Deloitte & Touche

Gartner Lee

# Anvil Range Mine Complex

## 2004 to 2008 Water Licence Renewal - Environmental Assessment Report

Volume 1 of 3 - Project Description
Anvil Range Mining Corporation
(Interim Receivership)
April 2003

FA022-R014

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Fannin Sheep photo provided by Frank Nice

# Volume 1
# Project Description

**Anvil Range Mining Corporation (Interim Receivership)**
**2004 to 2008 Water Licence Renewal**
**Environmental Assessment Report**

Submitted by:
**Deloitte & Touche Inc.**
**In its capacity as Interim Receiver for**
**Anvil Range Mining Corporation**

in association with:
**Gartner Lee Limited**

| Reference: | date: |
|---|---|
| **GLL 22-307** | **April 2003** |

distribution:
**55 Deloitte & Touche Inc.**
**10 Gartner Lee Limited**

Gartner Lee

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# 1 INTRODUCTION

## 1.1 INTRODUCTION TO THE ENVIRONMENTAL ASSESSMENT REPORT

The Anvil Range Mine Complex, located in Faro, Yukon, operated from 1969 to 1998 inclusive of several temporary closures. Mining and milling operations permanently ceased in early 1998 shortly after the owner, Anvil Range Mining Corporation ("Anvil Range"), filed for creditor protection under the Companies' Creditor Arrangement Act. Deloitte & Touche Inc. was appointed Interim Receiver ("Interim Receiver") of Anvil Range pursuant to an order ("Interim Receivership Order") of the Ontario Court (General Division) ("the Court") (now the Superior Court of Justice) in April 1998.

***The site is managed by the Court Appointed Interim Receiver, Deloitte & Touche Inc.***

The Interim Receiver has overseen the management of the property under the terms of the water licences in addition to the Interim Receiver's mandate to receive, preserve, protect and realize upon Anvil Range's assets. The Interim Receiver has worked with the Department of Indian Affairs and Northern Development ("DIAND"), the Yukon Territorial Government ("YTG"), the Town of Faro, the Ross River Dena Council, and other stakeholders to manage environmental programs that are required to protect the receiving environment.

The mine complex is currently regulated under two water licences, which specify the terms and conditions under which the licence holder (i.e. Anvil Range) can discharge water into the natural environment. The Faro mine site operates under licence QZ95-003 (formerly IN89-001) and the Vangorda Plateau mine site operates under licence IN89-002. The water licences were granted by the Yukon Territory Water Board under the Yukon Waters Act. Both licences will expire December 31, 2003.

The Interim Receivership Order grants the Interim Receiver the authority to "apply for any permits, licences, approvals or permissions on behalf of [Anvil Range] as may be required by any government or regulatory authority". In order to ensure that regulatory licencing that allows for the continued performance of necessary environmental protection activities, remains in place, the Interim Receiver filed documents, in May 2002, to initiate the process for application to the Yukon Territory Water Board for a single integrated licence for the mine complex for the period from January 1, 2004, to December 31, 2008 (5 years).

***Steps to renew a licence include CEAA and licence application***

Two overall steps are involved in the renewal and integration of the water licences:

1. A review process under the Canadian Environmental Assessment Act ("CEAA") which is required, in part, due to the disbursement of federal funds for the maintenance of this property. The review is focussed on the activities described in an Environmental Assessment Report ("EAR") that is submitted by the proponent following guidelines provided by DIAND; and
2. An application to the Yukon Territory Water Board for a water licence renewal.

*The CEAA process was initiated with a Project Description submitted in May 2002*

To initiate the CEAA process, the Interim Receiver submitted a Project Description in May 2002 that described the proposed activities for the proposed licence period. A Project Description Supplement was submitted in September 2002 in response to questions raised regarding the Project Description. At that time, preparation of a Final Closure and Reclamation Plan ("FCRP") for the mine complex was included into the Interim Receiver's scope of work.

Guidelines for preparation of the EAR were issued by DIAND in March 2003. The final scope of the project, as described in the Guidelines focussed solely on care and maintenance activities and excluded the development of a Final Closure Plan. This change was based on the announcement by DIAND in January 2003 that the development of a FCRP would be undertaken by a government project team ("closure Project Team") that would be formed for this specific purpose.

This EAR has been prepared to comply with the Guidelines provided by DIAND and to provide the information necessary to enable a screening decision per the CEAA.

The EAR is a three volume document:

*This Environmental Assessment Report (EAR) is presented in 3 volumes plus a standalone EAR summary document and a companion document describing the new mechanism for development of a closure plan*

1. Volume I provides a description of the existing facilities, a description of the proposed activities and a description of the adpative management program.
2. Volume II describes the current environmental conditions at the mine site.
3. Volume III describes the impacts of the proposed activities on the existing conditions at the mine site.

A general reference between the information requested in the Guidelines and location of that information in the EAR is provided in Table 1. A detailed conformity table is appended to each volume.

**Table 1. Information Reference Locations**

| Guideline Reference | EAR Reference |
|---|---|
| 2.0 Executive Summary | Volume I |
| 2.1 Project Summary | Volume I |
| 2.2 Project Description | Volume I |
| 2.3 Environmental Setting | Volume II |
| 3.0 Environmental Effect Assessment | Volume III |

The three-volume EAR is summarized in a standalone summary document, which provides a summary of the information and conclusions of the EAR.

While closure planning is not a specific, integral part of the Environmental Assessment Report, a document titled Anvil Range Mine Complex: Closure Planning Project Management, designed to address the planning process for the final closure of the site, will be submitted by the closure Project Team at a later date.

## 1.2 INTRODUCTION TO VOLUME I, PROJECT DESCRIPTION

This volume provides information requested in Sections 2.0, 2.1 and 2.2 of the Guidelines. The volume is structured as follows:

- Section 1: Introduction to the report and introduction to Volume 1.
- Section 2: A summary of the project, the project background, the project rationale and the management structure.
- Sections 3 and 4: Description of the development history and existing facilities for the Faro and Vangorda Plateau mine sites.
- Sections 5 to 12: Description of the proposed project including new activities, proposed studies, adaptive management plan, accidents and malfunctions and environmental monitoring programs.

# 2 DEFINITION OF THE PROJECT

## 2.1 PROJECT SUMMARY

### 2.1.1 PROJECT OVERVIEW

***The Anvil Range Mine Complex is managed by the Court Appointed Interim Receiver, Deloitte & Touche Inc.***

The Anvil Range Mine Complex, located in Faro, Yukon, operated from 1969 to 1998 inclusive of several temporary closures (see Figures 1, 2 and 3). Mining and milling operations ceased in early 1998. Deloitte & Touche Inc. was appointed Interim Receiver of the mine owner, Anvil Range, in April 1998. The mine complex is currently regulated under two water licences (QZ95-003 and IN89-002), both of which will expire December 31, 2003.

The Interim Receiver has overseen the management of the property under the terms of the water licences as well as the Interim Receiver's mandate to receive, preserve, protect and realize upon the assets. The Interim Receiver has worked with the DIAND who is the funder of all project activities, YTG, the Town of Faro, the Ross River Dena Council and other stakeholders to manage environmental programs that are required to protect the receiving environment.

***The mine complex is currently regulated under two water licences which will expire December 31, 2003***

The Interim Receiver plans to continue activities to manage the site in compliance with the water licences (and proposed new licence), including water collection and treatment and monitoring of water quality, as well as with any directives received from regulatory agencies. These activities are consistent with:

1. The mandate of the Interim Receiver to provide maintenance and protection of the property and the environment and to apply for all necessary licences, and;
2. Condition 48 of the Faro water licence and part b, condition 13 of the Vangorda Plateau water licence, which require the operator "to maintain all works of the property in accordance with sound engineering and environmental practices, in particular, the tailings disposal facility, the diversion canals, the freshwater supply reservoir, the waste rock dumps and all associated works."

The context that overarches both the selection of the proposed care and maintenance activities is that the Anvil Range property exists as a property resulting from former mining and milling activities. This property has recognized environmental liabilities. The proposed care and maintenance activities and the timeframe of the proposed licence were selected to allow the property to be maintained while allowing sufficient time for a FCRP to be developed. Therefore, it is important to note that the proponent of the proposed project (the Interim Receiver) is not proposing to start a new mine in the next five years, nor to close the property in the next licence term. As mentioned in the introduction to the EAR, closure planning is the responsibility of the government and will be addressed in a subsequent report entitled "Anvil Range Mine Complex: Closure Planning Project Management".

*There are six primary goals for care and maintenance activities proposed for 2004-2008*

The routine on-going care and maintenance activities that are proposed to be undertaken from 2004 to 2008 will focus on achieving these specific objectives:

1. to minimize the quantity of clean water that enters or crosses the mine site and subsequently requires treatment;
2. to maximize the capture of water that requires treatment;
3. to provide storage and treatment for water that requires treatment;
4. to assess the efficiencies of the above systems on an ongoing basis and to implement upgrades and maintenance as appropriate;
5. to monitor environmental conditions on the mine site and in the receiving environment and the physical stability of earth structures on an ongoing basis;
6. to interpret and utilize monitoring information on an ongoing basis to improve the water management systems;
7. to provide for efficient management of all activities providing for worker health and safety, public health and safety, contingency and emergency preparedness planning and cost effective management of public funding; and
8. to report on care and maintenance activities on a scheduled basis per the water licences to the Yukon Territory Water Board.

*Activities on the Faro and Vangorda sites will center on summer pumping and treatment for pits and ponds*

Project activities are proposed to centre on seasonal (summer) water pumping and treatment programs for the Faro Main Pit, the back-filled Faro Zone 2 Pit, the Intermediate Pond and the Vangorda Pit in addition to the maintenance of water diversions and dams. Proposed new activities include the tear down of unused buildings and on-site remediation of hydrocarbon contaminated soil.

The annual risk assessment approach, initiated in 2001, will continue to enable the Interim Receiver to identify and prioritize short-term risks in any given year and to develop mitigative plans for items identified as high risk. In addition, an adaptive management program will be used to provide a staged approach to mitigation of identified environmental effects based on a pre-determined series of triggers and responses.

*Deloitte & Touche Inc. consults with Faro & Ross River, as well as other stakeholders*

The Interim Receiver consults with stakeholders, including the Town of Faro and the Ross River community on its activities. It contacts leaders from both groups to discuss mine activities and future plans. A key focus is the identification of employment opportunities for members of these communities.

In addition, environmental issues are regularly discussed with other stakeholders. The Interim Receiver maintains close consultation with DIAND and YTG regarding environmental management activities at the site. From a regulatory perspective on a project-by-project basis, Environment Canada and the Department of Fisheries and Oceans ("DFO") have been and will continue to be consulted. Annual meetings of the Technical Advisory Committee ("TAC"), which includes the above-mentioned stakeholders, as well as semi-annual update memos to TAC members help ensure that stakeholders are informed on mine activities.

### 2.1.2 PROJECT PURPOSE AND NEED

***A water licence provides a regulatory framework for necessary environmental protection activities***

The existing water licences for the Faro and Vangorda Plateau mine sites will expire December 31, 2003. A water licence is required to provide a regulatory framework for the performance of the necessary environmental protection activities. Therefore, the Interim Receiver intends to apply for renewal of the water licences.

The advantages and disadvantages of applying for one water licence for the entire mine complex that would consolidate the two existing licences have been assessed with DIAND, YTG and other interested parties. These discussions have indicated that one licence is most appropriate for regulating the proposed project activities based on the following rationale:

***There are several advantages to combining the two existing water licences into one water licence***

1. A single water licence would streamline the process relating to the application, environmental review and the public consultation processes for this licence renewal.
2. A single water licence would maximize the coordination of management and operation of water treatment facilities with resulting benefits in efficiency and effectiveness.
3. The operational benefits of maintaining two water licences will not likely ever be realized given the confirmation from DIAND in January 2003 that mining operations are not expected to be economically viable at any time in the future.

The description of the existing environment that is provided in Volume II demonstrates that ongoing performance of environmental protection programs is required to prevent the degradation of the receiving environment and, because these activities are largely water related, a water licence is required.

### 2.1.3 TIMING CONSIDERATIONS

***The proposed 5-year term for the water licence will allow time for the development and approval of a FCRP***

The proposed term of the water licence (2004 to 2008) was developed to allow adequate time for the research and development of a FCRP for the mine complex. As described above, this task is the responsibility of a government closure Project Team.

Preliminary discussions with the closure Project Team confirm that the rationale for the proposed term of the licence remains valid.

The guiding principle of the proposed licence term, then, is to enable the necessary care and maintenance activities to be conducted while a FCRP is researched and developed by the closure Project Team.

### 2.1.4 PROJECT MANAGEMENT

***Deloitte & Touche Inc. was appointed Interim Receiver for Anvil Range in 1998***

Deloitte & Touche Inc. was appointed Interim Receiver of Anvil Range pursuant to the Interim Receivership order of the Court on April 21, 1998. This appointment and the Interim Receivership Order itself were recognized and confirmed by the Supreme Court of the Yukon Territory. As an officer of the Court, the Interim Receiver has overseen the management of the property under the terms of the existing water licences since that time.

*The Interim Receiver is responsible for preserving and protecting and for applying for licences.*

The rights and responsibilities of the Interim Receiver are set out in the Interim Receivership Order. These include, but are not limited to:

- "to receive, preserve, protect and realize upon the Assets"; and
- "the authority to "apply for any permits, licences, approvals or permissions on behalf of [Anvil Range] as may be required by any government or regulatory authority".

Through the authority granted by the Interim Receivership Order, the Interim Receiver will be applying for a new water licence for the mine site. Anvil Range (as represented by the Interim Receiver) will be legally bound by the terms of the new licence, as it is currently bound by the terms of its existing licences. The Interim Receivership Order provides for other rights and responsibilities related to the administration, but not relating to the physical care of the property.

There are still many outstanding legal issues to be resolved with regard to the property and the administration. It is the wish of DIAND and YTG to have the Interim Receiver stay in place to oversee the management of the site. If the Interim Receiver is discharged by the Court of its responsibility with respect to managing the mine site prior to the end of the next licence period, the Anvil Range property will become an Abandoned Site under the Devolution Transfer Agreement ("DTA") between the federal and territorial governments.

*The Interim Receiver oversees the activities of the Mine Manager. The site employs approximately 30 employees on a seasonal basis*

Upon Deloitte & Touche Inc.'s appointment, Mr. Wes Treleaven, a Senior Vice-President, was assigned the overall responsibility for the administration of the estate. Mr. Treleaven has over 25 years experience in dealing with large complex insolvencies. A professional staff team was assigned including senior managers in Toronto and Calgary with appropriate levels of industry and service line experience.

Upon taking possession of the property in April 1998, the Interim Receiver, in accordance with provisions of the Interim Receivership Order, identified and hired a site employee team to oversee the day-to-day operations. These employees were familiar with the site. An organization structure was set up with clearly established lines of authority, responsibilities and reporting levels. Mr. Dana Haggar continues under an employment contract as the Site Manager and reporting to him are four supervisors responsible to ensure that the property is maintained in a safe fashion and in compliance with regulatory requirements. On a seasonal basis, the Interim Receiver employs approximately 30 individuals from the communities of Faro and Ross River. There are six full-time employees who work throughout the year and some part-time employees assist during the off-season when necessary.

The Interim Receiver is committed to continuity to maximize stability at the site and has made efforts to minimize turnover of staff. Within Deloitte & Touche Inc., the engagement partner, senior management and environmental staff on the project have been consistent since 1998. The mine manager has been under contract with the Interim Receiver since 1998 and a majority of the seasonal employees have worked at the site for the past five years.

Contact information for key personnel involved include:

| | | |
|---|---|---|
| Deloitte & Touche Inc. | Mr. Wes Treleaven (Engagement Partner) | 416-601-4482 |
| Deloitte & Touche Inc. | Shannon Glenn (Manager, Environmental Services, Water Licence Renewal contact) | 416-601-6454 |
| Anvil Range Mining Corporation (Interim Receivership) | Mr. Dana Hagar, Mine Manager | 867-994-2600 |

***The Interim Receiver is committed to maximizing the use of local expertise and suppliers.***

The Interim Receiver will ensure that its consulting team has continuity with the engineering and environmental teams that have worked on the site in previous years and will continue to maximize the use of local expertise.

Sixty percent of Anvil Range's expenditures were directed within the Yukon economy in 2002. The Interim Receiver will continue to ensure that services are provided by Yukon suppliers as appropriate and available, to maximize the economic benefit to the Yukon Territory. In addition, with increased activity at the site arising from proposed new activities described in Section 6 of this document, the Interim Receiver will continue to make efforts to increase opportunity for employment to First Nations and, in particular, the community of Ross River.

***DIAND funds the activities of the Interim Receiver***

DIAND is currently advancing required funding on a secured basis to ensure ongoing care and maintenance activities continue at the mine site. As the mine has no economic value and there are no other present sources of funding to pay for the ongoing protection of the environment, DIAND continues to be the exclusive funder of the Interim Receiver. Therefore, all proposed activities are contingent on funding from DIAND. All accounts are submitted to the Court for review and approval. With the DTA having come into effect April 1 2003, the Interim Receiver will submit its proposed annual care and maintenance budgets to both DIAND and YTG for approval.

***Care and maintenance activities are driven by licence requirements and a risk based management approach***

The care and maintenance activities of the Interim Receiver will be carried out according to the same model that has been followed since its appointment in 1998. Specifically, care and maintenance objectives are driven by licence requirements and by a risk-based management approach defined in Section 7 of this volume of the EAR. These care and maintenance activities are carried out under the oversight of the regulatory agency relevant to each activity.

Whenever possible, the Interim Receiver addresses all matters in court reports before undertaking activities and obtains Court approval. On occasion, in the case of emergencies where advanced Court approval has not been obtained, the Interim Receiver ensures that such activities are described in detail in its next court report and it obtains DIAND's approval prior to carrying out the proposed work.

### 2.1.5 CARE AND MAINTENANCE STAKEHOLDER CONSULTATION AND COMMUNICATION

***Care and maintenance consultation will build on existing mechanisms***

For its care and maintenance activities, the Interim Receiver has established a working relationship with various stakeholders, as described below. The topic of consultation for closure planning is not part of the scope of the care and maintenance project. The topic of consultation for the purposes of the current environmental assessment project is described in Section 3 of Volume III of the EAR.

The Interim Receiver has and will continue to have regular contact with YTG Water Resources (previously DIAND Water Resources), Environment Canada and DFO on water licence requirement matters and any directives the Interim Receiver may receive from regulatory agencies.

Under the terms of one of its current water licenses (Vangorda IN89-002), the Interim Receiver meets annually with the TAC to review and discuss the ongoing care and maintenance activities at the mine site. The Interim Receiver will continue to maintain lines of care and maintenance consultation through this committee via meetings and updates. The Interim Receiver will advise the TAC of its budget approvals in March of each year. The Interim Receiver will continue to hold an annual site meeting outlining care and maintenance activities with a site tour. Also, mid-year reports will be provided to the TAC members to keep them apprised of site activities.

In addition, on reasonable notice, the Interim Receiver has and will continue to accommodate requests for tours of the mine. The Interim Receiver will also inform, with notice, both the Faro Town Council and the Ross River Dena Council of planned attendance at the mine by the Interim Receiver, with the intent of providing an opportunity to meet if desired by these parties.

***Care and maintenance reports are available from the Water Board***

The Interim Receiver will continue to file monthly and annual reports on its care and maintenance activities to the Yukon Territory Water Board. These reports are available to interested parties in the Yukon Territory Water Board library. Additional copies of the annual reports will be distributed to the Town of Faro, the Ross River Dena Council and Selkirk First Nations. The topic of availability of reports relating to site characterization and closure planning is not part of the scope of the care and maintenance project.

***Identified short to medium term risks will be addressed in collaboration with the closure Project Team.***

As a result of the risk-based management approach, short-term risks may be identified in any given year, which will need to be addressed. In addition, the care and maintenance project scope includes an adaptive management plan that includes the North Fork of Rose Creek, the Faro and Vangorda Diversions, the Grum Pit and potential acid drainage from Rose Creek Valley and from the Grum Rock Dump. The adaptive management plan consists of monitoring requirements, triggers and outlines either actions or planning/consultations mechanisms for determining actions.

For items arising either from the risk assessment or from the adaptive management plan that will need to be addressed within the 2004-2008 licence term, the Interim

Receiver will work closely with the relevant regulatory agencies, and where appropriate with the closure Project Team. In this manner, actions taken will be determined within the consultation framework adopted for closure planning and will be aligned to the extent possible with closure directions as they exist at the time that the item to be addressed is identified.

***Emergencies will be communicated immediately to any affected parties and will be addressed in a timely manner***

In case of any emergency at the site, the mine manager has contact numbers to advise potentially affected parties immediately. In addition, all members of the TAC will be advised as soon as practically possible. Emergency reclamation work to preserve and safeguard the environment will be carried out by the Interim Receiver in a timely fashion in consultation with YTG Water Resources and advisory groups as required.

## 2.1.6 OWNERSHIP HISTORY

### 2.1.6.1 Mine Development

***Mine production was from 1969 to 1982 and from 1986 to 1998***

The Faro and Vangorda Plateau mine sites were in production from 1969 to 1982, and from 1986 to 1998, respectively. Production was halted at several times due to low metal prices or changes in ownership. The most recent owner, Anvil Range was placed into receivership in April 1998. The mine sites have been under the management of Deloitte & Touche Inc., acting as the court-appointed Interim Receiver, since that time.

The first exploration work was conducted on the Vangorda deposit between 1953 and 1955 by Prospector Airways, a predecessor of Kerr Addison Mines. The deposit was considered to be too small and remote to be mined at that time.

The Faro deposit was discovered in 1964 and brought into production in 1969 by Anvil Mining Corporation, initially producing 5,000 tonnes per day. The Anvil operation was amongst the world's major producers of lead and zinc concentrates. Additional deposits were subsequently discovered in 1964 (Swim), 1973 (Grum) and 1976 (Grizzly, formerly known as Dy).

***The first mine operator was Anvil Mining Corporation***

The Faro open pit mine was first operated by Anvil Mining Corporation in 1969, which was later reorganized to form Cyprus Anvil Mining Corporation (CAMC) in 1975. CAMC terminated its mining operations in June of 1982.

Ownership changed again when Curragh Resources restarted operations in 1986 after approximately four years of inactivity. Production totalled approximately 13,500 tonnes per day. In addition to open pit mining, some underground mining was undertaken starting in 1989. From 1986 to 1992, Curragh mined an estimated 23.4 million tonnes of ore and generated 6 million $m^3$ of tailings. Curragh Resources initiated development of the Grum and Vangorda ore deposits in 1988. In 1992, Curragh Resources was placed into receivership.

Anvil Range purchased the Faro mining assets from KPMG Inc. in its capacity as Interim Receiver of Curragh Inc. in 1994. Anvil Range acquired the mine for approximately $27 million. Anvil Range's attempts at operating the Mine were troubled from the very beginning. Operations commenced in 1995, however falling metal prices forced the company to shut down mining in late 1996, and milling operations in the spring of 1997. Although operations were reactivated in the fall of 1997, Anvil Range applied for and obtained CCAA protection in January 1998. Mining and milling operations were shut down in 1998.

***The Vangorda Plateau mine site was developed in the late 1980's***

Development of the Vangorda Plateau mine site began in the late 1980's and ore production began in 1992. Two open pits were developed: Vangorda and Grum. All ore was hauled by truck to the mill at the Faro mine site (approximately 15 km) and all milling activities (including tailings deposition) took place at the Faro mine site. The Vangorda deposit was depleted of economic reserves in 1998. The Anvil Range mining plan for the Grum Pit was only partially completed at the time the mine ceased operations in 1998. However, extraction of the residual ore is not considered to be economically viable as was indicated in a letter released by DIAND in January 2003 and in supporting documents provided by Strathcona Minerals, an engineering consultant retained by the Interim Receiver.

#### 2.1.6.2 Interim Receivership

***The Interim Receiver has a mandate to preserve and protect the property***

On April 21, 1998, Deloitte & Touche Inc. was appointed Interim Receiver of the Anvil Range Mine Complex by the Ontario Court (General Division) ("the Court") (now the Superior Court of Justice). Among other responsibilities, the Interim Receiver's mandate is to "preserve and protect" the property. The Interim Receiver has overseen the ongoing care, maintenance and environmental protection activities at the mine site.

Since its appointment the Interim Receiver has successfully maintained compliance with the terms of the water licences by implementing a broad scope of tasks related to environmental protection and environmental monitoring, which have included:

1. Pumping and treatment of water from the Faro Main Pit, the Faro Zone 2 Pit and the Vangorda Pit (Vangorda initiated in 2002).
2. Treatment of water in the Intermediate Pond (Rose Creek Tailings Facility).
3. Compliance with the effluent discharge criteria in the water licences.
4. Conversion of equipment in the mill for use as a water treatment plant.
5. Water quality, biological and physical stability monitoring in accordance with and in excess of the terms of the water licences.
6. Preparation and submission to the Yukon Territory Water Board of monthly water quality reports and comprehensive annual environmental reports.
7. Assistance with large-scale DIAND scrap steel reclamation projects.
8. Removal of laboratory and process chemicals, PCB containing equipment and used oil from the mine sites.
9. TAC meetings and stakeholder consultation.
10. Physical maintenance and upgrading of water retention and diversion structures including substantial repairs to the Faro and Vangorda Creek Diversion Flume.
11. Completion of a comprehensive environmental study of the Rose Creek Tailings Facility.
12. Initiation of planning for long-term mine reclamation.
13. Completion of a comprehensive risk assessment of all key elements.

## 2.1.7 REGULATORY HISTORY

### 2.1.7.1 Land Tenure

*The area of the Faro Deposit is held by 12 mineral leases under the Yukon Quartz Mining Act*

The Faro mine site occupies mineral leases, which are leased from the Government of Canada under the Yukon Quartz Mining Act. The Vangorda Plateau mine site occupies mining claims but no Federal or Territorial leases.

The area of the Faro Deposit is currently held by 12 mineral leases under the *Yukon Quartz Mining Act*. These leases are due to expire on November 16th, 2009 and are listed in Table 2. All 12 mineral leases are currently held in the name Anvil Range.

**Table 2. Mineral Leases Granted under the Yukon Quartz Mining Act for Faro Deposit**

| Lease No. | Grant No. | Claim Name | Ownership | Expiry Date | Lot No. |
|---|---|---|---|---|---|
| 3427 | 92225 | FARO 39 | Anvil Range Mining Corporation | 2009.11.16 | 39 |
| 3428 | 92227 | FARO 41 | Anvil Range Mining Corporation | 2009.11.16 | 41 |
| 3429 | 92228 | FARO 42 | Anvil Range Mining Corporation | 2009.11.16 | 42 |
| 3430 | 92229 | FARO 43 | Anvil Range Mining Corporation | 2009.11.16 | 43 |
| 3431 | 92230 | FARO 44 | Anvil Range Mining Corporation | 2009.11.16 | 44 |
| 3432 | 92231 | FARO 45 | Anvil Range Mining Corporation | 2009.11.16 | 45 |
| 3433 | 92232 | FARO 46 | Anvil Range Mining Corporation | 2009.11.16 | 46 |
| 3434 | 92239 | FARO 53 | Anvil Range Mining Corporation | 2009.11.16 | 53 |
| 3435 | 92240 | FARO 54 | Anvil Range Mining Corporation | 2009.11.16 | 54 |
| 3436 | 92241 | FARO 55 | Anvil Range Mining Corporation | 2009.11.16 | 55 |
| 3437 | 92242 | FARO 56 | Anvil Range Mining Corporation | 2009.11.16 | 56 |
| 3438 | 94573 | WHI 8 FR | Anvil Range Mining Corporation | 2009.11.16 | 90 |

There are no current Land Use Permits over the mine site and surrounding area as none are required within the municipality of the Town of Faro. Only a small part of the mine is within the Faro Municipal Boundary.

*There are four Federal land leases at Faro*

There are four federal land leases at the Faro site:

1. #1646 Map Sheet 105K6 — pit, dumps, plant site, tailings impoundments
2. #1690 Map Sheet 105K6 — freshwater reservoir
3. #1777 Map Sheet 105K6 — Faro Valley rock dump
4. #4945 Map Sheet 105K6 — NE rock dump

The rest of the Faro Deposit and surrounding area is held by mineral claims under the *Yukon Quartz Mining Act*. This package includes the following Quartz Claims:

1. FARO Claims registered to Anvil Range, were to expire March 1St 2001 to November 16th, 2009.
2. BILL Claims registered to Pelly River Mines Ltd., were to expire March 1st, 2001.
3. WHI Claims registered to Anvil Range, were to expired March 1st, 2001.
4. ED Claims registered to Anvil Range, were to expire March 1st, 2001.

5. LO Claims registered to Pelly River Mines Ltd., were to expire March 1st, 2001.
6. GAL Claims registered to Anvil Range, were to expire March 1st, 2001 to March 1st, 2002.

***The Interim Receiver is granted relief from representation work on claims***

To maintain mining claims in good standing, the holder is to do annual representation work or pay cash *in lieu* of such representation work or seek relief under Section 5.55(1) of the *Yukon Quartz Mining Act.* As the Interim Receiver has limited funding and has set as its priority maintenance and protection of the environment, the Interim Receiver has written to the Minister of DIAND requesting relief under Section 55 (1) of the *Yukon Quartz Mining Act.* Each year, the Interim Receiver has received a letter from the Minister of DIAND granting work relief under the authority provided in subsection 55 (1) of the Act for claims coming due. In the Minister's letter of February 28 2002, it is also stated "the granting of work relief is only applicable to the claims as long as they are under the control and administration of the Interim Receiver. If conditions change and requirements for representation work falls on a third party by transfer or assignment, this work relief will become null and void".

***The Grum deposit is held by mineral leases under the Yukon Quartz Mining Act***

The area of the Grum Deposit is currently held by at least 28 mineral leases under the *Yukon Quartz Mining Act.* These leases are due to expire between June 1st, 2006 and August 21st, 2015 and are listed in Table 3. All 28 mineral leases are currently held in the name Anvil Range Mining Corporation. There are no surface leases registered under the Territorial Lands Act associated with the Grum Deposit. In November 1995 several surface leases were applied for, but to date, none have been granted.

**Table 3. Mineral Leases Granted under the Yukon Quartz Mining Act for Grum Deposit**

| Lease No. | Grant No. | Claim Name | Ownership | Expiry Date | Lot No. |
|---|---|---|---|---|---|
| 3204 | 66741 | FIRTH 6 | Anvil Range Mining Corporation | 2006.01.28 | 76 |
| 3205 | 66743 | FIRTH 8 | Anvil Range Mining Corporation | 2006.01.28 | 75 |
| 3206 | 66760 | CHUCK 1 | Anvil Range Mining Corporation | 2006.01.28 | 68 |
| 3207 | 66761 | CHUCK 2 | Anvil Range Mining Corporation | 2006.01.28 | 69 |
| 3208 | 66764 | CHUCK 5 | Anvil Range Mining Corporation | 2006.01.28 | 67 |
| 3209 | 66765 | CHUCK 6 | Anvil Range Mining Corporation | 2006.01.28 | 72 |
| 3210 | 66766 | CHUCK 7 | Anvil Range Mining Corporation | 2006.01.28 | 73 |
| 3211 | 66767 | CHUCK 8 | Anvil Range Mining Corporation | 2006.01.28 | 74 |
| 3195 | 70440 | BIX 2 | Anvil Range Mining Corporation | 2006.01.28 | 77 |
| 3196 | 70441 | BIX 3 | Anvil Range Mining Corporation | 2006.01.28 | 78 |
| 3335 | 66702 | CHAMP 3 | Anvil Range Mining Corporation | 2008.01.25 | 62 |
| 3336 | 66703 | CHAMP 4 | Anvil Range Mining Corporation | 2008.01.25 | 61 |
| 3337 | 66704 | CHAMP 5 | Anvil Range Mining Corporation | 2008.01.25 | 64 |
| 3338 | 66705 | CHAMP 6 | Anvil Range Mining Corporation | 2008.01.25 | 63 |
| 3329 | 66680 | ELLE MAY 1 | Anvil Range Mining Corporation | 2008.01.25 | 58 |
| 3330 | 66681 | ELLE MAY 2 | Anvil Range Mining Corporation | 2008.01.25 | 52 |
| 3331 | 66682 | ELLE MAY 3 | Anvil Range Mining Corporation | 2008.01.25 | 59 |
| 3434 | 92239 | GRUM 1 | Anvil Range Mining Corporation | 2009.11.16 | 53 |
| 3435 | 92240 | GRUM 2 | Anvil Range Mining Corporation | 2009.11.16 | 54 |
| 3436 | 92241 | GRUM 3 | Anvil Range Mining Corporation | 2009.11.16 | 55 |
| 3437 | 92242 | GRUM 5 | Anvil Range Mining Corporation | 2009.11.16 | 56 |
| 3499 | 66706 | CHAMP 7 | Anvil Range Mining Corporation | 2011.12.05 | 120 |

| Lease No. | Grant No. | Claim Name | Ownership | Expiry Date | Lot No. |
|---|---|---|---|---|---|
| 2125 | 77899 | HANK 2 FR | Anvil Range Mining Corporation | 2015.08.21 | 79 |
| 2126 | 77900 | HANK 3 FR | Anvil Range Mining Corporation | 2015.08.21 | 80 |
| 2127 | 77901 | HANK 4 FR | Anvil Range Mining Corporation | 2015.08.21 | 81 |
| 2128 | 77902 | HANK 5 FR | Anvil Range Mining Corporation | 2015.08.21 | 82 |
| 2129 | 77903 | HANK 6 FR | Anvil Range Mining Corporation | 2015.08.21 | 83 |
| 2130 | 77904 | HANK 7 FR | Anvil Range Mining Corporation | 2015.08.21 | 84 |

***There are Quartz Claims for the rest of the Grum deposit and surrounding area***

The rest of the Grum Deposit and surrounding area is held by mineral claims under the *Yukon Quartz Mining Act*. This package includes the following Quartz Claims:

1. MIAMI Claims, registered to Glamis Gold Inc., were to expire March 1st, 2001.
2. TIE Claims, registered to Pelly River Mines Ltd., were to expire March 1st, 2001.
3. SUN Claims, registered to Anvil Range, were to expire March 1st, 2001 to March 1st, 2002.
4. CHAMP Claims, registered to Anvil Range, are to expire March 1st, 2006 to December 5th, 2011.
5. RICH Claims, registered to Anvil Range, were to expire March 1st, 2001 to March 1st, 2006.
6. SALLY Claims, registered to Anvil Range, are to expire March 1st, 2006.
7. JACK Claims registered to Anvil Range, are to expire March 1st, 2006.
8. ELLE MAY Claims, registered to Anvil Range, are to expire March 1st, 2006 to January 25th 2008.
9. ROCKY Claims, registered to Anvil Range, are to expire January 28th, 2006 to June 1st, 2006.

As for the Faro site claims, the Interim Receiver has been granted work relief under Section 55(1) of the *Yukon Quartz Mining Act*.

***The Vangorda Deposit is held by mineral leases under the Yukon Quartz Mining Act***

The area of the Vangorda Deposit is currently held by 12 mineral leases under the *Yukon Quartz Mining Act*. These leases are due to expire between January 28th, 2006 and January 25th, 2008 and are listed in Table 4. These 12 mineral leases are currently held in the name Anvil Range.

**Table 4. Mineral Leases Granted under the Yukon Quartz Mining Act for Vangorda Deposit**

| Lease No. | Grant No. | Claim Name | Ownership | Expiry Date | Lot No. |
|---|---|---|---|---|---|
| 3197 | 66673 | ROCKY 2 | Anvil Range Mining Corporation | 2006.01.28 | 51 |
| 3212 | 66674 | ROCKY 3 | Anvil Range Mining Corporation | 2006.06.01 | 49 |
| 3213 | 66675 | ROCKY 4 | Anvil Range Mining Corporation | 2006.06.01 | 50 |
| 3214 | 66676 | ROCKY 5 | Anvil Range Mining Corporation | 2006.06.01 | 47 |
| 3327 | 66677 | ROCKY 6 | Anvil Range Mining Corporation | 2007.08.01 | 48 |
| 3215 | 66678 | ROCKY 7 | Anvil Range Mining Corporation | 2006.06.01 | 45 |
| 3328 | 66679 | ROCKY 8 | Anvil Range Mining Corporation | 2007.08.01 | 46 |
| 3198 | 66684 | WYNNE 1 | Anvil Range Mining Corporation | 2006.01.28 | 53 |
| 3332 | 66685 | WYNNE 2 | Anvil Range Mining Corporation | 2007.08.01 | 57 |
| 3199 | 66686 | WYNNE 3 | Anvil Range Mining Corporation | 2006.01.28 | 54 |
| 3333 | 66687 | WYNNE 4 | Anvil Range Mining Corporation | 2008.01.25 | 56 |
| 3334 | 66688 | WYNNE 5 | Anvil Range Mining Corporation | 2008.01.28 | 55 |

There are no surface leases registered under the *Territorial Lands Act* associated with the Vangorda Deposit. A surface lease was applied for in November of 1995 but has not been granted to date.

***There are Quartz Claims for the rest of the Vangorda Deposit and surrounding area***

The rest of the Vangorda Deposit and surrounding area is held by mineral claims under the *Yukon Quartz Mining Act*. This package includes the following Quartz Claims:

1. ROCKY Claims, registered to Anvil Range, are to expire January 28th, 2006 to August 1st, 2007.
2. GALE Claims, registered to Pelly River Mines Ltd., are to expire March 1st, 2005.
3. ALICE Claims, registered Anvil Range, are to expire March 1st, 2006.
4. WYNNE Claims, registered to Anvil Range, are to expire March 1st, 2006 to January 25th, 2008.
5. TIM Claims, registered to Anvil Range, are to expire March 1st, 2006.

#### 2.1.7.2 Water Licences and Amendments

***The Faro mine site water licence was initially issued in 1975 and was amended to accommodate expansion and to assign new ownership***

When Anvil Mining Corporation began operations at the Faro mine site in 1969, there was no regulatory regime in place in the Yukon for mine production. The first water licence was issued to Cyprus Anvil Mining Corporation in February 1975 for the Faro mine and mill site. This licence was renewed on December 1, 1979, and was to expire on November 30, 1984.

In September 1980, Cyprus Anvil requested an amendment to their water licence to accommodate the expansion of the Rose Creek Tailings Facility, which was expanded to include construction of the Intermediate and Cross Valley Dams. The amendment was granted by issuing a new water licence in March 1982. This new water licence was set to expire in March 1989.

Due to low metal prices, mining operations shut down in June of 1982 and did not resume until 1986 under the ownership of Curragh Resources. Curragh Resources Inc. assumed ownership of the Faro mine site in October 1985. An emergency amendment was granted on October 4, 1985, which assigned the water licence to that company.

Two amendments to this water licence were requested and granted on November 18, 1988 and September 22, 1989, respectively. The latter was a Renewal Interim Order of the water licence with an expiry date of January 31, 1990.

***A new water licence (1989) included a Trust Fund clause and was amended to allow the use of the Faro Pit for tailings disposal, to include the Trusteed Environment Fund and to incorporate an abandonment plan***

Curragh Resources then applied for a new water licence. A proposal was put forward to the Water Board to include a Trust Fund clause in the licence to build up $7,500,000 over 25 years for reclamation. On December 21, 1989, the water licence was granted. This licence, number IN89-001, had an expiry date of January 30, 1997.

The first amendment to Curragh Resources' Faro mine site water licence was made in October 1991, in order to allow the use of the Faro Pit for tailings disposal. The next amendment included the Trusteed Environmental Fund, which described the transfer of $368,229 into the fund, as well as incorporation of the above-noted monies.

In 1992, DIAND began the scoping for the Integrated & Comprehensive Abandonment Plan (ICAP) for Faro and Vangorda Plateau mine sites. Curragh Resources produced an abandonment plan with various options and introduced an option that was incorporated in the third amendment, which was approved in July 1993. This alternative required a final abandonment plan to be produced within two years of the expiry of the water licence in January 1997.

***The Vangorda Plateau mine site water licence was initially issued in 1990***

A water licence (IN89-002) for the Vangorda Plateau mine site was granted to Curragh Resources in September 1990. This licence is valid until December 31, 2003.

The Faro and Vangorda Plateau water licences were assigned to Anvil Range on November 8, 1994, including the provisions for security funding. Anvil Range signed a Reclamation Security Agreement with DIAND, which provided for reclamation funding based on metal prices and mining revenues.

In March 1995, Anvil Range set up a Reclamation Trust Indenture and signed an Economic Agreement with Ross River Dena Development Corporation. Further to this, an application for an amendment and extension to the Faro water licence was submitted to the Water Board in August of 1995.

A series of brief amendments (numbers four to seven) to the Faro mine site were issued, extending the term of the existing licence for brief periods until a new licence (QZ95-003) was issued in January 1998. The new licence has an expiry date of December 31, 2003, which corresponds to the expiry date of the Vangorda Plateau water licence. Licence QZ95-003 includes some re-organization of the reclamation security funds and the introduction of the Reclamation Trust Indenture.

