the LLO discharge channel downstream of the construction area or at a downstream location where the water is deep enough so that it is not likely to freeze. The collection of TSS and turbidity measurements at these sites will be done on a daily basis for at least a week prior to the construction of the sump upstream of the dam to establish background conditions and to establish the TSS/NTU relationship.

TSS monitoring will continue through the construction period, however, it may not be possible to collect water samples from the upstream section of the creek in mid winter if the creek freezes to the bottom. It is anticipated that downstream sampling will be possible throughout the construction period to monitor effects of the project. If necessary the background sediment or turbidity level will be the average of the values collected prior to the start of construction.

During the construction phase, construction water discharged from the holding area (or from some other form of treat and pump) must not exceed the CCME criteria for TSS when it is discharged back into the South Fork of Rose Creek. The monitor will take regular (at least daily) measurements of turbidity levels in the South Fork of Rose Creek downstream of the construction area. If this turbidity indicates that TSS levels are equivalent to or exceed the CCME guideline for TSS then the monitor will take a water sample for laboratory analysis and also investigate the source of the sediment. If the source of TSS is from the work area or discharge from the water treatment system, immediate action will be taken to stop the flow of sediment into the creek. This may involve stopping all work responsible for creating sediment until the source is properly contained or controlled. If the sediment is coming from the reservoir (upstream of the construction area), further investigation may be required to determine the source and if necessary corrective action taken. However, regardless of the source, either within or above the reservoir, it is necessary to continue the pumping of Rose Creek base flows around the work site to maintain flow in the channel below the dam. This is particularly important over the winter when cessation of flow could result in the creation of ice blockages in the channel and subsequent difficulties in re-establishing flow in the channel when pumping resumes.

5.5 Post-Construction Monitoring and Follow-up Monitoring

The following aspects will be the focus of the post construction monitoring and is an important component of the adaptive management approach that will be used to mitigate the effects of the initial freshet in the reservoir, through the breach and in the channel immediately downstream of the breach.

Subsequent monitoring is required to assess the success of the mitigation and compensation programs associated with the breach of the Fresh Water Supply Dam and restoring the South Fork of Rose Creek to pre-dam, natural conditions.

- Summer/Fall of 2003, evaluate the seed germination success rate of the grass seed put down for erosion control within the reservoir. Assess the need for additional seeding required in areas of poor germination or cover and of areas exposed during summer draw down of the reservoir.
- Evaluate channel stability after the 2004 freshet in the following areas:
  - Within the footprint of the reservoir;
  - Through the breach; and
  - In the fresh water channel immediately downstream of the channel through the breach.

  This evaluation will be done in conjunction with the Resident Engineer. Prepare a report on channel conditions with, recommendations for stream work that could be carried out, depending on access and logistics, prior to the 2005 freshet.
- Prepare a rehabilitation plan for the reservoir area that further refines the details provided in section 3.3, specifically to identify soil conditions with in the riparian areas, locations for planting willow and conifers. This will likely be done when the snow is off the reservoir area in the spring of 2004 but could be done in the fall of 2003 before snow accumulation if water levels are low enough.
- Monitor vegetation survival at the end of the 2004 growing season. In areas of poor survival (i.e. less that 80%) new plants will be added. Replanting can be done in late fall when the plants have become dormant or can be carried out in the spring while they are still dormant.
- 2004 survey of the out planting sites to assess densities of fish and look for tagged fish. Additional survey of the creek within the footprint of the reservoir to assess fish usage and to look for tagged fish.
- 2005 assessment of revegetation success and stream habitat conditions. Stream assessment should include channel stability, riparian condition, and availability of spawning and rearing habitat, fish sampling to determine densities and determine if there is any evidence of spawning and spawning success. Control sites should be established in another area of Rose Creek for comparison.
- Annual evaluation of areas planted with willows and conifers, on going mitigation or compensation measures for the re-establishment of instream habitat through 2008. The results will be reported annually with recommended maintenance or corrective actions.
- After 2008 the mine reclamation and closure plan will be complete and approved and will take over the requirements for maintaining and rehabilitating fish habitat affected by mining in the Rose Creek drainage. The mine closure plan will include a comprehensive plan for restoring fish habitat through out Rose Creek, including the area of the FWSD.

6. Reporting

- Environmental Monitor (supported by the Resident Engineer) will be required to maintain suitable records and photographs throughout the construction phase. Weekly reports that summarize work activities and incidents or issues will be submitted to the Interim Receiver, DIAND and DFO (and, possibly, Yukon Department of Environment).
- Any significant environmental issues will be reported immediately (the protocols for reporting will be defined as part of final design and the development of an Environmental Management Plan QA/QC program).
- Any significant changes in construction methods (detailed in the final design report), to habitat rehabilitation, stream channel design, monitoring procedures, etc. will be presented to the Interim Receiver, DFO, DIAND and the Yukon Department of Environment, along with justification for the changes.
- A report on the environmental aspects of the construction phase is required within 3 months of the completion of the construction work and should include photo documentation of the construction activities, summary of significant incidents.
- A report on the assessment of the success of revegetation program after the first full growing season and the condition of the stream channel after the first freshet along with recommendations for additional work or any remedial action taken will be submitted by December 2004.
- A report on the fish salvage and mark-recapture program and follow up survey in the fall of 2004 will be prepared and will include all the fish data collected, limnological data, habitat assessment and fish densities of out planting sites.
- A report on the 2004 survey of out planting sites and fish use of reach 3 of the south fork of Rose Creek. Plus annual reports on the condition of the stream habitat until 2008 that include the degree of utilization of the fish habitat, success of the revegetation, etc.