***There is no approved "closure plan" for the mine complex***

When operations at the Faro and Vangorda mine sites were shut down in February 1998, an abandonment plan had still not been approved. Anvil Range had filed an ICAP with the Yukon Territory Water Board in November 1996, but this document was not approved. Closure measures for different components of the mine sites are described in the water licences.

Table 5 summarizes all operators of the Faro and Vangorda Plateau mine sites, water licences held and amendments made, and the start and expiry dates of all licences and amendments.

**Table 5. Chronology of Operators, Water Licences and Amendments**

| Operators | Water Licence/Amendment # | Date | Expiry Date |
|---|---|---|---|
| Cyprus Anvil Mining Corp. | Y-2L3-0005 | Feb 4, 1975 | Nov 30, 1979 |
| | Y-2L3-2098 | Dec 1, 1979 | Nov 30, 1984 |
| | Y-2L3-2226 | Mar 24, 1982 | Mar 24, 1989 |

| Operators | Water Licence/Amendment # | Date | Expiry Date |
|---|---|---|---|
| Curragh Resources Inc. | YIN85-05AL (amendment to Y-2L3-2226 | Oct 4, 1985 | Mar 24, 1989 |
| | YIN85-05A (amendment to Y-2L3-2226) | Sep 21, 1987 | Mar 24, 1989 |
| | Amendment #88-1 to YIN85-05A | Nov 18, 1988 | Mar 24, 1989 |
| | Amendment #89-1 to YIN85-05A | Sept 22, 1989 | Jan 31, 1990 |
| | IN89-001 (Faro) | Jan 23, 1990 | Jan 30, 1997 |
| | IN89-002 (Vangorda) | Oct 25, 1990 | Dec 31, 2003 |
| | Amendment #1 to IN89-001 | Oct 2, 1991 | Jan 30, 1997 |
| | Amendment #2 to IN89-001 | Dec 11, 1991 | Jan 30, 1997 |
| | Amendment #3 to IN89-001 | Jul 23, 1993 | Jan 30, 1997 |
| Anvil Range Mining Corp. | IN89-001 & IN89-002 assigned to Anvil Range Mining Corporation | Nov 8, 1994 | |
| | Submitted Application QZ95-003 to YTWB | Aug, 1995 | |
| | Submitted Application to amend IN89-002 to YTWB | Aug, 1995 | |
| | Amendment #4 IN89-001 | Sept 9, 1993 | Jan 30, 1997 |
| | Amendment #5 | Jan 8, 1997 | May 30, 1997 |
| | Amendment #6 | May 28, 1997 | Sept 30, 1997 |
| | Amendment #7 | Oct 7, 1997 | Dec 31, 1997 |
| | QZ95-003 (amendment to IN89-001) | Jan 30, 1998 | Dec 31, 2003 |

# 3 DESCRIPTION OF FACILITIES – FARO SITE

## 3.1 OVERVIEW OF STRUCTURES

***This section of the report describes each of the key facilities at the Faro Mine site and their development and operational history***

The Faro Mine site consists of the following primary structures:

1. Faro Main Pit.
2. Faro Zone 2 Pit.
3. Faro Rock Dumps.
4. Rose Creek Tailings Facility including Original, Second and Intermediate Dams.
5. Cross Valley Pond and Dam.
6. Mill and Other Buildings.
7. Water Treatment Facilities.
8. Faro Creek Diversions.
9. Fresh Water Supply Dam and Reservoir.
10. Pumphouse Pond and Dam.
11. North Fork Rose Creek Diversion.
12. North Wall Interceptor Ditch.
13. Rose Creek Diversion Canal.

This section of the report discusses the development and operational history of the Faro Mine site and provides a description of each of the key facilities. A general arrangement plan of the site is provided in Figure 2. Some information regarding earth structures and water diversions contained in this section was provided by BGC Engineering Inc.

## 3.2 DEVELOPMENT AND OPERATIONS HISTORY

***The Faro mine started production in 1969***

Stripping of the Faro Pit began in 1968 and commercial milling of ore began in September 1969. The initial production rate was 5,000 tonnes of ore per day, increasing to 6,000 tonnes in 1970 and 9,300 tonnes in 1974. The Faro Pit was mined as a conventional truck and shovel operation. Initially, 58.5 tonne trucks were utilized, which were replaced with 108 tonne trucks in 1977.

The first pit mined was Zone 1, from which waste rock was dumped in the Faro Valley and Northwest Dumps. The pit was initially developed as a narrow, northwesterly elongate cut into the hill slope northwest of Faro Creek. The pit was then broadened to the southwest in the early 1970's, with the waste dumped to the west side of the Northwest Dumps and into the west Main Dump. The pit was extended to the southeast across Faro Creek following establishment of the initial Faro Creek Diversion in the mid 1970's. Waste rock was deposited in the Main Dump and also the Northeast Dumps, which were started at that time. Zone 1 was mined into the early 1980's and was essentially completed by Cyprus Anvil. Curragh Resources mined several small remnants of ore from the pit walls between 1986 and 1992, with waste dumps internal to the pit. Cyprus Anvil deposited several million tonnes of oxidized ore from Zone 1 and Zone 2 near the mill.

*The Zone 2 pit was mined in the late 1970's and early 1980's*

In the late 1970's and early 1980's, Zone 2 was mined as a smaller, satellite pit and the Intermediate Dumps were started. It is believed that during the initial stripping of oxidized ore, metal-enriched overburden and sulphide waste rock from the Zone 2 Pit were deposited on the Intermediate Dump. Therefore, the lower lift of this dump likely contains a significant quantity of potentially acid generating material.

The Zone 3 area of the Main Pit was a down-dropped block of ore, which required considerable stripping of waste rock. This stripping was begun by Cyprus Anvil in the mid-1970's, in conjunction with mining of Zone 1, using the Northeast Dumps. During the mid-1980's shutdown, Cyprus Anvil conducted a major stripping effort, with waste rock being deposited in the Main and Intermediate Dumps. The southeast slot access to the Zone 3 area of the Main Pit was developed at that time. Non acid generating calc-silicate and schist waste from the Zone 3 stripping was segregated on top of the east Main Dump for possible future use. Waste from the Zone 3 stripping was also deposited by Cyprus Anvil in the mined-out Zones 2 Pit and in the Intermediate Dump.

*Curragh Resources mined primarily in the Zone 3 area of the Main Pit*

Curragh Resources mined primarily in Zone 3 where considerable stripping was required. Waste rock was deposited in the Main and Intermediate Dumps and the Zone 2 Pit. Curragh Resources deposited most of their sulphide waste rock in a cell on the upper lift of the Intermediate Dump, but later also deposited sulphide waste rock on top of the calc-silicate and schist placed by Cyprus Anvil on the upper lift of the Main Dump. Calc-silicate breccia, stripped from Zone 3, was used for the North Fork of Rose Creek rock drain. Schist, calc-silicate breccia and minor intrusive rock was used to build the haul road to Vangorda Plateau and a haul road to the mill on the southwest side of the Main and Intermediate Dumps. Rock placed in the haul road southeast of the North Fork of Rose Creek was derived from stripping in Zone 3 and, therefore, the southeast section of the haul road is believed to be constructed of non-sulphide waste rock, as that was all that was reportedly being mined in that part of the pit at the time. Curragh Resources also placed a considerable amount of waste rock, much of which was sulphide bearing in the previously mined portions of the Zone 1 and Zone 3 Pits. The Ramp Zone, a small extension of Zone 2, was mined by Curragh Resources in 1986 and then backfilled. The Ramp Zone was located immediately southwest of the southeast slot access to the Zone 3 Pit. Thus the pit wall between the slot and the Ramp Zone is thin.

Curragh Resources deposited low-grade ore (3 to 5% lead and zinc) in two stockpiles, A and C, beside the main haul road from the Zone 1 Pit. Curragh Resources processed the oxidized ore stockpiled by Cyprus Anvil after screening out the fine fraction of the ore. The oxidized fines are still present near the mill.

Curragh Resources mined 1.7 million tonnes of ore from an underground room and pillar mine developed through a portal into the southwest wall of the Main Pit. All openings into this mine were internal to the Faro Pit and are now flooded.

Tailings were deposited into the mined out Faro Main Pit from August 1992 to mine closure in 1998.

# 3.3 FARO MINE SITE FEATURES

## 3.3.1 OPEN PITS

### 3.3.1.1 Faro Main Pit

The Faro ore deposit has been described as an ellipsoidal and somewhat tabular mass that had a major axis of approximately 1,220 m and a minor axis of 370 m. The vertical thickness was up to 100 m. The ore zone was covered by waste rock and alluvium up to a depth of 170 m.

***A seasonal pumping program maintains the in-pit water elevation***

The Faro Main Pit (Zone 1 and 3) measures approximately 1675 m long by 975 m wide. Its circumference is 4.2 km covering a surface area of approximately 1.06 km$^2$. The lowest point in the Faro Pit has an elevation of 975 mASL, which is 335 m below the highest point on the west pit wall.

The Faro Pit has two access ramps which constitute low points in the pit perimeter. One access ramp is located in the southwest wall in proximity of the old Faro Creek channel with an invert elevation at 1180.5 mASL. The second access ramp is located in the southeast corner of the pit and has a lower invert at an elevation of 1174.5 mASL.

The pit was allowed to flood from runoff, seepage inflows and tailings inflows from 1992 to 1997. In 1997, the water elevation had reached the desired maximum range, as defined in Kilborn 1991 at approximately 15 m below the lowest overflow elevation. Subsequent to mine shut down in early 1998, the recycle water system has been incorporated into a seasonal pumping program that maintains the in-pit water elevation within the desired range.

***The crest of the northeast pit wall is retrogressing toward Faro Creek diversion***

The northeast wall of the Main Pit is undergoing a progressive failure of the slope face wherein the crest of the pit wall is retrogressing towards the Faro Creek Diversion. The stability of this pit wall has been professionally assessed (Golder 2002) and the rate of crest retrogression is monitored. It is considered unlikely that the crest of the pit wall will retrogress to the point of compromising the stability of the Faro Creek Diversion channel within the licence period (i.e. to 2008).

### 3.3.1.2 Zone 2 Pit

The Zone 2 Pit is located immediately southeast of the Faro Main Pit and was excavated into the west valley wall of North Fork Rose Creek to mine a small, faulted extension of the Faro ore body. The ultimate surface area of the excavation was 0.27 km$^2$ with the pit reaching 100 m at the deepest point and a total volume of 6.8 million m$^3$ of material removed (total waste rock, ore and overburden). Following excavation, the pit was backfilled with waste rock.

The low point in the pit perimeter is in the southeast area such that uncontrolled filling would result in an overflow of water into the North Fork of Rose Creek.

***The Zone 2 Pit is pumped to prevent overflow to Rose Creek***

Subsequent to a brief overflow from the pit into North Fork Rose Creek during backfilling in 1983, several control measures were implemented. These included construction of an external rock drain to collect water from the pit with an overflow pipe to provide a discreet discharge towards North Fork Rose Creek, installation of a well to monitor water level and installation of a pumping well to pump water from the backfilled pit to surface.

The pit volume up to the elevation at which overflow would occur to the North Fork of Rose Creek is 1.6 million $m^3$. Assuming an average porosity of 30% for the backfilled mine rock, the maximum storage capacity available for water collecting in the pit would be approximately 480,000 $m^3$. The pumping well is utilized to maintain the water elevation in the backfilled pit below the overflow elevation by pumping water to surface and into the Main Pit. The water is then incorporated into the seasonal water pumping/treatment process and, ultimately, discharged to Rose Creek.

### 3.3.2 ROCK DUMPS

***Waste dumps at the Faro Mine site include the Faro Valley and Northwest Dumps, Northeast Dumps, Main and Intermediate Dumps, "Parking Lot Dumps," and Outer Haul Road West Dump***

The waste dumps were developed over the sequence of the mining of the Faro pits. Generally, the Faro Valley and the Northwest Dumps were the first to be developed, from 1968 to the early 1970's, receiving waste from the early stripping and mining of the Faro Zone 1 Pit. The other rock piles developed during this period were marginal ore or low grade stockpiles. In the 1970's, the Northeast Dumps were built, primarily with waste from the Zone 1 and Zone 2 pits. The third section of the Northwest Dump, the Lower Northwest Dump, was also built from about 1970 to 1971. The two largest dumps on the Faro site, the Main and the Intermediate Dumps, were also started during the 1970's. These dumps continued to be used until 1990, when mining at Faro was almost finished. The "Parking Lot Dumps" were built in the mid-1970's.

Dump construction in the early 1980's was primarily in the Zone 2 East Dump. In the later 1980's several smaller dumps were built (<10,000 tonnes). The majority of the waste was deposited in the Outer Haul Road West Dump, with continued deposition on the Main and Intermediate Dumps.

In the 1990's, deposition continued on the Main and Intermediate Dumps, and on the low-grade stockpiles. In addition, waste was placed on some of the smaller dumps that were started in the late 1980's.

Tables 6 and 7, repeated from RGC 1996, provide a listing of the individual rock dumps, the years of construction, their dimensions and tonnages. The individual dumps are illustrated on Figures 4 and 5 and a section that illustrates the surface topography around the perimeter of the dumps is provided on Figure 6. RGC 1996 provides a detailed listing of the estimated composition of the individual rock dumps according to rock type, which is not repeated here.

#### 3.3.2.1 Faro Northwest Dumps

*The Northwest Dumps were formerly used as "boneyards"*

The Northwest Dumps are located northwest of the Main Pit, and north of the plant site area. The dumps were constructed primarily by end-dumping. There are three major lifts to the dump, referred to as the Upper, Middle and Lower Northwest Dumps.

These dumps cover a total area of about 393,000 m$^2$, and have an average height of 21 m. The total tonnage of waste rock is estimated at about 15 million tonnes.

These dumps were used as "boneyards" for storage of used and spare equipment subsequent to completion of dump construction. These boneyards were the focus of a scrap steel reclamation project funded by DIAND in 1999 and 2000. This project removed the majority of scrap steel from the boneyards on the northwest rock dumps off the mine site and also removed all other garbage and buildings such that the rock benches were left clear of mining debris.

*The "Parking Lot Dumps" were also used as "boneyards" over the life of the mine*

There are two other dumps located immediately to the north of the mill site and south of Northwest Dumps which are described as the "Lower Parking Lot Dump" and the "Upper Parking Lot Dump". These dumps were constructed between 1975 and 1976. The two dumps are reported to contain about 2.9 million tonnes of rock and cover an area of about 0.1 km$^2$. The dumps were also used as boneyards over the life of the mine but were not cleared of scrap in the manner of the upper Northwest Dumps.

These dumps were constructed at their angle of repose on moderately sloping well-drained terrain. These dumps have been stable since construction, over 30 years ago, and there are no signs of instability. There is no significant upstream water source that could cause elevated pore pressures in the dumps. Over time, as the surficial rock weathers, some shallow slope creep and slumping of the surficial layers on the angle of repose dump faces may be anticipated. Very little water flows from the dumps and there is no significant erosion from surface water flows.

#### 3.3.2.2 Faro Valley Dump

*The Faro Valley Dump is in the original channel of Faro Creek*

The Faro Valley Dump was constructed during the same period as the Northwest Dumps, from the early development of the Faro Main Pit. This dump is located north of the open pit, in the original channel of Faro Creek. Faro Creek was diverted around the pit to the northeast to minimize the flow of clean water into the pit during mining. The dump fills the original creek channel and is, in part, draped over the edge of the pit resulting in a variable dump height, with a maximum of 23 m and an average of 11 m. The Faro Valley Dump is described in two sections: the larger Faro Valley North Dump covers an area of approximately 136,000 m$^2$ and the smaller Faro

**Table 6. Period of Construction of Faro Waste Rock Dumps**

| Dump Symbol | Name | Age of Dump | |
|---|---|---|---|
| | | start | end |
| NWU | Upper Northwest Dump | 1968 | 1969 |
| NWM | Middle Northwest Dump | 1969 | 1970 |
| NWL | Lower Northwest Dump | 1970 | 1971 |
| UPL | Upper Parking Lot Dump | 1975 | 1976 |
| LPL | Lower Parking Lot Dump | 1975 | 1976 |
| FVN | Faro Valley North | 1968 | 1970 |
| FVS | Faro Valley South | 1968 | 1975 |
| MDW | Main Dump West | 1974 | 1990 |
| MDE | Main Dump East | 1972 | 1990 |
| ID | Intermediate Dump | 1979 | 1990 |
| NEU | Upper Northeast Dump | 1974 | 1977 |
| NEL | Lower Northeast Dump | 1975 | 1979 |
| NEO | Outer Northeast Dump | 1975 | 1980 |
| ZIIW | Zone II West | 1987 | 1990 |
| ZIIE | Zone II East | 1980 | 1985 |
| RZD | Ramp Zone Dump | 1989 | 1990 |
| RD | Ranch Dump | 1989 | 1990 |
| SWPWD | Southwest Pit Wall Dump | 1990 | 1991 |
| LGSPA | Low Grade Stockpile A | 1987 | 1990 |
| LGSPC | Low Grade Stockpile C | 1987 | 1990 |
| FTW | Fuel Tank DumpW | 1969 | 1971 |
| FTE | Fuel Tank Dump E | 1969 | 1971 |
| MMW | Mt. Mungly West | 1969 | 1970 |
| MME | Mt. Mungly East | 1969 | 1970 |
| SPB | Stockpiles Base | 1969 | 1975 |
| OXSP | Oxide Fines Stockpile | 1969 | 1974 |
| MGSP | Medium Grade Stockpile | n/a | 1998 |
| CHSP | Crusher Stockpile | n/a | 1998 |
| OHRW | Outer Haul Road West | 1987 | 1989 |
| OHRE | Outer Haul Road East | 1983 | 1989 |
| NFRD | North Fork Rock Drain | 1988 | 1988 |

## Table 7. Estimated Size of Faro Waste Rock Dumps

| Dump Symbol | Name | Area ($m^2$) | Max Height (m) | Average Height (m) | Volume ($m^3$) | Tonnage (tonnes) |
|---|---|---|---|---|---|---|
| NWU | Upper Northwest Dump | 128,833 | 15 | 10 | 1,332,833 | 2,665,666 |
| NWM | Middle Northwest Dump | 158,069 | 30 | 18 | 2,861,748 | 5,723,496 |
| NWL | Lower Northwest Dump | 105,653 | 37 | 31 | 3,279,066 | 6,558,131 |
| UPL | Upper Parking Lot Dump | 53,716 | 27 | 21 | 1,111,427 | 2,222,855 |
| LPL | Lower Parking Lot Dump | 32,724 | 12 | 10 | 338,540 | 677,080 |
| FVN | Faro Valley North | 135,869 | 23 | 13 | 1,757,025 | 3,514,051 |
| FVS | Faro Valley South | 32,605 | 18 | 9 | 303,583 | 607,166 |
| MDW | Main Dump West | 220,861 | 76 | 57 | 12,566,943 | 25,133,886 |
| MDE | Main Dump East | 436,065 | 85 | 78 | 33,834,525 | 67,669,051 |
| ID | Intermediate Dump | 421,463 | 82 | 62 | 26,161,236 | 52,322,473 |
| NEU | Upper Northeast Dump | 254,309 | 67 | 31 | 7,892,780 | 15,785,561 |
| NEL | Lower Northeast Dump | 290,351 | 61 | 39 | 11,264,246 | 22,528,492 |
| NEO | Outer Northeast Dump | 12,787 | 9 | 8 | 99,211 | 198,423 |
| ZIIW | Zone II West | 89,315 | 67 | 34 | 3,003,004 | 6,006,008 |
| ZIIE | Zone II East | 126,084 | 137 | 65 | 8,152,422 | 16,304,843 |
| RZD | Ramp Zone Dump | 60,265 | 18 | 18 | 1,091,072 | 2,182,144 |
| RD | Ranch Dump | 42,305 | 8 | 6 | 262,597 | 525,195 |
| SWPWD | Southwest Pit Wall Dump | 78,294 | 15 | 10 | 809,981 | 1,619,962 |
| LGSPA | Low Grade Stockpile A | 29,353 | 18 | 16 | 455,502 | 911,003 |
| LGSPC | Low Grade Stockpile C | 34,537 | 11 | 11 | 393,034 | 786,069 |
| FTW | Fuel Tank DumpW | 8,372 | 6 | 5 | 43,308 | 86,615 |
| FTE | Fuel Tank Dump E | 95,879 | 21 | 13 | 1,239,888 | 2,479,775 |
| MMW | Mt. Mungly West | 20,287 | 8 | 6 | 125,927 | 251,853 |
| MME | Mt. Mungly East | 34,130 | 34 | 13 | 441,364 | 882,728 |
| SPB | Stockpiles Base | 91,250 | 21 | 16 | 1,416,028 | 2,832,056 |
| OXSP | Oxide Fines Stockpile | 20,793 | 9 | 8 | 161,335 | 322,670 |
| MGSP | Medium Grade Stockpile | 33,899 | - | - | - | - |
| CHSP | Crusher Stockpile | 22,917 | - | - | - | - |
| OHRW | Outer Haul Road West | 186,942 | 46 | 34 | 6,285,461 | 12,570,923 |
| OHRE | Outer Haul Road East | 86,644 | 49 | 26 | 2,240,913 | 4,481,826 |
| NFRD | North Fork Rock Drain | | - | - | - | - |
| | **Total** | **3,344,570** | | | **128,925,000** | **257,850,000** |

Valley South Dump covers an area of about 32,600 $m^2$. The two dumps contain a combined total of about 4.1 million tonnes of waste rock.

The Faro Valley Dumps are located on the Faro Valley alluvium immediately adjacent to the Faro Pit north slope. The dump currently acts as a rock drain for the old Faro Creek channel and impounds a shallow pool of water on its upstream side. Stability of the southern slopes of this dump is dependent on the stability of the north wall of Faro Pit in the Faro Valley alluvium. The valley alluvium is an aquifer and has a relatively high water table, which is drawn down as seepage occurs into the Faro Pit. The alluvium has, over time, slumped and raveled into the pit and this may be expected to progress with time. The performance of the Faro Creek Diversion Channel could impact the stability of the dump and the local pit slope since a failure of the diversion could allow a large flow of water which would exacerbate this progressive erosion.

#### 3.3.2.3 Faro Main and Intermediate Dumps

***The Faro Main and Intermediate Dumps are the largest at the Faro Mine site***

The Main and Intermediate Dumps are the largest waste rock dumps, and were used for waste rock disposal over a period of about 18 years. The Main Dump East was the first to be constructed, beginning in 1972. The Main Dump West was initiated in 1974. Deposition of waste rock in the Intermediate Dump began in 1979. The Main and Intermediate Dumps are located south and southwest of the open pit, covering a total area of about 1.1 $km^2$. With a combined total of 145 million tonnes, the two dumps together contain over half of the total waste rock on site.

These dumps were constructed at their angle of repose on moderately sloped well-drained terrain. The outer slopes of these dumps have been stable since construction and there are no signs of instability. There is no significant upstream water source that could cause elevated pore pressures in the dumps. Over time, as the surficial rock weathers, some shallow slope creep and slumping of the surficial layers on the angle of repose dump faces may be anticipated. Very little water flows from the dumps and there is no significant erosion from surface water flows.

A portion of these rock dumps overlooks the North Fork of Rose Creek at the upstream side of the haul road rock drain. The physical stability of the dump face is of importance because of the potential for a slope failure to compromise the performance of the rock drain and, as a result, is specifically inspected on an annual basis by a qualified geotechnical engineer. The slope displays signs of minor surficial slumping and settlement.

#### 3.3.2.4 Faro Northeast Dumps

***The Northeast Waste Dumps are comprised of the Outer, Upper, and Lower Northeast Dumps***

The Northeast Waste Dumps are considered in three areas: the Outer Northeast Dump, the Upper Northeast Dump, and the Lower Northeast Dump. These dumps are located to the southeast of the main pit. The western portion of the Upper and Lower Dumps infill the Zone 2 Pit. The Upper and Lower Northeast Dumps are relatively large, containing a total of 38.3 million tonnes of waste rock. Since these dumps are located within the pit, the dumps are high and average 31 and 39 m, respectively. They cover an area of approximately 0.5 $km^2$. The Outer Northeast Dump is small by comparison, containing about 0.2 million tonnes of rock, with an average dump height of 8 m and an area of 0.01 $km^2$.

These dumps were constructed at angle of repose on moderately sloped well-drained terrain. The outer slopes of these dumps have been generally stable since construction although the slope displays signs of minor surficial slumping and settlement. There is no significant upstream water source that could cause elevated pore pressures in the dumps and surface seepage from the rock dumps is intermittent. Over time, as the surficial rock weathers, some shallow slope creep and slumping of the surficial layers on the angle of repose dump faces may be anticipated.

#### 3.3.2.5 Zone 2 Dumps

***The Zone 2 Dumps fill the Zone 2 pit***

The Zone 2 Dumps are located mostly within the backfilled Zone 2 Pit, to the southeast of the Main Pit. The dumps were built as the pit was mined, with the Zone 2 East Dump built first in the early 1980's, and the Zone 2 West Dump build in the late 1980's. In total, the two dumps comprise approximately 2.3 million tonnes of waste rock. The Zone 2 East Dump is the larger of the two in terms of tonnage and covers an area of about 0.1 $km^2$. The Zone 2 West Dump covers a slightly smaller area, at about 0.09 $km^2$. The difference in the two dumps is the height of each dump, as a result of the configuration of the area of the pit and surrounding topography . The Zone 2 East Dump has a maximum height of 137 m and an average height of 65 m, compared to values 67 m and 34 m, respectively, for the Zone 2 West Dump.

These dumps were constructed at angle of repose. The outer slopes of these dumps have been stable since construction and there are no signs of instability. Over time, as the surficial rock weathers, some shallow slope creep and slumping of the surficial layers on the angle of repose dump faces may be anticipated.

#### 3.3.2.6 Near Pit Dumps

***The Near Pit Dumps are composed of the Ramp Zone Dump, Ranch Dump, and Southwest Pit Wall Dump***

The Near Pit Dumps are considered to include the Ramp Zone Dump, the Ranch Dump, and the Southwest Pit Wall Dump. Other nearby dumps are included in "Low Grade Stockpiles". The Near Pit Dumps are located immediately to the south and southwest of the pit, and just north of the Main and Intermediate Dumps. The three were constructed between 1989 and 1991 and are relatively small dumps comprising a total of about 4.3 million tonnes of rock. Since the dumps are located at the edge of the pit and on the ramp, the dumps are high with a maximum height of 60 m. The total area of the dumps is comparatively low at about 0.2 $km^2$.

The Near Pit Dumps were developed on well-drained terrain sloping away from the pit. The outer slopes of these dumps have been stable since construction and there are no signs of instability. There is no significant upstream water source that could cause elevated pore pressures in the dumps. Over time, as the surficial rock weathers, some shallow slope creep and slumping of the surficial layers on the angle of repose dump faces may be anticipated. Very little water flows from the dumps and there is no significant erosion from surface water flows.

### 3.3.2.7 Low Grade Stockpiles

***Six stockpiles composed of various types of low grade ore and high sulphide waste rock are located near the Faro Main Pit***

Various types of low grade ore and high sulphide waste rock are located in small piles near the crusher and the Faro Main Pit. These are identified as six stockpiles:

1. low grade 'A'.
2. low grade 'C'.
3. Crusher Stockpile Base.
4. Mt. Mungley Dumps.
5. Oxide Fines Dumps.
6. Fuel Tank Dumps.

Two large stockpiles have been developed near the main haul entrance to the Faro Pit. These stockpiles, low grade "A" and "C", are between the lube shack and the Ranch Dump, and behind the lube shack, respectively. These stockpiles were built from 1987 to 1990 with low grade ore from the Zone 3 Pit. Some of the material originally placed in these stockpiles has been removed and milled, and the stockpiles currently contain an estimated 1.7 million tonnes. The residual material is now oxidized and was determined by Anvil Range to be unsuitable for processing through the mill.

An active ore stockpile was maintained near the mill during mine operations. Ore that was economic to process was passed through the mill prior to mine shut down in 1998. The crusher stockpile base remains, however, as a wide ramp that was used to dump ore and is thought to be constructed of various rock types that may include low grade and regular grade ore.

About 400 m northeast of the Crusher Stockpile in the west Mt. Mungly Dump is material brought from the concentrate storage facility in Skagway during a cleanup of that site. The material was delivered by Curragh and characterized as "concentrate contaminated with soil returned for reprocessing". The material appears to consist of sand, gravel and cobbles but also contains lead and zinc concentrates and plastic sheet remnants. The concentrates would have originated from the Faro mine site and were likely accepted onto the mine site by Curragh for that reason.

Immediately east of the Crusher Stockpile are several piles of fines originating from the processing of a former large stockpile of oxidized ore from the sub-crop of the Faro Deposit. The oxidized ore was screened with the coarse fraction processed through the mill. A small amount of this fine material is also present across the Main Haul road in the west Fuel Tank Dump.

All of these Low Grade Stockpiles Dumps are small relative to the other rock dumps, are internal to the area encompassed by the major rock dumps, are generally located on flat ground and the physical stability of these piles is not a substantial concern.

#### 3.3.2.8 Haul Road, Haul Road Dumps and Rock Drain

***The haul road joins the Faro and Vangorda Plateau Mine sites and is constructed from mine rock***

The North Fork Rock Drain was built between 1986 and 1988 and forms part of the haul road between the Faro and the Vangorda Plateau Mine sites. The haul road is constructed from mine rock and has similar stability characteristics to small rock dumps. No substantial stability problems have been experienced on the haul road since construction although surface cracking is visible in some locations and some slopes display signs of minor surficial slumping and settlement.

The two Haul Road Dumps were built between 1983 (East Dump) and 1989 (West Dump). The Outer Haul Road East Dump is located between the Intermediate Dump and the North Fork Rock Drain and the Outer Haul Road West Dump forms the haul road around the south of the Intermediate and Main Dumps. These dumps are commonly considered to be a part of the Main/Intermediate rock dump assemblage.

***Long term permeability of the rock drain is key to stability***

The physical stability of the rock drain will depend on the long term maintenance of permeability through the drain. The drain was formed by end dumping coarse durable mine rock from the top of the haul road embankment as it was advanced over the North Fork of Rose Creek according to a design provided by Golder Associates. The performance of the rock drain is considered to be acceptable. A head pond is present on the upstream side of the rock drain.

### 3.3.3 TAILINGS IMPOUNDMENTS

#### 3.3.3.1 Rose Creek Surface Impoundments

***An estimated 54.4 million tonnes of tailings is included in three separate surface impoundments at Rose Creek***

Mill tailings were deposited in three separate surface impoundments: the Original Impoundment, the Second Impoundment and the Intermediate Impoundment as follows:

1. The Original Impoundment contains tailings that were deposited between 1969 and 1975.
2. Tailings were deposited in the Second Impoundment from 1975 until 1982, and for approximately 5 months in 1986. Mine production was suspended from 1982 to 1986 and, therefore, no tailings were deposited.
3. The Intermediate Impoundment contains tailings that were deposited between 1986 and 1992. From 1992 to mine closure in 1998, tailings were deposited under water in the mined-out Faro Pit and not in the surface impoundments. Beginning in 1997, the Intermediate Impoundment has been used, periodically, for settlement and storage of lime treatment sediments generated from lime treatment of water pumped from the Main pit.

In total, the surface impoundments contain an estimated 54.4 million tonnes of tailings (28.6 million cubic metres), as listed in Table 8, repeated from RGC, 1996. The tailings are up to 25 metres thick and overlie native soils comprised largely of sand/gravel of glacial outwash origin with some glaciolacustrine sediments. Native soils may extend to 60 m below ground surface. A basal silt till overlies bedrock beneath the sand and gravel.

**Table 8. Rose Creek Tailings Facility, Tailings Volumes and Impoundment Surface Areas**

| Impoundment | Periods of Tailings Deposition | Surface Area (ha) | | Tailings Volume (m³) | |
|---|---|---|---|---|---|
| | | As of Sept. 1990 | Estimated Current | As of Sept. 1990 | Estimated Current |
| Original | 1969 to 1975 | 41.7 | 41.7 | 6,300,000 | 6,300,000 |
| Secondary | mid 1975 to June 1982, June 1986 to Oct. 1986 | 54.5 | 54.5 | 10,400,000 | 10,400,000 |
| Intermediate Dam | Oct. 1986 to July 1992 | 88 | 99 | 7,600,000 | 11,900,000 |
| **Total** | | **184.3** | **195.7** | **24,300,000** | **28,600,000** |

### Original Tailings Impoundment

***The Original Tailings Impoundment operated from 1969-1975***

The Original Impoundment covers an area of approximately 42 ha, located on the north side of Rose Creek at the mouth of the old Faro Creek channel. It was initially developed by raising a 7.5 to 9 m high waste rock starter dyke. The initial decant system consisted of a vertical riser leading to a 1.2 m diameter pre-stressed concrete pipe culvert placed in the space of the starter dyke. The starter dyke was raised in the winter of 1969 using un-compacted pit run waste rock with no impervious core. Dyke raising continued each summer until 1975, when a breach occurred. After a survey by DIAND was concluded following the breach, it was estimated that 247,000 $m^3$ of frozen slurry, containing approximately 12,300 $m^3$ of tailings solids, had been deposited between the tailings impoundment and the mouth of Rose Creek (RGC, 1996).

### Second Tailings Impoundment

***The Second Tailings Impoundment operated from 1974 – 1986***

The Second Impoundment was constructed in 1974 by building a second dam around the perimeter of the original dam using, in part, spilled tailings. Construction on this impoundment began in 1974 and was completed in 1975 after the breach in the original tailings impoundment. The second tailings impoundment consists of a west dam, with a height of nearly 27 m and an east dam, with a typical height of 4.3 m.

During winter months, tailings were deposited into the Second Impoundment from a single point discharge originating from various locations along the Original Tailings Dam. Excess surface water was decanted via a surface decant spillway located at the right abutment of the West Dam. During summer months, tailings were spigotted from multipoint discharges along the crest of the new (Second) tailings dam, until 1978. From 1978 to 1982, tailings were deposited from the hillside to the north of the impoundment, or from the Original Tailings Dam. Tailings deposition was suspended in June 1982, when the mine halted operations, and resumed in June 1986 when the mine reopened. For a few months afterward, tailings were deposited in the Second Tailings Impoundment. Following that, tailings were placed in the Intermediate Dam Impoundment, with only occasional (emergency) discharge into the Second Impoundment.

Tailings were deposited in 1986 in the western part of the impoundment and have been shown (SRK, 1991) to grade in thickness from about 1m to 0m. An east/west cross-section of the Second Impoundment would show the 1986 tailings pinching out toward the east. Thus, the eastern half of the impoundment contains surface tailings at least six years older than the western area.

### Intermediate Tailings Impoundment

***The Intermediate Tailings Impoundment operated from 1981 – 1992***

A third dam was built downstream of the Second Impoundment across the valley of Rose Creek. This dam, the Intermediate Dam, retains seepage water and tailings solids. Native ground on the north, the Rose Creek Diversion channel on the south, and the Intermediate Dam on the west contain the Intermediate Impoundment. Beached tails below the downstream toe of the Secondary Tailings Dam forms the eastern portion of the impoundment. Submerged tailings extend to the upstream toe of the Intermediate Dam. Water is passed by siphons or spillway overflow from the Intermediate Pond into a polishing pond that is retained by the Cross Valley Dam.

The Intermediate Dam was initially constructed in 1981 and was raised in 1988, 1989 and 1991 to its current maximum vertical height of approximately 34.4 m. Upstream and downstream slopes were constructed at 2H:1V. The downstream slope also includes a 20 m wide bench at the toe that provides an overall slope of 2.1H:1V at its maximum section.

As a result of mine shutdown in 1982, no tailings were placed in the Intermediate Impoundment until October 1986 and deposition continued until 1992. Tailings were deposited in the Intermediate Dam Impoundment from a single discharge at the northeast corner of the impoundment (near the north abutment of the Second Tailings Dam). This resulted in a sloped tailings surface, with the apex at the discharge point and the low point at the Intermediate Dam. Baffles were constructed across the tailings surface in 1990 and 1991 to steepen the tailings surface, but these were later covered with tailings.

### Cross Valley Pond

***The Cross Valley Dam creates a polishing pond for water coming from the Intermediate Impoundment, before release into Rose Creek***

The Cross Valley Dam was constructed during 1980 and 1981 approximately 500 m downstream of the Intermediate Dam. The dam is a zoned earthfill dam with a low permeability core that is founded on permeable valley bottom sands and gravels and that incorporates both a low permeability core and an upstream blanket of glacial till to control seepage. The dam has a maximum vertical height of approximately 19 m. It has a 6 m crest width, and upstream and downstream slopes of 2H:1V. The crest elevation is approximately 1033.4 mASL. A granular toe drain was added in 1991.

The purpose of the dam is to create a polishing pond for water discharged from the Intermediate Impoundment prior to release into Rose Creek. The polishing pond contains lime treatment sediments but does not hold tailings.

The Cross Valley Dam is equipped with a riprap-lined outflow spillway on the north abutment. Water is released as required via syphon pipes or spillway overflow into Rose Creek.

#### 3.3.3.2 Faro Main Pit Tailings Impoundment

*Tailings from the Grum and Vangorda deposits were deposited in the Main pit between 1992 and 1998*

The Faro Pit was used between August 1992 and April 1993 and again from August 1995 until shutdown in 1998 for tailings deposition from the Grum and Vangorda deposits. Tailings entered the pit near the southern corner. The distribution of tailings at depth in the pit bottom has not been accurately determined but settlement was observed to be rapid (pers. comm., Anvil Range). A water pumping station was operated beginning in 1997 to provide process water to the mill and this pumping station did not experience problems with silt in the intake.

*The water elevation within the Faro Main Pit is controlled by a seasonal pumping program*

Since the shutdown in 1998, the Main Pit has undergone a seasonal dewatering program that maintains the water level within an acceptable range. Inflow to the Main Pit comes from several sources, such as rock dump seepage, surface run-off, groundwater inflow and water pumped from the Zone 2 Pit. The water level management plan is to draw down the Main Pit water elevation during the summer to such a level that the water does not rise to a critical elevation by the start of the following season.

### 3.3.4 BUILDINGS AND INFRASTRUCTURE

*The Faro Mill produced lead and zinc concentrates*

The Faro Mill was designed to produce lead and zinc concentrates. The concentrator began operation in September 1969 with a capacity of 5,000 tonnes of ore per day. This was increased to 6,000 tonnes in 1970, to 9,300 tonnes in 1974 and to 13,500 tonnes in 1986.

The facilities located at the Faro mill site include:

1. Primary crusher and coarse ore storage.
2. Mill and concentrate loadout.
3. Offices and warehouses.
4. Heavy duty equipment repair shops.
5. Guardhouse and administration building.
6. Tire shop and light vehicle repair shops.
7. Electrical substation belonging to the regional supplier.
8. Electrical distribution and switch gear belonging to the mine.

In addition, a lube station and core shacks are located near the Faro Pit. Other buildings not located directly at the mill site include the Copper Sulphate Plant, the Bulk Explosives Plant and the Pump House, located on the mine access road.

### 3.3.4.1 Process Buildings

***Primary crushing was the first stage of ore processing***

The primary crusher was originally fed directly by dump trucks hauling from the pits. During the mining of the Grum Deposit, tractor/trailer combinations were used to haul the ore to the crusher. Difficulties associated with dumping the trailers necessitated the use of an ore stockpile adjacent to the crusher. The ore was then fed to the crusher by a front-end-loader.

The primary crusher is a 1.37 m x 1.88 m gyratory crusher, crushing material to a size of minus 15 cm. The crusher discharge was screened, with the minus 1.27 cm material conveyed directly to the fine ore bins. Oversize material was conveyed to the coarse ore storage building, which had a live capacity of 14,400 tonnes. An estimated 8,000 to 10,000 wet metric tonnes of crushed ore remains in the coarse ore building.

***Secondary crushing and screening reduced particle size to minus 1.27 cm***

Ore was withdrawn from the bottom of the coarse ore storage by vibrating feeders and fed by conveyor to the 17.8 cm Simon shorthead secondary cone crusherset at 3.175 cm. The crushed product was screened, with the minus 1.27 cm material conveyed to the fine ore bin and the oversize material fed to the two 17.8 cm Simon shorthead tertiary crushers set at 0.95 cm. Discharge from the tertiary crushers was screened, with the undersize material conveyed to the fine ore bin and the oversize material recycled. The fine ore bin consists of three circular silos each with a capacity of 1,550 tonnes.

Feed from the three fine ore bin silos was delivered to three parallel grinding circuits. Each circuit consisted of a rod mill, ball mill and a tertiary ball mill.

***Concentrates were separated by flotation***

Flotation equipment consists of conventional flotation cells, column flotation cell, air compressors, pumps, pipes and regrind (ball) mills. The general flotation process that was employed was the addition of pH modifiers and various reagents that promoted the formation of a surface froth containing the minerals of economic interest. Residual solids ("tailings") passed out the bottom of the flotation cells and, ultimately, to the tailings impoundments. Some flotation equipment was converted and some additional equipment was added in 2001 to serve as a water treatment system for water pumped from the Faro Main Pit. This treatment process is described in Section 3.3.5 of this volume.

The lead and zinc concentrates were thickened in four large rake thickeners, using Percol 351 (1975) as a settling aid. This was followed by filtering through disc filters.

***Rotary kiln dryers were used to dry the concentrates***

The concentrates were dried in five rotary kilns. Four of these kilns were originally coal fired. The coal was mined near Ross River and Carmacks and hauled to the mill as required. The other kiln was originally oil fired. The kilns were converted to combination oil and propane burner systems in 1995/96. The rotary kiln dryers were equipped with wet scrubbers and exterior discharge with the discharges and filtrates pumped to the appropriate thickeners.

A lime mixing and distribution system is contained within the mill, which consists of an external dump bin for dry lime, a storage silo for dry lime, a ball mill for pulverizing coarse lime, a mixing system to slake lime and two lime slurry distribution tanks.

A boiler/heat plant, metallurgical laboratory and sample preparation/bucking room are located within the mill. A reagent storage and mixing building is attached to the mill. It is currently empty of residual reagents except for those that may be required for environmental protection purposes.

***Concentrates were shipped to Skagway Alaska***

Mineral concentrates were conveyed to a storage building where they were placed onto piles. Originally a front-end loader was used to load truck mounted containers that were transported to the railway in Whitehorse. Following closure of the railway, the concentrates were trucked to Skagway, Alaska using tractor-trailer combinations with a capacity of about 50 tonnes ("muffin trucks"). These trucks were loaded through a conveyor/bin system, with the trucks weighed during loading on a horizontal truck scale. From Skagway, the concentrates were shipped by ocean going vessel to various international smelters.

### 3.3.4.2 Offices, Warehouse, Storage and Shops

***An office and warehouse facility is adjacent to the mill***

An office and warehouse facility is located adjacent to the mill. This office and warehouse facility was utilized by technical and administrative staff but has been largely unused since mine shut down in 1998. All warehouse inventory and office supplies that were not directly required for care and maintenance activities or that were not directly related to the fixed equipment in the mill were removed from the site in 1998 and 1999 and sold.

The warehouse and office complex is constructed mainly from structural steel with lesser amounts of dimension lumber and other building materials. Reinforced concrete was used for foundation footings and basement walls and floors. The warehouse has a floor space of approximately 18,000 $ft^2$, with 4,000 $ft^2$ of second floor office space.

***A heavy equipment shop, repair shop, tire shop, guardhouse and a few shacks are located at the Faro Mine site***

A heavy equipment shop, used for repairing haul trucks and other heavy equipment, is semi-attached to the office/warehouse facility. A second equipment repair shop, utilized for lighter-duty trucks and construction equipment, is located near the office and warehouse building to the south.

The repair shop consists of 10 bays for mobile equipment, including two lubrication bays. A general shop located in a 13,400 $ft^2$ housing includes an electric shop, a welding bay, a carpenter shop and a machine shop. The "Wabco repair shop" consists of 6 bays on 10,000 $ft^2$. Southwest of the heavy duty equipment repair shops is the tire shop, a steel framed, two storage metal clad building with a concrete slab.

The Guardhouse is located at the entrance to Faro Mine's main operational area. This facility is currently utilized as the mine office.

There are a few buildings outside of the mill area, including the lube shack near the Main Pit Haul Road entrance.

*Scrap yards are present on various rock dumps*

Some scrap yards are present on the tops of various dumps around the Faro site. The scrap includes materials from mill expansions, old mobile equipment (shovels, trucks), old light vehicles, tires, etc. The major sites include the east Main Dump, the north end of the west Main Dump (possibly a long term parking area), the east Tank Farm Dump and the upper and lower Parking Lot Dumps.

*Two contractor owned plants are present*

Two contractor-owned buildings are present at a small yard located immediately upstream of the Rose Creek Tailings Facility. One building is a bulk explosives (ANFO) plant that consists of one large and two smaller metal pre-fabricated buildings which housed chemicals and machinery utilized for the manufacture and delivery of bulk explosives. One building is a copper sulphate plant that consists of several reactor tanks used to manufacture copper sulphate (mill reagent). A small, lined collection pond is located between the copper sulphate plant and the North Fork Rose Creek Diversion.

There are several above ground storage tanks on the mine site that were used to store diesel and gasoline. The tanks are inactive except for one tank that is utilized for storage and dispensing of diesel fuel and one tank that is utilized for storage and dispensing of gasoline.

*Power is supplied from the regional hydroelectric grid*

Electrical power is supplied to the Faro site via a 38 kV power line connected to the Whitehorse-Aishihik-Faro Grid. Transformers at the Faro Mill step the power down for on-site distribution. A standby EMD diesel generator is available to provide an emergency power supply. A 27 kV overhead power line runs from the Faro mill site to the Vangorda Plateau site.

#### 3.3.4.3 Landfill

A landfill is located on the Main/Intermediate Rock Dump that was initiated and largely developed during past mining activities. The incremental volume of waste that has been deposited into the landfill since mine closure in 1998 is small. The specific contents of the landfill are unknown and no inventory or operating procedures related to past mining activities are available.

A fire started at the landfill in January 1997. Attempts were made in 1997 to manually extinguish the fire but the source quickly migrated underground and these attempts were unsuccessful (pers. comm., Anvil Range). The active waste dumping location during the interim receivership period has been a higher area away from the previous dumping location. There is currently no active burning (pers. comm. Anvil Range).

## 3.3.5 WATER TREATMENT FACILITIES

### 3.3.5.1 Water Treatment - General

***Water treatment in the Rose Creek Valley began in 1992 due to a general increase in zinc concentrations***

The Intermediate Impoundment was used for tailings deposition from 1986 to 1992. Following the cessation of tailings deposition in 1992 and until 1997, there was a general increase in the concentration of zinc in water flowing through the Intermediate Pond. This was the anticipated trend attributed to:

1. The removal of a large inflow of alkalinity that previously entered the pond via the tailings slurry.
2. The continued inflow of contaminated rock dump seepage water via location X23.
3. The continued flushing of contaminants by run off over beached (exposed) tailings in the upstream portion of the Intermediate Impoundment.

***Treatment was accomplished by various methods of pH modification***

Water treatment in the Rose Creek Valley was started in 1992 to ensure that surface outflow from the Cross Valley Pond met the allowable discharge limits. Water treatment has continued, on an as-required basis, since that time. The methods employed for the treatment have involved raising the pH of the Intermediate Pond effluent with lime or sodium hydroxide and subsequently utilizing the Cross Valley Pond for settlement of the treatment sediments. The pH modification has been accomplished at various times by:

1. Hauling lime slurry mixed in the mill to a gravity feed tank for addition into the outflow spillway.
2. Delivering lime slurry mixed in the mill to the outflow spillway via an overland pipeline.
3. Hauling lime slurry mixed in the Grum/Vangorda Water Treatment Plant to the south abutment of the dam for addition into a syphon line.
4. Adding sodium hydroxide into a syphon line at the south abutment.
5. Inflow into the upstream end of the Intermediate Pond of water pumped from the Faro Main Pit that was pre-treated with lime at the mill.

The latter method, inflow of pre-treated water from the Faro Main Pit, began in fall 1997 and continued in 2001 in conjunction with lime treatment in the outflow spillway.

***The Faro pit pumping system was installed in 1997***

The Faro Pit pumping/treatment program was initiated in 1997 and has been established as an annual seasonal (summer) program. The program utilizes a water pumping system that was installed in 1997 to provide an estimated minimum 95% of the water required for processing while the mill was operating prior to February 1998. Since mine shut down in 1998, the system has been used exclusively to pump water from the Faro Main Pit to the mill for treatment to maintain the in-pit water level within the pre-determined range. The recycle water system is made up of the following primary components:

1. Three electric pumps mounted on a floating barge in the pit rated at providing 5,000 USgpm each to the mill (only one or occasionally two pumps are utilized for effluent discharge).
2. A 30" sclair pipeline from the barge to the mill with flexible sections near the barge to prevent damage to the pipeline which might otherwise result from vertical movement of the barge.

#### 3.3.5.2 2001 Mill Conversion

***The mill was converted for use as a water treatment system in 2001***

Certain fixed equipment in the mill was converted for use as a water treatment system in 2001. New equipment was also installed, where necessary. The purpose of the new system was to provide efficient treatment of water pumped from the Faro Main Pit such that the effluent can be released to the Polishing Pond or to Rose Creek. The system was successfully operated in 2001 and 2002.

***Components of the new water treatment system are primarily pre-existing equipment***

The system consists of these primary components:

1. A 24-inch influent pipeline.
2. Existing lime handling, storage and mixing system.
3. Lime conditioning in two sets of flotation cells operated in parallel with automated control on lime addition.
4. A 24-inch pipeline to settlement tanks.
5. Two settlement tanks (previous thickeners) operated in series or in parallel with optional lime and flocculent addition.
6. Instrumentation and control systems.
7. Flocculent mixing and distribution system.
8. Sediment pump and re-circulation pipe.
9. A 24-inch effluent pipeline with optional discharge into the Cross Valley Pond or the Cross Valley Dam outflow spillway.

This new system provides many benefits over the previous treatment methods including:

1. Reduction in lime consumption (and resultant cost savings).
2. Increased confidence in achieving objectives.
3. Improved control on operating parameters including automated controls.
4. Incorporation of contingency/emergency procedures.
5. Reduction in deposition of treatment sediments in Cross Valley Pond.
6. Productive use of existing infrastructure.
7. Substantial reduction in the volume of water requiring treatment at the Cross Valley Pond.

## 3.3.6 DAMS AND DIVERSIONS

### 3.3.6.1 Faro Creek Diversion

***The Faro Creek Diversion Channel diverts water around the northeast side of the Main Pit and into the North Fork of Rose Creek***

The original channel of Faro Creek passed through the center of the Faro Main Pit, past the mill site, and joined Rose Creek at what is currently the toe of the Original Tailings Embankment. As part of mine development, the Faro Creek Diversion Channel was constructed.

The Faro Creek Diversion Channel collects water from the original Faro Creek channel upstream of the Main Pit and diverts the water around the northeast side of the Main Pit and into the North Fork of Rose Creek. Some flow in the old Faro Creek drainage area upstream of the Faro Valley rock dumps cannot be collected by gravity into the Faro Creek Diversion and continues to flow directly into the Faro Main Pit. During operations, this excess flow was pumped around the pit perimeter.

The diversion starts approximately 1,370 m upstream of the Main Pit, follows the eastern side of the Faro Creek valley, passes along the northern crest of the pit past the Northeast Waste Dumps and empties into the North Fork of Rose Creek, approximately 2,100 m upstream of the Vangorda Haul Road near the upstream toe of the Northeast Rock Dumps. The total length of the diversion is approximately 3,350 m.

The diversion has an average bottom width of approximately 3.7 m and an average gradient (from the inlet to the point where it passes the Northeast Waste Dumps) of approximately 0.5%. In the upper portion of the channel (from its origin to the Faro Valley Rock Dump), the downgradient bank is formed by a dyke constructed of rock fill placed at an angle of approximately 1.5H:1V and the upgradient bank by shallow excavation into native soil cut to an angle generally around 2H:1V. Downgradient of the Faro Valley Rock Dump, the depth of cut increases reaching a maximum depth of approximately 7.6 m. Side slopes are typically excavated at 1H:2V in rock, and 2H:1V in soil. Beyond the Northeast Waste Rock Dumps, the gradient increases sharply (to as steep as 35%) as it plunges into the valley of the North Fork of Rose Creek.

The initial diversion channel directed water into the North Fork of Rose Creek immediately below the Zone 2 Pit. This operation is believed to have resulted in the deposition of some mineralized surface rock in the area between the Zone 2 Pit and the North Fork of Rose Creek. This temporary diversion was replaced shortly afterwards by the current Faro Creek Diversion.

The Faro Creek Diversion is known to leak water into the Main pit along the northeast wall of the pit due to the nature of the soils and the ditch construction. The flow loss is estimated to be in the order of 24%.

#### 3.3.6.2 Faro Valley Interceptor Ditch

Runoff from the hillsides north and northwest of the Faro Valley Rock Dump is intercepted by the Faro Valley Interceptor Ditch and directed into the Faro Creek Diversion. No reviewed records identify the design, construction, or as-built details of the Faro Valley Interceptor Ditch. The ditch consists of a small excavation into surficial soils.

#### 3.3.6.3 Fresh Water Supply Dam and Reservoir

***The Fresh Water Supply Dam and Reservoir were redundant after installation of the recycle pumping system from the Main Pit in 1997***

The Fresh Water Supply Dam ("FWSD") and Reservoir are original (1969) mine structures that were required prior to 1997 to provide water for ore processing. The Reservoir was used to store fresh water for use in the milling process through the winter season. A recycle water system constructed in 1997 replaced the FWSD Reservoir as the primary supply of water to the processing plant.

The Interim Receiver received a directive from the DFO, as a separate project, to remove the FWSD by excavating a channel through the dam to original ground. This project to breach the dam is undergoing an approval process that includes assessment under the *Canadian Environmental Assessment Act* and, therefore, is not described in this report for water licence renewal.

The new channel is proposed, in that project description, to be completed by March 2004 and, therefore, the FWSD and Reservoir and associated water control and monitoring programs are considered to be absent in the context of this proposal for care and maintenance activities from 2004 to 2008.

#### 3.3.6.4 Pumphouse Pond Dam

***The pumphouse pond dam was rebuilt after construction of the Second Tailings Impoundment in 1974***

During 1969, a pumphouse pond was constructed by building a small dam in the Rose Creek channel just downstream of the confluence of the North and South Fork of Rose Creek. The pumphouse supplied water from this pond to the mill via a 2 km long insulated steel pipe.

Construction of the Second Tailings Impoundment in 1974, necessitated raising the tailwater elevation at the pumphouse dam. This required diversion of the North Fork of Rose Creek and rebuilding of the pumphouse and pumphouse pond dam.

#### 3.3.6.5 North Fork Rose Creek Diversion

***The North Fork of Rose Creek consists of a primary and a secondary channel***

The North Fork of Rose Creek downstream of the mine access road crossing consists of two separate channels.

The primary flow channel approximately follows the natural stream course through a series of small, constructed ponds prior to joining with the South Fork of Rose Creek immediately upstream of the pumphouse pond. The small ponds are intended to allow surface water to recharge the groundwater system through the sand/gravel surface soils. This was an operating concern for the mine because groundwater wells local for that area were utilized during the winter season to augment the supply of water for processing (prior to 1997).

A secondary channel passes high flow water around the groundwater recharge ponds and into the South Fork of Rose Creek immediately downstream of the pumphouse pond. This channel was constructed in response to previous mine operating concerns regarding excess sediment entering the pumphouse pond during freshet and to allow fish passage to the North Fork (possible only prior to construction of the haul road rock drain in 1986). A common operating practice (prior to 1997) was to open up this secondary channel in the spring to avoid sedimentation and to close this secondary channel in the fall in order to maximize the water supply to the pumphouse pond through winter. There have not been any recent (post 1996) alterations to the channel configuration.

#### 3.3.6.6 Intermediate Dam

***The Intermediate Dam retains tailings and non compliant water***

The primary purpose of the Intermediate Dam is to retain tailings. The dam was initially constructed in 1981 to an elevation of 1068 mASL, approximately 20 m higher than the underlying native ground. The entire foundation area beneath the ultimate dam footprint was prepared and raised to 1064 mASL at that time as preparation for scheduled future raising of the dam. The dam was raised in 1988 (to 1073 m) and the emergency spillway situated at the south abutment was moved to the north abutment. The dam was further raised in 1989 to 1078 m and in 1991 to 1081.7 m, resulting in a height of approximately 34 m.

The dam is a zoned earthfill dam and initially, included a vertical, low permeability core excavated down into the foundation. The core is provided with granular filter zones on either side and a drainage blanket extends under the entire downstream side. A portion of the Intermediate Dam was located on terrace material and a 5 m wide blanket of till was placed on the excavation slopes to assist with seepage reduction. After the initial construction, the dam was raised in a downstream manner such that the vertical core became a sloping element. Upstream and downstream slopes were constructed at 2H:1V. The downstream slope also includes a 20m wide bench at 1064 m elevation to give it an overall slope of 2.1H:1V at its maximum section (Figure 7).

***The Intermediate Dam is performing satisfactorily***

Little information currently exists with regard to stability assessments for the Intermediate Dam. By extension of the initial design work in 1980 for the Cross Valley Dam, it is assumed that the dam was designed to the same seismic criteria (1 in 200-year event) as that dam. Upstream sloping core elements can represent increased stability concerns and this is a consideration regarding the portion of the dam above the initial height.

The Intermediate Dam is equipped with a riprap-lined spillway channel on the north abutment with a bottom width of 30 m and a depth of 1.5 m (to top of riprap). Golder Associates Ltd. (1992) note that this spillway has a discharge capacity of approximately 100 $m^3/s$, equivalent to a 1:500 year flood event.

The Intermediate Dam appears to be performing in a satisfactory manner. Some cracking has occurred on the crest, likely in reaction to either frost action on the core or due to saturation effects in wet years, which is scheduled to be remediated in 2003 as part of the routine care and maintenance activities. Visual seepage has been observed at the toe of the dam, at its south abutment. The seepage is considered to be related to seepage originating from the uphill Rose Creek Diversion Canal and to the presence of the backfilled initial spillway channel at this abutment.

The Intermediate Dam is instrumented with thermistors and pneumatic piezometers that are routinely monitored on a twice per year basis. The monitoring results are reviewed by a qualified geotechnical engineer.

#### 3.3.6.7 Cross Valley Dam

***The Cross Valley Dam creates a polishing pond for water released from the Intermediate Pond***

The Cross Valley Dam is a water retaining structure built to contain water discharged from the Intermediate Impoundment. The retention pond formed by the dam, also referred to as the polishing pond, was designed to contain 1.4 million $m^3$ of water. The pond contains no tailings but it does contain lime treatment sediments. Compliant water is released from the pond via syphon pipes or spillway overflow.

The Cross Valley Dam was constructed in 1981 to a maximum vertical height of approximately 20 to 21 metres (Figure 8). The dam is a zoned earthfill dam with a low permeability core of silty till, a downstream chimney drain/filter and a downstream side blanket drain. In addition, an upstream side low permeability blanket was placed to approximately 60 m upstream from the upstream toe. A new toe drain and a toe berm configuration were designed and constructed by Golder Associates Ltd. in 1991 to reduce the heavy seepage that was observed along the toe of the dam. The work included widening of collector ditches, installation of drains, construction of berms and installation of monitoring weirs.

The dam is founded on permeable valley bottom sands and gravels. Some fine-grained permafrost existed in a small portion of the footprint. The dam has a crest width of 6 m and the upstream and downstream slopes are 2H:1V. Stability analyses were undertaken by Golder Associates Ltd. and reported in the 1980 design document. A 200-year return event of 0.097g was used as the PGA for the pseudo-static analyses and the following Factors of Safety were provided:

| Stability Aspect | Factors of Safety for the Upstream Side | Factors of Safety for the Downstream Side |
|---|---|---|
| Static | 2.4 to >3 | 1.46 to 2.0 |
| Pseudo-static (PGA = 0.097g) | 1.5 to 2.2 | 1.05 to 1.6 |

The stability of the dam under MDE conditions (PGA=0.13g) has not been assessed.

***The dam is performing satisfactorily***

The Cross Valley Dam is equipped with a riprap-lined emergency spillway (and smaller pilot channel) on the north abutment of similar dimensions and capacity as the Intermediate Dam spillway. The 1992 as-built report by Golder Associates Ltd.

notes that the discharge capacity of the 1991 Intermediate Dam spillway was 100 $m^3/s$, approximately the discharge expected from the 1:500 year flood.

The dam has performed in a satisfactory manner over its history. The higher level of seepage encountered after construction was handled with the construction of a toe berm with drainage. The seepage amount measured by the weir system at the toe appears to be decreasing over time. Some minor cracking of the crest has occurred, possibly induced by frost, which is scheduled to be remediated in 2003 as part of the routine care and maintenance activities.

The Cross Valley Dam is instrumented with thermistors and pneumatic piezometers that are routinely monitored on a twice per year basis. The monitoring results are reviewed by a qualified geotechnical engineer.

#### 3.3.6.8 North Wall Interceptor Ditch

***The North Wall Interceptor Ditch diversion consists of three segments***

The North Wall Interceptor Ditch intercepts clean runoff from the north side of the Rose Creek Valley and diverts it around the north abutment of the Cross Valley Dam.

The diversion consists of three segments:

1. The "mine leg" begins just north of the guardhouse within the drainage of Upper Guardhouse Creek and diverts flow from that drainage area into the adjacent drainage to the west.
2. The "Borrow Area F leg" conveys the flow to the northwest above the Intermediate Impoundment.
3. The outfall section conveys the flow under the mine site access road and around the north abutment of the Cross Valley Dam.

The North Wall Interceptor Ditch is excavated in a variety of materials, ranging from silty sand and gravel till to coarse sand and gravel alluvium and bedrock. The ditch was not lined with erosion protection measures. The ditch has performed reasonably well although erosion and sedimentation have caused partial blocking of this ditch at times. Periodic maintenance and repairs have been completed as follows:

1. The containment berm on the downstream side of the ditch was upgraded (height and width increased) in 2000 near its upper portion just north of the mine heavy equipment shops.
2. The containment berm near a corner just below the borrow area was upgraded in 2001 to prevent potential seepage from occurring.
3. The two culverts placed under the haul road are prone to icing in the winter and, as a result, these culverts are closely monitored and icing is removed as required. The culverts are scheduled for replacement in 2003.

### 3.3.6.9 Rose Creek Diversion Canal

***The Rose Creek Diversion Canal passes Rose Creek water around the Rose Creek Tailings Facility***

The Rose Creek Diversion Canal passes Rose Creek water around the Rose Creek Tailings Facility. The Diversion was developed in two stages, referred to as the Upper and Lower Diversions. The Upper Diversion was constructed in 1974 in conjunction with the development of the Second Tailings Impoundment. The Lower Diversion is an extension of the Upper Diversion. It was constructed in 1980-81 in conjunction with the development of the Intermediate Impoundment.

Water from both the South and North Forks of Rose Creek enters the upper section of the Rose Creek Diversion Channel. The upper section is a predominantly straight channel that is constrained by natural slopes on the south side and by a constructed dyke augmented by tailings on the north side. The channel was excavated with a bottom width of 15 m, and side slopes of 2H:1V and lined with riprap for erosion protection. The channel has an initial gradient of 0.23% that increases to 2% and the channel includes a number of drop weirs in addition to riprap for erosion protection. Initially, the gradient increased to 5% where it rejoined the original channel of Rose Creek below the toe of the Second Tailings Embankment. This last section was abandoned with the development of Lower Diversion.

The lower section passes water along the south side of the Intermediate Impoundment and returns flow into the natural Rose Creek Channel downstream of the Cross Valley Dam. The lower section includes a series of boulder-lined drop structures and a sharp corner at the downstream end. The lower section is constrained by natural slopes on the south side and by a till dyke on the north side. Most of the Lower Diversion channel has a gradient of 0.19%, with two drop weir sections with a 5% gradient. The channel has a bottom width of 12.2 m and side slopes of 2H:1V in soil and 0.5H:1V in rock. The low gradient (0.19%) sections of the channel included a pilot channel 3.65 m wide by 0.6 m deep to control glaciation during low winter flows. The crest of the diversion dam, which diverts the flow from the upper section into the lower section, was constructed approximately 1 m lower than the crest of the adjacent diversion canal dyke, and armoured with riprap. This was done to ensure that any flows in excess of the design flow overtop the diversion dam at that location into the Intermediate Impoundment. The Lower Section is designed to pass the 1:50 year flood event safely (Golder, 1980) and to pass the 1:500 year flood event with no freeboard. The design value provided by Hydrocon (1980) was 160 $m^3/s$.

The water level in the lower section of the diversion canal is higher than the water level in the Intermediate and Cross Valley Ponds. Water seeps through and/or under the containment dyke into the ponds at two locations.

There is one primary tributary (natural drainage) that enters the upper section of the canal from the south side, just downstream of the pumphouse pond. Another primary tributary enters the lower section of the canal from the south side near the downstream end.

***The canal is prone to ice build up over the winter***

The canal is prone to ice build up over the winter and clearing of ice has been required on occasion. The water licence requires the provision of a minimum flow (controlled via manual operation of the low level outlet pipe at the FWSD through the winter with the intention of preserving flow for fisheries habitat. The provision of winter flow also minimizes the risk of ice damming in the channel (complete freezing to bottom). Visual inspection and instrumentation have been used to monitor the condition of the canal. Generally, most of the permafrost in the backslope has been thawed and no significant deformations have occurred. One portion of the canal dike just upstream from the Intermediate Dam is still underlain by permafrost. As a result of continued thawing of the ice lens, cracking and deformations still occur within this area of the dike. Repairs to the backslope were completed in 2002 in an area of surface deformation related to thawing of permafrost.

The Rose Creek Diversion Canal containment dyke and backslope are instrumented with themistors, pneumatic piezometers and slope indicators that are routinely monitored on a twice per year basis. The monitoring results are reviewed by a qualified geotechnical engineer.

# 4 DESCRIPTION OF FACILITIES – VANGORDA PLATEAU SITE

## 4.1 OVERVIEW OF STRUCTURES

***Facilities associated with the Vangorda Plateau Mine Site***

The Vangorda Plateau Mine site consists of these facilities:

1. Vangorda Pit.
2. Vangorda Rock Dump including Seepage Collection System.
3. Grum Pit.
4. Grum Rock Dump and Overburden Dump.
5. Little Creek Dam.
6. Vangorda Creek Diversion.
7. Water Treatment Plant and the Sludge Pond Embankments.
8. Office, Heavy Equipment Shop and Other Buildings.
9. Grum Interceptor Ditch.
10. Sheep Pad Sediment Ponds.
11. Electrical substation and control gear.

This section of the report discusses the development and operational history of the Vangorda Plateau Mine site and provides a description of each of the key facilities. A general arrangement plan of the site is provided on Figure 3. Some information regarding earth structures and water diversions contained in this section was provided directly by Steffen Robertson Kirsten (Canada) Inc.

## 4.2 DEVELOPMENT AND OPERATIONS HISTORY

***The Vangorda deposit was discovered in 1953. Other occurrences, Champ, Firth and Grum, were also discovered***

The Vangorda Deposit was discovered in 1953 and drilled on several occasions through to the late 1980's when it was developed for production. During that time, two small occurrences, Champ and Firth, were also discovered. The Grum Deposit was later found between these two minor occurrences. From 1975 to 1977, extensive work programs were carried out at Grum to delineate the deposit, including an underground exploration program. The deposit was accessed by a ramp from a portal elevation of about 1265 m and twin declines followed the ore zone for 700 m. Extensive definition drilling was done from these declines.

***Development of the Vangorda Plateau site was initiated with surface pond dewatering in 1988***

Development of the Vangorda Plateau site for mine operation was initiated in 1988 with dewatering of surface ponds. Several drainage ditches were dug at Vangorda and Doal Lake, a shallow pond overlying the (future) Grum Pit, was drained. Stripping at the Grum site began first with the wet soils from the vicinity of Doal Lake being placed in the "wet dump" area of the Grum Rock Dump, immediately southwest of the pit area.

***Mining in the Vangorda Pit was commenced in 1990 by Curragh Inc.***

Mining in the Vangorda Pit commenced in 1990 following issuance of a Water Licence from the Yukon Territory Government. Between 1990 and 1993, Curragh Inc. mined 5.7 million tonnes of ore from the Vangorda Pit. Stripping was carried out intermittently at Grum during this time, resulting in the excavation of approximately 22 million tonnes of glacial till overburden and rock and 52,000 tonnes of ore. Waste rock from the Vangorda Pit was placed at the Vangorda Rock

Dump. The rock dump was redesigned from the initial application to accommodate increased volumes of waste rock and reduced volumes of till.

***DIAND commissioned construction of the Vangorda Seepage Collector Ditch in 1993 while mining activities were suspended***

Mining activities were suspended from 1993 to late 1994 due to insolvency of the mine owner. During this time, DIAND commissioned the construction of the Vangorda Seepage Collector Ditch, re-sloped a 200 m section of the Vangorda Rock Dump and installed five groundwater monitoring wells at the toe of the Vangorda Rock Dump. A 2-m thick cover of compacted glacial till was placed on a 75 m section of the re-sloped area of the dump.

Anvil Range took ownership of the mine site in November 1994 and resumed pre-production stripping at Grum. Loose soil and broken rock was placed in the Overburden Dump located on the southeast side of the Grum Pit. The Grum Rock Dump was redesigned in response to higher than anticipated amounts of waste rock and sulphide bearing material. Mining at the Grum and Vangorda Open Pits were suspended in January 1998 and the shut down has continued since that time. Known economic ore reserves in the Vangorda open pit had been depleted at the time of the shut down.

***All ore was trucked to the Faro concentrator plant***

Ore from all phases of mining on the Vangorda Plateau Mine site was trucked approximately 13 km via the haul road to the Faro concentrator plant from the Ore Transfer Pad. There have been no milling operations and no tailings deposition at the Vangorda Plateau Mine site.

# 4.3 VANGORDA PLATEAU MINE SITE FEATURES

## 4.3.1 OPEN PITS

### 4.3.1.1 Vangorda Pit

The Vangorda Pit is 1.15 km in length, 200 to 350 m wide and 150 m at the deepest point. The longitudinal axis of the pit is approximately northwest/southeast with the deepest portion to the northwest end of the pit. The southeast half of the pit is a narrower slot about 200 m wide and only 50 m deep. Access to the pit was by a ramp. The entrance was at the southeast end of the pit and led to the deeper northwest area where the thickest ore was located.

Vangorda Creek, which originally passed directly over the thickest part of the ore body, is diverted around the north perimeter of the pit in an open 2.4 m diameter corrugated metal pipe half round flume.

***Two rock dumps were placed in the Vangorda Pit***

Two small rock dumps were placed in the pit by Anvil Range on either side of the haul road near the pit entrance. The size of these dumps is estimated to be in the order of a few tens of thousands of tonnes each (RGC, 1996). The dumps are estimated to contain 50% sulphides and 50% phyllites.

The Vangorda Pit walls have experienced local bench scale instability that is largely associated with faults in the northwest and west areas. A professional assessment of wall stability was carried out by SRK Consulting (SRK 2002) that assessed the physical stability of the northwest wall along the Vangorda Creek Diversion Flume. The assessment concluded that it is unlikely that any mode of large scale failure of the pit wall below the flume will affect the performance of the flume for a timeframe in excess of 50 years. The assessment also concluded that several areas along the bench face overlooking the Vangorda Creek Diversion Flume were of high risk of localized bench scale failures that could damage the flume and short term remediation work was recommended for these areas, as described in Section 4.3.6 of this volume.

***Economic reserves were depleted in 1998***

Economic ore reserves in the Vangorda Pit were depleted in early 1998. The pit was not dewatered subsequent to the completion of mining activities and the in-pit water level rose to the maximum desired elevation early in 2002. The sources of water entering the pit are runoff and precipitation, groundwater inflows and water pumped or syphoned into the pit from external sources. A seasonal water pumping and treatment program commenced in 2002.

***ARD is occurring on the pit walls***

Sulphide-bearing rock is exposed in the Vangorda Pit walls and is observed to be highly oxidized in some locations. For example, copper precipitates and iron staining are visible on the north walls. The effects of acid rock drainage (ARD) from the pit walls are mitigated by diversion of uncontaminated water around the pit. No other in-pit mitigative measures have been implemented to date.

A cleared area at the southern end of the pit was used for temporary storage and transfer of ore through the life of the operation. Economic quantities of ore were removed and processed during the mine operation. However, residual ore remains in the area and the area has been demonstrated as a source of contaminants entering the pit pond.

#### 4.3.1.2 Grum Pit

The Grum Pit is located approximately 2 km northwest of the Vangorda Pit. The Grum Deposit consists of several horizons that form a complex fold pattern. Due to the local geometry of the deposit, there are two separate zones that comprise the surface mineable Grum Deposit: the Main Zone and the Champ Zone. The Champ Zone was not mined and the Main Zone was partially mined at the time of mine shut down in 1998.

***Phase 1 of 3 to 4 planned phases of mining in the Grum pit was completed in 1998***

The Anvil Range mine plan provided for mining of the Grum Pit in 3 or 4 phases. The Phase 1 Pit was essentially completed at the time of mine shut down in 1998 and the Phase 2 expansion was underway with some pre-stripping completed. An estimated 3-6 years of mine life remained in the Anvil Range mine plan. However, extraction of the residual ore is not considered to be economically viable as was indicated in a report to the Interim Receiver by and engineering firm, Strathcona Minerals.

The ultimate pit was designed, by Anvil Range, to be approximately 1,100 m long, 700 m wide and up to 200 m deep, with a volume of 42.6 million $m^3$ or 47 million $m^3$ with mining of the Champ Zone. A new access slot (nearly complete at the time of mine shutdown) was excavated at the southeast end of the pit that would have provided more efficient access to the pit.

***Mining in the Grum pit intersected old underground workings***

Mining of the lower benches of the Phase 1 Pit intersected the underground exploration workings. This created a direct hydraulic connection such that the water level in the pit controls the water elevation in the underground workings. The elevation of the adit above the elevation of the pit perimeter precludes any future discharge of water from the adit provided that the hydraulic connection remains.

Rocks exposed on the walls and the floor of the Grum Pit are largely calcareous phyllite with minor exposed sulphides. This provides better physical stability of rock walls and better water quality than observed in the Vangorda Pit.

The Phase 1 Grum Pit has a well-developed slope failure on the northeast till wall. The Grum Pit intersected a bedrock valley that is infilled with glacial till at this location that is up to approximately 100 m in depth. Water flow at the base of the till is thought to be the cause of the instability. Till has slumped into the pit bottom that currently prevents access to the Phase 1 Pit bottom.

***Surface water is diverted around the pit***

Surface water is diverted around the Grum Pit via the Grum Interceptor Ditch. Although there was not a well defined creek passing over the Grum Pit prior to development, the area was generally "wet" and supported Doal Lake and is thought to have contained shallow groundwater flow. Dewatering of the Grum Pit has not taken place since mine shut down in 1998 and water from intercepted shallow groundwater flow, runoff and precipitation has accumulated. The in-pit water elevation is monitored and has increased more slowly than the Vangorda Pit due to the large storage volume and low inflow volumes.

## 4.3.2 ROCK DUMPS

### 4.3.2.1 Vangorda Rock Dump

The Vangorda Rock Dump is located directly southwest of the Vangorda Pit. The rock dump is located on a topographic high with the original ground surface sloping west toward Shrimp Creek and northwest toward Vangorda Creek. The southern area of the rock dump is underlain by shallow soil or bedrock. The soil thickness increases towards the west and northwest and can be greater than 35 m thick at the toe of the dump. The soil profile consists of a thin veneer of organic soil overlying a fine grained glacial till and a thin basal sand unit overlying bedrock.

***All rock is potentially acid generating***

The Vangorda Rock Dump was constructed from May 1990 to January 1998 and contains glacial till overburden and waste rock excavated from the Vangorda Pit. A stockpile of till overburden is located in the southeast area of the rock dump. Waste rock was classified as either "sulphide" or "phyllite" for placement into the rock dump. Geochemical analyses indicated that both of these rock groups are potentially acid generating as described in Volume II, Description of the Existing Environment.

The Vangorda main dump contains approximately 16 million tonnes of rock (Table 9). A plan view of the dump is illustrated on Figure 9 and a perimeter section is provided on Figure 10.

Sulphide rock has a higher potential for acid generation than phyllite and the design of the rock dump called for the segregation of sulphides into a sulphide cell. The arrangement provided for a more direct collection of seepage from the sulphide cell into Little Creek Dam storage pond. It is thought that the segregation of the two rock classifications was largely followed through the life of the operation.

***Original closure plan was resloping and covering***

The original closure plan for the facility required the resloping and encapsulation of the mined rock with glacial till that would be stripped during development of the pit. The closure plan was to be implemented progressively as the rock pile expanded. The design required a starter dyke to be constructed from compacted glacial till, to 1135 m elevation. Till berms were to be constructed as extensions to the starter dyke around the perimeter of the rock pile. The berms were to be located to ensure an overall slope of 3H:1V. A till cap would then be placed over the top of the pile. Construction of the starter dyke was initiated in May 1990 and completed in the same year. No additional lifts were constructed.

The design of the dump was modified in 1992 to accommodate changes to the projected volumes of rock and overburden. A greater quantity of rock and a reduced quantity of overburden were predicted in a revised mine plan. The footprint of the dump was not enlarged but the height was increased to the current elevation.

The near surface zone of the Vangorda Deposit was oxidized and could not be economically processed in its entirety. This oxidized ore was screened such that the coarse fraction was processed and the fine fraction, which contained the majority of the oxidation products, was placed into the rock dump in an area of shallow bedrock east of the extensive till blanket that underlies the bulk of the Vangorda dump. This material (approximately 225,000 tonnes) is generally referred to as "oxidized fines" and occupies an area of the sulphide cell where some of the material is exposed to surface and some is covered with waste rock. This material has been shown to generate and release substantial concentrations of contaminants.

***Rehabilitation of the dump seepage collection system, test resloping and capping and groundwater quality monitoring was instituted in 1993/94***

In November 1993 during the "Curragh receivership", Government Services of Canada commissioned Pelly Construction Limited to rehabilitate the Vangorda Dump seepage collection system and initiate work on the resloping and capping of the rock dump. Steffen Robertson Kirsten (Canada) Inc. was retained to provide engineering consulting services for the work.

The work involved the upgrading of the existing seepage collection system located around the perimeter of the containment facility, recontouring rock slopes within a section of the rock pile, and providing instrumentation to monitor both the physical stability of the rock pile and any impact on the groundwater quality. The work took place from March 1994 to June 1994. The configuration of the rock dump and collection facility has not changed since that time.

**Table 9. Composition of Vangorda Plateau Mine Site Dumps**

| Dump | Composition | As-built (tonnes) | % of Total |
|---|---|---|---|
| **Vangorda Main** | **Phyllites** | | |
| | Phyllite, including calcareous, non-calcareous and chloritic | 213,200 | 1% |
| | carbonaceous phyllite | 882,700 | 6% |
| | Vangorda Formation | 1,095,900 | 7% |
| | Mt. Mye non-calcareous phyllite | 7,295,600 | 46% |
| | altered phyllites | 4,608,500 | 29% |
| | ***subtotal phyllites*** | ***13,000,000*** | ***81%*** |
| | **Sulphides** | | |
| | massive pyritic quartzite | 422,577 | 0% |
| | pyritic quartzites | 845,155 | 1% |
| | banded carbonaceous quartzites | 1,732,268 | 1% |
| | ***subtotal sulphides*** | ***3,000,000*** | ***19%*** |
| | **Total Main Dump** | **16,000,000** | |
| **Vangorda North Pit Dump** | Phyllite | 10,000 | 50% |
| | Sulphide | 10,000 | 50% |
| | **Total North Pit Dump** | **20,000** | |
| **Vangorda South Pit Dump** | Phyllite | 25,000 | 50% |
| | Sulphide | 25,000 | 50% |
| | **Total North Pit Dump** | **50,000** | |
| **Vangorda Pit Stockpile** | Sulphide | 510,000 | 100% |
| **Oxide Fines** | Vangorda Oxide Fines | 225,000 | 100% |
| **Grum Main** | **Phyllites** | | |
| | Phyllite, including calcareous, non-calcareous and chloritic | 76,053,018 | |
| | carbonaceous phyllite | 15,906,892 | |
| | Vangorda Formation | 91,959,910 | 85% |
| | Mt. Mye non-calcareous phyllite | 10,146,190 | 9% |
| | altered phyllites | 2,193,370 | 2% |
| | ***subtotal phyllites*** | ***104,299,470*** | ***96%*** |
| | **Sulphides** | | |
| | massive pyritic quartzite | 164,020 | 0% |
| | pyritic quartzites | 688,850 | 1% |
| | banded carbonaceous quartzites | 2,969,360 | 3% |
| | ***subtotal sulphides*** | ***3,822,230*** | ***4%*** |
| | **Total Grum Main Dump** | **108,121,700** | |
| **Southwest Dump** | calcareous phyllites | 42,000,000 | 100% |

Six transverse gravel drains were installed beneath the till starter dyke during its construction in 1994 to allow release of water from the dump and to allow sampling of seepage flow. The drains were equipped with V-notch weirs for flow measurement. Five of the weirs remain operational and three of the weirs consistently have flow. However, the observed seepage flow rates are substantially less than predicted from water balance calculations, which may be related to high rates of water storage and evaporation from dump surfaces.

In 1994, five groundwater monitoring wells were installed around the perimeter of the dump in order to monitor the quality of the groundwater seepage at the toe of the dump. Four of these wells remain operational. In 2001, two additional monitoring wells were installed, one at bedrock. The wells were located at a location of deep bedrock as identified from a surface seismic reflection survey. Additional details are described in Section 4.

#### 4.3.2.2 Grum Dumps

***Grum Waste Dumps: Overburden Dump, Southwest Rock Dump, and Main Rock Dump***

There are three Grum Waste Dumps: the Overburden Dump, the Southwest Rock Dump and the Main Rock Dump. The Main and Overburden Dumps are being built on the moderate northwest slope of the Vangorda Creek valley and the Southwest Dump is in a relatively flat saddle on the crest of the ridge between the two branches of Vangorda Creek southwest of the Grum Pit. The composition of each dump is described below . The rock dumps are illustrated in plan on Figure 13 and a section view at the toe is provided on Figure 14.

**Overburden Dump**

The Overburden Dump contains glacial till stripped from Phase 1 of the Grum Pit. The dump has been built in five 15 m lifts with setbacks resulting in gentle slopes suitable for resloping to 3H to 1V. A portion of the northeast side of the dump was resloped by Anvil Range Mining Corporation. The Overburden Dump contains approximately 24 million tonnes of glacial till.

**Southwest Rock Dump**

***Southwest Rock Dump contains only calcareous phyllites***

The Southwest Dump consists of mainly calcareous phyllite with about one third of the dump designed to contain non-calcareous phyllite. The volume of the dump is approximately 20 million $m^3$. This dump drains primarily to the south towards the main stem of Vangorda Creek. However, the west edge of the dump extends into the drainage of the West Fork of Vangorda Creek. Only rock from the pre-stripping of Phase 3 of the Grum Pit is located in this dump, which is believed to consist entirely of calcareous phyllite and include no sulphide waste. The design for the Southwest Rock Dump was enlarged from the initial design by extending 200 m to the west and increasing the height by approximately 10 m.

### Main Rock Dump

The largest of the three dumps, the Main Rock Dump was built on a moderate slope dipping 6 to 10 degrees southeast to south. Local areas vary from as steep as 12 degrees to flat. Permafrost was not identified on this slope. The main dump covers two minor areas of groundwater seepage. The more significant of these areas, the Grum Creek valley, was not incorporated into the design of the dump because of stability concerns related to near saturated surface soils. The surface of this southwest slope is mantled by variable thickness of glacial till (0.1 to 6.7 m). The till is generally overlain by fluvial sand and gravel which varies from 0.3 to 5.5 m in thickness. A thin organic soil layer (0.2 to 0.7 m deep) covers most of the area. Bedrock is generally within 7 or 8 m of ground surface and in many places bedrock is immediately beneath the thin organic soil layer.

***The Main Grum rock dump consists of 30 m high lifts and includes a sulphide cell***

The Main Rock Dump was designed to consist of seven lifts, mostly 30 m high each. The lifts were designed to be constructed as a series of overlapping lifts wedging out against the hillside, each providing a foundation and buttress for the lift above it with an overall slope of 2.5H to 1V or flatter. The dump is currently only partially constructed according to the proportional composition of the Grum Pit. The lifts, as constructed, largely follow this design although one lift contains a substantial quantity of glacial till excavated from the slough at the southeast pit wall. Each lift was end dumped at the angle of repose and a setback was provided for each lift to reach the overall design slope.

Sulphide waste rock was placed into the central area of the rock dump (the "sulphide cell") per the dump design. Sulphides were dumped on a minimum base of 10 m of phyllite to isolate the sulphides from the original ground surface and to provide buffering capacity for seepage through the sulphide cell. The sulphides were dumped 45 m back from the final dump face to allow for future placement of phyllite and till as a reclamation cover.

The ultimate size of the Main Rock Dump, dependent on the ultimate size of the Grum Pit, was designed to hold 108 million tonnes of rock, most (92 million tonnes) of which was to be calcareous phyllite, and about 5.2 million tonnes would be sulphides and altered phyllite.

#### 4.3.2.3 Ore Transfer Pad

***The Ore Transfer Pad was used as a temporary stockpiling location***

The Ore Transfer Pad is at the north end of the Grum Pit. The pad was used as an ore transfer point from pit trucks to the long-haul trucks that carried ore to the Faro mill. The pad was built on a base of calcareous phyllite and is located on the drainage divide between the main stem of Vangorda Creek and the West Fork of Vangorda Creek.

Economic volumes of ore were removed from the ore transfer pad to the Faro mill during mine operations. However, residual quantities of low, regular and high grade ore are thought to be present on the pad.

#### 4.3.2.4 Haul Road

*Location, extent and development of Vangorda Plateau Haul Road*

The Vangorda Plateau Haul Road is a heavy haul road developed for use by 154 tonne off-highway trucks hauling ore from the Ore Transfer Pad to the Faro mill, a distance of 13 km. The road extends an additional 3 km past the transfer pad along the south side of the Grum Pit to the pit entrance on the south side of the Vangorda Pit (refer to Figures 1, 2, 3). The road was built by Curragh Resources starting in October 1986 and was completed in 1989. There has been significant upgrading of the road surface over the years.

*Geology and design of haul road*

The road surface is up to 30 m wide and there is a 2 m high safety berm on either side of the road. The majority of the road was built as a fill road and is up to 30 m high. There are two minor cut areas, one on the east side of the West Fork of Vangorda Creek and the other on the west side of the South Fork of Rose Creek. The central 2 km of the road was built from locally borrowed surficial deposits. Otherwise, roadfill material was hauled from the Faro and Grum pits.

*Haul road stream crossings*

The haul road crosses several major streams including the North and South Forks of Rose Creek as well as the West Fork and main stem of Vangorda Creek. The North Fork of Rose Creek crossing is a rock drain. A second, smaller rock drain crosses Reservoir Creek, a tributary to the FWSD reservoir. The other crossings are corrugated metal pipes of 600 to 1600 mm diameter and 600 mm overflow culverts exist at most crossings. Culvert crossings were sized for a 1:25 year return period flood and were not designed to allow for fish passage. The two largest fills over these culverts are the West Fork of Vangorda Creek and the main stem near the Vangorda Pit. Side slopes are 2H: 1V for sections built from overburden and 1.5H: 1V for sections built from pit rock.

### 4.3.3 BUILDINGS AND INFRASTRUCTURE

*Overhead power line from Faro mill site to Vangorda Plateau area*

A 27 kV overhead power line runs to the Vangorda Plateau area from the Faro mill site. This line feeds a 4160-volt distribution system for the Grum and Vangorda mine site. Poles on this grid are single log poles. A distribution of overhead 4167-volt lines feeds power to various substations around the site where temporary ground lines are used to connect to equipment.

*Facilities located at the Grum and Vangorda mine sites*

The following facilities are located at the Grum and Vangorda mine sites:

1. Grum office/dry complex.
2. Grum shop building.
3. Water Treatment Plant.
4. Grum exploration portal buildings.
5. Old exploration camp.
6. Grum ore haul contractors office and shop.
7. Explosives magazine.
8. Grum lube/fuel building.
9. Grum ore storage pad.

*Buildings*

Ownership of some of the buildings located at the Vangorda Plateau mine site is in transfer to the Town of Faro in 2003 and the transfer of ownership is anticipated to include the office/dry complex and the Grum shop building. The office/dry complex is a two-story building of approximately 1,500 $m^2$ per floor of wood frame construction on a concrete slab. Exterior cladding is sheet steel. The adjacent shop building is of similar size and construction.

There are also a small water well house, ambulance garage, and trailer buildings used for miscellaneous storage near the office building.

*The Water Treatment Plant site and Grum exploration portal buildings*

The Water Treatment Plant is housed in a steel frame building on a concrete pad. The site also includes a lime bin and related structures and a few small temporary buildings or sheds used for storage, office and lunchroom space. A Butler building with a wooden extension is located at the old Grum exploration portal. This building was formerly used as a shop for the underground project and then became a truck maintenance shelter used during the early days of the Grum stripping. Currently, the building is unused.

*Buildings located near fuel station*

Several small temporary wood frame buildings, some of which are modified trailers, core racks and a wood frame core logging building of about 300 $m^2$ floor space are located near the fuel station.

*The explosives magazine*

The explosives magazine for the pit area is a small wood frame building in a clearing on the ridge running along the northwest side of Vangorda Creek near treeline. There is also a small blaster's shack near the Water Treatment Plant that was used for minor maintenance and office purposes.

*Grum lube/fuel building and ore storage pad*

There are several large fuel and glycol tanks in bermed areas, which are all currently inactive. Fuel and lube distribution was via several pumps housed in a small building near the major fuel tanks at the main exit from the Grum Pit. The contractors hauling ore from the Grum Transfer Pad to the Faro Mill use a shop and scale facility along the haul road near the ore transfer pad.

### 4.3.4 WATER TREATMENT FACILITIES

*Construction of 'Water Treatment Plant*

The Grum/Vangorda Water Treatment Plant ("WTP") was constructed in 1989/90 during the initial development of the Vangorda Plateau Mine site. During mine operations from about 1990 to 1993 and from 1995 to 1998, the plant was used to treat water from the Grum Pit, Vangorda Pit and Little Creek Dam.

*WPT pumping facilities*

Water from the Grum Pit was pumped to the WTP via a holding pond. Water was pumped from the Vangorda Pit into Little Creek Dam where it mixed with runoff from the Vangorda Rock Dump and the mixed water was then pumped directly to the WTP via a long (>2 km) buried pipeline.

*WTP effluent, design capacity and discharge*

The conventional lime neutralization plant with flocculant addition produces a low density sludge. Effluent exiting the WTP passes through a clarification pond prior to discharge. The design capacity of the plant is 2,000 USgpm (75.7 $m^3$/min) based on the design influent characteristics from the Grum and Vangorda Pits. The discharge from the sludge settling pond passes into the Grum Interceptor Ditch and into Vangorda Creek via the Sheep Pad Settlement Ponds.

***Management of runoff water since mine shut down***

The WTP was not operated from mine shut down in January 1998 to 2001. During this time, runoff water was allowed to accumulate in the Grum and Vangorda Pits and run off water from Little Creek Dam was been pumped into the Vangorda Pit on an as-required basis.

***WTP reactivation***

The water level in the Vangorda Pit reached the determined maximum desired elevation in early 2002 and, therefore, the WTP was reactivated and successfully operated in summer 2002. In preparation for scheduled reactivation of the WTP in 2002, an overland piping and pumping system had been installed in 2001 to pump water directly from the Vangorda Pit to the plant. The system consists of a barge mounted pump in the pit, a booster pump located out of the pit on the south side and high pressure steel pipe in the lower sections grading to plastic (sclair) pipe towards the WTP. The WTP is scheduled for annual seasonal (summer) operation to maintain the water level in the Vangorda Pit within the desired range.

***Water level in Grum Pit***

The water level in the Grum Pit is not expected to reach an elevation where active intervention is desired during the proposed licence renewal timeframe (2004 to 2008) due to lower inflows and larger storage volume compared to the Vangorda Pit. Nonetheless, faster than anticipated filling of the Grum Pit is included in the Adaptive Management Plan that is described in this volume.

## 4.3.5 SETTLEMENT PONDS

### 4.3.5.1 Moose Pond

***Moose Pond use, location and influent***

The Moose Pond is a natural depression on the northwest side of Vangorda Creek that was prepared for use as a settling pond for Grum Creek water in response to elevated levels of total suspended solids in Grum Creek during 1995. A diversion ditch that delivers part of the Grum Creek flow into the Moose Pond was constructed in 1996 and is currently in place.

The Moose pond is located on the top of a gravel bank overlooking Vangorda Creek and influent water has been observed to continually seep into the ground. There has not been any observed accumulation of water in the pond due to the infiltration.

### 4.3.5.2 Clarification Pond

***Dimension and design***

The Clarification Pond is a settlement pond for effluent exiting the WTP. Treatment sediments are intended to settle in the pond such that the discharge from the pond (licence location X25) is compliant with the terms of the water licence.

The dimensions of the pond are approximately 120 m by 80 m by approximately 4 m deep. The pond is excavated into surficial soil. Water enters the pond via a horizontal header pipe that intends to distribute inflow evenly across the width of the pond. The original header pipe was replaced in 2001 with a modified design. The pond was designed to release water via either a gravel underdrain or an outlet pipe buried in the embankment fed by a horizontal exit drain. The design anticipated that the underdrain would become plugged with sediments over time and this is believed to have occurred. The discharge header pipe was replaced in 2002.

*Pond embankment*

The embankment exhibits cracking and surficial slumping in some locations such that the crest width is currently less than design. The downstream face of the embankment on the north side was treated with geomembrane and rip rap rock in 1995 in response to observed seepage. The recommended maximum pond water elevation is 2 metres below the crest of the embankment, which is intended to prevent excessive water pressures within the embankment.

#### 4.3.5.3 Sheep Pad Ponds

*Mitigation of suspended sediments entering Vangorda Creek*

The Sheep Pad ponds were constructed in 1995 in conjunction with upgrading of the Grum Interceptor Ditch as a means of mitigating elevated levels of suspended sediments entering Vangorda Creek. Two ponds were constructed with the intention of allowing settlement of suspended sediments prior to discharge into Vangorda Creek via the Plunge Pool at the lower end of the Vangorda Creek Diversion Flume.

*Coarse settlement pond*

A coarse settlement pond receives the initial inflow and allows initial settling of coarse sediment. Accumulated sediment has been excavated from the pond on occasion since 1995. The inflow channel into this pond from the Grum Interceptor Ditch was upgraded in 2001 with a rip rap apron. Water flows to the second pond via a short (approximately 15 m) half-culvert flume. The two ponds are separated by an earth dyke.

*Main settlement pond*

The second, larger pond is the main settlement pond and is commonly referred to as the "Sheep Pad Pond". This pond is contained on three sides by an earth dyke and on the fourth side by natural ground. Water flows out of this pond via a riprap-lined exit channel.

*Flocculant addition*

In 1996 and 1997, fine, clayey sediment in suspension was observed not to settle completely in the pond during freshet and early summer such that the concentration of total suspended solids was out of compliance with the Water Licence. Flocculants were added into the flume between the ponds as a settlement aid. Two flocculants, Ferric sulphate and Percol E10, were utilized. From 1998 to 2000, water was re-directed from the Sheep Pad Pond into the Vangorda Pit for brief periods during freshet as a means of reducing the risk of a discharge of non-compliant (for total suspended solids) water.

## 4.3.6 DAMS AND DIVERSIONS

### 4.3.6.1 Water Management Overview

***Dewatering of the Grum Pit during previous mine operations***

During previous mine operations, dewatering of the Grum Pit was accomplished in several ways. Water was pumped from deep wells located around the eastern perimeter of the pit in an attempt to intercept groundwater prior to it entering the pit. Water pumped from these deep wells was directed into the Grum Interceptor Ditch. Dewatering of the underground exploration workings below the Grum Pit was performed via wells into the workings drilled from within the pit. In 1997 and 1998, some of the underground workings were intercepted by pit development and it was subsequently unnecessary to dewater the workings. Water pumped from the underground exploration workings and any other water that accumulated in the pit was pumped to the WTP holding pond prior to pumping into the plant for treatment.

***Grum Creek***

Grum Creek contains water from only a portion of its original watershed due to re-routing of surface water and interception of groundwater in the Grum Pit. A portion of the remaining Grum Creek flow has been diverted, since 1996, towards a settlement pond referred to as the Moose Pond which is a natural swale in sandy gravely soil that is bermed at the downstream end. Use of this diversion is intended to minimize suspended sediment loadings entering Vangorda Creek via Grum Creek. To date when the Moose Pond Diversion has been in-place, the diverted Grum Creek water has seeped into the ground and there has been no accumulation of water in the Moose Pond.

***Water diversion around the Vangorda Pit***

Water is diverted around the Vangorda Pit via the Vangorda northeast and northwest interceptor ditches as well as through a diversion of Vangorda Creek. The Vangorda northeast interceptor ditch passes water from the slopes to the north east of the pit into Shrimp Creek which, in turn, reports to the Main Fork of Vangorda Creek. The northwest interceptor ditch diverts water from the north west slopes into a settlement/groundwater recharge basin with overflow from the basin entering the plunge pool above the haul road. Vangorda Creek is diverted around its natural channel via a half culvert flume which discharges into the plunge pool above the haul road. Vangorda Creek is then returned into its original channel below the haul road.

***Vangorda Open Pit dewatering and runoff management***

Prior to the depletion of economic ore reserves in the Vangorda open pit in 1998, the Vangorda open pit was dewatered into Little Creek Dam from which location water was subsequently pumped to the WTP. During the current cessation of mining activities, runoff water which accumulates in Little Creek Dam has been pumped into the Vangorda open pit in order to maintain an appropriate water level in Little Creek Dam. The runoff water which accumulates in Little Creek Dam is typically non-compliant for levels of zinc required under the Water Licence and other parameters due to the presence of surface runoff from the Vangorda Rock Dump which enters Little Creek Dam via a dump seepage collector ditch.

***Pumping system from Vangorda Pit to WTP at Grum Pit***

A pumping system was installed in 2001 to pump water from the Vangorda Pit to the WTP. The system consists of an overland pipeline, floating pump/barge assembly in the pit and booster pump located outside of the pit. Operation of the pumping system and the WTP commenced in 2002 and is scheduled to continue on an annual seasonal (summer) basis to maintain the water level in the Vangorda Pit within the desired range.

#### 4.3.6.2 Little Creek Dam

***Location***

The Little Creek collection facility is located immediately northwest of the Vangorda Rock Dump, at an approximate elevation of 1100 mASL, in the side valley of Little Creek, a small tributary to Vangorda Creek. Upstream of the facility, Little Creek is intersected by the Vangorda Pit and by the access road to the Vangorda Rock Dump. The facility is located approximately 90 m upstream of Vangorda Creek.

***Purpose and associated facilities***

The Little Creek collection facility was constructed in 1990 to collect water pumped from the Vangorda Pit and seepage from the Vangorda rock pile. A detailed as-built report was prepared (SRK, 1991). The Little Creek collection facility consists of Little Creek Dam, an earth embankment built from local compacted till and a storage pond (Little Creek Pond) with a reservoir capacity of approximately 120,000 $m^3$ (Figures 13 and 14). Other associated facilities include a wet well, pump house, and pipeline system to direct the water in Little Creek Pond to the WTP near Grum Pit.

***Crest elevation of dam***

The crest elevation of Little Creek Dam varies from 1114.5 to 1120 mASL, i.e., some 10 m above natural ground. The side slopes are 2H:1V on the downstream side and 2.5 H:1V on the upstream side.

***Overflow spillway***

An emergency overflow spillway was constructed in 1999 that consists of a 0.61 m diameter culvert pipe buried into the crest of the dam near the south abutment. Pipe discharge falls into a riprap lined channel prior to discharging downhill into Vangorda Creek. Since mine shut down in 1998, the water elevation in Little Creek Dam has been controlled by periodic pumping into Vangorda Pit.

***Dam monitoring***

Little Creek Dam is instrumented with thermistors and pneumatic piezometers that are routinely monitored on a twice per year basis. The monitoring results are reviewed by a qualified geotechnical engineer.

#### 4.3.6.3 Vangorda Rock Dump Seepage Collection Ditch

The Vangorda Rock Dump Seepage Collector ditch collects toe seepage and surface runoff from the dump and passes this water into Little Creek Dam. The ditch was constructed in 1994, is approximately 2 m wide at the base and has 2.5H:1V side slopes. The ditch walls and bottom are armoured with riprap.

#### 4.3.6.4 Vangorda Creek Headworks Diversion

***Construction, condition and stability of dam***

The headworks for the diversion of Vangorda Creek from its natural channel into the Vangorda Creek Diversion Flume was constructed around an existing crossing of Vangorda Creek on the Blind Creek Road which consisted of an 1,800 mm diameter CMP culvert embedded in an earth embankment. The work involved raising the road embankment and extending the culvert using a smaller 1500 mm diameter corrugated metal pipe.

The headworks diversion shows no signs of settlement, cracking or surficial slope movement.

#### 4.3.6.5 Grum Interceptor Ditch

*Length, water collection and routing*

The Grum Interceptor Ditch runs for a length of approximately 2,500 m from above the northeast corner of the Grum Pit to Vangorda Creek. The ditch collects surface runoff in the upper reaches above the WTP. During mine operations, dewatering pumps installed into the aquifer upgradient of the Grum Pit also delivered water into the ditch. The ditch receives treated effluent from the WTP clarification pond and passes this combined flow around the west and south perimeter of the Grum Overburden and into the Sheep Pad Ponds (post 1995). Prior to construction of the Sheep Pad Ponds in 1995, the Grum Interceptor Ditch passed water through a culvert in the haul road and into the Grum Creek channel.

*Grum Creek suspended solids mitigation*

The initial routing of the ditch into Grum Creek, combined with the nature of the ditch as a shallow, steep-walled excavation in surficial soils, was identified as the cause of high levels of suspended sediment in Grum Creek. In response, the Sheep Pad Ponds were constructed and the Grum Interceptor Ditch was upgraded to include some rip rap protection in steeper sections.

*Ditch upgrade*

The Grum Interceptor Ditch was upgraded further in 2001. Sloughed soil was cleaned from the ditch and riprap rock was placed along the length of the ditch. The work also included placement of a riprap apron at the inlet to the Sheep Pad Pond.

#### 4.3.6.6 Vangorda Creek Diversion

*Diversion components and design objectives*

The development of the Vangorda Pit in 1991 required the construction of a 1,000 m long diversion of Vangorda Creek around the ultimate perimeter of the pit. The diversion was built between January and April 1991 and consisted of a number of components including the headworks, a partially lined open channel, a plunge pool, culverts, and drop structures. Design objectives for this facility required a system that would accommodate the 100-year storm event, would minimize seepage losses into the pit, and would be stable.

A 250 m long realigned section of the channel was completed in early 1992 to accommodate an extension of the ultimate pit perimeter to the west.

*Open channel*

The diversion consists of an open channel lined with 2.4m diameter half-round culvert. Riprap is used to protect sideslopes of the channel from erosion. The channel is seated on the north wall of the Vangorda Pit. A portion of the channel is underlain by a french drain that collects and passes leakage from the flume to the downstream culvert.

*Plunge pool, culverts and drop structure*

At the downstream end of the open channel, flow discharges into a riprap-lined plunge pool, which serves as an energy dissipater. Flow then enters a 2.0m diameter culvert, which feeds a vertical 3.0m diameter drop box structure located just north of the Vangorda haul road. The drop box redirects the flow into a 1.6m diameter pipe to the outfall on the south side of the haul road and back into Vangorda Creek (Figures 15 and 16).

***Structural damage***

Portions of half-round culverts have suffered major structural damage related to a fall of rock in 1999 and a soil slide in 2002 that damaged and required replacement of portions of the flume. Minor damage to the flume has occurred over the life of the operation due to ice clearing and less severe sloughing of rock and soil into the flume. A program of controlled blasting was executed at the Vangorda Creek Diversion flume in March 2001. The work removed some overhanging blocks in the location of the 1999 fall of rock.

The Vangorda Pit wall below the Vangorda Creek Diversion Flume has experienced local bench scale instability that is largely associated with faults in the northwest and west areas. A professional assessment of wall stability was carried out by SRK Consulting (SRK 2002) that assessed the physical stability of the northwest wall along the Vangorda Creek Diversion Flume. The assessment concluded that it is unlikely that any mode of large scale failure of the pit wall below the flume will affect the performance of the flume for a timeframe in excess of 50 years.

The SRK Consulting assessment also concluded that several areas along the bench face overlooking the Vangorda Creek Diversion Flume were of high risk of localized bench scale failures that could damage the flume and short term remediation work was recommended for these areas, as described in Section 4.3.6 of this volume. The recommended mitigation measures included localized slope flattening, removal of loose boulders and creation of catchment space adjacent to the flume. A remedial plan is scheduled for implementation during 2003.

#### 4.3.6.7 Vangorda Pit Diversion Ditches

Surface run off is diverted around the Vangorda Pit via the Vangorda northeast and northwest interceptor ditches. The Vangorda northeast interceptor ditch passes water from the slopes to the north east of the pit into Shrimp Creek which, in turn, reports to the Main Fork of Vangorda Creek. The northwest interceptor ditch diverts water from the northwest slopes into a settlement/groundwater recharge basin with overflow from the basin entering the plunge pool above the haul road.

The northeast diversion ditch was rehabilitated in 2002 to repair a breach that allowed flow of clean water into the Vangorda Pit and to provide increased channel capacity to Dixon Creek.

# 5 DESCRIPTION OF CARE AND MAINTENANCE ACTIVITIES

## 5.1 OVERVIEW OF THE CARE AND MAINTENANCE PLAN

The fundamental objective of the Care and Maintenance Plan is to ensure that the terms and conditions of the water licence are achieved. The risk-based approach that is used to plan the care and maintenance activities has consistently identified water management as the highest priority issue, and the most immediate in nature. Therefore, water management is the priority of the activities proposed for the licence renewal period, focusing on providing treatment of water and maximizing the amount of emergency storage capacity for non-compliant water and unforeseen events.

These proposed activities represent a direct continuation of the activities that have been performed by the Interim Receiver since 1998 to provide ongoing protection to the receiving environment in accordance with best management practices and the requirements of the water licence.

***Specific objectives of the Care and Maintenance Plan***

Many of the existing mine facilities that are described in Sections 3 and 4 of this volume have had, or are having, an impact on the environment that is the direct result of previous mining activities, as described in Volume 2 Description of the Existing Environment. The short term impacts have, since 1998, been mitigated by the activities of the Interim Receiver and the activities proposed in this care and maintenance plan are intended to continue this short term mitigation from 2004 to 2008. The long term impacts are planned to mitigated under the FCRP that is being developed by the closure Project Team. However, progressive degradation over time or catastrophic failure of some of the existing mine facilities is possible, with possible increased environmental impacts, within the timeframe for development and implementation of the FCRP. Therefore, the care and maintenance plan specifically provides for monitoring of these facilities and provides a framework for responding to unforeseen events relating to these facilities. This response framework is the Adaptive Management Plan that is described in Section 7 of this volume.

The specific objectives of the Care and Maintenance Plan are as follows:

1. to minimize the quantity of clean water that enters or crosses the mine site and subsequently requires treatment;
2. to maximize the capture of water that requires treatment;
3. to provide storage and treatment for water that requires treatment;
4. to assess the efficiencies of the above systems on an ongoing basis and to implement upgrades and maintenance as appropriate;
5. to monitor environmental conditions on the mine site and in the receiving environment and the physical stability of earth structures on an ongoing basis;
6. to interpret and utilize monitoring information on an ongoing basis to improve the water management systems;
7. to provide for efficient management of all activities providing for worker health and safety, public health and safety, contingency and emergency preparedness planning and cost effective management of public funding; and

8. to report on care and maintenance activities on a scheduled basis per the water licences to the Yukon Territory Water Board.

These objectives will be achieved by continuing the management systems and physical activities that are summarized as follows and further described in the subsequent sections:

***Summary of management systems and physical activities***

1. continue to utilize the Faro Main Pit as a storage location for water that requires treatment in the pit and rock dumps area and treat this water on a seasonal (summer) basis in the mill water treatment system, including maintenance of the existing Faro Creek Diversion;
2. continue to utilize the Intermediate Pond as a storage location for water that requires treatment from the plant site and Rose Creek tailing facility areas and treat this water on a seasonal (summer) basis in the intermediate Dam outflow spillway, including maintenance of the existing Rose Creek Diversion;
3. continue to utilize the Vangorda Pit as a storage location for water that requires treatment in the pit and Vangorda rock dump areas and treat this water on a seasonal (summer) basis in the existing WTP, including maintenance of the existing Vangorda Creek Diversion;
4. continue environmental and physical stability monitoring programs according to the site monitoring protocols and the requirements of the water licences; and
5. continue to provide dedicated on-site management that will continue to employ high standards for worker and public health and safety.

A schematic summary of the proposed care and maintenance activities is illustrated on Figure 17 and a summary listing of the proposed care and maintenance activities is provided in Appendix B. These summaries accompany the activity descriptions and rationales provided in the following sections.

## 5.2 WATER MANAGEMENT PLAN – ROSE CREEK DRAINAGE

### 5.2.1 PIT PONDS

#### 5.2.1.1 Faro Zone 2 Pit

***Seepage water compliance with Water Licence and the pumping system used for dewatering as per 1991 Management Plan***

The back-filled Zone 2 Pit collects seepage water that is non-compliant with the terms of the water licence, with zinc being the primary contaminant of concern. The management plan that was initiated in 1991 requires seasonal (summer) dewatering into the Main Pit via a pump installed in a deep well. The measured in-pit water elevations from 1997 to 2002 are illustrated on Figure 18.

Water is pumped vertically to surface from depth in the Zone 2 Pit and discharged into the Main Pit via an overland pipeline. The pumping system is operated manually based on manual measurements of the in-pit water elevation. Pump hours are recorded and subsequently used to estimate the quantity of water moved. Electrical power is provided via overhead powerlines from the substation at the mill and on/off control switches are located at the pump.

*Proposal to continue pumping to the Main Pit*

This same management plan is proposed to be carried forward through the term of the water licence. Maintaining the pit water level near the bottom of the pumping range is in agreement with the general priority, as described in section 5.1 of this volume, of maximizing emergency storage capacity for non compliant water. Maintenance of the pumping system will be implemented as appropriate on a preventative or repair basis. This might include inspection, repair or replacement of the deep well pump, repair of the overland pipeline, installation of a new pumping well, installation of automated switching and water level monitoring devices, or other appropriate activities.

### 5.2.1.2 Main Pit Pumping Program

*Pit water compliance with Water Licence and prevention of uncontrolled release to Rose Creek by maintaining the water level in the Pit below the overflow elevation*

The pit water is currently non-compliant with the terms of the water licence, as described in Volume II Description of the Existing Environment, with zinc being the contaminant of primary concern. In order to prevent an uncontrolled release of this water to Rose Creek, the water level in the Main Pit will continue to be maintained below the overflow elevation within the prescribed desired range as described below and as has been done since 1998. Maintaining the pit water level within the established range is in agreement with the general priority, as described in section 5.1 of this volume, of maximizing emergency storage capacity for non compliant water.

The maximum recommended water elevation that is illustrated on Figure 19 is approximately 15 m (50 feet) below the elevation at which water would overflow from the south wall of the Main Pit into the Zone 2 Pit.

This maximum recommended water elevation was initially presented in 1991 in a technical report prepared by Kilborn Engineering (Kilborn 1991) that evaluated, among other topics, alternative methods for installation of a recycle water system for mill process water (the current pumping system that was installed in 1997 was ultimately the selected method). The maximum recommended water elevation was determined, at that time, on the basis of minimizing the risk of increased seepage through the fractured wall rock separating the Main and Zone 2 pits that was, at that time, a possible risk. Experience to date has demonstrated that there has not been an observable increase in the seepage flow from the Main Pit to the Zone 2 Pit based on observed pumping volumes from the Zone 2 Pit.

*Emergency storage capacity in the Pit*

The freeboard below overflow in the Main Pit also provides emergency storage capacity for an unforeseen event, such as a breach of the Faro Creek Diversion. The 1996 report "Integrated Comprehensive Abandonment Plan" (RGC 1996) demonstrated that this emergency storage capacity was sufficient to contain a complete breach of the Faro Creek Diversion for a 1-week period during a probable maximum flood event.

In 2002, the barge anchor was modified to enable drawing the pit water level down to a lower elevation than was previously possible (Figure 19). This modification increased the operational flexibility to provide increased emergency storage capacity at the end of the pumping season.

*Seasonal pumping program purpose and objectives*

A seasonal (summer) program for pumping water from the pit to the mill water treatment plant will be undertaken in order to eliminate the extra costs and increased safety hazards that are experienced in the winter season. Under the anticipated normal conditions, the pumping season would be scheduled to commence in early June and be completed by late August, which would allow extra time for unforeseen delays or extra pumping requirements at the end of the summer prior to the onset of winter weather. The pumping program will include routine measurement of the pit water level.

The objective of the summer pumping program will be to draw the pit water level down to a predetermined minimum elevation. The pit water level will then be allowed to slowly increase through the subsequent fall, winter and spring seasons. The minimum elevation required at the end of the summer pumping season will provide sufficient storage for fall, winter and spring inflows. The typical annual pumping range that has been experienced from 1998 to 2002 is approximately 2.0 m, as illustrated on Figure 19.

*Pumping system components*

Pumping from the pit will be accomplished via the existing barge-mounted pumping system. The primary physical components of the system are:

1. A steel construction barge with fixed walkway and sliding anchor point;
2. Three submersible electric pumps on the barge, each rated at 5,000 USgpm delivered to the mill;
3. A 30-inch sclair plastic pipe from the barge to the mill; and
4. An electrical transformer and control switches located near the barge.

*Pumping system maintenance*

The existing pumping system has been used to provide up to 6,100 USgpm to the mill water treatment system. However, the three-pump system provides capacity to pump water from the pit at a greater rate if circumstances required this. Maintenance of the pumping system will be implemented as appropriate on a preventative or repair basis. This could include inspection, repair or replacement of the pumps, barge or overland pipelines, modifications to the barge anchor point, installation of an alternate land-based pumping configuration or other appropriate activities.

### 5.2.1.3 Water Treatment System

*Main pit water lime treatment*

From 1998 to 2000, water pumped from the Main Pit was limed in a spill box and directed into the Intermediate Pond where lime treatment took place again in the Intermediate Dam outflow spillway. The treatment methods employed were effective in the short-term but were inefficient in the use of lime and manpower and generally required greater effort to achieve compliance than more conventional methods.

*Conversion of the mill to a water treatment system*

In 2001, the mill was converted for use as a water treatment system and this system was successfully utilized to provide increased efficiency and reduced risk in 2001 and 2002. A flow sheet of the typical treatment process is illustrated on Figure 20. The mill system utilizes agitated flotation cells for lime conditioning and clarifier tanks for settlement of treatment sediments. The system is outfitted with new (2001) control instrumentation including automated lime control circuits, alarms, data recorders and centralized emergency shut down switches. The emergency switching includes an emergency shut down for the Faro Pit pumps. The system incorporates a contingency back up that allows for the outlet of upset water to the Intermediate Pond or the Main Pit via the existing tailings pump system.

***Discharge of compliant effluent***

Effluent water that is compliant with the Water Licence can be discharged directly to Rose Creek via the Cross Valley Dam outflow spillway, directly into the Cross Valley Pond or into the Intermediate Dam outflow spillway. The specific discharge location is determined based on operational considerations. The ability to bypass water pumped from the Main Pit around the Intermediate Pond (as was necessary prior to 2001) is of benefit for management of the Intermediate and Cross Valley Ponds.

***Physical components of the mill water treatment system***

The primary physical components of the mill water treatment system include:

1. 20-inch steel pipeline to the distribution box, which feeds water pumped from the Main Pit into two flotation cells;
2. four "banks" of flotation each comprised of three agitated cells that are operated as two parallel lines for lime conditioning of Faro Pit water;
3. 20-inch steel discharge header and pipe from lime conditioning to a distribution box and open "launder" feeding the centre well of the 40-foot diameter thickener;
4. 20-inch sclair pipe that passes overflow from the primary clarifier into the centre well of the 52-foot diameter clarifier tank;
5. 20-inch sclair pipe effluent discharge pipe, which passes overflow approximately 3 km from the clarifier tank to the ultimate final discharge location;
6. 24-foot sediment storage tank, which is used to store treatment sediments drawn from the bottom of the clarifiers for periodic removal to the Main Pit;
7. 20-inch steel outlet pipe, which passes overflow from the clarifier tank to the tailings pumpbox for release to the Intermediate Pond (via the existing open ditch) or pumping to the Main Pit;
8. underflow pumps, which convey the treatment sediments from the thickener and clarifier to the tailings pumpbox, to be discharged via gravity to the Intermediate holding pond.
9. lime mixing and distribution system including lime hopper, lime blower, lime silo, lime mixing tank, lime slurry storage tanks (2), lime distribution pumps (2), 4-inch plastic lime distribution pipeline; lime addition control valves (automatic and manual); and
10. process monitoring and control system including, pH probes, lime valve actuators, flow metre, display and data storage panel and centralized on/off control switches (including emergency off for the Main Pit pumps).

***Continuing assessment and maintenance of the treatment system***

The mill water treatment system will be utilized through the proposed term of the licence for the treatment of water pumped from the Main Pit. Compliant effluent will be discharged directly into Rose Creek via the Cross Valley Dam outflow spillway, directly into the Cross Valley Pond or into the Intermediate Dam outflow spillway at the discretion of the site manager. Assessment of means for increasing the efficiency of the treatment system will continue to be conducted and maintenance work will be implemented where beneficial to improving the removal of zinc and other contaminants. The effluent pipeline that conveys water from the mill to the

Intermediate and Cross Valley Ponds and Rose Creek will be utilized and appropriate maintenance work will be implemented to ensure adequate performance.

#### 5.2.1.4 Management of Treatment Sediments from the Mill Water Treatment System

***Sludge, storage capacity, removal methods, and deposition***

The treatment sediments ("sludge") from the mill treatment system are stored in a clarifier tank in the mill and periodically removed to the Intermediate Impoundment of the Rose Creek Tailings Facility to maintain storage capacity. A study is proposed for 2003, as described in this volume under Proposed Studies, that will determine the most appropriate sludge management plan for the duration of the care and maintenance period (i.e. until the FCRP is developed and implemented). In the interim while this plan is being developed, sludge will be deposited into the Intermediate Pond of the Rose Creek Tailings Facility via the ditch from the mill, as requested by DIAND Water Resources.

### 5.2.2 ROCK DUMP SEEPAGE

#### 5.2.2.1 Seepage to the North Fork of Rose Creek

***Seepage from Main and Intermediate rock dumps***

Surface and shallow subsurface seepage from portions of the Northeast, Zone 2, Main and Intermediate rock dumps flows directly to the North Fork of Rose Creek. If there were an overflow from the Zone 2 Pit, then this overflow would discharge to surface from the backfilled pit near the toe of the Zone 2 rock dumps and would enter the North Fork of Rose Creek in that area.

***Water quality monitoring***

The observed surface seepages are largely intermittent and flow in spring and immediately after heavy rainfall events. A series of groundwater monitoring wells are located along the toe of these rock dumps.

The surface and subsurface flows are monitored as part of the site water monitoring protocol, and have not been identified as having a demonstrable impact on surface water in the North Fork of Rose Creek. No routine care and maintenance activities are proposed beyond continued water quality monitoring. The Adaptive Management Plan described in Section 7 of this volume includes provision for monitoring and responding to degraded seepage quality to the North Fork of Rose Creek.

#### 5.2.2.2 Seepage to the Rose Creek Tailings Facility

***Seepage from the Main, Intermediate and Northwest rock dumps as well as stockpiles***

Surface and shallow subsurface seepage from portions of the Main, Intermediate and Northwest rock dumps, crusher stockpile and several other smaller piles within the overall footprint of the "Faro rock dumps" flows to the Rose Creek Tailings Facility. In some cases, the flow passes through the plant site area.

***Seepage flow and surface flow paths***

The old Faro Creek channel lies beneath a portion of the Main rock dumps, including the area of the current landfill site, and is considered to act as a seepage collector and flow path for seepage to the Rose Creek Tailings Facility. A small continuous stream is present in the old Faro Creek channel where it exits at the toe of the Main rock dump, which passes through the emergency tailings area. This area (between the mill and the mine access road) contains tailings that were released from the mill during upset events such as power failures.

Surface flow in the old Faro Creek channel is directed into the Intermediate Pond of the Rose Creek Tailings Facility via an open ditch and, thereby, receives treatment prior to release to Rose Creek. Shallow and deep groundwater in the old Faro Creek channel at the toe of the dumps is monitored for water quality and is thought to largely report to surface into the ditch that flows into the Intermediate Pond due to the presence of outcrops in the flow path.

The proposed activities include continued monitoring of surface and ground water quality and progressive reclamation of the emergency tailings area. The progressive reclamation work is described later in this section.

#### 5.2.2.3 Seepage to Upper Guardhouse Creek

***Runoff from the Northwest rock dumps***

A portion of the runoff from the Northwest rock dumps reports directly into Upper Guardhouse Creek and, thereby, into the North Wall Interceptor Ditch. There is no indication that this seepage is having a demonstrable impact on water quality in the North Wall Interceptor Ditch.

Additionally, Upper Guardhouse Creek passes under the extreme northwest toe of the rock dump. The creek is monitored immediately upstream and immediately downstream of this area and there is no indication of an impact on water quality in the creek.

No care and maintenance activities are proposed for this area beyond continued monitoring of water quality.