7. References

Canadian Council of the Ministers of the Environment. 2002. Canadian water quality guidelines for the protection of aquatic life: Summary table. updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of the Ministers of the Environment, Winnipeg.

Gartner Lee Ltd. 2003. Fisheries and Aquatic Studies at the Anvil Range Mine Complex in 2002 - Technical Memorandum. Prepared for Deloitte & Touche as Interim Receivers.

SRK Consulting. 2003a. Final Breach Design, Fresh Water Supply Dam, Faro Mine. Prepared for Deloitte & Touche as Interim Receivers.

SRK Consulting. 2003b. Supplement to the Preliminary Brach Design, Fresh Water Supply Dam, Faro Mine. Prepared for Deloitte & Touche as Interim Receivers

Appendices

Appendix A

Arctic Alpine Seed Ltd. Reclamation Plan

Gartner Lee

Arctic Alpine Seed Ltd

RECLAMATION PLAN

ANVIL RANGE MINING COMPLEX
FARO, YUKON

FRESHWATER SUPPLY DAM

Prepared for:

Deloitte & Touche

May 7, 2003

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INTRODUCTION

- The site is the Fresh Water Supply Dam (FWSD) at the Anvil Range Mining Complex, Faro, Yukon.
- The FWSD at the Anvil Range Mining Complex, Faro is to be drawn down over a period of time in preparation for mine closure.
- There is currently a six-meter (approximately), area of shoreline, between elevation 1096 and 1090 m (area is 17.2 hectares), which is exposed and will require revegetation to minimize erosion and to stabilize the shoreline as more water is drawn down.
- By August 2003, the water level is to be drawn down from elevation 1090 to 1082 m amsl (area is 27.5 ha). This will further expose the shoreline and will require revegetation to minimize erosion and to stabilize the shoreline.

Randy Lewis, Partner, Arctic Alpine Seed Ltd. conducted the site analysis and evaluation of the property on May 2, with Mr. Dana Hagger of Deloitte & Touche:

Arctic Alpine Seed Ltd:

- Conducted a literature and information review:
    - Government of Yukon - "Guidelines for Reclamation / Revegetation in Yukon".
        - Seed Mixtures / Specifications for sub alpine regions / sandy soils.
    - Government of Canada – "Reclamation Guidelines for Northern Canada"
        - Chapter 4 – "Drainage and Erosion Control"
        - Chapter 5 – "Revegetation"
        - Chapter 6 – "Seed Mixture Recommendations"
        - Chapter 7 – "Monitoring"
    - Review of previous Arctic Alpine Seed Ltd. Projects:
- Prepared seed specifications based on the most prominent indigenous grass and legume species identified on site analysis
    - Recommended rate of seeding – 30 kg /hectare
    - Seeding rate is based on site / soils analysis information and the proposed methodology for installation.
    - The following grass and legume species were identified on site
        - Agropyron violaceum – Violet Wheatgrass
        - Deschampsia caespitosa – Tufted Hairgrass
        - Festuca saximontana – Northern Fescue
        - Festuca ovina – Sheep Fescue
        - Poa alpina – Alpine Bluegrass

- Poa palustris – Fowl Bluegrass
- Agrostis scabra – Ticklegrass
- Puccinellia nutalliana – Alkaligrass
- Oxytropis campestris – Northern Oxytrope
- Others to be indentified

SITE LOCATION

Fresh Water Supply Dam at the Anvil Range Mining Complex, Faro, Yukon

PHYSICAL DESCRIPTION

The site is located primarily in a sub alpine boreal forest, narrow valley of deciduous and coniferous plant community.

The grade of the area to be reclaimed is primarily a gentle slope to the existing waterline. The freshwater lake has deposited a sand / silt sediment over a period of approximately 30 to 40 years. The shoreline is irregular due to wave action.

The site is sensitive to disturbance.

PRINCIPLES OF PROJECT DESIGN

Arctic Alpine Seed Ltd. acting as project manager will ensure that the area will be revegetated using 100% indigenous (native) species:

The site analysis determined site-specific requirements:

1) Due to the sensitivity of the site:
   a) Access for revegetation will be restricted to currently existing access
      i) Access road on the dam.
      ii) Access road to lake half way along the east side.
      iii) Addition access to the site will be via a boat.
2) No mechanical activity is to occur on the newly exposed shoreline.
3) All revegetation activity will be limited to only manual labor.

4) 100% of grass and legume seed types will be indigenous to the site and surrounding areas.
5) No fertilizer will be used on this site, due to the proximity of the lake and creek.
6) Hydro seeding is not required or recommended for this site.
7) The reclamation project is time sensitive and should be completed before June 30, 2003, to maximize germination and to establish sufficient growth this season to limit erosion.