### 5.2.3 PLANT SITE SEEPAGE

***Direction of surface runoff, care and maintenance activities***

Surface runoff from the plant site area, including the emergency tailings area and the crusher stockpile area, is directed into the Intermediate Pond of the Rose Creek Tailings Facility via either the open ditch from the emergency tailings area or via Guardhouse Creek. In either case, the runoff water becomes incorporated into the Intermediate Pond management system and receives treatment prior to release to Rose Creek.

The only care and maintenance activities that are proposed for this runoff water are maintenance to the surface water control ditches and monitoring of surface water quality. These activities will be determined on the basis of maintaining safe work areas around the plant site area and maximizing the efficiency of capture of water into the Intermediate Pond.

### 5.2.4 ROSE CREEK TAILINGS FACILITY

#### 5.2.4.1 Intermediate and Cross Valley Ponds

***Water conveyance from Ponds***

The Intermediate and Cross Valley Dams were constructed with overflow spillways that have been used to convey water from the ponds over the life of the structures. Since 1998, measures have been implemented that have allowed syphon pipes to be utilized as the primary means of conveying water from the ponds.

The use of syphon pipes in place of overflow spillways provides for lower water levels in the ponds, which provides several environmental benefits:

***Environmental benefits of lower water levels in ponds***

1. Maintaining the pond water levels below the spillway outflow elevations allows for the immediate termination of water release in the event of upset conditions.
2. A lower pond water levels reduce the water pressures acting on the dam and, thereby, reduce the risk of dam failures (Klohn-Crippen, 2003).
3. A lower pond water level provides increased storage capacity in the ponds for unforeseen or flood inflows from upstream sources.

***Preventing the release of non-compliant water***

The use of syphon pipes to maintain the water level in the Intermediate Pond below the spillway outflow elevation is in agreement with the general priority, as described in section 5.1 of this volume, of maximizing emergency storage capacity for non compliant water. Although a variable water level periodically increases the area of tailings exposed to the atmosphere, which could result in increased metal concentrations and reduced pH in the Intermediate Pond from the flushing of contaminants from a larger exposed area, the water in the Intermediate Pond is scheduled for treatment with lime on an annual basis and, therefore, the incremental increase in contaminant loading will not result in the release of non compliant water.

***Results of lowering the water level in the Intermediate Pond***

A long term and consistent depression in the water level in the Intermediate Pond could result in a general lowering of the water table in the tailings upstream of the pond, which would allow sulphide oxidation to proceed to a deeper level (i.e. to the new water table). However, the proposed use of syphon pipes is a continuation of the established practice that results in wide variations in the water level in the Intermediate Pond as opposed to a long term lowering of the pond water level and, therefore, the impact on the general water level in the upstream tailings is considered to be of substantially lower risk that maintaining the Intermediate Pond level at its maximum level, which would introduce increased risk of dam failure and release of non compliant water.

***How the mill water treatment system has benefited pond management***

The use of the mill water treatment system for water pumped from the Main Pit since 2001 has had a beneficial effect for management of the Intermediate and Cross Valley Ponds. The mill water treatment system allows water pumped from the Main Pit to bypass one or both of the ponds. Prior to 2001, water pumped from the Main Pit entered the Intermediate Pond at a high flow rate (typically around 5,000 USgpm) and made syphoning from the pond less practical due to the large diameter pipes required and the need for supplementary lime treatment at the Intermediate Dam spillway. The lower volumes of water that have required treatment in the

Intermediate Pond since 2001 have enabled an increase in the efficiency of the treatment method. This has meant that, in addition to effluent quality being compliant since 1998, concentrations of zinc in the final effluent released from the Cross Valley Pond have been, on average, less since 2001 (i.e. since operation of the mill water treatment system) as described in Volume II Description of the Existing Environment.

***Lime treatment will be required from the Intermediate Pond through to 2008***

Even in light of the bypass of water pumped from the Main Pit, lime treatment of water conveyed from the Intermediate Pond will be required through to 2008. This is because the pond is anticipated to remain non-compliant due to inflows from plant sites, the Faro rock dumps and from the exposed tailings beach. The water treatment system at the Intermediate Dam outflow spillway consists of the following primary physical components:

1. A 12-inch syphon pipe from the Intermediate Pond to the treatment box.
2. A lime mixing system including storage bin, screw feeder, mix/stock tank and discharge pipe.
3. Miscellaneous small pumps and diesel generator (estimated 100KW required);
4. steel construction treatment tank located in the spillway into which syphoned pond water and lime slurry are added (mixing is by the force of the incoming syphoned water).
5. The Cross Valley Pond, which acts as settlement pond for treatment sediments.

***Continued operations and monitoring***

Water that is compliant with the discharge criteria of the water licence will continue to be released from the Cross Valley Pond to Rose Creek on an intermittent basis during the summer. In order to capitalize on the benefits of syphon pipes, they will continue to be used where practical to maintain water levels in the Cross Valley and Intermediate Ponds below their overflow elevations. The typical anticipated operating ranges may be from 1 to 5 m below the overflow elevations. Monitoring of the water level in the Cross Valley Pond and the quality of the water released from the Cross Valley Pond will be monitored as part of the site water monitoring protocol.

#### 5.2.4.2 Management of Treatment Sediments from the Cross Valley Pond Water Treatment System

***Factors reducing the risk of water quality deterioration in the Main Pit from continued implementation of the sediment management plan***

An estimated 13,100m$^3$ of treatment sediments that had accumulated in the Cross Valley Pond at the base of the inflow spillway were excavated and removed to the Faro Main Pit in the winter of 2001/2002. A study is proposed for 2003, as described in this volume under Proposed Studies, that will determine the most appropriate sludge management plan for the duration of the care and maintenance period (i.e. until the FCRP is developed and implemented). In the interim while this plan is being developed, sludge will be deposited into the Intermediate Pond of the Rose Creek Tailings Facility. This practice will correspond to the planned placement of treatment sediments from the mill water treatment system into the Intermediate Pond.

### 5.2.4.3 Intermediate and Cross Valley Dams

The Intermediate and Cross Valley Dams are important environmental protection structures in that they retain water and solids that would have a substantial impact on the receiving environment, if released. These structures have been maintained in good physical condition.

***Activities to maintain condition of dam structures***

The proposed care and maintenance activities are monitoring for physical stability as described in the site geotechnical and general monitoring protocols and performing those maintenance activities that are required to continue to maintain the structures in good condition. Those maintenance activities might include:

1. investigation and repair, if appropriate, of surficial cracks;
2. upgrading and/or replacement of rip rap and other erosion protection measures;
3. repairs to surficial erosion rills on the downstream slopes; and
4. reconstruction or upgrading of the crest, spillways or other features to the initial design configurations where erosion or mining activities have altered those structures.

***Site geotechnical monitoring***

The site geotechnical monitoring protocol includes the proposed continuation of reading geotechnical instrumentation associated with the Intermediate and Cross Valley Dams (thermistors and piezometers) on a twice per year basis (spring and fall). An annual inspection of the dyke and backslope including a review of geotechnical instrumentation data is also included. Seepage flow at the toe of the Cross Valley Dam will continue to be monitored and assessed by the geotechnical engineer in the context of implications on the physical stability of the dam.

### 5.2.4.4 Original and Second Tailings Impoundments

All of the Original and Second Tailings Impoundments and the upstream portion of the Intermediate impoundment contain exposed (i.e. not submerged) tailings.

***Infiltration, subsurface flow and surface runoff***

Precipitation and snow melt water on the Original and Second Tailings Impoundments infiltrates completely into the tailings and joins with the subsurface flow in the Rose Creek Valley aquifer, with the exception of rare extreme events during which some short duration surface overflow from these ponds can take place. The Original and Second Impoundment dams do not retain water near surface. Surface run off from these two upper impoundments into the Intermediate impoundment is observed only rarely during extreme precipitation events.

***Care and maintenance activities***

No care and maintenance activities are planned for the Original and Second Tailings Impoundments or for the dams. Maintenance of the Original and Second Impoundment Dams is not considered to be generally necessary since damage to these structures due, for example, to an extreme precipitation event, would not result in an impact to the environment as any breached material would be largely unsaturated tailings retained within the tailings facility. The crest of the Second Impoundment dam provides vehicle access to the Intermediate impoundment and, therefore, some minor maintenance work may be performed to maintain this access.

#### 5.2.4.5 Intermediate Tailings Impoundment

***Surface runoff from Intermediate Tailings Impoundment***

The upstream portion of the Intermediate Impoundment is sloped towards the Intermediate Pond and, therefore, a portion of the precipitation and snow melt water reports into the Intermediate Pond as surface runoff. The ditch that carries water from the plant site, emergency tailings and Faro rock dump area directs this flow onto the surface of the Intermediate Impoundment in the extreme southeast corner. This water flows through a channel eroded into the surface of the tailings.

***Wind dispersed tailings***

Tailings in the upstream area of the Intermediate Impoundment (near the toe of the Second Impoundment Dam) have been observed to swirl in the wind during dry windy periods of the summer season. This has typically been observed on at least one occasion each year. A study of metal levels in vegetation was undertaken in 2002, which was the first documented study of this type, as a means of assessing possible impacts on local vegetation related to wind dispersed tailings. The 2002 study is described in Volume II Description of the Existing Environment.

***Proposed studies for the care and maintenance timeframe***

The proposed studies for the care and maintenance timeframe (described in this volume) include investigations of the terrestrial environment (vegetation, soil and wildlife) to follow up on the initial data collected from 2002. Follow up studies are required, in this case, to verify the single existing data set (2002) and to identify sources and indicate temporal and spatial trends. The follow up studies will be designed such that the need for a mitigation plan can be assessed and a plan can be developed, if necessary, by the end of 2005.

#### 5.2.4.6 North Wall Interceptor Ditch

***Diverting clean upper Guardhouse Creek water from the Rose Creek Tailings facility***

The continued use of the North Wall Interceptor ditch through the proposed licence period is important in order to prevent the "clean" water from Upper Guardhouse Creek and the slopes to the north of the Rose Creek Tailings Facility entering the tailings facility, where it would become non-compliant and require treatment.

***Maintenance activities***

Therefore, the existing diversion is proposed to be utilized and maintained through the licence period. A number of maintenance activities have been carried out in recent years and similar activities are anticipated to be required through the licence period. These activities might include:

1. clearing of ice;
2. clearing of sloughed bank material;
3. reconstruction of channel sections to design configuration; and
4. maintenance or upgrading to the culvert road crossing near the Cross Valley Pond.

#### 5.2.4.7 Rose Creek Valley Aquifer

*Results of hydrogeological and geochemical characterizations of the Rose Creek tailings facility and native aquifer*

A comprehensive hydrogeological and geochemical characterization of the Rose Creek tailings facility and native aquifer was undertaken in 2001 as described in Volume II Description of the Existing Environment. The 2001 study and 2002 follow up investigations demonstrated that the combined effects of progressive oxidation of the tailings and infiltration through the tailings into the aquifer has resulted in elevated concentrations of heavy metals and other ARD indicators in the native aquifer directly beneath the tailings impoundments. However, these elevated concentrations diminish to or near to "background" levels a short distance downgradient of the tailings impoundments and the study identified no need for the immediate collection and treatment of subsurface flow.

*Current and proposed monitoring activities*

The 2001 geochemical characterization could not provide a definitive conclusion regarding the rate of oxidation of the tailings and the future rate of release of contaminants into the aquifer due to a lack of sufficient temporal data. However, it is considered highly unlikely, given all of the amassed data and the hydrogeological interpretation completed for the 2001 study that the rate of release of contaminants will increase in the proposed licence timeframe (i.e. to 2008) to the degree where interception and collection of groundwater will be required to protect surface waters and aquatic resources. However, diligent environmental management demands the continued collection of monitoring information to verify that the receiving environment is not being adversely affected and, therefore, continued monitoring of groundwater quality is proposed. The Adaptive Management Plan described in this volume of the report will be the management tool used to assess the implications of the information collected.

Monitoring the quality of subsurface flow within the tailings mass and within the underlying aquifer at various locations, including upgradient and downgradient locations, is currently undertaken on a twice per year basis (spring and fall), including all monitoring wells that were installed in 2001. This monitoring program is proposed to be continued as described in the site water monitoring protocol.

### 5.2.5 FARO CREEK

#### 5.2.5.1 Faro Creek Diversion

*Diverting clean Faro Creek water from the Main Pit*

The continued use of the Faro Creek Diversion channel through the proposed licence period is important in order to prevent the "clean" Faro Creek water from entering the Main Pit, where it would become non-compliant and require treatment. The "Faro Valley Diversion" on the north side of the Faro Creek valley is part of the Faro Creek Diversion in the context of the planned care and maintenance activities.

*Maintenance activities*

Therefore, the existing diversion is proposed to be utilized and maintained through the licence period. A number of maintenance activities have been carried out in recent years and similar activities are anticipated to be required through the licence period. These activities might include:

1. clearing of ice;
2. clearing of sloughed bank material;
3. lining portions of the channel with natural, plastic composite or other liners to minimize leakage and provide erosion protection; and
4. repairs or upgrades to the containment dyke.

#### 5.2.5.2 Faro Northeast Pit wall

***Crest retrogression toward Faro Creek diversion***

The Faro Creek Diversion passes in close proximity to the northeast wall of the Main Pit, which is undergoing a progressive failure of the slope face, wherein the crest of the pit wall is retrogressing towards the Faro Creek Diversion. The stability of this pit wall has been professionally assessed (Golder 2002) and the rate of crest retrogression is monitored. It is considered unlikely that the crest of the pit wall will retrogress to the point of compromising the stability of the Faro Creek Diversion channel within the licence period (i.e. to 2008).

***Monitoring activities***

Continued monitoring of the physical stability of the pit wall and the rate of retrogression of the crest of the pit wall are also proposed to be continued. The Adaptive Management Plan described in this volume of the report will be the management tool used to assess the implications of the information collected.

### 5.2.6 ROSE CREEK

#### 5.2.6.1 North Fork of Rose Creek

***Current and proposed water quality monitoring activities along the North Fork of Rose Creek. Water Quality in this area is the trigger for initiation of contingency plans***

Water quality is monitored at a number of locations along the North Fork of Rose Creek as a means of detecting possible impacts in the receiving environment from the Faro Creek Diversion, rock dumps, the Zone 2 Pit and the rock drain at the haul road crossing. The continued monitoring of water quality along the North Fork of Rose Creek is an important aspect of the proposed site water monitoring protocol because of the reference in the current water licence, which is proposed to remain in the licence, to water quality in the North Fork of Rose Creek as the trigger for initiation of contingency plans.

A continuous flow recorder with data logger is installed in the North Fork of Rose Creek upstream of the mine facilities and the continued operation of this recorder is included in the site water monitoring protocol.

***Rock drain performance monitoring***

Continued monitoring of the performance of the rock drain at the haul road crossing is proposed, as is any maintenance work necessary to maintain the structure in good condition. No maintenance work has been required in recent years and little is anticipated through the proposed licence period.

***Diversion stability***

The North Fork Diversion, downstream of the mine access road crossing, is considered to be physically stable and no care and maintenance activities are proposed for this structure through the licence period.

*Benthic invertebrate monitoring*

Monitoring of the benthic invertebrate community on an every second year basis is proposed to be continued at the established location in the North Fork of Rose Creek (upstream of mine facilities) as described in the site biological monitoring protocol.

### 5.2.6.2 South Fork of Rose Creek

*Breaching the fresh water supply dam to original ground as a separate project*

The largest structure requiring care and maintenance in the South Fork of Rose Creek is the FWSD and reservoir. However, the dam is proposed, as a separate project, to be breached to original ground to restore natural flow conditions and remove the reservoir by March 2004. This project is undergoing environmental assessment and water licencing as a stand alone project. Therefore, environmental designs, construction monitoring, determination of environmental effects, environmental mitigation, post construction monitoring and regulatory water licencing issues related to breaching the FWSD and reservoir are all managed under that project and no information is presented herein. The assessment of cumulative effects in Volume III Environmental Assessment, however, includes the effects of the FWSD breach project.

*Monitoring and maintenance of creek crossings*

There are two culverted road crossings along the South Fork of Rose Creek at the haul road and the mine access road and there are two small bridge crossings at the shooting club access road and a smaller cabin access trail. All of these structures will require monitoring and maintenance, as appropriate to maintain the structures in good condition. The bridges are not a part of the mine infrastructure and are not the direct responsibility of the Interim Receiver and the culvert crossing of the access road is a public facility under the overall management of the Yukon Territorial Government. However, these structures will be monitored as part of the site general monitoring protocol due to their potential impacts on water quality in the South Fork of Rose Creek and the Interim Receiver will attempt to initiate appropriate maintenance activities with the responsible parties if these are necessary. Additional information specifically regarding the crossing of the mine access road is described in this volume under the topic "Site Access and Security".

*Visual monitoring of drainage "push-outs" from the haul road*

Runoff from portions of the haul road enters the South Fork of Rose Creek. The haul road is not considered to represent a risk of acid rock drainage or metal leaching but can represent a source of elevated sediment loadings during precipitation events. The site general monitoring protocol describes the proposed continuation of visual monitoring of drainage "push-outs" as sources of sediment entering the creek.

*Benthic invertebrate monitoring*

Monitoring of the benthic invertebrate community on an every second year basis is proposed to be continued at the established location in the South Fork of Rose Creek (upstream of the pumphouse pond) as described in the site biological monitoring protocol.

### 5.2.6.3 Pumphouse Pond

*Physical stability of pond, dam and spillway*

The current configuration of the Pumphouse Pond and the Pumphouse Pond Dam is considered to be physically stable and to remain so for the proposed licence period. The outflow spillway is not configured to design but has not undergone erosion or caused sediment loading into Rose Creek in recent years even in the context of significant storm events.

*Care and maintenance activities*

No care and maintenance activities are proposed beyond monitoring as described in the site general monitoring protocol and any maintenance work that is required to maintain the facility in a stable condition.

#### 5.2.6.4 Rose Creek Diversion Canal

*Diverting clean Rose Creek water from entering the tailings facility*

The continued use of the Rose Creek Diversion Canal through the proposed licence period is important in order to prevent the "clean" Rose Creek water from entering the tailings facility, where it might become non-compliant and require treatment and where it might increase water induced pressures on the Intermediate and Cross Valley Dams. Therefore, the existing diversion is proposed to be utilized and maintained through the licence period.

*Maintenance activities*

The Rose Creek Diversion Canal was constructed in an area of ice lensing and discontinuous permafrost and some maintenance work has been required in recent years to restore the containment dyke and the backslope to design configuration. The maintenance activities through the proposed licence renewal timeframe might include:

1. clearing of ice;
2. grading and restoration of the crest of the containment dyke;
3. repairs or upgrading to the backslope;
4. installation or replacement of new monitoring instrumentation; and
5. verifying the hydraulic capacity of the canal.

*Site geotechnical monitoring*

The site geotechnical monitoring protocol includes the proposed continuation of reading geotechnical instrumentation associated with the Rose Creek Diversion Canal (thermistors, piezometers and slope indicators) on a twice per year basis (spring and fall) and according to the recommendations of the geotechnical engineer. An annual inspection of the dyke and backslope by a professional geotechnical engineer including a review of geotechnical instrumentation data is also included.

The Adaptive Management Plan described in this volume of the report will be the management tool used to assess and respond to unexpected overfilling or breaching of the containment dyke.

#### 5.2.6.5 Rose Creek Downstream of the Mine Facilities

*Water quality representation and monitoring*

Water quality in Rose Creek downstream of the mine facilities is representative of the receiving environment and is monitored routinely immediately downstream of the tailings facility, where a continuous flow recorder with data logger is also installed.

Continued water quality monitoring and maintenance and operation of the continuous flow recorder are proposed for the licence period as described in the site water monitoring protocol.

*Benthic invertebrate monitoring*

Monitoring of the benthic invertebrate community on an every second year basis is proposed to be continued at three established locations along the length of Rose Creek to Anvil Creek as described in the site biological monitoring protocol.

#### 5.2.6.6 Anvil Creek

*Water quality representation and monitoring*

Water quality in Anvil Creek upstream of the confluence with Rose Creek is representative of background conditions in Anvil Creek. Water quality in Anvil Creek immediately downstream of the confluence with Rose Creek is representative of the receiving environment in Anvil Creek. Water quality and benthic invertebrates are monitored routinely at these two locations on an every second year basis.

*Benthic invertebrate monitoring*

Monitoring of the benthic invertebrate community and water quality on an every second year basis is proposed to be continued at the two locations in Anvil Creek as described in the site biological and water monitoring protocols.

## 5.3 WATER MANAGEMENT PLAN – VANGORDA CREEK DRAINAGE

### 5.3.1 PIT PONDS

#### 5.3.1.1 Vangorda Pit Pumping Program

*Pit water compliance with the water licence and prevention of uncontrolled release to Vangorda Creek by maintaining water levels in the Pit below the overflow elevation*

The pit water is currently non-compliant with the terms of the water licence, with zinc being the contaminant of primary concern as described in Volume II Description of the Existing Environment. In order to prevent an uncontrolled release of this water to Vangorda Creek, the water level in the Vangorda Pit will continue to be maintained below the overflow elevation as has been done since 2002, when the pit water level reached the maximum desired range. Maintaining the pit water level within the established range is in agreement with the general priority, as described in section 5.1 of this volume, of maximizing emergency storage capacity for non compliant water.

The maximum recommended water elevation (1092 m ASL) is approximately 30.5 m (100 feet) below the elevation at which water would overflow from the southwest wall of the pit into Vangorda Creek (taken as the base of the surficial till where seepage from the pit would be expected to commence).

*Emergency storage capacity*

The maximum recommended water elevation was determined on the basis of providing emergency storage capacity for an unforeseen event, such as a breach of the Vangorda Creek Diversion. This emergency storage capacity is sufficient to contain 50% of a complete breach of the Vangorda Creek Diversion for a 1-week period during a probable maximum flood event.

The pit was "dry" at the time of mine shut down in January 1998. The water level was allowed to rise and reached the maximum recommended elevation in 2002, at which time the pumping system was activated.

***Seasonal pumping program purpose and objectives***

An annual or bi-annual (every second year) seasonal summer program for pumping water from the pit will continue to be undertaken in order to eliminate the extra costs and increased safety hazards that are experienced in the winter season. Under an annual program, the pumping season would be scheduled to commence in mid July and be completed by late August. The pumping season could be extended under a bi-annual program.

The objective of the summer pumping program will be to draw the pit water level down to a predetermined minimum elevation. The pit water level will then be allowed to slowly increase through the subsequent seasons. The minimum elevation required at the end of the summer pumping season will provide sufficient storage for one or two years of inflow. The determination of whether pumping will take place in the subsequent year or in two years (i.e. bi-annual schedule) will be based on the level of drawdown achieved and on the observed rates of inflow. The typical annual pumping range that is anticipated is approximately 7.0 m. Monitoring of the pit water level will be an integral part of the pumping program.

***Pumping system components***

Pumping from the pit will be accomplished via the existing barge-mounted pumping system. The primary physical components of the system are:

1. steel construction barge with fixed walkway and pivoting anchor point;
2. one electric pump on the barge plus one booster pump located on land at the top of the pit that are rated at 2,000 USgpm delivered to the water treatment plant;
3. combination steel and sclair plastic pipe, approximately 4 km from the barge to the plant; and
4. electrical transformer and switchgear located near the booster pump.

***Pumping system maintenance***

Maintenance of the pumping system will be implemented as appropriate on a preventative or repair basis. This could include inspection, repair or replacement of the pumps, barge or overland pipelines, lowering of the barge anchor point, installation of an alternate land-based pumping configuration or other appropriate activities.

#### 5.3.1.2 Water Treatment System

***Water Treatment system components***

In 2002, the existing Grum/Vangorda Water Treatment Plant was reactivated for treatment of water pumped from the Vangorda Pit. The treatment system involves agitation with lime slurry, addition of flocculent and settlement of treatment sediments in an open air pond. In 2002, in-pit treatment with lime was conducted to determine the treatability of the water and to determine lime consumption rates prior to pumping. Effluent water that is compliant with the water licence is discharged from the settlement pond into the Grum Interceptor Ditch and subsequently enters Vangorda Creek via the Sheep Pad Ponds.

#### 5.3.1.3 Management of Treatment Sediments from the Grum/Vangorda Water Treatment Plant

***Sludge storage capacity maintenance and removal***

The treatment sediment ("sludge") from the water treatment plant accumulates in the settlement pond and is periodically removed as practical to maintain storage capacity. An estimated 100 tonnes of sludge is generated each year. On one occasion during mine operations, sludge was removed to the Faro Main Pit and in 2001, prior to reactivation of the WTP, sludge dating from operation of the WTP during mining operation was removed to the Vangorda Pit. A study is proposed for 2003, as described in this volume under Proposed Studies, that will determine the most appropriate sludge management plan for the duration of the care and maintenance period (i.e. until the FCRP is developed and implemented). The available storage capacity in the settlement pond is adequate to contain sediment produced in the interim period while the 2003 study is undertaken.

#### 5.3.1.4 Grum Pit

***Pit water level***

Runoff and seepage water has been allowed to accumulate in the Grum Open Pit since mine shut down in January 1998. A determination of a maximum recommended water elevation and the timeframe for filling to that elevation is one of the proposed studies described in this volume. The pit water level is not currently anticipated to reach the likely maximum allowable water elevation during the proposed licence period.

***Care and maintenance activities***

The planned care and maintenance activities involve continued monitoring of water quality and pit water elevations. Additional information regarding the Grum Pit is provided in the contingency plan.

### 5.3.2 ROCK DUMP SEEPAGE

#### 5.3.2.1 Seepage from the Vangorda Rock Dump to Little Creek Dam

***Little Creek Dam water compliance***

Seepage from the Vangorda Rock Dump is currently collected in Little Creek Dam and pumped, periodically, into the Vangorda Pit for treatment. The Little Creek Dam water is non-compliant, with zinc being the primary contaminant of concern.

Little Creek Dam is an important environmental protection structure in that it retains water that would have an impact on the receiving environment, if released. The structure has been maintained in good physical condition.

***Maintenance activities for physical stability***

The proposed care and maintenance activities are monitoring for physical stability as described in the site geotechnical and general monitoring protocols and performing those maintenance activities that are required to continue to maintain the structure in good condition. Those maintenance activities might include:

1. investigation and repair, if appropriate, of surficial cracks;
2. upgrading and/or replacement of rip rap and other erosion protection measures;
3. repairs to surficial erosion rills on the downstream slopes; and
4. reconstruction or upgrading of the crest, spillways or other features to the initial design configurations where erosion or mining activities have altered those structures.

***Site geotechnical monitoring***

The site geotechnical monitoring protocol includes the proposed continuation of reading geotechnical instrumentation associated with Little Creek Dam (thermistors and piezometers) on a twice per year basis (spring and fall) and according to the recommendations of the geotechnical engineer. An annual inspection of the dyke and backslope by a professional geotechnical engineer including a review of geotechnical instrumentation data is also included.

#### 5.3.2.2 Groundwater Seepage from the Vangorda Rock Dump

***Groundwater quality monitoring***

Some seepage from the Vangorda Rock Dump may not be intercepted in the surface collection system if it passes through the largely till soils that comprise the aquifer. The quality of groundwater seepage is monitored on a twice per year basis in a series of piezometers that ring the toe of the rock dump.

Groundwater quality will continue to be monitored on a twice per year basis (spring and fall) through the proposed term of the licence as described in the site water monitoring protocol.

#### 5.3.2.3 Seepage from the Grum Rock Dump to Grum Creek

***Runoff and seepage flow paths, monitoring, and diversions***

Runoff and seepage from the Grum Rock Dump flows into Vangorda Creek. A large portion of the seepage, including seepage from the area of the sulphide cell (potentially acid generating rock), passes through Grum Creek. Surface and subsurface seepage water quality is routinely monitored in the Grum Creek channel. Seepage from other areas of the dump is intermittent and is monitored during spring.

A portion of the flow in Grum Creek is diverted into the Moose Pond, which is a bermed depression atop a gravel bank overlooking Vangorda Creek. This partial diversion of Grum Creek has been in place since 1996 and all water entering the Moose Pond has infiltrated immediately into the ground, as per the design of the pond, such that there has been no accumulation of water in the pond. The diversion was constructed to provide protection against elevated sediment loadings in Grum Creek.

The current monitoring of seepage water quality is proposed to be continued as described in the site water monitoring protocol.

#### 5.3.2.4 Grum and Vangorda Rock Dumps Physical Monitoring

***Visual inspection of the dumps***

The Vangorda and Grum rock dumps overlook Vangorda Creek and a large scale failure of these dumps could cause an adverse effect in the creek. The outer crests of the Vangorda and Grum rock dumps are visually inspected on an annual basis by a professional geotechnical engineer.

The current annual visual inspection by a professional geotechnical engineer is proposed to be continued as described in the site physical monitoring protocol.

#### 5.3.2.5 Grum Overburden Dump

***Risks of ARD, runoff and monitoring***

The Grum Overburden Dump is not considered to represent a risk of acid generation or metal leaching since it contains overburden soil stripped from the area of the Grum

Pit. Runoff from the dump flows largely into the Sheep Pad Pond either directly or via the Grum Interceptor Ditch.

The site general monitoring proposes that visual monitoring for potential or occurring erosion into the Sheep Pad Pond or Grum Interceptor Ditch be conducted on a routine basis.

#### 5.3.2.6 Grum Ore Transfer Pad

***Risk of ARD from residual ore, runoff and monitoring***

The Grum Ore Transfer Pad was utilized for the temporary storage of ore en route to the Faro mill. Although, the economic quantities of ore were removed prior to mine closure, residual ore stockpiles and (assumed) low grade ore in the base of the storage area remain and represent a risk of acid generation and metal leaching. A portion of the runoff from the pad reports into the Grum Pit and a portion of the runoff flows to the north into AEX Creek and, ultimately, into the West Fork of Vangorda Creek.

Water quality in surface runoff towards AEX Creek is currently monitored on a quarterly basis.

The current monitoring of seepage water quality is proposed to be continued on a quarterly basis as described in the site water monitoring protocol.

### 5.3.3 GRUM INTERCEPTOR DITCH/SHEEP PAD POND

***Ditch path and upgrades***

The Grum Interceptor Ditch passes runoff water and compliant effluent from the Grum/Vangorda Water Treatment Plant around the Grum Overburden Dump and into the Sheep Pad Pond. The ditch includes some steep sections cut into the native soils that represent a risk of introducing suspended sediment into Vangorda Creek. A substantial upgrade to the ditch was completed in 2001 that included excavation of sloughed soil, widening of the ditch, flattening of side slopes, placement of geotextile and placement of riprap. This type of maintenance and repair work will be continued through to 2008 as appropriate to maintain the ditch in good operating condition.

## 5.3.4 VANGORDA CREEK

### 5.3.4.1 Vangorda Creek Diversion

***Diverting clean Vangorda Creek water from the tailings facility***

The continued use of the Vangorda Creek Diversion through the proposed licence period is important in order to prevent the "clean" Vangorda Creek water from entering the tailings facility, where it might become non-compliant and require treatment.

***Maintenance activities***

Some maintenance work has been required in recent years to repair damage to the flume sections. Therefore, the existing diversion is proposed to be utilized and maintained through the licence period. The maintenance activities might include:

1. clearing of ice;
2. grading, repair or replacement of flume sections; and
3. repairs or upgrading to the rock sand soil backslope.

The site general monitoring protocol describes the proposed continuation of stability monitoring. Monitoring of the benthic invertebrate community on an every second year basis is proposed to be continued at this established location as described in the site biological monitoring protocol.

***Crest retrogression toward Faro Creek diversion***

The stability of the pit wall below the flume and of the rock and soil slopes overlooking the flume has been professionally assessed (SRK 2002). Recommendations for short term mitigation of risks associated with localized failures of the rock and soil slopes overlooking the flume were presented and an action plan was scheduled for completion during 2003. It is considered unlikely that a large scale failure of the pit wall below the flume would affect the performance of the flume for a timeframe of at least 50 years.

***Monitoring activities***

Continued monitoring of the rock and soil slopes overlooking the flume is also proposed to be continued. The adaptive management plan described in this volume of the report will be the management tool used to assess the implications of the information collected.

### 5.3.4.2 Main Stem of Vangorda Creek

***Runoff received and monitoring activities***

The Main Stem of Vangorda Creek immediately below the mine facilities receives runoff from Grum Creek and the Grum rock dump and water quality is monitored.

The proposed care and maintenance activities are continued monitoring of water quality as described in the site water monitoring protocol. Monitoring of the benthic invertebrate community on an every second year basis is proposed to be continued at this established location as described in the site biological monitoring protocol.

#### 5.3.4.3 AEX Creek

***Seepage received and monitoring activities***

AEX Creek is a tributary to the West Fork of Vangorda Creek and receives seepage from a portion of the Grum ore transfer pad, which contains residual mineralized rock. Water quality is monitored at point of entry into the West Fork of Vangorda Creek and this monitoring is proposed to be continued as described in the site water monitoring protocol. Water quality monitoring to date does not indicated any observable indications of acid rock drainage or metal leaching from the ore transfer pad.

#### 5.3.4.4 Haul Road

***Runoff received and monitoring activities***

Runoff from portions of the haul road enters the West Fork of Vangorda Creek. The haul road can represent a source of elevated sediment loadings during precipitation events. The site general monitoring protocol describes the proposed continuation of visual monitoring of drainage cutouts in the safety berms to prevent surface runoff form entering directly into creeks.

#### 5.3.4.5 West Fork of Vangorda Creek

***Monitoring activities***

Water quality in the West Fork of Vangorda Creek is monitored immediately upstream of the confluence with the Main Stem.

This monitoring is proposed to be continued as described in the site water monitoring protocol. Monitoring of the benthic invertebrate community on an every second year basis is proposed to be continued at this established location as described in the site biological monitoring protocol.

#### 5.3.4.6 Lower Vangorda Creek

***Water quality representation and monitoring activities***

Water quality in Lower Vangorda Creek immediately upstream of the Pelly River is representative of the receiving environment in the area of fish habitat and is monitored routinely for water quality and flow, via a continuous flow recorder with data logger.

Continued water quality monitoring and maintenance and operation of the continuous flow recorder are proposed for the licence period as described in the site water monitoring protocol.

Monitoring of the benthic invertebrate community on an every second year basis is proposed to be continued at established locations along the length of Vangorda Creek as described in the site biological monitoring protocol.

## 5.4 SITE ACCESS AND SECURITY

*Maintenance activities for the road access from the Town of Faro*

Road access to the mine site from the Town of Faro must be maintained to a standard for safe passage of heavy loads such as the "float" trucks used to mobilize heavy equipment to the site. Since 1998, summer and winter maintenance of the mine access road has been performed by the Interim Receiver. This has included localized resurfacing, grading, patching, steaming culverts and snow clearing. This work will continue through to 2008 in accordance with activities at the mine site. For example, winter snow clearing may not be required during the winter, or a portion thereof, when no activities are underway or planned at the mine site.

*Security gate control*

A security gate is present at the "guardhouse", located at the entrance to the Faro mill area, which is controlled when scheduled activities are underway at the mine site. The gate provides control on persons entering the mill and mining areas who are required to receive management authorization, sign-in and be in possession of personal safety equipment appropriate for the intended areas and activities. The guardhouse security gate and the procedures that are currently in place will be continued through to 2008 with any amendments made from time to time that are appropriate to controlling access onto the mine site and minimizing public and worker safety risks.

*Road access restrictions*

Road access to the Vangorda Plateau mine site via the heavy haul road must be maintained to a standard for safe passage of heavy loads such as the "float" trucks used to mobilize heavy equipment. Road access to the Vangorda Plateau mine site from the Town of Faro has been blocked since 1998 with the exception of brief time periods when special safety protocols were implemented that allowed direct access for contractor work. This practice of restricting general access except for brief periods where special safety protocols are implemented will continue through to 2008.

Other road accesses to the mine sites will remain blocked to public vehicle traffic through to 2008. These will include the Blind Creek road to the Vangorda Plateau mine site and the fuel truck ramp to the heavy haul road. The ATV crossing of the haul road will be maintained as accessible in order to allow First Nations and recreational access to the land upslope of the haul road.

## 5.5 MATERIALS HANDLING

### 5.5.1 SUPPLIES

*Handling*

Gasoline, diesel fuel and lime will continue to be the major supplies brought to the mine site during the care and maintenance timeframe. All supplies brought to the site will be handled according to applicable regulations (i.e. Transportation of Dangerous Goods) and diligently managed for protection of the environment, public safety and worker health and safety.

***Gasoline and diesel fuel storage***

Gasoline and diesel fuel will be stored in and dispensed from the same storage tanks that have been used since 1998. Of the storage tanks present on the mine site, only one tank will be active for gasoline and one tank for diesel fuel except for mobile tanks used to fuel equipment remotely or during special projects where operating procedures for additional tanks are expressly incorporated into the project work plan. The active tanks will be located within secondary containment berms. Operating procedures for the tanks will follow from those that have been in place since 1998.

***Lime storage***

Lime is currently delivered to site and stored in 20 tonne sea containers pending emptying of the containers at the mill, Cross Valley Pond or Grum/Vangorda water treatment systems. The specific method of delivery and storage may vary through the care and maintenance timeframe depending on the costs and other aspects of delivery. For example, lime may be delivered in bulk trailers that are offloaded directly into the treatment systems or that are stored on site and exchanged for an empty trailer. Regardless of the specific delivery and storage method, lime will be handled on site according to operating procedures that provide for worker health and safety and that follow from the procedures that have been in place since 1998.

### 5.5.2 USED OIL AND LUBRICANTS

***Handling storage and removal***

Used oil and lubricants will be present on site in relatively small quantities as a result of equipment maintenance and repair activities. The liquids will be handled and stored on site following standard industry procedures and, ultimately, removed from the site to an appropriate disposal facility.

## 5.6 OTHER ENVIRONMENTAL PROTECTION AND SAFETY ACTIVITIES

***Proposed continuation of environmental protection and safety activities***

There are several environmental protection and safety activities that are proposed for continuation. These are:

1. The continued identification and provision of secure storage for highly contaminated (hydrocarbons and metals) surficial soils that are having an immediate adverse effect. The intent of this work is to provide adequate environmental protection via the consolidation into secure storage of obviously contaminated soils such as hydrocarbon saturation or mineral concentrate dust.
2. The continued tear down of small buildings that represent an immediate health and safety hazard with the disposal of debris in the existing landfill. The intent of this work is to ensure that an adequate level of worker and public safety is provided.
3. The continued identification and storage of salvage (unused equipment and material that could be reused in the future for their original purpose) and scrap (unused equipment and material that could have residual value for recycle). The intent of this work is to identify and isolate equipment with potential economic value and to provide for safe and environmentally secure storage of scrap.

# 6 PROPOSED NEW ACTIVITIES

The proposed new activities that are described here represent activities that are planned to be initiated or undertaken by the Interim Receiver in order to mitigate short term environmental or health and safety risks, as per the fundamental objectives of the care and maintenance plan that are described in Section 5.1. In some cases, the proposed new activities represent a continuation of initiatives that have been under development for some time and that have been previously presented to the TAC. Further, in some cases, the proposed new activities represent an opportunity for increased training and employment benefits to the Town of Faro and the community of Ross River in the short term.

These proposed new activities have been designed and would be implemented according to these general guidelines:
1. Mitigate short term environmental or health and safety risks.
2. Complement or avoid conflict with possible future closure and reclamation work, such as those concepts are understood at the time by the closure Project Team.
3. Maximize the local training and employment benefits to the Town of Faro and the community of Ross River.
4. Conform to all applicable Acts, Regulations and Best Management Practices.

For activities that require an engineering design, a conceptual design is provided here and it is proposed that a detailed design would be developed prior to implementation in consultation with regulators and interested parties according to the design and intent of the consultation and communication processes described in Section 2.1.5.

## 6.1 BUILDING DEMOLITION AND DISPOSAL

### 6.1.1 DEMOLITION

***A detailed demolition plan will be prepared to provide appropriate environmental control for building demolition***

The on site buildings represent safety and environmental risks of varying degrees. For example, some of the buildings are old and in poor repair and could be a public safety hazard, given the widespread public access onto the site via snowmobiles and ATV's. Also, the interior and exterior surfaces of some buildings are coated with concentrate and ore dust that could be dispersed in the wind or directly ingested by wildlife.

These risks will be addressed by initiating a program for demolition of buildings in a controlled manner that provides for appropriate environmental control during the tear down process. The environmental controls are required to identify and provide appropriate management of any regulated materials such as PCB's (light ballasts), solvents, industrial degreasers, etc. Environmental controls may also be required to anticipate and provide protection against the potential wind dispersion of concentrate and ore dust as interior surface become exposed to the atmosphere.

A detailed demolition plan will be prepared prior to the initiation of work. The plan will describe all of the details relating to the systematic demolition of buildings including the following components:

1. Work Plan.
2. Worker Health and Safety Protocol.
3. Environmental Monitoring and Mitigation Plan.
4. Hazardous and Regulated Materials Identification and Management Protocol.
5. Salvage and Recycle Materials Identification and Management Plan.
6. Cost comparison of off-site transport of demolition waste versus on-site disposal.

## 6.1.2 ON-SITE DEMOLITION WASTE LANDFILL

### 6.1.2.1 Introduction

***On-site disposal of demolition waste is planned***

The current landfill is not considered appropriate for the landfilling of demolition debris generated from the demolition of major buildings for reasons described below (including insufficient capacity), and, therefore, an alternate demolition debris disposal method is required.

A new on-site demolition debris landfill is proposed for the following reasons:

- the costs of bulk material transport of demolition debris from Faro for either scrap or recycle would be extremely high;
- the opportunities for economic recovery of costs from sale of goods for recycle are considered to be very poor;
- disposal of demolition debris into the Main Pit is not considered to be as practical as a new landfill;
- the new landfill is proposed to be located within the already-impacted rock dump area and, therefore, no new ground disturbance would be required;
- the new landfill will have a finite operating life and will then be permanently closed such that it will not become an "open-ended" facility;
- all activities will be controlled and all landfilled materials will be inventoried such that there will be no public or municipal access or placement of undesired materials.

A conceptual design for the demolition landfill, prepared by Gartner Lee Limited, is presented in the following sections.

### 6.1.2.2 Conceptual Demolition Debris Quantity Estimates

**Overview**

An inventory of the existing infrastructure and waste materials at the Faro and Vangorda mine sites was completed that included all buildings, indoor equipment, outdoor equipment, and miscellaneous waste materials (e.g. drum storage, scrap metal waste piles, etc.). A conceptual "order of magnitude" estimate of the demolition waste was then developed. The actual volume of waste to be landfilled after demolition would be smaller than the total insitu volume of all the buildings, equipment and miscellaneous waste and, therefore, a reduction factor was estimated for each category of waste. In the case of scrap metal piles, a bulking factor was used. Ownership of some buildings has been transferred to the Town of Faro since the volume estimate was completed and the overall volume estimate will be refined in the future to accommodate this change.

Operation of the demolition landfill would be for the duration of the active mine reclamation period with supervision and controls provided by the site manager.

**Methodology**

***A summary of the conceptual waste volume is appended***

The footprint of the existing buildings or other large items was measured individually. The height of each building was calculated using an inclinometer to sight the top of the structure (measured angle) and the measured horizontal distance to the building. The size of other large items such as above ground tanks or silos was completed in a similar manner. The reduction factor assigned to each category of waste depended largely on the type of structure or waste. For buildings, the reduction factor assigned depended on the type of structure. For example, it was assumed that building shells consisting of sheet metal and support beams would compress into about 5% of the insitu volume when demolished. Buildings or structures containing a significant amount of concrete were assumed to compress down to 10% to 25% (silos) of the insitu volume. It was also assumed that concrete structures above ground (floors, stairs, retaining walls) would be deconstructed and placed into the landfill, but foundations below ground would not be removed.

**Conceptual Volume Estimates**

***The landfill will require a total volume of approximately 212,000 $m^3$***

The total estimated conceptual waste volume to be landfilled from both Faro and Vangorda sites is 135,000 $m^3$, which includes the 10,000 $m^3$ allowance for the above ground storage tanks (AST's).

However, the total volume required for the landfill must also make provision for intermediate cover soil (soil used to cover waste and fill voids) and a final soil cover for the landfill. It is assumed that the waste-to-soil (intermediate) ratio will be 3:1, which would require 45,000 $m^3$ of airspace.

The total volume required for waste and intermediate cover soil would then be 180,000 $m^3$. Assuming the waste and intermediate cover soil is placed to a maximum height of 25 m and sloped between 3H:1V to 4H:1V, the area required for the demolition landfill would be about 28,000 $m^2$.

The final cover would likely be 1.15 m thick (1.0 m soil and 0.15 m topsoil) and would require about 32,000 $m^3$ of airspace. Therefore, the landfill will require a total volume of approximately 212,000 $m^3$.

### 6.1.2.3 Siting

***Three potential sites were assessed, and Site 2 is preferred***

After inventory of the two mine sites was completed, potential landfill sites were visually assessed by Gartner Lee Limited. Since the majority of the waste (over

95%) would originate from the Faro site, the focus for potential locations was at the Faro site only. A landfill at the Vangorda mine site is not considered to be cost effective. Three potential locations at the Faro mine site were identified (Figure 21):

Site 1 - within the pit that forms the existing landfill;
Site 2 - adjacent to a large waste rock pile located northeast of the Faro mill (known as "Faro Ranch Dump"); and
Site 3 - on top of the Main Rock Dump.

None of the three potential landfill sites would cause new land disturbance as all are located within rock dump areas. The advantages and disadvantages of each location are described in Table 10.

**Table 10. Assessment of Potential Landfill Sites at the Faro Mine Site**

| Location | Advantages | Disadvantages |
|---|---|---|
| 1 | • Slightly closer to mill site. | • Requires construction of an access road;<br>• Placement of waste would have to start at the bottom, which will be slow and costly;<br>• Existing waste at bottom of landfill has not been characterized. It would be covered and there is a possibility that it would have to be removed some time in the future. |
| 2 | • Could make use of existing waste rock pile to reduce cover costs;<br>• Placement of waste may be from top and bottom (fast placement of waste);<br>• Metals or other materials could be recovered at some time in the future. | • Further from mill site than existing landfill. |
| 3 | • Metals or other materials could be recovered at some time in the future. | • Longer haul distance than the other two potential sites, resulting in lower productivity and higher costs;<br>• Waste placement would require a larger area than the other two sites resulting in a larger requirement for final cover material and higher costs. |

Based on the comparison of advantages and disadvantages, Site 2 ("Faro Ranch Dump"), adjacent to the waste rock pile, is recommended.

#### 6.1.2.4 Placement of Waste

*Waste materials will be cut to suitable dimensions to reduce the volume of waste in the landfill*

The waste to be placed into the landfill will be classified as construction and demolition waste. The majority of the materials will be bulky and will not compact to any great extent. Hence, in order to reduce the volume of waste in the landfill and to reduce the amount of soil required to fill voids within the waste, it is imperative that the waste materials are cut to suitable sizes and shapes to allow stacking to the maximum extent possible. The size and shape of the deconstructed materials will then likely depend on the size and type of the equipment available. It is assumed that a crane with an electromagnet and/or an excavator with thumb would be used to stack the deconstructed materials to minimize creation of void spaces.

The waste materials should be stacked as closely together as possible in lifts that are about 3 m high. The waste at the outer edge of the landfill should be placed with a slope between 3H:1V and 4H:1V slope, depending on the final design. Once the waste height has reached the desired lift height, soil cover should be applied to fill the voids between waste materials. It is anticipated that a dragline (crane and bucket) or large dozer will place the soil cover. After soil has been placed, the waste and soil should be compacted with several passes of a compactor, dozer or a tracked excavator (whichever is available). Placement should be continued in this manner to match the grades of the final landfill design.

#### 6.1.2.5 Final Cover

*Sloping and compaction of the final cover*

The top of the waste will be sloped at a 5% grade and the sideslope should be constructed to a 4H:1V grade to promote surface runoff (Figure 22). Final cover will be placed on top of the waste and likely consist of 1 m of compacted soil. The final soil will be compacted in lifts to provide a relatively dense and stable cover. Furthermore, till soil is available at the site and when compacted, it should form a low permeable barrier that will limit the amount of surface water infiltration through the cover to the waste. If available, a layer of topsoil will be spread over the final cover to promote re-vegetation, which will further reduce the amount of surface water infiltration and also prevent erosion of the final cover. If topsoil is not available, the final cover may be hydroseeded. A hydroseeded cover should result in some vegetative growth and erosion protection. Erosion control blankets (ECB) may be used to provide additional temporary protection from erosion.

#### 6.1.2.6 Surface Water Management

Surface water control ditches will be excavated to intercept surface water flowing towards the covered waste. The ditches will carry the water away from the waste in a controlled manner. Use of surface water ditches will reduce the amount of water available for infiltration and will also reduce the potential for erosion of the final cover.

## 6.2 INVESTIGATION AND REMEDIATION OF HYDROCARBON CONTAMINATED SOIL

### 6.2.1 APPROACH

A preliminary investigation of hydrocarbon contaminated soils will be undertaken to provide an estimate of soil volumes and the types of hydrocarbons present. This information is necessary to initiate final design and construction of the proposed on-site bioremediation cells.

The investigation may involve test pit sampling in areas of potential concern and analysis of samples for a variety of parameters. The investigation may adopt an iterative approach, where appropriate, consisting of reconnaissance sampling followed by detailed infill sampling.

The intent will be to identify and characterize hydrocarbon contamination in areas that are clearly above standard remedial guidelines and benchmarks, as a continuation of the efforts of the Interim Receiver to date. The investigation proposed here will not take the form of a "Phase 2 Environmental Site Assessment" but rather to investigate areas of clear contamination such that the remediation of the most highly contaminated areas can be initiated even while the FCRP is under development.

### 6.2.2 POTENTIAL AREAS AND CONTAMINANTS OF CONCERN

There are several locations at the mine site (Faro Mine Site and Vangorda Site) where soil is suspected or known to be contaminated with petroleum hydrocarbons. Table 11 lists the areas of suspected soil contamination and the potential contaminants of concern (PCOCs):

**Table 11. Areas of Suspected Soil Contamination and the Potential Contaminants of Concern (PCOCs) at the Faro Mine Sites**

| **Faro Mill (Faro Mine Site)** | **PCOCs** |
|---|---|
| Heavy duty equipment repair shop | Diesel, waste petroleum hydrocarbons, hydraulic oil, solvents, antifreeze |
| Tire shop and light vehicle shop | Gasoline, waste petroleum hydrocarbons, hydraulic oil, solvents, antifreeze |
| Former used oil storage area/coal storage | Gasoline, diesel |
| Existing active AST diesel | Diesel |
| Existing active AST gasoline | Gasoline |
| Hydraulic fluid storage | Hydraulic oil |
| Partially buried UST | Used oil |
| **Faro Pit (Faro Mine Site)** | |
| Lube shack | Waste petroleum hydrocarbons, hydraulic oil, solvents, antifreeze |

| | |
|---|---|
| Tank farm | Diesel |
| **Grum Pit (Vangorda Site)** | |
| Maintenance shop-no concrete floor | Gasoline, diesel, waste petroleum hydrocarbons, hydraulic oil, solvents, antifreeze |
| Fuel tank farm | Diesel, antifreeze |
| Lube shop | Diesel, waste petroleum hydrocarbons, hydraulic oil, solvents, antifreeze |
| Contractor maintenance area | Waste petroleum hydrocarbons, hydraulic oil, solvents, antifreeze |
| Existing AST gasoline | |

## 6.2.3 ON-SITE BIOREMEDIATION

### 6.2.3.1 Introduction

***On-site bioremediation is planned***

Given the high costs of bulk material transport from Faro, an on-site treatment facility would be beneficial to avoid the high costs of transporting soils off site. A conceptual design of a bioremediation cell, prepared by Gartner Lee Limited, is presented in the following sections.

Initiating this activity during the care and maintenance timeframe (2004 to 2008) will ensure that the bioremediation process is well underway or completed for the initiation of mine reclamation activities.

### 6.2.3.2 The Bioremediation Process

***Bioremediation, a technology that utilizes microbial degradation, can be applied using an on-site biotreatment facility***

Bioremediation is a remediation technology that uses microbial degradation to treat soil contaminated with organic compounds (e.g. hyrdrocarbons). A bioremediation cell is a temporary containment structure that can be used to treat the contaminated soil above-ground.

Bacteria is naturally present in soils and consumes the organic compounds, which is usually the contaminant. This natural degradation of contaminants can be accelerated by adding fertilizer (nutrients) to the soil and controlling moisture and oxygen levels to promote microbial growth. The addition of nutrients, air, moisture stimulates microbial activity and their growth is enhanced, which increases the rate of contaminant consumption or degradation. In some cases, the soils are inoculated with special microbes that promote increased degradation rates.

An on-site biotreatment facility can be lined or unlined, covered or uncovered and may or may not contain a leachate collection system. A biotreatment facility may have a system in place where forced air is provided through a pipe network or air is manually applied by turning the soil using earth moving equipment such as a tracked excavator. A biotreatment facility is generally designed according to site-specific conditions and regulatory requirements.

On-site biotreatment facilities have been successful at reducing contaminant levels in soils containing hydrocarbons. Lighter hydrocarbon products (gasoline, diesel) are typically degraded more efficiently than heavier hydrocarbons (heating or lubricating oils). Hence, more time is required to treat soils contaminated with heavier end hyrdrocarbons.

The presence of heavy metals and additives in lubricating oils may adversely affect bioremediation (i.e. by destroying organisms or limiting microorganism growth). These issues must be considered in the design of the facility.

#### 6.2.3.3 Considerations for Northern Applications

***The summer months are likely to be the only months where bioremediation will occur at the site***

Extreme climatic conditions make bioremediation difficult in northern regions because biodegradation is limited at temperatures of less than 10°C (USAEC ETL 1110-1-176). As a result, most degradation will only occur in the warmer months of the year. At the Faro site, June, July, August and September are likely the only months where biological activity will be sufficient to reduce petroleum hydrocarbon concentrations in soil. Furthermore, a large snow pack may inhibit access to the site for soil tilling or turning, which means biological activity will likely be dormant or very low from fall to spring. Snowmelt events may also cause considerable run off and must be adequately controlled to maintain proper moisture levels in the soil for bioremediation.

Despite these difficulties, many researchers have successfully treated contaminated sites in northern climates (Mohn, W. W., *et al.* 2001, Reynolds *et al.*, 1998). Mohn et al., indicated that significant reduction in hydrocarbon contamination can occur in biopiles that have been treated with fertilizer within 1 year at biopile sites located in the Arctic. The study further suggests that a clear plastic liner was a significant help in maintaining higher temperatures. However, snow precipitation at these sites was minimal. Similarly, Reynolds *et al.*, have shown biodegradation to occur in a biotreatment facility (landfarm) located in Fairbanks, Alaska. However, problems were encountered when trying to manage the excessive soil moisture due to spring melt. Reynolds *et al.*, 1998 concluded that physical snow removal in the spring was necessary to limit excessive moisture. However, in this case the landfarm was left uncovered.

#### 6.2.3.4 Possible Locations

***Five siting criteria were used to assess possible locations of the biotreatment facilities for the Faro and Vangorda Plateau mine sites***

A siting assessment was conducted by Gartner Lee Limited to identify possible locations of the biotreatment facility. The preliminary site assessment identified two potential locations at the Faro mine site and two potential locations at the Vangorda Plateau mine site. The locations of these sites are shown on Figures 21 and 23, respectively.

The following siting criteria were applied in assessing the locations:

1. Is the facility located close to the source to reduce transport costs?
2. Is the area accessible and out of the normal work places?
3. Are sufficient soils and gravel available reasonably local for construction?

4. Is the topography at a suitable grade (1 to 4 %)?
5. Are there potential pathways for contaminant migration?

Based on the five criteria above, the preferred location for the biotreatment facility at the Faro mine site is close to the present tank farm located north of the Faro lube shack and adjacent to the proposed demolition waste landfill (Figure 21). The area is relatively flat and large and is central to the lube shack and mill site at the Faro Mine Site. An alternate location of the treatment facility is on top of the Main Rock Dump.

The preferred location for the biotreatment facility at the Vangorda Plateau mine site is near the present Lube Shack and Tank Farm (Figure 23). The advantage of this area is that it is close to contaminant sources and there is access to electrical power. The site is approximately 40 m long by 40 m wide and is capable of holding approximately 2,500 to 3,000 $m^3$ of soil, depending on the cell design. An alternative location was selected on top of the Grum Rock Dump.

These locations are within previously disturbed areas of the rock dumps.

#### 6.2.3.5 Design Considerations

**Testing**

***Chemical testing, treatability studies and a pilot study will be conducted prior to the construction of a full-scale treatment facility***

Before construction of the biotreatment facility, tests must be completed to characterize the contamination and determine the nutrient loading rate.

Chemical testing is completed on the soils to help characterize the types of contamination. Typically, soil samples are sent to an analytical laboratory for analyses of total petroleum hydrocarbons (TPH), oil and grease (O&G), benzene, toluene, ethylbenzene and xylene (BTEX). The pH of the soil is also tested to determine if a buffering agent is required. Because solvents are suspected at the some of the truck maintenance facilities at the Anvil Range site, additional testing should be completed for volatile organic compounds. The soil should also be tested to determine the concentration of heavy metals that may exist in the suspected contaminated soils. Other factors to consider that will affect biodegradation rates are the moisture content of the soils, soil grain size and the ambient air temperature.

Treatability studies are required to determine biodegradability of the contaminants and the nutrient (fertilizer) requirements. These studies are performed by mixing the contaminated soils with a various amounts of fertilizer to determine biodegradation success and the rate of biodegradability. Buffering material to regulate soil pH may be required if the soil is acidic or basic. Treatability studies should be used to determine the initial nutrient loading rates and assess what rate of nutrient addition will be toxic to the microorganisms (i.e. lethal doses of nutrients will prevent degradation).

Pilot studies are often recommended when it is necessary to ascertain if field conditions or the type of contamination is conducive to biodegradation. A pilot study may be beneficial for the Anvil Range site to determine the rate of biodegradation under cold weather conditions.

### Design of full-scale Treatment Facility

Once the tests have been completed and the nutrient loading rates are determined, the design of the biotreatment facility can be undertaken.

#### Size

***Each bioremediation facility will consist of individual biocells with volumes of about 2,000 $m^3$ each***

The size of the biotreatment facility is directly related to the amount of soils needed to be treated (i.e. from a Phase II/III Environmental Site Assessment) and the amount of buffering agent added to the soils. Based on very preliminary estimates, without the aid of subsurface investigation, the subsurface soil contamination is projected to range from 15,000 $m^3$ to 25,000 $m^3$. This suggests that the facility will require an area of approximately 150 m by 200 m. However, given the distance between the Faro and Vangorda Plateau mine sites, two smaller treatment facilities, one located at each mine site, are recommended. The advantage of two separate sites is lower hauling costs for the contaminated soil. Another advantage is that it is easier to bioremediate smaller soil piles (nutrient addition, moisture conditioning and turning).

Each bioremediation facility would consist of individual cells (biocells) approximately 12 m wide by 100 m long. Each cell would contain soils no greater than 2 m high; hence, the volume of each cell would be about 2,000 $m^3$. The division of the facility into cells will facilitate maintenance and operations and allow the use of a factory seamed liner, thereby reducing the need to complete field seams. GLL anticipates that the biotreatment facility will be comprised of several treatment cells. Figure 24 provides a schematic sketch of a typical treatment cell.

#### Leachate Control

***Each biotreatment cell will be bermed and lined to prevent leachate from infiltrating the ground***

Each biotreatment cell would be bermed and lined to prevent leachate from infiltrating the ground. Each biocell would have a cushion sand base layer overlain by a 0.75 mm (30 mil) thick "Arctic Liner" geomembrane. An upper cushion layer of sand or protective geotextile would be placed above the base liner, if required (depends on material used for leachate collection). Leachate drainage pipes would be lain on top of the liner followed by a layer of gravel approximately 15 cm thick. Soil berms around each cell would be approximately 1 m high.

The base of the cell would be sloped at a minimum of 1% but less than a 4% grade to allow leachate to collect in a sump located at the lowest corner of the cell (Figure 24). Once contaminated soils are in place, a reinforced polyethylene tarpaulin or clear polyethylene sheeting would be used to cover the biocells to prevent precipitation infiltration.

Leachate collected from the sump would be collected and redistributed on top of the soils to maintain moisture conditions. Nutrients may be added to the circulated leachate to maintain an adequate nutrient balance in the soils. Distribution of the leachate will be via a network of perforated hoses or pipes. If excess leachate is generated (more than required to maintain soil moisture), a holding tank would be required to store the excess leachate.

#### 6.2.3.6 Operation Considerations

**Excavation of Contaminated Material**

Once contaminated soils are delineated and the biocells constructed, contaminated soil may be excavated and transported to the biotreatment facility. In general, soils exceeding 10% oil and grease content tend to clog pore space and limit the effectiveness of biodegradation at the treatment facility. If soils containing over 10% oil and grease are encountered, other treatment options for these soils should be evaluated including possible dilution of oil & grease concentration with clean soils for subsequent bioremediation.

Hydrocarbon contamination is commonly associated with the fine fraction (sand size and smaller) of the soil. If this is confirmed for the Anvil Range site (i.e. a Phase II/III Environmental Site Assessment), then soils should be screened to separate the coarse and fine fractions (sized according to the site specific data). The fine fraction would be transported to the on-site facility and placed in the biocells and the coarse fraction, which would likely not be considered to be contaminated, could be available for general use.

**Soil Turning**

***Mixing will ensure more efficient remediation***

Contaminated soils in each biocell would be turned to aerate the soils. The additional influx of air into the soils enhances aerobic biodegradation of contaminants. Turning of soils may be completed by an excavator or front end loader.

It is recommended that the piles be turned at least twice annually. Due to severe weather conditions during winter, it is unlikely that the piles could be turned between December and March. Hence, the soil in the biocells should be turned at end of spring (when snow has partially or completely melted) and in the fall. An additional soil mixing in the summer could be beneficial in reducing the remediation time required. Before turning, the top liner must be removed from each cell and replaced after completion of the turning.

**Soil Testing**

Soil in the biocells should be analyzed on an annual basis. Soil is typically analyzed after a fall turning to assess biodegradation. Microbial enumeration analyses (plate counts) may also be performed, in addition to hydrocarbon analyses, to determine the viable microbial population in the biocell.

## 6.3 MAINTENANCE OF ACID GENERATING MATERIALS

### 6.3.1 OVERVIEW

***Highly acid generating piles are proposed for interim reclamation measures while the FCRP is being developed***

There are numerous areas of acid generation and metal leaching risks on the mine sites, ranging in scope from small discreet piles, to individual portions of the larger rock piles and tailings impoundments to the large rock piles and tailings impoundments themselves. The water licence (IN89-002) requires that waste dumps be maintained to minimize acid generation. Although, final reclamation of waste dumps is to be undertaken following development and approval of the FCRP, there are maintenance activities that will minimize acid generation during the proposed care and maintenance timeframe.

Some of these materials are relatively small quantities of highly acid generating material that are known to be highly oxidized and possibly having a detrimental impact on the environment. For these materials, interim reclamation measures are proposed that will mitigate environmental impacts while the FCRP is undergoing development and approval.

### 6.3.2 OXIDIZED FINES NEAR THE CRUSHER STOCKPILE

***Oxidized fines piles should be consolidated and covered as an interim reclamation measure***

Several discreet piles of oxidized fines are located near the crusher stockpile that are, by definition, highly acid generating and that are known to be releasing contaminants at a high rate. Small pools of water that form on surface at these piles are highly acidic and are a human health and wildlife hazard.

It is proposed to consolidate and cover these piles with a 1.0 m cover of compacted silt or clay in order to mitigate the release of acidity and contaminants in the short term. The work would take place in the crusher stockpile area in order to minimize the work required to consolidate the piles. The consolidated pile would be in the order of 5 m high with side slopes flatter than 3H:1V to facilitate cover placement. The cover would not need to be vegetated for this interim reclamation work.

Removal of this material to the Faro Main Pit is not preferred in this case because of the (assumed) extremely high stored load of contaminants (i.e. greater available stored load than tailings or waste rock) and acidity that would be immediately released into the pit water and that might have a detrimental effect on pit water. The accessible location of the piles and the relatively low work effort required to consolidate the piles offer advantages to covering as the interim reclamation measure.

### 6.3.3 OXIDIZED FINES IN THE VANGORDA ROCK DUMP

The oxidized fines in the Vangorda rock dump are demonstrated to be highly acid generating and to be releasing contaminants at a high rate. The acidic pH and extremely high metal concentrations observed in seepage from drains 5 and 6 of the Vangorda rock dump are considered to be related to the presence of the oxidized fines in the drainage area. This extremely poor water quality increases the treatment requirement for lime and increases the risks related to possible subsurface seepage losses to the environment.

It is proposed to cover this pile with a 1.0 m cover of compacted clay in order to mitigate the release of acidity and contaminants in the short term. The cover would be extended beyond the visible pile of fines to cover the projected total extent of the fines pile, which is known to be partially covered by other rock. The cover would not need to be vegetated for this interim reclamation work.

Removal of this material to another location is not preferred in this case because of the existing location within the water collection system and the difficulty in excavating the complete pile.

### 6.3.4 OTHER AREAS CURRENTLY UNIDENTIFIED

An updated assessment of relatively small piles of highly acid generating materials will be conducted with the specific intent of identifying any additional areas where this type of interim reclamation would provide a substantial short term mitigation of contaminant generation and release.

If any such areas are identified, then an interim reclamation plan will be developed and implemented.

# 7 ADAPTIVE MANAGEMENT PLAN

## 7.1 INTRODUCTION

### 7.1.1 OVERVIEW

The planning and prioritization of care and maintenance activities will be carried out according to the same model that has been followed since 1998. Specifically, care and maintenance objectives are driven by a risk-based management approach that identifies short-term risks in any given year, which are then addressed.

Additionally, the care and maintenance program includes an Adaptive Management Plan that provides a framework for responding to unforeseen events related to the degradation of previously developed mine facilities such as the Faro rock dumps, the Faro and Vangorda Creek Diversions, the Grum Pit, the Rose Creek Tailings Facility and the Grum Rock Dump. The Adaptive Management Plan consists of monitoring requirements, triggers and either proposed actions or planning/consultations mechanisms for determining actions.

### 7.1.2 RISK BASED APPROACH TO MANAGEMENT PLANNING

***Two key aspects of management planning and components of the risk-based approach***

In order to fulfill their mandate to provide environmental protection and the water licence requirements to maintain all works in good condition, the Interim Receiver conducts an annual management assessment of all of the defined risk elements. This process identifies issues that may not present an immediate concern with respect to non-compliance but have the potential to require an action plan under certain circumstances or events. A risk-based approach is used, which ensures that two key aspects of management planning are provided:

1. All risk elements are included and assessed.
2. A standard methodology is applied to assess all risk elements according to likelihood and consequences such that a risk classification rating is assigned that ranks the risk elements from high to low priority.

The approach is as follows:

1. Identify and update risk elements: risk elements are identified, as well as potential risk-events.
2. Analyze risk: the risk of each event is analyzed against a number of likelihood and consequence criteria and a risk classification rating is determined.
3. Evaluate risk and determine acceptability: the risk estimate is compared against the criteria for acceptability using the "ALARP" principle, whereby it is desirable to manage risk until it is "As Low As Reasonably Practicable".
4. Management Decision: Decide to accept or respond to the risk represented by each element.
5. Develop Care and Maintenance Plan: Develop and implement plans to manage immediate risks. An Adaptive Management Plan then takes into account possible

future events of high environmental risk identified by the risk-based management approach to provide an appropriate response framework.

### 7.1.3 APPROACH TO ADAPTIVE MANAGEMENT

***The AMP provides an approach to respond to unforeseen events. It must be linked to a monitoring program and requires active management***

The Adaptive Management Plan ("AMP") is a management tool that provides for a consistent and predictable approach to responding to unforeseen events. The AMP envisions an event that could happen, defines a response trigger and describes the general responses and the approach to the determination of appropriate responses that could be implemented. This provides the site manager with a pre-planned framework within which decisions can be quickly and efficiently made and provides regulators with the security of a consistent and predictable approach to unforeseen events.

Since the actual details of an unforeseen event are, by definition, unknown, the AMP does not provide detailed description of responses. The AMP, rather, provides a description of a range of possible responses that are staged to varying degrees of severity of the event that has been envisioned.

To be effective, the AMP must be linked to a monitoring program that is designed to provide an indication of when a response trigger is activated. In this way, confidence is provided that the information necessary for possible activation of response triggers is gathered in a manner that is complementary to the AMP. For example, in certain cases, monitoring of water quality at certain locations, at certain frequencies and for certain parameters may be appropriate to initiate some response triggers while physical monitoring and observations may be appropriate to activate other response triggers.

Also, the AMP requires the active management of site conditions and a consistent management review of monitoring information. This ensures that the monitoring results are regularly checked for activation of response triggers on a schedule that is complementary to the AMP. For example, some events might quickly cause an adverse environmental effect and these require frequent management review of triggers while other events may be evolutionary in nature and require less frequent management review.

### 7.1.4 ADAPTIVE MANAGEMENT PLAN FOR THE ANVIL RANGE MINE COMPLEX

The general approach for the AMP for the Anvil Range Mine Complex is to provide, for a number of envisioned events, a staged response that accompanies an assessment of the severity of the event.

***Envisioned Events***

The events that have been envisioned for the Anvil Range Mine Complex AMP are summarized in Table 12 and are described in additional detail in the subsequent sections.

### Table 12. Summary of Adaptive Management Plan

| AMP Event | Trigger | Possible Consequences | Response |
|---|---|---|---|
| Degraded Water Quality the North Fork of Rose Creek. | Water quality in the North Fork of Rose Creek contains sustained concentrations of substances at levels that are likely to cause a significant adverse effect. | Exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in the North Fork, the Rose Creek Diversion channel and possibly further downstream in Rose Creek, Anvil Creek, and the Pelly River. | Staged. Section 7.2 |
| Degraded Groundwater Quality in Rose Creek Valley Aquifer | Water quality in Rose Creek Valley aquifer immediately downgradient of the tailings deposits contains sustained concentrations of substances at levels that are likely to cause a significant adverse environmental impact in Rose Creek. | Exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Rose Creek, Anvil Creek and the Pelly River. | Staged. Section 7.4 |
| Degraded Seepage Quality from the Grum Rock Dump. | Water quality in Vangorda Creek contains sustained concentrations of substances at levels that are likely to cause a significant adverse environmental impact in Rose Creek that are caused by seepage from the Grum Rock Dump. | Exposure of aquatic resources, terrestrial resources, and human resource users to increased levels of contaminants in the Creek and the Pelly River. | Staged. Section 7.5 |
| Water Level in Grum Pit Reaches Maximum Desired Elevation | The water elevation in the Grum Pit reaches the maximum desired operating range. | An uncontrolled release of non-compliant water to the receiving environment in Vangorda Creek. This could result in the exposure of aquatic resources, terrestrial resources, and human resource users to increased levels of contaminants in Vangorda Creek and the Pelly River. | Staged. Section 7.8 |
| Wind Dispersed Tailings Result in Adverse Effects in the Terrestrial Environment | Mitigation measures to be developed and implemented by 2005, based on the results of the 2002 and follow up studies of environmental contaminants in the terrestrial environment. | Increased adverse effects on wildlife and human resource users. There could also be potential effects on socio-economic use, traditional/ cultural use and human health. | Staged. Section 7.6 |
| Complete Breach of the Faro Creek Diversion | A breach of the Faro Creek Diversion into the Main Pit due to failure of the northeast pit wall. | Uncontrolled release of non-compliant water into the environment. | Staged including immediate, secondary and long term. Section 7.3 |
| Breach of the Rose Creek Diversion Canal into the Intermediate or | A breach of water from the Rose Creek Diversion Canal into the Intermediate or Cross | Depends on the location and extent of the breach and the magnitude of the inflows from Rose Creek. | Staged including immediate, secondary and long term. |

| AMP Event | Trigger | Possible Consequences | Response |
|---|---|---|---|
| Cross Valley Ponds | Valley Ponds as a result of overtopping or breaching of the containment dyke. | | Section 7.9 |
| Complete Breach of the Vangorda Creek Diversion | A breach of the Vangorda Creek Diversion into the Vangorda Pit due to the failure of the north pit wall. | Uncontrolled release of non-compliant water into the environment | Staged including immediate, secondary and long term. Section 7.7 |
| Failure of the Vangorda Creek Haul Road Culvert | Failure of the Vangorda Creek haul road crossing that causes a complete or partial failure of the haul road embankment. | Exposure of aquatic resources, terrestrial resources, and human resource users to increased levels of sediment in Vangorda Creek | Staged including immediate, secondary and long term. Section 7.11 |
| Failure of the Intermediate Dam | Failure of the Intermediate Dam | Exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Rose Creek, Anvil Creek, and the Pelly River. | Staged including immediate, secondary and long term. Section 7.10 |

## 7.2 DEGRADED WATER QUALITY IN THE NORTH FORK OF ROSE CREEK

### 7.2.1 TRIGGER

*The trigger for implementation of contingency measures*

Water quality in the North Fork of Rose Creek could be negatively affected by rock dump seepage, seepage or overflow from the Zone 2 Pit, seepage from the disturbed area between the creek and the Zone 2 Pit and the rock drain at the haul road crossing. The trigger for the implementation of contingency measures is proposed to be water quality in the North Fork of Rose Creek.

Specifically, the action trigger is proposed to be "water quality in the North Fork of Rose Creek contains sustained concentrations of substances at levels that are likely to cause a significant adverse environmental impact", as per the wording that is in the current Faro water licence (QZ95-003, clause 39).

### 7.2.2 ENVIRONMENTAL CONSEQUENCES

The environmental consequences of degraded water quality in the North Fork of Rose Creek could result in the exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in the North Fork, the Rose Creek Diversion canal and, possibly, further downstream in Rose Creek, Anvil Creek and the Pelly River. Zinc is currently the primary contaminant of concern and zinc and sulphate are currently the primary indicators of acid rock drainage. However, the consideration of degraded water quality should include other metals and contaminants which could source for the rock dumps, open pits and other mine facilities.

### 7.2.3 RESPONSE

***Staged response***

As per the general approach to the adaptive management plan, a staged response to degraded water quality in the North Fork of Rose Creek will be implemented if the response trigger is activated.

***Initial response***

The initial response to the trigger will be to identify, in a broad sense, the source of contamination and to increase the monitoring intensity in the creek to verify and isolate the suspected source of contaminants. This may require increasing the frequency and number of samples collected, conducting a test pitting program, consulting with technical experts and consulting with regulatory agencies. Initial notification to the water inspector and to the Water Board will be made at this time.

***Mitigation depending on the source of contamination***

If the source of contamination is identified to be seepage from all or a portion of the rock dumps, then a short term mitigation measure will be implemented to control the migration of contaminants at the source while a longer term mitigation plan is implemented. This might include pumping, berming, ditching or whatever other means are possible to the degree where water quality is not further degraded in the short term. A longer term mitigation system will then be designed, permitted and implemented such that the contaminants are securely prevented from entering the creek to the degree where water quality in the creek returns to the initial condition. This would be designed to provide security until the scheduled implementation of the Final Reclamation Plan. This may involve surficial ditching near the toe of the rock dump(s) that directs seepage water to a collection sump, from where the water would be pumped into the Main Pit.

If the source of contamination is identified to be seepage from the Zone 2 Pit, then the water level in the Zone 2 Pit will immediately be lowered to the lowest achievable elevation. The Zone 2 Pit dewatering system will be immediately re-evaluated and upgraded or repaired, as appropriate.

If the source of the contamination is identified to be groundwater flow that is too deep for interception by surface ditching, then a groundwater interception plan, or another long term remedial measure, will be designed, permitted and implemented.

### 7.2.4 MONITORING AND MANAGEMENT REVIEW

***Site water monitoring protocol and review of water quality monitoring***

The type of monitoring information required is surface and subsurface water quality. The locations required are several locations along the North Fork of Rose Creek, surface seepage from the rock dumps and subsurface flow from the rock dumps. The site water monitoring protocol provides for the routine collection of this information on a quarterly, semi-annual or annual basis and this is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A management review of this water quality information will be conducted initially during preparation of the monthly water quality data report and subsequently during preparation of the annual environmental report. This is considered to be adequate management review for activation of the response trigger, if required.

## 7.3 DEGRADED WATER QUALITY IN THE ROSE CREEK VALLEY AQUIFER

### 7.3.1 TRIGGER

*The trigger for implementation of contingency measures*

Groundwater in the Rose Creek valley aquifer collects seepage and contaminants released from the surface tailings impoundments and has the potential to become contaminated to the degree where discharge from the aquifer to Rose Creek may result in a sustained adverse effect in Rose Creek. The trigger for the implementation of contingency measures is proposed to be groundwater quality in the Rose Creek Valley aquifer below the downstream extent of the tailings deposits.

Specifically, the action trigger is proposed to be "water quality in the Rose Creek Valley aquifer immediately downgradient of the tailings deposits contains sustained concentrations of substances at levels that are likely to cause a significant adverse environmental impact in Rose Creek", which is similar to wording that is in the current Faro water licence (QZ95-003, clause 39).

### 7.3.2 ENVIRONMENTAL CONSEQUENCES

The environmental consequences of degraded water quality in the Rose Creek Valley aquifer could result in the exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Rose Creek, Anvil Creek and the Pelly River. Zinc is currently the primary contaminant of concern and zinc and sulphate are currently the primary indicators of acid rock drainage. However, the consideration of degraded water quality should include other metals and contaminants which could source for the rock dumps, open pits and other mine facilities.

A substantial amount of work has been completed to characterize the environmental conditions in the Rose Creek Valley aquifer, as described in Volume 2, Description of the Existing Environment. This work serves to provide information that is important to both the short term needs of the care and maintenance plan (via assessing consequences and triggers in the Adaptive Management Plan) and the long term needs of the FCRP that is being developed by the closure Project Team.

### 7.3.3 RESPONSE

*Staged response*

As per the general approach to the adaptive management plan, a staged response to degraded water quality in the North Fork of Rose Creek will be implemented if the response trigger is activated.

*Initial response*

The initial response to the trigger will be to increase the monitoring intensity to verify the initial indication, which activated the trigger, that groundwater contamination is present. This may require extra groundwater sampling.

*Confirmation of the water balance projection*

Upon confirmation of the level of groundwater contamination that is present, the water balance projection will be confirmed to provide the best indication possible of the anticipated timeframe for adverse effects in Rose Creek and the severity of the anticipated effects. Also, the available information will be evaluated for indications of dominant source areas within the Rose Creek Tailings Facility.

A response plan will be designed, permitted and implemented with the intent of mitigating the adverse effects that were predicted by the water balance projection. This plan might include:

*Possible components of a response plan*

1. Mitigation of the source area(s).
2. Installation of groundwater pumping wells to intercept the portion of aquifer flow that would prevent adverse effects in Rose Creek.
3. Strategic release of dilution water from the Cross Valley Pond at times when increased dilution in Rose Creek would mitigate seasonal or periodic effects caused by groundwater discharge to surface.
4. A strategy for treatment, on surface, of intercepted groundwater.

### 7.3.4 MONITORING AND MANAGEMENT REVIEW

*Site monitoring protocol and review of information*

The type of monitoring information required is groundwater quality in the Rose Creek valley aquifer. The site water monitoring protocol provides for semi-annual (spring and fall) collection of groundwater quality data in the Rose Creek valley aquifer and this is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A management review of the required information will be conducted initially during preparation of the monthly water quality data reports and subsequently during the preparation of the annual environmental report. This is considered to be adequate management review for activation of the response trigger, if required.

## 7.4 DEGRADED SEEPAGE QUALITY FROM GRUM ROCK DUMP

### 7.4.1 TRIGGER

*Trigger for implementation of contingency measures*

Surface and subsurface seepage from the Grum Rock Dump contains contaminants that are released from the waste rock and other facilities in the Grum Rock Dump. This seepage water flows into Vangorda Creek and has the potential to become contaminated to the degree where the receiving environment in Vangorda Creek is adversely affected. The trigger for the implementation of contingency measures is proposed to be surface water quality in Vangorda creek local to the Grum rock dump.

Specifically, the action trigger is proposed to be "water quality in Vangorda Creek contains sustained concentrations of substances at levels that are likely to cause a significant adverse environmental impact that are caused by seepage from the Grum rock dump", which is similar to wording that is in the current Faro water licence (QZ95-003, clause 39).

### 7.4.2 ENVIRONMENTAL CONSEQUENCES

The environmental consequences of degraded water quality in Vangorda Creek could result in the exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in the creek and the Pelly River. Zinc is currently the primary contaminant of concern and zinc and sulphate are currently the primary indicators of acid rock drainage. However, the consideration of degraded water quality should include other metals and contaminants that could source from the rock dumps.

### 7.4.3 RESPONSE

***Staged response***

As per the general approach to the adaptive management plan, a staged response to degraded water quality in Vangorda Creek will be implemented if the response trigger is activated.

***Initial response***

The initial response to the trigger will be to identify, in a broad sense, the source of contamination and to increase the monitoring intensity in the creek and the rock dump to verify and isolate the suspected source of contaminants. This may require increasing the frequency and number of samples collected, conducting a test pitting program, consulting with technical experts and consulting with regulatory agencies. Initial notification to the water inspector and to the Water Board will be made at this time.

***Mitigation depending on the source of contamination***

If the source of contamination in Vangorda Creek is verified to be seepage from all or a portion of the Grum rock dump, then a short term mitigation measure will be implemented to control the migration of contaminants at the source while a longer term mitigation plan is implemented. This might include pumping, berming, ditching or whatever other means are possible to the degree where water quality is not further degraded in the short term. A longer term mitigation system will then be designed, permitted and implemented such that the contaminants are securely prevented from entering the creek to the degree where water quality in the creek returns to the initial condition. This would be designed to provide security until the scheduled implementation of the Final Reclamation Plan. This may involve surficial ditching near the toe of the rock dump(s) that directs seepage water to a collection sump, from where the water would be pumped into the treatment system.

If the source of the contamination is identified to be groundwater flow that is too deep for interception by surface ditching or control at the source, then a groundwater interception plan, or another long term (5 to 10 years life) remedial measure, will be designed, permitted and implemented.

### 7.4.4 MONITORING AND MANAGEMENT REVIEW

The type of monitoring information required is surface and subsurface water quality. The locations required are several locations along the toe of the Grum rock dump and Vangorda Creek. The site water monitoring protocol provides for the routine collection of this information on a quarterly, semi-annual or annual basis and this is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

***Site monitoring protocol and review of water quality information***

A management review of this water quality information will be conducted initially during preparation of the monthly water quality data report and subsequently during preparation of the annual environmental report. This is considered to be adequate management review for activation of the response trigger, if required.

## 7.5 WATER LEVEL IN GRUM PIT REACHES MAXIMUM DESIRED ELEVATION

### 7.5.1 TRIGGER

***The trigger for implementation of contingency measures***

Water quality in the Grum Pit is currently non compliant with the discharge criteria in the water licence and can not, therefore, be released to the receiving environment. The water elevation in the Grum Pit has been rising since mine shut down in 1998 and may reach a maximum desired operating range during the proposed term of the water licence renewal (2004 to 2008). A study is proposed as part of the care and maintenance activities that will assess the rate of filling and determine an appropriate maximum desired operating range.

The trigger for the implementation of contingency measures is proposed to be the water elevation in the Grum Pit. Specifically, the action trigger is proposed to be "the water elevation in the Grum Pit reaches the maximum desired operating range."

### 7.5.2 ENVIRONMENTAL CONSEQUENCES

***Consequences of the water elevation in the Grum Pit reaching the maximum elevation***

The environmental consequences of the water elevation in the Grum Pit reaching the maximum desired elevation could result in the absence of adequate emergency storage capacity for containment of a flood event and, ultimately, a release of non compliant water to the receiving environment in Vangorda Creek. This could result in the exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Vangorda Creek and the Pelly River.

Zinc is currently the primary contaminant of concern and zinc and sulphate are currently the primary indicators of acid rock drainage. However, the consideration of degraded water quality should include other metals and contaminants which could source from the pit.

### 7.5.3 RESPONSE

***Staged response***

As per the general approach to the adaptive management plan, a staged response to an increasing water elevation in the Grum Pit will be implemented if the response trigger is activated.

*Components of the recommended action plan designed to maintain adequate emergency storage capacity in the Grum Pit.*

The study that is proposed to assess the filling rate and determine a maximum desired operating range will produce, by 2004, a report that includes a recommended action plan. Therefore, the response to the activation of the trigger will be to implement the action plan recommended in the 2004 study report.

The actions recommended will be designed to maintain an adequate emergency storage capacity in the Grum Pit and might include:

1. Installation of a pumping system and integration of Grum Pit water into the summer season pumping program for the Vangorda Pit.
2. In-Situ treatment of pit water such that compliant water can be pumped, syphoned or otherwise released to Vangorda Creek, likely via the Sheep Pad Pond and established discharge location V25BSP.

### 7.5.4 MONITORING AND MANAGEMENT REVIEW

*Site water monitoring protocol and review of information*

The type of monitoring information required is water elevation and water quality in the Grum Pit. The site water monitoring protocol provides for the routine collection of this information throughout the proposed term of the licence and this is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A management review of this information will be conducted initially during preparation of the monthly water quality data report and subsequently during preparation of the annual environmental report. This is considered to be adequate management review for activation of the response trigger, if required.

## 7.6 WIND DISPERSION OF TAILINGS RESULTS IN INCREASING ADVERSE EFFECTS ON THE TERRESTRIAL ENVIRONMENT

### 7.6.1 TRIGGER

*Possible sources of wind dispersed contaminants and effects*

The available information demonstrates that wind dispersed contaminants (i.e. heavy metals) are present in the terrestrial environment near the mine site as described in Volume 2, Description of the Existing Environment. However, the data does not, at this time, clearly identify the source of the contaminants (i.e. tailings, waste rock, mining activities or emissions from the concentrator during operating periods, for example), the extent of their distribution, or whether the effects have increased, diminished or remained static through the care and maintenance timeframe (i.e. post-1998) in comparison to the operating period of the mine.

*The trigger for implementation of contingency measures*

The trigger for the implementation of contingency measures is proposed to be the results of studies of contaminants in the terrestrial environment described in Section 10.1. A study of environmental effects in the terrestrial environment is proposed that would be designed to identify the primary sources of contaminants in the terrestrial environment and whether the level of contamination is increasing, decreasing or static with time. This could include a care and maintenance mitigation plan

Specifically, the action trigger is proposed to be "mitigation measures that are recommended to be implemented in the 2005 mitigation plan, based on the results of the 2002 and follow up studies of environmental contaminants in the terrestrial environment".

### 7.6.2 ENVIRONMENTAL CONSEQUENCES

While the environmental consequences of levels of contaminants in the terrestrial environment have the potential to cause adverse effects on wildlife and human resource users, it is not possible to quantify these effects at this time. There could be potential effects on socio-economic use, traditional/ cultural use and human health.

### 7.6.3 RESPONSE

*Staged response*

As per the general approach to the adaptive management plan, a staged response to increasing levels of contaminants in the terrestrial environment will be implemented if the response trigger is activated.

*Mitigation measures will be proposed in 2005*

The mitigation plan that is proposed to be developed by 2005 will recommend care and maintenance mitigation measures , if required during the 2004-2008 timeframe, that are based on the results of the 2002 and follow up studies and that will provide protection for the environment, socio-economic use of the land and human health.

### 7.6.4 MONITORING AND MANAGEMENT REVIEW

*Collection of adequate monitoring information to activate the response trigger and review of the information*

The type of monitoring information required is contaminant concentrations in vegetation and soils, contaminant concentrations in wildlife, health and diversity of the vegetation community, health and diversity of the wildlife community and traditional knowledge. The proposed studies that are described in Section 10.1 of this volume provides for the routine collection of this information by 2005 and this is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A rigorous management review and interpretation of this information will be completed by 2005 as part of the mitigation plan that is proposed to be conducted, by 1995, as part of the project activities that are described in Section 5 of this volume. This is considered to be adequate management review for activation of the response trigger, if required.

## 7.7 COMPLETE BREACH OF THE FARO CREEK DIVERSION

### 7.7.1 TRIGGER

A complete breach of the Faro Creek Diversion into the Main Pit could be the result of failure of the northeast Faro Pit wall. The proposed action trigger is "a breach of the Faro Creek Diversion into the Main Pit due to failure of the northeast pit wall".

## 7.7.2 ENVIRONMENTAL CONSEQUENCES

*The first consequence of filling would be damage to the pumping system*

If the pit water elevation were to increase because pumping could not be undertaken at a rate to match inflows, then physical damage to the pumping system would be expected to be the first consequence. Ultimately, if the excess inflow were not controlled, then the pit water elevation would reach the point overflow into the Zone 2 Pit and, subsequently, into the North Fork of Rose Creek. This would represent an uncontrolled release of non-compliant water into the environment.

The elevations at which these events would be expected to occur are as follows:

1. physical damage to the barge anchor point and pipeline: 3866 feet mine datum
2. water damage to the electrical switchgear and transformer: 3877 feet mine datum
3. overflow to Zone 2 Pit: 3910 feet mine datum

The timeframes for reaction to prevent these consequences from occurring will depend on the rate of inflow, the rate of pumping outflow and the water elevation in the Main Pit at the time of the breach. Several hypothetical examples are listed in Table 13:

**Table 13. Hypothetical Timeframes for Reaction to Prevent Consequences from a Complete Breach of the Faro Creek Diversion**

| Event | Inflow (Breach) | Outflow (Pumping) | Initial Water Elevation | Time to damage piping | Time to flood electrical gear | Time to overflow |
|---|---|---|---|---|---|---|
| 7-day PMF | 7.44 | 0.28 (4500gpm) | 3862 | 1 day | 4 days | 13 days |
| 7-day PMF | 7.44 | 0.56 (9000gpm) | 3862 | 1 day | 4 days | 13 days |
| "Normal" inflows | 0.155 | 0.28 (4500gpm) | 3862 | never | never | never |
| "Freshet-level" inflows | 0.360 | 0.28 (4500gpm) | 3862 | 96 days | 362 days | 3 years |

Notes: flows are m3/s (except where noted otherwise)
elevations are feet

## 7.7.3 RESPONSE

As per the general approach to the adaptive management plan, a staged response to a breach of the Faro Creek Diversion will be implemented if the initial trigger is activated.

### 7.7.3.1 Immediate Response

*Initial response*

The initial response to the event will be to immediately assess inflows into the Main Pit and immediately implement pumping from the pit if such is necessary to prevent or delay damage to equipment. Initial notification to the water inspector and to the Yukon Territory Water Board will be made at this time.

The rates of inflow and outflow will be assessed and an assessment made of the ability of the pit pumping program to prevent a continued increase in the pit water level and, if necessary, a projection made of the anticipated increase in the pit water level, with the pumping program underway.

***Mitigation for various pumping rates***

If pumping from the pit can be undertaken at a rate equivalent to or in excess of the rate of inflow while providing adequate treatment of the pumped water, then this rate of pumping will be undertaken and maintained such that the water elevation in the pit does not increase.

If pumping from the pit can not match the inflow rate due to pumping capability, inability to maintain compliance for effluent released to Rose Creek or other reasons, then the maximum possible pumping rate will be implemented such that the rate of rise of the pit water elevation is slowed. The high pumping rates that have been achieved to date while maintaining compliance with the effluent discharge criteria in the licence is in the order of 0.384 $m^3/s$ (6,100 USgpm).

***Alternatives for increasing the pumping rate to greater than typical rates***

There are several potential alternatives for increasing the pumping rate to greater than the typical rates while maintaining compliance with the discharge criteria of the water licence and these will be investigated, if necessary. The potential alternatives might include:

1. Re-initiating the past practice (pre-2001) of treating water with lime slurry in a "drop box" outside of the mill and utilizing the Intermediate Pond for settlement of treatment sediments. This would also likely require initiation of lime treatment at the Intermediate Dam outflow spillway; and
2. The addition of a second treatment "circuit" in the mill utilizing additional flotation cells and clarifiers. This might require in the order of 3 months and $1M to make operational.

#### 7.7.3.2 Secondary Response

***Options for accomplishing short term mitigation goals***

The breach location will be assessed for access and a plan will be made and implemented for short term reduction or prevention of inflows into the Main Pit while a long term mitigation plan is implemented. The options for accomplishing this short term mitigation goal may include: ditching around the breach, berming the upstream side of the breach to direct water into a pipe spanning or circumventing the breach and installation of a pumping sump to enable pumping water across or around the breach.

This measure will be implemented as quickly as possible with the intention of preventing damage to the pumping and electrical systems by preventing the water elevation from rising to those elevations.

***Mitigation measures for various pit water elevations***

If the pit water elevation rises to the elevation at which the barge anchor point and pipeline will be damaged, then the anchor point will be dismantled and the on shore pipeline will be progressively blocked and raised to enable the barge to float higher without breaking the pipeline.

If the water elevation rises to the elevation where the safe operation of the electrical switchgear or transformer is compromised, then power to the transformer will be disconnected at the main substation at the mill. At this time, no further pumping from the Main Pit would be possible until a generator of approximately 1 MW capacity was installed (for start up of a single pump). This might be accomplished by activating the EMD (on-site 2.7 MW diesel emergency generator) or installing a rental 1 MW diesel generator. In either case, a substantial pumping down time will be experienced.

If the water elevation rises to the elevation where overflow into the Zone 2 Pit is imminent, then an assessment of the most effective means of minimizing impacts to Rose Creek will be made. This might include: allowing overflow into the North Fork of Rose Creek via the Zone 2 Pit or implementing increased pumping from the Main Pit to Rose Creek in the absence of the ability to adequately treat the water.

#### 7.7.3.3 Long Term Response

***Timeframe and mitigation methods***

Subsequent to implementation of the Secondary Response, a long term mitigation plan will be designed, permitted and implemented. This would be designed to provide security until the scheduled implementation of the Final Reclamation Plan. This is likely to involve construction of a new channel or a new channel to bypass the breach. A study is scheduled for completion in summer 2003 that will provide preliminary engineering designs for alternative methods of relocating the diversion channel (Golder 2002) and these designs will provide a starting point for a new design for restoring flow.

### 7.7.4 MONITORING AND MANAGEMENT REVIEW

***Site monitoring protocol and review of information***

The type of monitoring information required is visual observation of the Faro Creek Diversion and the northeast wall of the Faro Main Pit. The site general monitoring protocol provides for the routine documented observation of this area on a minimum weekly basis throughout the year and the site physical monitoring protocol provides for an annual professional engineering review of the area. Monitoring of the water level in the Faro Main Pit is complementary to the required observational information and is also collected routinely throughout the year as part of the site water monitoring protocol. This information is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A management review of the required information will be conducted initially during preparation of the monthly site status reports and subsequently during the professional engineering site inspection and, ultimately, during preparation of the annual geotechnical inspection report. This is considered to be adequate management review for activation of the response trigger, if required.

# 7.8 BREACH OF THE ROSE CREEK DIVERSION CANAL INTO THE INTERMEDIATE OR CROSS VALLEY PONDS

## 7.8.1 TRIGGER

*The proposed action trigger*

A breach of the Rose Creek Diversion Canal into the Intermediate or Cross Valley Ponds could be the result of a large flood event (say 1:500 years or greater) that overtops or erodes the containment dyke or the result of freshet runoff flows that travel on top of the winter ice and overtop or breach the containment dyke.

The proposed action trigger is "a breach of water from the Rose Creek Diversion Canal into the Intermediate or Cross Valley Ponds as a result of overtopping or breaching of the containment dyke".

## 7.8.2 ENVIRONMENTAL CONSEQUENCES

The environmental consequences of a breach of the Rose Creek Diversion Canal would be dependent on the location and extent of the breach and the magnitude of the inflows from Rose Creek.

*Consequences dependent on the location and extent of the breach and magnitude of the inflows*

A complete breach of the canal during a flood event wherein all of Rose Creek passed into the Intermediate Pond could result in complete or partial failure of the Intermediate Dam and the release of sediment, tailings solids and non compliant water into the receiving environment. Similarly, a breach into the Cross Valley Pond could result in a partial or complete failure of the Cross Valley Dam and the release of sediment and lime treatment sludge into the receiving environment.

A smaller but substantial inflow of water into the Intermediate Pond could result in an exceedance of the treatment capability installed at the Intermediate Dam outflow spillway and the release of non compliant water. A smaller still inflow of water into the Intermediate Pond could result in the need for unscheduled operation of the treatment system requiring unscheduled expenditures and increased environmental risks.

## 7.8.3 RESPONSE

*Staged response*

As per the general approach to the adaptive management plan, a staged response to a breach of the Rose Creek Diversion Canal will be implemented if the initial trigger is activated.

### 7.8.3.1 Immediate Response

*Initial response*

The initial response to the event will be to immediately assess inflows into the Intermediate and/or Cross Valley Ponds. Initial notification to the water inspector and to the Water Board will be made at this time.

*Mitigation depending on the inflow*

If the inflow rate is sufficiently low, an appropriate water management plan will be immediately implemented in the ponds to ensure that water is adequately treated prior to release to the environment. This might include activation or increased operation of the water treatment system, pumping from Cross Valley Pond to Intermediate Pond or cessation of effluent discharge.

If the inflow rate is high such that there is a risk to the integrity of the dam, then the geotechnical engineer will be immediately contacted and emergency protection for the integrity of the dams will be immediately implemented.

#### 7.8.3.2 Secondary Response

***Options for accomplishing short term mitigation goals***

The breach location will be assessed for access and a plan will be made and implemented for short term reduction or prevention of inflows into the pond(s) while a longer term mitigation plan is implemented. The options for accomplishing this short term mitigation goal may include: ditching around the breach, berming the upstream side of the breach to direct water into a pipe spanning or circumventing the breach and installation of a pumping sump to enable pumping water across or around the breach.

This measure will be implemented as quickly as possible with the intention of minimizing the volume of water entering the pond(s).

If sediment, tailings solids or non compliant were released, then an environmental effects monitoring program will be initiated to determine impacts in the receiving environment and assess the needs for remedial work.

### 7.8.4 LONG TERM RESPONSE

***Timeframe and mitigation measure***

Subsequent to implementation of the Secondary Response, a long term mitigation plan will be implemented such that security is provided until the scheduled implementation of the Final Reclamation Plan. This is likely to involve construction of a new channel section to bypass the breach.

### 7.8.5 MONITORING AND MANAGEMENT REVIEW

***Site physical monitoring protocol, water level, water quality monitoring, and review of information***

The type of monitoring information required is visual observation of the Rose Creek Diversion Canal and monitoring of geotechnical instrumentation. The site general monitoring protocol provides for the routine documented observation of this area on a minimum weekly basis throughout the year and on a daily basis through freshet. The site physical monitoring protocol provides for an annual professional engineering inspection of the containment dyke and for the twice per year (spring and fall) monitoring of geotechnical instrumentation in the containment dyke. Monitoring of water quality and water levels in the Intermediate and Cross Valley Ponds is complementary to the required observational information and is also collected routinely throughout the year as part of the site water monitoring protocol. This information is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A management review of the required information will be conducted initially during preparation of the monthly site status reports and subsequently during the professional engineering site inspection and, ultimately, during preparation of the annual geotechnical inspection report. This is considered to be adequate management review for activation of the response trigger, if required.

# 7.9 COMPLETE BREACH OF VANGORDA CREEK DIVERSION

## 7.9.1 TRIGGER

A complete breach of the Vangorda Creek Diversion into the Vangorda Pit could be the result of failure of the north pit wall. The proposed action trigger is "a breach of the Vangorda Creek Diversion into the Vangorda Pit due to failure of the north pit wall".

## 7.9.2 ENVIRONMENTAL CONSEQUENCES

*Timeframes for reaction to prevent uncontrolled release of non-compliant pit water into the environment*

If the pit water elevation were to increase because pumping could not be undertaken at a rate to match inflows, then the pit water elevation would ultimately reach the point of overflow into Vangorda Creek. This would represent an uncontrolled release of non-compliant water into the environment. The elevations at which overflow would be anticipated is 1122.5 m ASL versus the maximum desired operating elevation of 1092 m ASL.

The timeframes for reaction to prevent these consequences from occurring will depend on the rate and duration of inflow and the water elevation in the Main Pit at the time of the breach. The outflow pumping rate is currently fixed at 2,000 USgpm. Several hypothetical timeframe examples are listed Table 14:

**Table 14. Hypothetical Timeframes for Reaction to Prevent Consequences from a Complete Breach of the Vangorda Creek Diversion**

| Event | Inflow (Breach) ($m^3/s$) | Outflow (Pumping) ($m^3/s$) | Initial Water Elevation (m ASL) | Time to overflow |
|---|---|---|---|---|
| 50% of 7-day PMF | 5.1 | 0.12 (2000gpm) | 1092 | 7 days |
| 7-day PMF | 10.2 | 0.12 (2000gpm) | 1092 | 4 days |

## 7.9.3 RESPONSE

*Staged response*

As per the general approach to the adaptive management plan, a staged response to a breach of the Vangorda Creek Diversion will be implemented if the initial trigger is activated.

### 7.9.3.1 Immediate Response

*Initial response*

The initial response to the event will be to immediately assess inflows into the Vangorda Pit and immediately implement pumping from the pit if such is necessary to prevent the pit water level from exceeding the maximum desired operating elevation. Initial notification to the water inspector and to the Water Board will be made at this time.

*Mitigation depending on the pumping rate from the pit*

The rates of inflow and outflow will be assessed and an assessment made of the ability of the pit pumping program to prevent a continued increase in the pit water level and, if necessary, a projection made of the anticipated increase in the pit water level, with the pumping program underway.

If the rate of pumping from the pit is equivalent to or in excess of the rate of inflow while providing adequate treatment of the pumped water, then pumping will be undertaken and maintained such that the water elevation in the pit does not increase.

If pumping from the pit does not match the inflow rate due to pumping capability, inability to maintain compliance for effluent released to Vangorda Creek or other reasons, then the maximum possible pumping rate will be implemented such that the rate of rise of the pit water elevation is slowed.

#### 7.9.3.2 Secondary Response

*Options for accomplishing short term mitigation goals*

The breach location will be assessed for access and a plan will be made and implemented for short term reduction or prevention of inflows into the pit while a longer term mitigation plan is implemented. The options for accomplishing this short term mitigation goal may include: ditching around the breach, berming the upstream side of the breach to direct water into a pipe spanning or circumventing the breach and installation of a pumping sump to enable pumping water across or around the breach.

This measure will be implemented as quickly as possible with the intention of minimizing the rise in the pit water elevation.

*Mitigation for various pumping rates*

The electrical switchgear and transformer for the Vangorda Pit pump are located out of the pit perimeter and, therefore, are at risk of a rising pit water elevation. If the pit water elevation rises to the elevation at which the barge anchor point will be damaged, then the anchor point will be dismantled and the on shore pipeline will be progressively blocked and raised to enable the barge to float higher without breaking the pipeline.

If the water elevation rises to the elevation where overflow into Vangorda Creek is imminent, then an assessment of the most effective means of minimizing impacts to Vangorda Creek will be made. This might include: allowing overflow into Vangorda Creek or implementing direct pumping from the Vangorda Pit to Vangorda Creek even in the absence of the ability to adequately treat the water as a means of minimizing erosion and sedimentation at the outflow location.

#### 7.9.3.3 Long Term Response

*Timeframe and mitigation methods*

Subsequent to implementation of the Secondary Response, a long term mitigation plan will be implemented such that security is provided until the scheduled implementation of the FCRP. This is likely to involve construction of a new channel or a new channel to bypass the breach. A study was completed in 2002 that provides preliminary engineering designs for alternative methods of relocating the diversion channel (SRK 2002) and these designs will provide a starting point for a new design for restoring flow.

### 7.9.4 MONITORING AND MANAGEMENT REVIEW

***Site monitoring protocol and review of information***

The type of monitoring information required is visual observation of the Vangorda Creek Diversion and the north wall of the Vangorda Pit. The site general monitoring protocol provides for the routine documented observation of this area on a minimum weekly basis throughout the year and the site physical monitoring protocol provides for an annual professional engineering review of the area. Monitoring of the water level in the Vangorda Pit is complementary to the required observational information and is also collected routinely throughout the year as part of the site water monitoring protocol. This information is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A management review of the required information will be conducted initially during preparation of the monthly site status reports and subsequently during the professional engineering site inspection and, ultimately, during preparation of the annual geotechnical inspection report. This is considered to be adequate management review for activation of the response trigger, if required.

## 7.10 FAILURE OF THE VANGORDA CREEK HAUL ROAD CULVERTS

### 7.10.1 TRIGGER

***The proposed action trigger***

A failure of the Vangorda Creek haul road crossing could be the result of collapse, rusting or separation of joints of one of the two buried culverts or the vertical drop box that passes Vangorda Creek through the haul road.

The proposed action trigger is "failure of the Vangorda Creek haul road crossing that causes a complete or partial failure of the haul road embankment".

### 7.10.2 ENVIRONMENTAL CONSEQUENCES

If leakage from the buried culverts caused partial or complete failure of the haul road embankment, this would result in sedimentation directly into Vangorda Creek, which could expose aquatic resources, terrestrial resources and human resource users to increased levels of sediment in Vangorda Creek.

### 7.10.3 RESPONSE

***Staged response***

As per the general approach to the adaptive management plan, a staged response to a failure of the Vangorda Creek haul road crossing will be implemented if the initial trigger is activated.

#### 7.10.3.1 Immediate Response

*Initial response*

The initial response to the event will be to immediately assess the stability of the road embankment and degree of sedimentation into Vangorda Creek. Initial notification to the water inspector and to the Water Board will be made at this time.

The geotechnical engineer will be immediately contacted and emergency remediation to stabilize the road embankment and the rate of sedimentation into the creek will be immediately implemented.

#### 7.10.3.2 Secondary Response

*Options for accomplishing short term mitigation goals*

The area will be assessed for access and a plan will be made and implemented for short term stabilization of the road embankment and creek passage and the prevention of further release of sediment into the environment. The options for accomplishing this short term mitigation goal may include backfilling or rip rap (erosion protection) in the failed location or excavation of the residual roadfill to allow a straight stream channel to be constructed.

An environmental effects monitoring program will be initiated to determine impacts in the receiving environment and assess the needs for remedial work.

These measures will be implemented as quickly as possible.

#### 7.10.3.3 Long Term Response

*Timeframe and mitigation measures*

Subsequent to implementation of the Secondary Response, a long term (5 to 10 years life) remediation plan will be designed and implemented such that security is provided until the scheduled implementation of the Final Reclamation Plan. This is likely to involve some channel and road/bridge construction and any required restorative work in the receiving environment.

### 7.10.4 MONITORING AND MANAGEMENT REVIEW

*Site monitoring protocol and review of information*

The type of monitoring information required is visual observation of the Vangorda Creek haul road crossing. The site general monitoring protocol provides for the routine documented observation of this area on a minimum weekly basis throughout the year and this information is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A management review of the required information will be conducted initially during preparation of the monthly site status reports and this is considered to be adequate management review for activation of the response trigger, if required.

# 7.11 FAILURE OF THE INTERMEDIATE DAM

## 7.11.1 TRIGGER

*The proposed action trigger*

A failure of the Intermediate Dam could be the result of flood inflows from a breach of the Rose Creek Diversion Canal and other upstream sources, an earthquake, slumping/caving of embankment or foundation soils, "piping" through the embankment or another unforeseen event.

The proposed action trigger is "failure of the Intermediate Dam".

## 7.11.2 ENVIRONMENTAL CONSEQUENCES

*Assuming that failure of the Intermediate Dam causes a failure of the Cross Valley Dam*

The environmental consequences of a failure of the Intermediate Dam would the release of sediment, tailings solids and non-compliant water into the receiving environment of Rose Creek and the exposure of aquatic resources, terrestrial resources and human resource users to increased levels of contaminants in Rose Creek, Anvil Creek and the Pelly River. This assumes that a failure of the Intermediate Dam will cause a failure of the Cross Valley Dam.

## 7.11.3 RESPONSE

*Staged response*

As per the general approach to the adaptive management plan, a staged response to a failure of the Intermediate Dam will be implemented if the initial trigger is activated.

### 7.11.3.1 Immediate Response

*Initial response*

The initial response to the event will be to immediately assess the state of the dams and provide initial notification to the water inspector and to the Water Board.

The geotechnical engineer will be immediately contacted and emergency remediation to stabilize the dam and the release of contaminants will be immediately implemented.

### 7.11.3.2 Secondary Response

*Options for accomplishing the short term mitigation goal*

The breach location will be assessed for access and a plan will be made and implemented for short term stabilization of the dams and the prevention of further release of contaminants into the environment. The options for accomplishing this short term mitigation goal may include backfilling or rip rap (erosion protection) in the breach location.

An environmental effects monitoring program will be initiated to determine impacts in the receiving environment and assess the needs for remedial work.

These measures will be implemented as quickly as possible.

### 7.11.3.3 Long Term Response

*Timeframe and mitigation measures*

Subsequent to implementation of the Secondary Response, a long term mitigation plan will be designed and implemented such that security is provided until the scheduled implementation of the Final Reclamation Plan. This is likely to involve some dam construction and any required restorative work in the receiving environment.

## 7.11.4 MONITORING AND MANAGEMENT REVIEW

*Site monitoring protocol, water level, water quality monitoring and review of information*

The type of monitoring information required is visual observation of the Intermediate Dam and monitoring of geotechnical instrumentation. The site general monitoring protocol provides for the routine documented observation of the dam on a weekly basis throughout the year and the site physical monitoring protocol provides for an annual professional engineering inspection of the dam and for the twice per year (spring and fall) monitoring of geotechnical instrumentation in the dam. Monitoring of water quality and water levels in the Intermediate and Cross Valley Ponds is complementary to the required observational information and is also collected routinely throughout the year as part of the site water monitoring protocol. This information is considered to be adequate to provide the information required for activation, if necessary, of the response trigger.

A management review of the required information will be conducted initially during preparation of the monthly site status reports and subsequently during the professional engineering site inspection and, ultimately, during preparation of the annual geotechnical inspection report. This is considered to be adequate management review for activation of the response trigger, if required.

An environmental effects monitoring program will be initiated to determine impacts in the receiving environment and assess the needs for remedial work.

# 8 ACCIDENTS AND MALFUNCTIONS

## 8.1 OVERVIEW

Accidents and malfunctions, in this report, refer to the breakdown of systems that are necessary components of the project activities and that have the potential to have an adverse environmental effect. These breakdowns can be grouped together as follows:

1. Pipeline breaks within the mine water collection systems.
2. Pipeline breaks releasing water to the environment.
3. General loss of electrical power.
4. Pump failure at a major pumping station.
5. Gasoline and diesel fuel spills.
6. Loss of Road Access.
7. Loss of Communication.

Contingency plans and operating procedures are in place at the mine site that provide for these accidents and malfunctions and these will be continued through the proposed term of the water licence renewal.

## 8.2 PIPELINE BREAKS WITHIN THE MINE WATER COLLECTION SYSTEM

Some of the water pipelines that will be utilized for the proposed project activities lie entirely within the mine water collection systems and, therefore, do not pose an environmental risk if a break occurs. There will be an operational disruption if these pipelines break. However, repairs can be made by on site personnel and operational disruptions would be anticipated to be relatively minor.

The pipelines that would fall into this category include:

1. Pipeline from the Zone 2 Pit wellhead to the Main Pit.
2. Pipeline from the Main Pit to the mill water treatment system.
3. Tailings pipeline from the Mill to the Main Pit.
4. Effluent pipeline from the mill water treatment system to the Intermediate Pond/Cross Valley Pond.
5. Pipeline from Little Creek Dam to Vangorda Pit.
6. Syphon pipeline from Intermediate Dam to Cross Valley Pond.

The contingency plan that is in place for these pipeline breaks is to have repair materials on hand or readily available from an off-site source as well as any specialized repair equipment that may be required. A break in any of these pipelines would be quickly noted by the operating personnel as part of the normal operating procedures.

## 8.3 PIPELINE BREAKS RELEASING WATER TO THE ENVIRONMENT

One water pipeline, from the Vangorda Pit to the Grum/Vangorda Water Treatment Plant, that will be utilized for the proposed project activities lies partially outside of the mine water collection systems and, therefore, poses an environmental risk if a break occurs. This pipeline contains non compliant water and, in the event of a break, this water could enter Vangorda Creek. There would also be an operational disruption if this pipeline were to break. However, repairs can be made by on site personnel and operational disruptions would be anticipated to be relatively minor.

This pipeline was installed in 2001 with contingency planning in mind. The pipeline incorporates pressure sensors that will automatically shut down pumping if pressure is lost within the pipe.

The contingency plan that is in place for this pipeline break is to have repair materials on hand or readily available from an off site source as well as any specialized repair equipment that may be required. A pipeline break in this pipeline would be quickly noted by the automatic pressure sensors and by operating personnel as part of the normal operating procedures.

## 8.4 GENERAL LOSS OF ELECTRICAL POWER

A general loss of electrical power could occur as a result of a local or regional disruption or accident to the Whitehorse-Aishihik-Faro hydroelectric power grid. This necessitates a shut down of all site operations save those that are powered by a portable on site generator, such as the Intermediate Pond lime treatment system and the Little Creek Dam pump.

The operational and environmental implications of a general loss of power are dependent on the duration of the event. Experience since 1998 has demonstrated that the regional power supplier has restored power quickly in these events and the contingency plan provides for two alternate power sources in the event of an imminent environmental emergency.

The major project equipment that would be shut down in this event includes:

1. Main Pit pumping.
2. Zone 2 Pit pumping.
3. Vangorda Pit pumping.
4. Mill water treatment system.
5. Grum/Vangorda water treatment plant.

The contingency plan that is in place for a general loss of power is to conduct an operational check of equipment status such that equipment is configured appropriately for restart, contact with the regional power supplier to confirm status and ascertain restart timeframe, arrangement with the regional power supplier that power can be re-instated to the mine from the Town of Faro diesel generator if an environmental emergency was imminent and maintenance of the on site EMD emergency generator such that it can be utilized in an environmental emergency situation.

## 8.5 PUMP FAILURE AT A MAJOR PUMPING STATION

Pump failure at a major pumping station such as the Main Pit, the Zone 2 Pit or the Vangorda Pit could be caused by mechanical failure or loss of power locally or regionally. The pump failure would cause an operational disruption and the implications of the disruption would be dependent on the duration.

If the cause of the failure was loss of power from the regional grid, then the contingencies described for "General loss of electrical power" would apply.

If the cause of the failure was loss of power locally (i.e. on the mine site), then the contingency plan that is in place is to have a qualified electrician employed at the site or readily available from off site to identify and resolve the problem. Standard electrical replacement gear is either on hand or an off site source has been identified.

If the cause of the failure was mechanical failure, then the contingency plan that is in place is perform routine maintenance on the pumps, to have an experienced mechanic employed at the site or readily available from off site to identify and resolve the problem. Standard mechanical replacement parts are either on hand or an off site source has been identified.

In the extreme event where repairs could not be made in a timely manner and an environmental emergency was imminent, then a substitute pump would be expedited from an off site source and installed on an emergency rush basis. The timeframe for implementing this action would depend on the circumstances surrounding the pit water levels and would be at the discretion of the site manager.

## 8.6 GASOLINE AND DIESEL FUEL SPILLS

Spills of gasoline and diesel fuel can occur due to operator error, malfunctioning dispensing equipment, overfilling of storage tanks, leaking/damaged storage tanks or leaking/damaged mobile and heavy equipment. Even relatively small spills can have an environmental implication if they occur near a stream or other environmental receptor.

The contingency plan that is in place includes the following:
1. Only one storage tank for gasoline and one for diesel fuel are to be utilized.
2. The active storage tanks are located within containment berms with capacity to contain the full tank volume.
3. The secondary containment berms are visually monitored and clean water is removed periodically to maintain storage capacity.
4. The storage tanks were registered with DIAND Lands Department.
5. Operating procedures are in place that provide for monitoring of storage tank levels and for security control on dispensing.

6. Operator awareness training is provided regarding the environmental implications of spills.
7. A spill response kit is maintained at the mine site that includes dry absorbent and floating absorbent booms and pads.
8. A spill response plan is in place that provides for notification to site management as well as to the Yukon 24-hour spill reporting office.

## 8.7 LOSS OF ROAD ACCESS

Loss of road access to the mine site could be caused by a flood that erodes the roadway, washout due to culvert failure or exceedance of culvert capacity or by heavy snowfall. The implications of loss of road access could be substantial depending on the time of the occurrence. For example, if the road was lost due to a flood event, then even a brief inability to inspect and repair damage to mine facilities, particularly dams and ditches, could result in an environmental impact.

Therefore, regardless of the cause of the loss of road access, it would be important to restore access quickly. The contingency plan that is in place includes the following:

1. Park a grader or plow truck in the Town of Faro during winter periods when the road is not being cleared regularly.
2. Maintain a grader, plow truck, front-end loader and gravel truck on-site or maintain contact with off site contractors for emergency provision of road repair services.
3. Aggressively steam ice from culverts and clear ice from roadside ditches through the winter and spring as required to maintain flow and prevent road washout.
4. Maintain contact with the YTG highways maintenance department as regards joint monitoring, maintenance and repairs to the access road.

## 8.8 LOSS OF COMMUNICATION

Loss of communication to the mine site could be caused by the loss of telephone lines from the Town of Faro to the mine site. The implications of loss of communication could be substantial if contingency measures were not in place due to the time delay that would be introduced into communicating and arranging responses to emergency events.

Therefore, the following contingency measures are in place:

1. Portable satellite phones are carried by senior site managers and would be used in a general loss of communications.
2. A state-of-the-art telephone system is scheduled for installation at the mine site in 2003.
3. The "Guest House" in the Town of Faro is equipped with an operable fax machine and telephone.

# 9 PROPOSED AMENDMENTS TO THE WATER LICENCES

## 9.1 APPROACH

***Four primary topic areas for which changes are proposed to the existing terms and conditions of the two water licences***

The Faro and Vangorda Plateau water licences (QZ95-003 and IN89-002, respectively) were issued at a time when mining activities were underway and many of the terms and conditions reflect mine operations activities. The nature of the activities proposed for the term of the licence renewal (i.e. care and maintenance) and the announcement by DIAND in January 2003 that the mine is not considered to be economically viable suggest that modifications to some of the terms and conditions in the water licence are appropriate.

There are four primary topic areas for which changes are proposed to the existing terms and conditions of the two water licences:

1. Proposed consolidation of the two existing "mine operating licences into one "care and maintenance" water licence. The rationale for this is presented in Section 2 of this volume and will be expanded upon in the application to the Yukon Territory Water Board.
2. Adoption of the Adaptive Management Plan described in this report in place of references to various contingency plans that were developed at various times in the past for conditions when the mine was actively operating.
3. Adoption of the site water monitoring protocols described in this report in place of the schedules for "normal operations" and "temporary cessation of operations" (Schedule A of each current water licence). The site water monitoring protocols that have been in place since mine closure in 1998 exceed the requirements of the licence schedules for temporary cessation of operations and were implemented to ensure that adequate information was collected to diligently manage the environmental protection programs.
4. "Held in Abeyance" terms and conditions that are specifically related to closure planning or mine abandonment pending the development, by the closure Project Team, of a FCRP for the mine complex.

***The application for renewal of water licences will contain the requested changes***

The application for renewal of the water licences that is scheduled for submission to the Yukon Territory Water Board in mid-May 2003 will contain a detailed description of requested changes to the terms and conditions of the water licences.

A general description of the key proposed changes to each licence is provided below.

## 9.2 FARO WATER LICENCE (QZ95-003)

The changes to the Faro water licence listed in Table 15 are proposed for the water licence renewal. The consolidation of the two licences into one is not repeated here but is also a primary proposed change.

**Table 15. Proposed Changes to Faro Water Licence**

| Clause | Topic | Proposed Change | Rationale |
|---|---|---|---|
| 20 | flow rate in Rose Creek | Removal | Removal of the Fresh Water Supply Dam (per a separate project) removes the ability of the mine operator to exercise control on flow rates in Rose Creek |
| 39 | Zone 2 Pit seepage contingency plan | Removal | Incorporated into the AMP |
| 59 | North Fork Rose Creek contingency plan | Removal | Incorporated into the AMP |
| 71 | Closure studies | Abeyance | Pending development of a FCP by the government project team |
| 77 | Temporary closure, Rose Creek Diversion | Removal | Incorporated into the AMP |
| 78 | Temporary closure, Faro Creek Diversion | Removal | Incorporated into the AMP |
| 35/63/64 | Abandonment of Rose Creek Tailings Facility | Abeyance | Pending development of a FCP by the government project team |
| 46/47 | Faro Pit Dam | Abeyance | Pending development of a FCP by the government project team |
| 62 | Abandonment notification | Abeyance | Pending development of a FCRP by the government project team |
| 67/68 | Abandonment of various structures | Abeyance | Pending development of a FCRP by the government project team |
| 70 | Implement 1996 ICAP | Abeyance | Pending development of a FCRP by the government project team |
| Sch A | Water Monitoring Schedules | Replace | Replace with the proposed site water monitoring protocols |
| 18 | Water Use | Removal | No freshwater from Rose Creek is contemplated for the proposed activities |

Notes: AMP = Adaptive Management Plan
FCRP = Final Closure and Reclamation Plan
ICAP = 1996 Integrated Comprehensive Abandonment Plan

## 9.3 VANGORDA PLATEAU WATER LICENCE (IN89-002)

The changes to the Vangorda Plateau water licence listed in Table 16 are proposed for the water licence renewal. The consolidation of the two licences into one is not repeated here but is also a primary proposed change.

**Table 16. Proposed Changes to Vangorda Plateau Water Licence**

| Clause | Topic | Proposed Change | Rationale |
|---|---|---|---|
| B.11 | Grum Dump Seepage | Removal | Incorporated into the AMP |
| B.9 | Abandonment of Vangorda Pit | Abeyance | Pending development of a FCRP by the government project team |
| G.2 | Abandonment water treatment requirement | Abeyance | Pending development of a FCRP by the government project team |
| G.4 | Submission of detailed abandonment plan | Abeyance | Pending development of a FCRP by the government project team |
| G.5 | Report on Success of Abandonment Measures | Abeyance | Pending development of a FCRP by the government project team |
| Sch A | Water Monitoring Schedules | Replace | Replace with the proposed site water monitoring protocols |
| C.1 | Water Use | Reword | No groundwater use is contemplated for the proposed activities but a small volume of clean surface runoff water is used in the water treatment plant |

Notes: AMP = Adaptive Management Plan
FCRP = Final Closure and Reclamation Plan
ICAP = 1996 Integrated Comprehensive Abandonment Plan

# 10 PROPOSED STUDIES

## 10.1 ASSESSMENT OF TERRESTRIAL EFFECTS RELATED TO THE FARO MINE COMPLEX

***Metal concentrations in soil and vegetation are elevated relative to background concentrations***

The 2002 study of contaminant concentrations in the terrestrial environment (C.E. Jones 2003) provided information concerning the presence of metals in some samples of soil and vegetation in concentrations that are greater than concentrations present at local background reference locations. The results of this preliminary study are consistent with the long term (1969 to 1998) mining and milling operations.

The 2002 study results complement local and traditional knowledge regarding the potential for metal contamination in the terrestrial environment. The 2002 study represents the first scientific study that attempts to quantify the degree and extent of metal dispersion and should be considered to be a "reconnaissance" level study. The following still needs to be understood: 1) detailed spatial distribution of observed concentrations; 2) whether the wind dispersion of contaminants is on-going or whether dispersion was restricted to past mine operating activities; 3) what the human health and ecological implications of observations are and, following from items 3 and 4 above, 5) whether short-term dust control mitigation is required while the FCRP is being developed and implemented.

A proposed follow up study of environmental effects in the terrestrial environment pertains to the proposed "care and maintenance" licence renewal because of: 1) the possibility that wind dispersion of tailings from the Rose Creek Tailings Facility is an on-going and current source of contamination; and 2) the consequent need to confirm whether or not short-term dust-control mitigation is required. This possibility is the focus of the study described here and is specifically included into the Adaptive Management Plan.

***A multi-year study is proposed for continued investigation of the terrestrial environment***

The follow up study program is proposed to be a multi-year study culminating in a characterization and mitigation report by the end of 2005, with annual updates circulated to interested parties and the Technical Advisory Committee. The exact scope of the proposed study and the detailed study workplan would be developed, based on both community and scientific objectives, prior to the initiation of work in consultation with interested parties and with the closure Project Team. The proposed objectives include:

***Study objectives***

1. Gather and use traditional knowledge throughout the study design, execution and reporting.
2. Determine and delineate contaminants in the terrestrial environment following from the indications of the preliminary (2002) study.
3. Estimate proportional contributions of contaminants from various possible sources, both historical and current (i.e. Rose Creek Tailings Facility, concentrator plant when operating, rock dumps, roads, etc.).
4. Compare the data collected to appropriate regulatory benchmarks and evaluate the data through the Human Health and Ecological Risk Assessment screening

level study in order to determine the significance of the observed contaminant levels on the health of the land and users of the land.
5. Provide recommendations for short term mitigation measures, if required.

*Traditional knowledge program*

The gathering and use of traditional knowledge would primarily be based on information provided through the Ross River Dena Council. The workplan would include field trips with elders and community members, coordinated design of the study parameters and routine discussion of results throughout the project.

*Components of the characterization of effects*

In addition to the traditional knowledge program, the characterization of effects is likely to include the components listed below:

1. Sampling of vegetation, including leaves, roots and lichen, and soil in locations that repeat key 2002 sample locations and that extend the area covered in the preliminary (2002) study; analysis for both metal concentrations and geochemical speciation to estimate the proportions of the total metal content that is bioavailable.
2. Sampling of air quality for determination of total particulate matter and metal concentrations in select particulate samples.
3. Sampling of tissues of mammals, likely to include both large and small mammals.
4. Interviews with Yukon Territorial Government staff, local outfitters and local recreational resources users.
5. Aerial or satellite imagery.

*Study report*

A study report will be prepared, proposed by the end of 2005, that provides all of the results of the study and recommendations for mitigative actions that will ensure the protection of the biophysical environment, traditional land users and recreational land users in the short term while the FCRP is being developed and implemented.

## 10.2 GRUM PIT MANAGEMENT STUDY

*The water level in the Grum Pit has increased progressively and may reach an action level during the proposed term of the water licence*

Runoff water has been allowed to accumulate in the Grum Pit since the mine shut down in 1998 and this water is currently non compliant with the water licence. As compared to the Vangorda Pit which filled from empty to the action level from 1998 to 2002, the Grum Pit is larger and the inflows are less such that the rate of filling has been substantially lower. Nonetheless, the water elevation in the Grum Pit has increased on a progressive basis and may reach an action level during the proposed term of the water licence renewal as described in the Adaptive Management Plan.

*A one year study is proposed to project the rate of filling and determine a short term management plan*

A study to more precisely project the rate of filling and to determine an appropriate short term (life of 10 years) management plan is of interest to provide diligent environmental management during the period of development of a Final Closure Plan. This is proposed to be a 1-year study to be completed in 2003.

*Study objectives*

The specific study objectives are proposed to be:

1. Review the rate of filling and develop a filling projection.

2. Determine a maximum desired water elevation for the purpose of diligent management through the care and maintenance timeframe modeled on similar determinations for the Faro Main Pit and Vangorda Pit.
3. Assess management options at a conceptual engineering level including in-pit treatment, pumping to the Grum/Vangorda water treatment plant and any other relevant alternatives.

A preliminary study workplan is described below. A detailed study workplan would be developed prior to the initiation of work.

***Workplan components***

The work required to complete this study is likely to include the following components:

1. Surveying of the pit by ground or aerial methods.
2. Review of hydrologic data and groundwater flow estimates.
3. Water sampling and water column profiling in the pit.
4. Treatability testing for lime consumption rates and effluent quality predictions.
5. Conceptual design of a pumping/piping system.

***Study report***

A study report will be prepared that provides all of the results of the study, a projection of the anticipated timeframe for filling of the pit to the maximum recommended elevation and a comparison of management alternatives for the care and maintenance timeframe.

## 10.3 TREATMENT SEDIMENT MANAGEMENT PLAN

Treatment sediment ("sludge") is produced each year form the mill water treatment system (approximately 200 tonnes per year) and the Grum/Vangorda water treatment plant (estimated 100 tonnes per year).

The long term strategy for operation of water treatment systems and management of sludge is anticipated to be a component of the FCRP. However, a sludge management plan is required for the duration of care and maintenance activities to ensure that sludge is managed in an appropriate manner that does not compromise the environmental protection measures being implemented while the FCRP is being developed and implemented.

The study proposes to accomplish two specific objectives:

1. Provide a baseline environmental characterization of the sediments, with due consideration to the available interim management options.
2. Provide a Sediment Management Plan, with consideration of a timeframe of 5-years (i.e. to 2008).

The specific tasks that would likely be completed are as follows:

1. Review of information collected by Canmet during a 2001/2002 study of sediment from the Cross Valley Pond and the mill water treatment system.
2. Sample collection and shipment for analysis.

3. Field assessment of sediment characteristics including photos, observations and volume/density estimates.
4. Laboratory chemical analyses.
5. Laboratory physical properties testing.
6. Definition of management options to minimize potential environmental impacts (based on the chemical and physical properties characterization).
7. Evaluation of management options including consideration of past practices, best practices, licence requirements and site conditions.

A treatment sediment management plan would then be finalized and, ultimately, implemented in consultation with regulators and other interested parties according to the design and intent of the consultation and communication processes described in Section 2.1.5.

## 10.4 INVESTIGATION OF TAILINGS OUTSIDE OF THE ROSE CREEK TAILINGS FACILITY

### 10.4.1 AREAS OF INVESTIGATION

There are several areas where tailings have been deposited on land during past mining activities outside of the Rose Creek Tailings Facility. These include:

1. The emergency tailings area.
2. The 1970's spill area downgradient of the Cross Valley Dam.
3. The upgradient extent of the Rose Creek Tailings facility near the copper sulphate and bulk explosives plants.
4. The north side of the upper length of the Rose Creek Diversion Canal.

***The emergency tailings area should be excavated and hauled to the Faro Main pit as an interim reclamation measure***

The emergency tailings area, adjacent to the mill and mine access road in the old Faro Creek channel, is assumed to contain tailings produced from all generations of mine operations. The tailings are acid generating and are known to be producing highly contaminated seepage derived from surface infiltration as well as, possibly, subsurface flow originating in the old Faro Creek channel. This seepage is suspected to largely report to the Intermediate Pond of the Rose Creek tailings facility but may also contribute to contaminant loading in the Rose Creek Valley aquifer. These tailings are isolated from the Rose Creek Tailings Facility.

***Residual tailings from the 1970's surface spill are contained between the Cross Valley Dam and Rose Creek***

The area of land generally between the Cross Valley Dam and Rose Creek contains residual tailings from the 1970's tailings spill on surface. Further, residual patches of dead vegetation remain in the area. These tailings have not been specifically characterized to date but are assumed to comprise a relatively thin surface layer overlying native soils and to be acid generating or potentially acid generating. The 2002 Water Balance study (Gartner Lee 2002) indicated a possible unquantified source of sulphate in Rose Creek that might be related, in part, to these tailings.

The area generally between the copper sulphate and bulk explosives plants and the Rose Creek Tailings Facility and the flat area on the north side of the upper length of the Rose Creek Diversion Canal are observed to have tailings on surface that were deposited during past mining activities. The extent, depth, specific geochemical characteristics and possible impacts on surface water quality of these tailings is unknown.

## 10.4.2 STUDY RATIONALE AND DESIGN

***A characterization study is necessary***

A study to characterize the physical extent, specific geochemical characteristics and possible impacts on water quality of these tailings areas is necessary to determine whether these areas are having a current and ongoing impact on water quality and to determine whether short term mitigation is necessary while the FCRP is being developed and implemented.

The investigation is proposed to be a one-year study that would be conducted in 2004 intended to accomplish these objectives:

1. Delineate the extent and depth of the tailings in the areas described.
2. Provide a geochemical characterization of the tailings.
3. Evaluate the current impacts on water quality and recommend short term mitigation measures.

***Test pitting program***

The work tasks that would likely be involved in the study would include:

1. A test pitting program to delineate the extent and depth of the tailings. A visual distinction between native soils and tailings is anticipated to be possible and this will be the basis of the delineation. Field tests might also be used, where necessary. This will allow for a delineation map and volume estimate to be developed.
2. Drilling may be required in the emergency tailings area in order to delineate and sample tailings and soils at depth if the thickness of tailings exceeds the effective depth of test pit excavation. In this case, drilling would be linked, if possible, to other drill projects that are carried out at the mine site from time to time.
3. Samples of tailings and native soils will be collected during the test pitting program and a representative subset of the samples will be selected for analysis. The analyses will include acid base accounting, trace metal concentrations and contaminant leaching. These test will allow for an assessment of the geochemical characteristics of the tailings.
4. Review of the site water balance to evaluate current impacts on water quality.

***Sample collection***

A project report would, ultimately, be prepared that provides recommended short term mitigation measures. Any proposed mitigation measures would be implemented in consultation with regulators and other interested parties according to the design and intent of the consultation and communication processes described in Section 2.1.5.

# 11 PROJECT SCHEDULE

*All the project schedule events will be assessed by the site manager*

The project schedule revolves around scheduled annual events as listed in Table 17, which represents the targeted timing of activities. All of the events will be assessed on an ongoing basis by the site manager to ensure that the targeted timeframes will achieve the desired environmental protection objectives.

*Modification of the target dates is possible where appropriate*

If specific climatic or other conditions indicate that modifying the targeted dates is more appropriate for management of environmental risks, then a more optimal time could be implemented. For example, if early freshet conditions result in an earlier than targeted response in the water level in the backfilled Zone 2 Pit, then pumping from the pit will be initiated earlier than the target date.

The site monitoring protocols provide for the collection of monitoring information that will allow the site manager to assess conditions and make determinations regarding the optimal timeframes for executing the care and maintenance activities.

*Provisions of the overall schedule*

The overall schedule provides for:

1. A site preparation period during which time access is opened for inspection and maintenance through freshet.
2. An active summer season during which time all of the water pumping and treatment activities and physical maintenance activities are scheduled to be completed.
3. A non-active winter season during which time minimal activities are scheduled beyond site security, maintenance/repairs to mobile equipment and site monitoring.

**Table 17. Summary Schedule of Annual Scheduled Activities**

| Type of Activity | Activity | Target Timing |
|---|---|---|
| Site Preparation | Clear road accesses | All year |
| | Ditch maintenance & ice clearing | All year |
| | Mechanical and electrical maintenance and checks | April to May |
| Pumping & Treatment | Zone 2 Pit pumping | June to October – intermittent |
| | Main Pit pumping and treatment | June to August – continuous |
| | Intermediate Pond treatment | June to October – intermittent |
| | Vangorda Pit pumping ad treatment | July to August – continuous |
| | Little Creek Dam pumping | June and September – two events |
| | Sludge disposal | Mill: throughout pumping season<br>Grum/Vangorda: September<br>Cross Valley Pond : winter as required |
| Effluent Release | Effluent release from Cross Valley Pond | June to October – intermittent |
| | Effluent release from Grum/Vangorda water treatment plant | July to August – continuous |
| Monitoring | Surface water quality | Weekly, monthly, quarterly, annually per the site water monitoring protocol |
| | Groundwater quality | Twice per year (spring and fall) |
| | Benthic Invertebrates/Stream sediments | Alternating years: Rose Creek and Vangorda Creek: |

| Type of Activity | Activity | Target Timing |
|---|---|---|
| | | Place colonization baskets – July<br>Retrieve colonization baskets – August |
| | Reading geotechnical instrumentation | Twice per year (spring and fall) or more frequently per recommendations of the engineer |
| | Monitoring rock drain head pond | Monthly photographic record |
| | Professional geotechnical inspection | Vangorda Plateau site – June<br>Faro site – September |
| Reporting to Yukon Territory Water Board | Monthly water reports | End of the subsequent month |
| | Annual Environmental Report (inclusive of geotechnical inspection reports) | March 1 of the subsequent year |
| Site Security & Road Maintenance | 24-hour guardhouse attendant | Full time during operating season |
| | Day guardhouse attendant | Winter season when road is cleared – intermittent November to March |
| | Culvert opening/steaming | Late winter and freshet – as required March to April |
| | Grading, resurfacing & snow clearing | As required – intermittent |

***One time event activities will be optimized***

Activities that are one time events through the licence timeframe (such as establishment of the demolition waste landfill) or are special projects that will operate under a project specific schedule (such as tear down of buildings) will be scheduled and executed on the basis of optimizing those activities.

# 12 ENVIRONMENTAL MONITORING AND PROTECTION

## 12.1 SITE WATER MONITORING PROTOCOL

***The protocols include surface and groundwater monitoring for Faro and Vangorda Plateau Sites***

The site water monitoring protocol was established in 2000 to include the requirements of the water licence plus additional water monitoring for site management purposes. The protocols appended (Appendix C) include surface and groundwater monitoring for the Faro and Vangorda Plateau sites and are proposed to be implemented for the proposed licence renewal timeframe (2004 to 2008).

The data is proposed to be reported to the Yukon Territory Water Board on a monthly basis and to be included in an annual environmental report according to the provisions of the current water licences.

## 12.2 SITE GENERAL MONITORING PROTOCOL

***The protocol includes the facilities to be observed and the nature of the information to be documented***

The site general monitoring protocol was established in 1999 as a means of establishing a standard methodology for visual inspection of the mine facilities that could be conducted by on-site personnel. The protocol appended (Appendix D) includes the facilities to be observed and the nature of the information to be documented. The information is recorded in a log book that is kept on-site.

## 12.3 SITE BIOLOGICAL MONITORING PROTOCOL

***The protocol is unchanged from the current water licence***

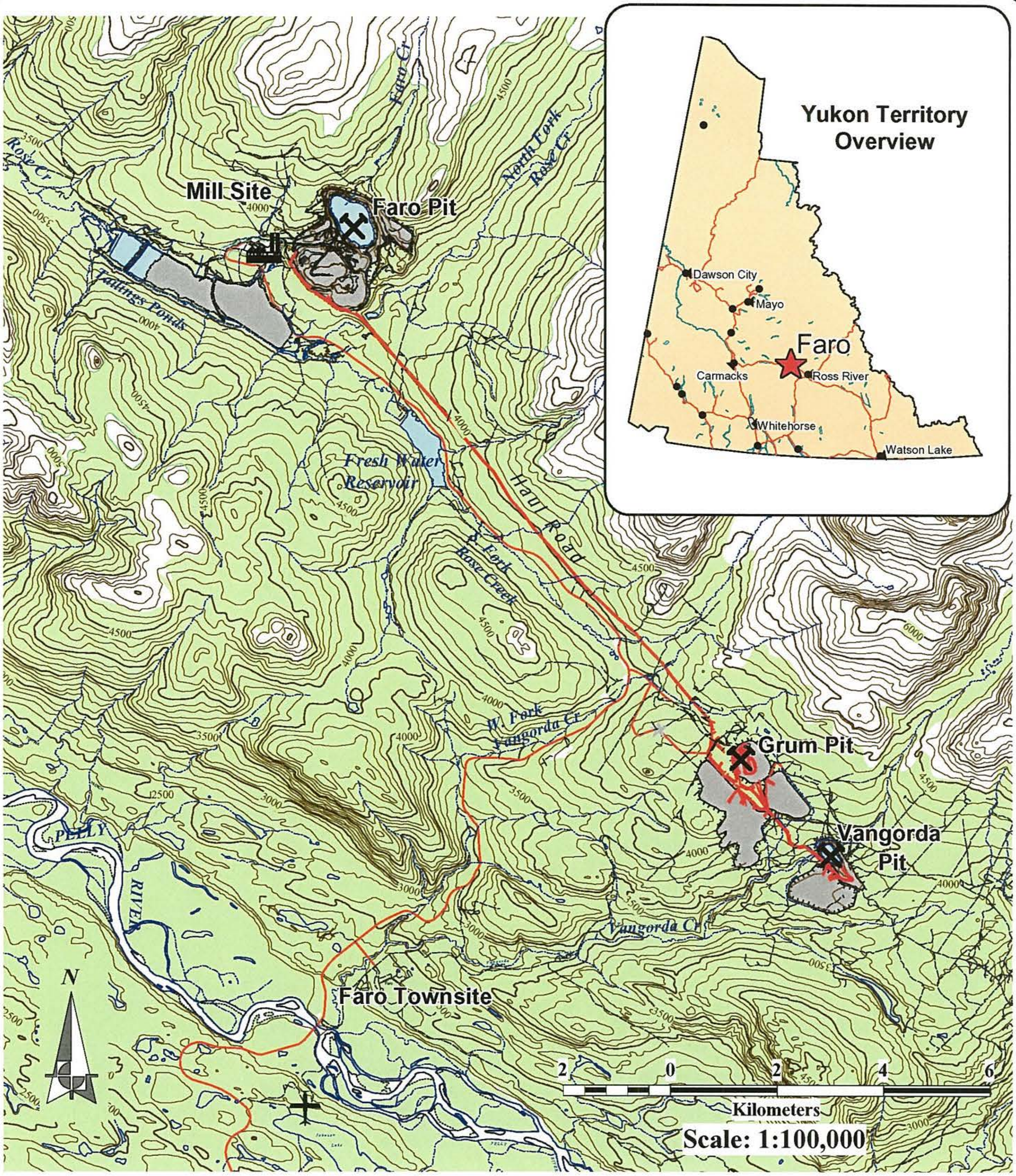
The site biological monitoring protocol is unchanged from the requirements of the current water licences. The intent is to continue the methodologies employed to date and the established locations to ensure that the information collected is consistent with previous studies and allows for the identification of temporal trends.

## 12.4 SITE PHYSICAL MONITORING PROTOCOL

***The protocol is unchanged from the current water licence***

The site physical monitoring protocol is unchanged from the requirements of the current water licences for an annual review of earth structures by a professional geotechnical engineer. The intent is to continue to conduct an annual professional inspection of the prescribed structures and to continue reading of geotechnical instrumentation on a twice per year basis or more frequently, as directed by the engineer.

# Figures




Site Name: FARO
File : 22307-D6-V1-FIG1.PDF

Gartner Lee Limited

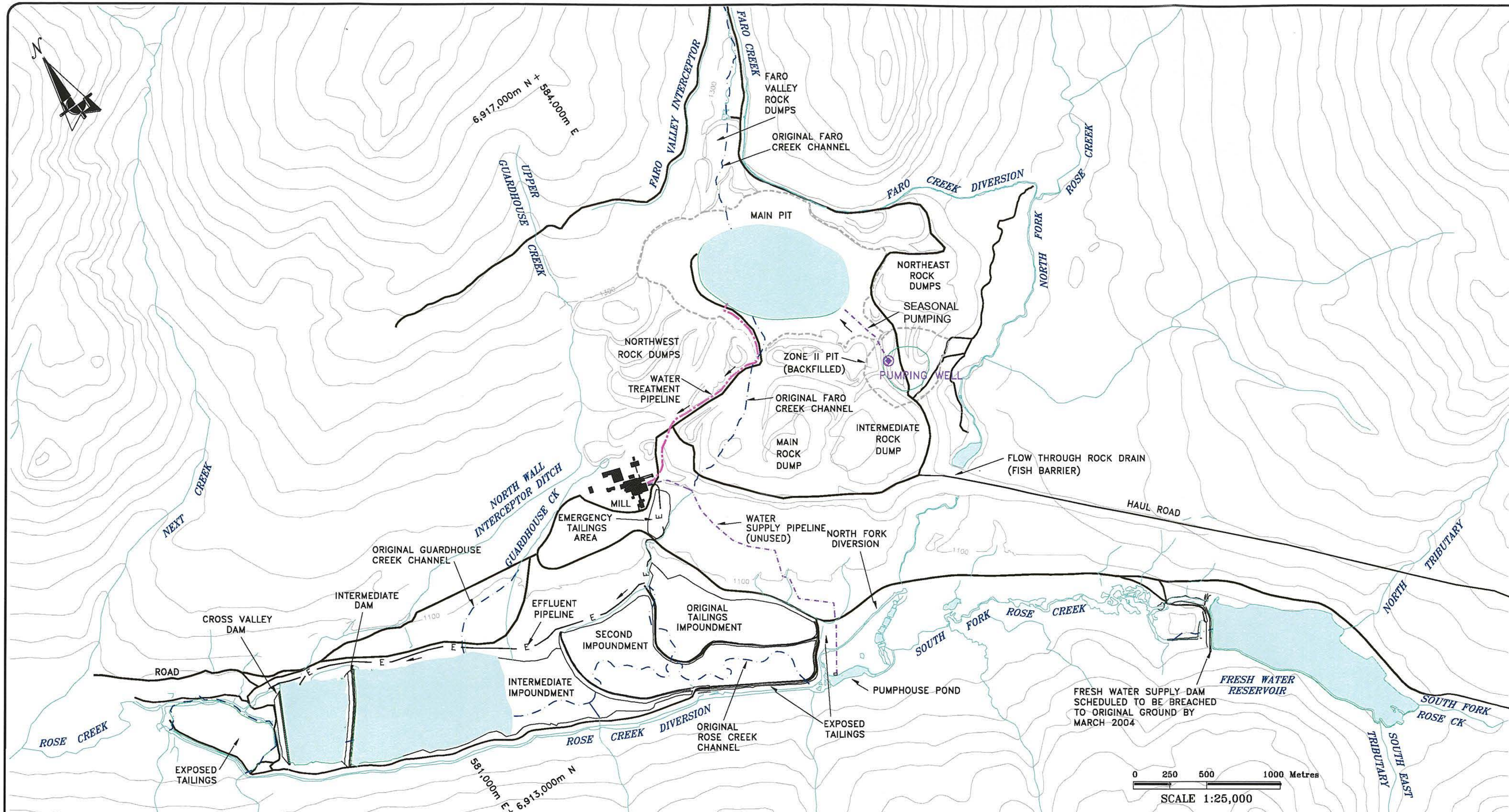
Scale: 1: 100,000

DELOITTE & TOUCHE INC.

**Project Location Map**

Project No: 22-307
Date Issued: APR. 2003

Figure 1




LEGEND:

- ROADS
- EXISTING SURFACE DRAINAGE
- PRE-MINE DRAINAGE
- EFFLUENT PIPELINE
- PIPELINE
- WATER TREATMENT PIPELINE
- SURFACE WATER

SOURCES OF INFORMATION:

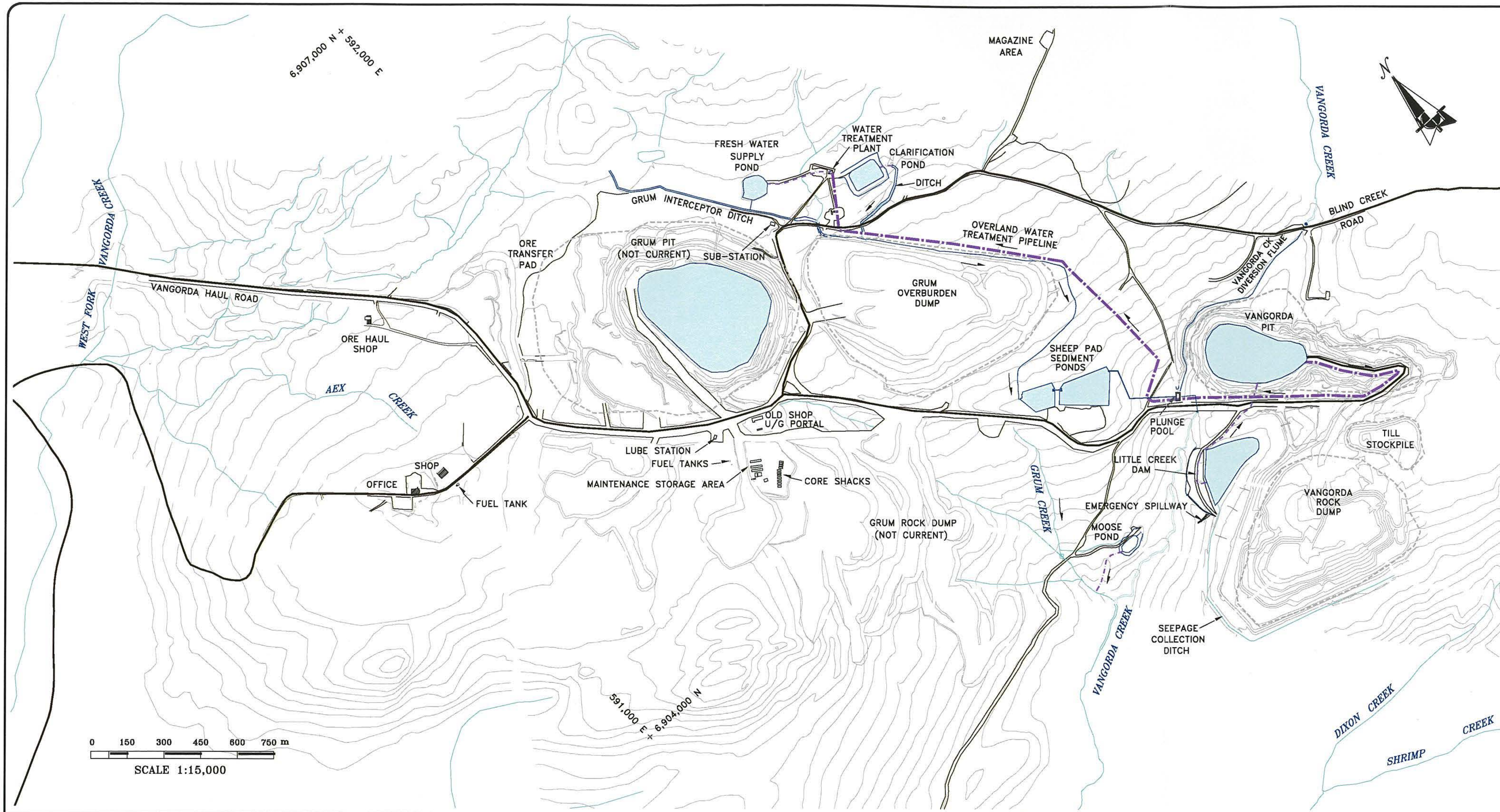
1. DIGITAL COPY OF 1:50,000 TOPOGRAPHIC MAP SUPPLIED BY SRK CONSULTING.
2. MAP COORDINATES ARE UTM NAD83 ZONE 8; CONTOUR INTERVAL 100 FT.
3. FARO MINE DETAILS ADAPTED FROM DRAWINGS BY ROBERTSON GEOCONSULTANTS INC.

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-01.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORTATION (INTERIM RECEIVER)
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**FARO MINE SITE OVERVIEW**

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 2




LEGEND:

- ROADS
- EXISTING SURFACE DRAINAGE
- PRE-MINE DRAINAGE
- EFFLUENT PIPELINE
- PIPELINE
- WATER TREATMENT PIPELINE
- SURFACE WATER

SOURCES OF INFORMATION:

1. DIGITAL COPY OF 1:50,000 TOPOGRAPHIC MAP SUPPLIED BY SRK CONSULTING.
2. FARO MINE DETAILS ADAPTED FROM DRAWINGS BY ROBERTSON GEOCONSULTANTS INC.

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-02.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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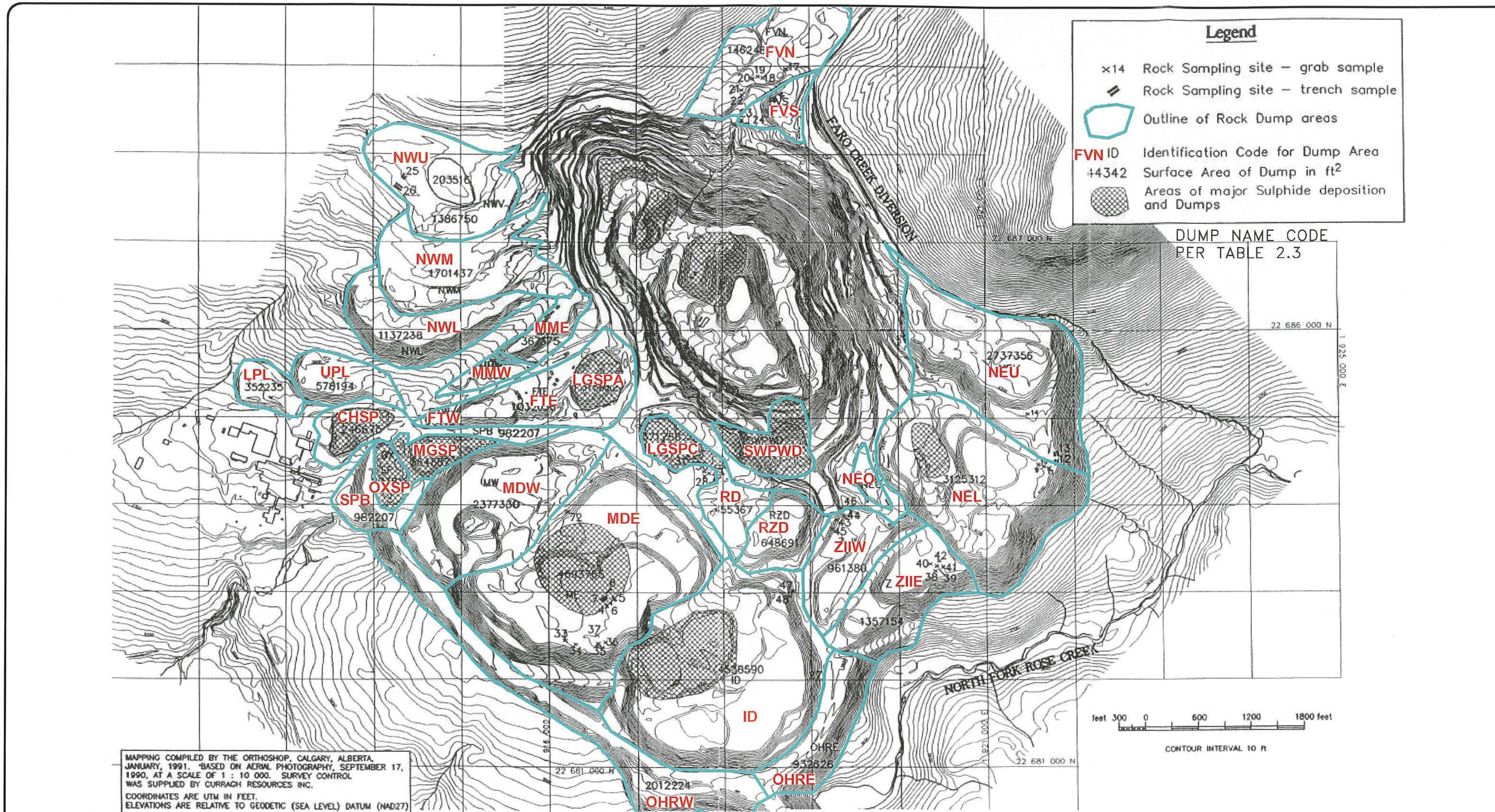
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**VANGORDA PLATEAU MINE SITE OVERVIEW**

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 3




SOURCE OF FIGURE:
DRAWING SHOWN BELOW DRAWN FROM REPORT BY ROBERTSON GEOCONSULTANTS INC.
REPORT NO. 033001/3 DATED NOVEMBER 1996
"ANVIL RANGE MINING COMPLEX – INTEGRATED COMPREHENSIVE ABANDONMENT PLAN"

ROBERTSON GEOCONSULTANTS INC.
Consulting Geotechnical and Environmental Engineers

Anvil Range Mining Corporation

Anvil Complex Closure Plan
Faro Dumps Sampling Sites and Dump Classification

Project No. 033001 | Date Oct. 1996 | Figure 4-5

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-03.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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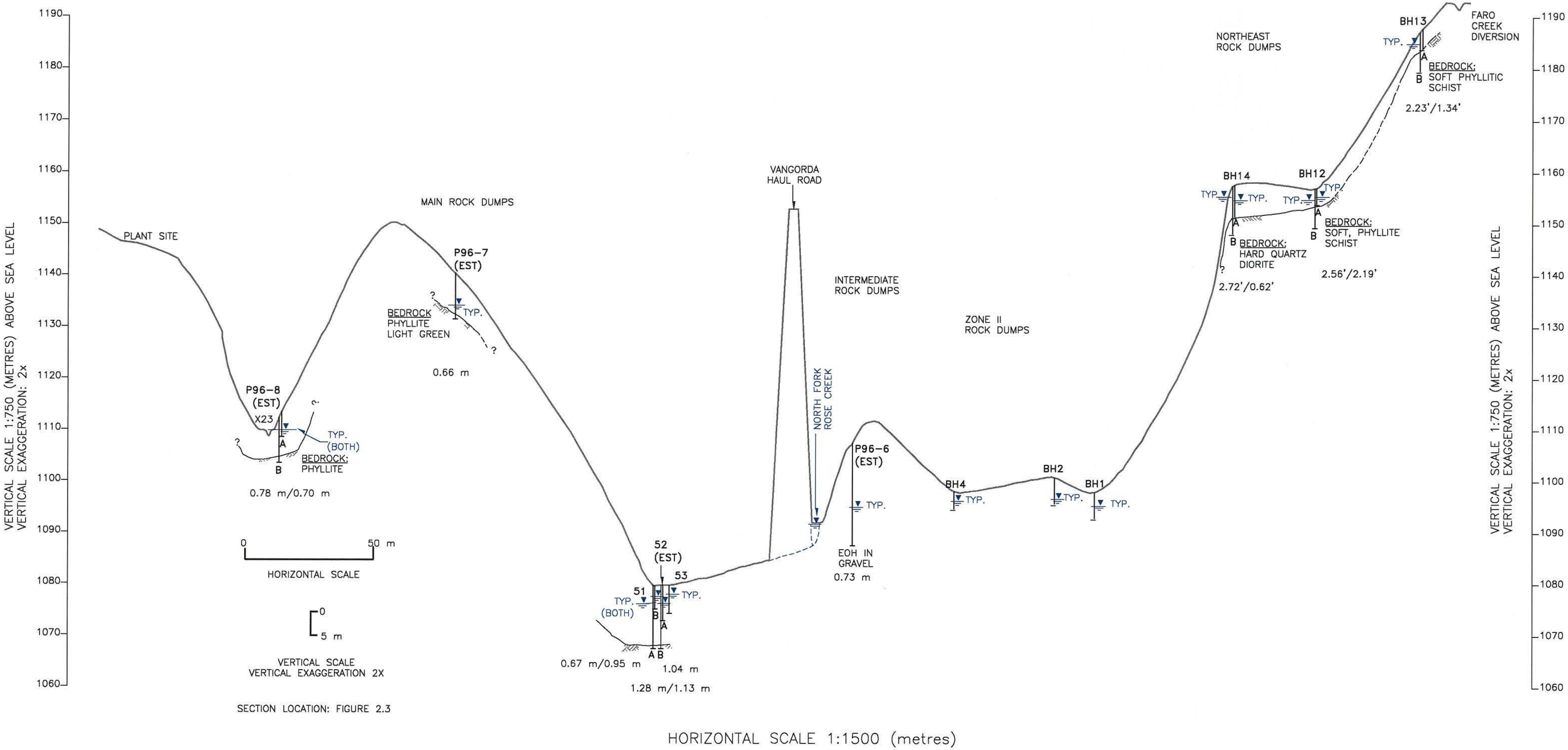
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**FARO DUMPS NAMING CONVENTION**

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 4




SOURCE OF FIGURE:
SKETCH BY ERIC DENHOLM, GARTNER LEE LIMITED

- MEASURED GROUNDWATER (m)
- ——— STRATIGRAPHY BOUNDARY
- - - - - INTERPRETED STRATIGRAPHY BOUNDARY

P96-8 (EST)

0.78 m/0.70 m ← STICKUP ABOVE GROUND FOR EACH WELL

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-05.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORTATION
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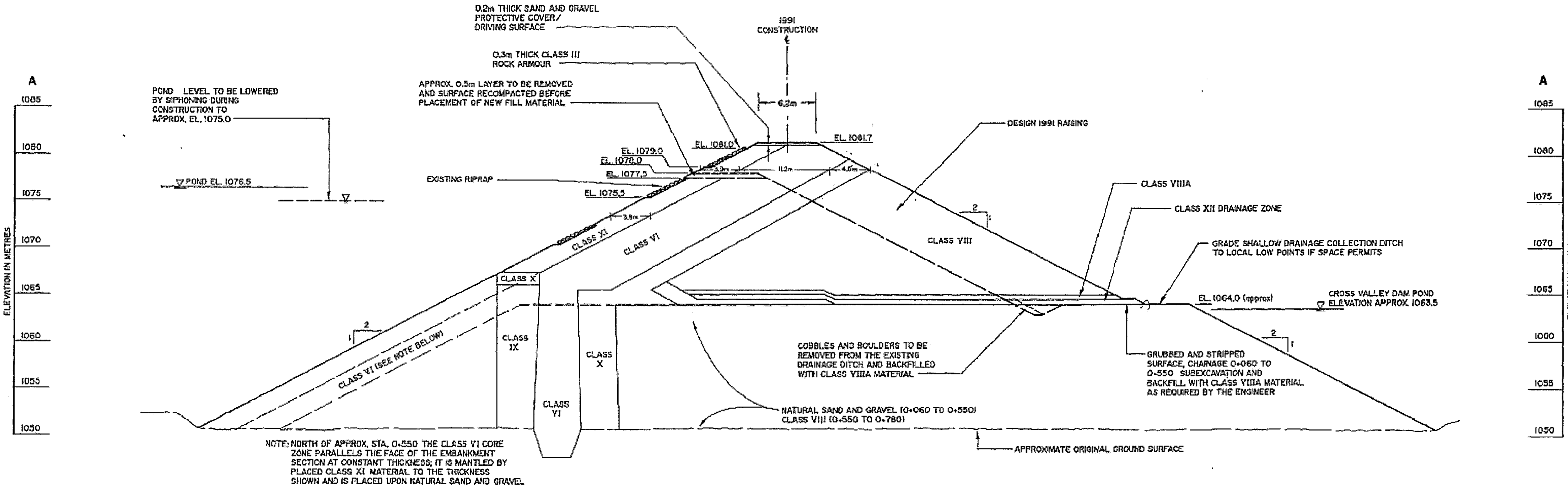
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

# FARO DUMPS PERIMETER SECTION

Gartner Lee | Deloitte & Touche

VOLUME I
FIGURE NO. 6




**SECTION A-A**

SCALE : 1 : 250, HORIZONTAL AND VERTICAL

(SEE DETAILED PLAN BELOW)

SOURCE OF FIGURE:
DRAWING SHOWN BELOW DRAWN FROM REPORT BY GOLDER ASSOCIATES LTD.
REPORT NO. 912-2402
DATED: JULY 1991
"INT. DAM RAISING & CV DAM TOE DRAIN"

CURRAGH RESOURCES INC — Faro Yukon Territory — CROSS SECTION AND DETAILED PLAN — Golder Associates Ltd.

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-06.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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