PROJECT MANAGEMENT

As Project Manager, Randy Lewis, Partner, Arctic Alpine Seed Ltd., would be primarily responsible for ensuring that the Reclamation Plan is fully and completely implemented to the Owner's satisfaction including management and training of all labour forces and expediting of materials to complete the:

- Layout and design of key and all other planting areas at the Fresh Water Supply Dam
- Seeding of disturbed areas
- Biweekly (or as required) reporting, production of final report.

It is proposed that a Ross River Dene Council Crew (4 persons) is hired to work with Arctic Alpine Seed Ltd. until project completion; and it is anticipated that the local crewmembers would be fully trained to be able to provide ongoing support for future reclamation projects.

Reclamation Activities:

- Layout and design of areas to be seeded
- Crew Training / Site Supervision
- Site specific seed mixes for the lakeshore
- Raking (Preparation of Seed Bed for Planting)
- The area to be seeded will need to be scarified (raked) to a depth of 2 to 3 inches in order to loosen the site soils
- Hand seeding of disturbed areas
    - The seed will be applied by broadcast spreading
    - Final raking - incorporated into the soil surface by hand raking.

This method will significantly increase the results of the reclamation plan as well as ensuring that the work is completed on schedule and on budget.

SCHEDULE

The scheduled completion date is June 30, 2003.

Site Inspection Dates: To be determined

Changes to the Contract:

- All changes or additions to the work described here in will be approved in advance of any expenditures being made.

Schedule: (To be confirmed)

- May 8 Submission of Plan
- May 12 Authorization to proceed
- May 14-16 Labor request with RRDC
- May 19 –23 Mobilize
- May 26 On site at fresh water supply dam
- June 30 Completion

RECLAMATION AREAS

LOCATION	TREATMENT
1. Shoreline Areas (see site sketch)	Hand raking / Seeding / Hand raking

Appendix B

Contractor Environmental Orientation Record

Gartner Lee

CONTRACTOR ENVIRONMENTAL ORIENTATION RECORD

The Contractor Environmental Orientation Record shall be completed for all contract work involving an environmental component. The Owner's Representative is responsible for ensuring that the environmental requirements of the work are reviewed with the Contractor before work is started, and that a record of the discussion is documented on this form. The form must be signed by both the Owner's Representative and the Contractor. Signing this form indicates that the Contractor has been advised of the environmental requirements of the project. In field situations, compete two (2) copies of the form (one for the Contractor and one for the Owner) or photocopy the form.

	Date:		File No.
1	**Project Information**		
	Project Title		
	Project Description		
	Project Location		
2	**Contractor Information (if applicable)**		
	Company Name		
	Company Address		
	Site Contact/Representative Name		
	Tel. #	Fax #	E-mail
3	**Environmental Management Plan / Environmental Practices** Review the environmental issues and requirements of the work as specified in the Environmental Management Plan (EMP) or Environmental Practices (EP).		
	Is there an EMP or are there Eps for the work?	❑ Yes.	❑ NA.
	Have the environmental requirements been reviewed with the contractor and the contractor's staff? (Use the checklist below to guide discussion)	❑ Yes.	❑ NA.

Environmental Issues	***Environmental Protection Requirements***	**Discussed**	**NA**
Soil erosion / compaction		❑	❑
Vegetation disturbance or removal			
Generation and disposal of hazardous substances			
Generation and disposal of waste			
Spill of hazardous substances			
Fuel and flammable storage			
Dust generation / other air emissions			
Water quality – erosion and siltation			
Fish and Aquatic - Habitat alteration, disturbance or loss			

	Wildlife and Bird – Habitat Alteration, Disturbance or Loss			
	Disturbance to Heritage Resources / Archaeological Sites			
	Visual Impacts / Noise Concerns			
	Property Considerations			
	Disruption of Recreation Use			
	Public Safety Concerns			
	Do the tools and equipment meet the requirements?			
4	**Permits and Approvals Information:** Ensure the necessary environmental permits and approvals relating to the work have been obtained prior to starting work.			
	Are environmental notification, permits, licenses or approvals required?		❑ Yes	❑ NA
	List applicable regulatory requirements and permit reference numbers. .			
	Have the permits, licenses and approvals obtained and / or checked?		❑ Yes.	❑ NA
5	**Emergency Response Plan / Oil and Chemical Spill Response Plan**			
	Has the Emergency Response Plan discussed?		❑ Yes	❑ NA
	Has the Oil and Chemical Spill Response Plan discussed?		❑ Yes	❑ NA
	Are there spill kits available on location?		❑ Yes	❑ NA
	Where are the spill kits located?			
6	***Environmental Incident Reporting***	Ensure Contractor is aware of BCH EIR system.		
	Environmental Incident Reporting Procedures discussed?		❑ Yes	❑ NA

The undersigned has been briefed on the environmental requirements of the work as detailed above.

Signed: _____ Contractor Date: _____

Counter-signed: _____ Owner's Representative Date: _____

Additional Comments: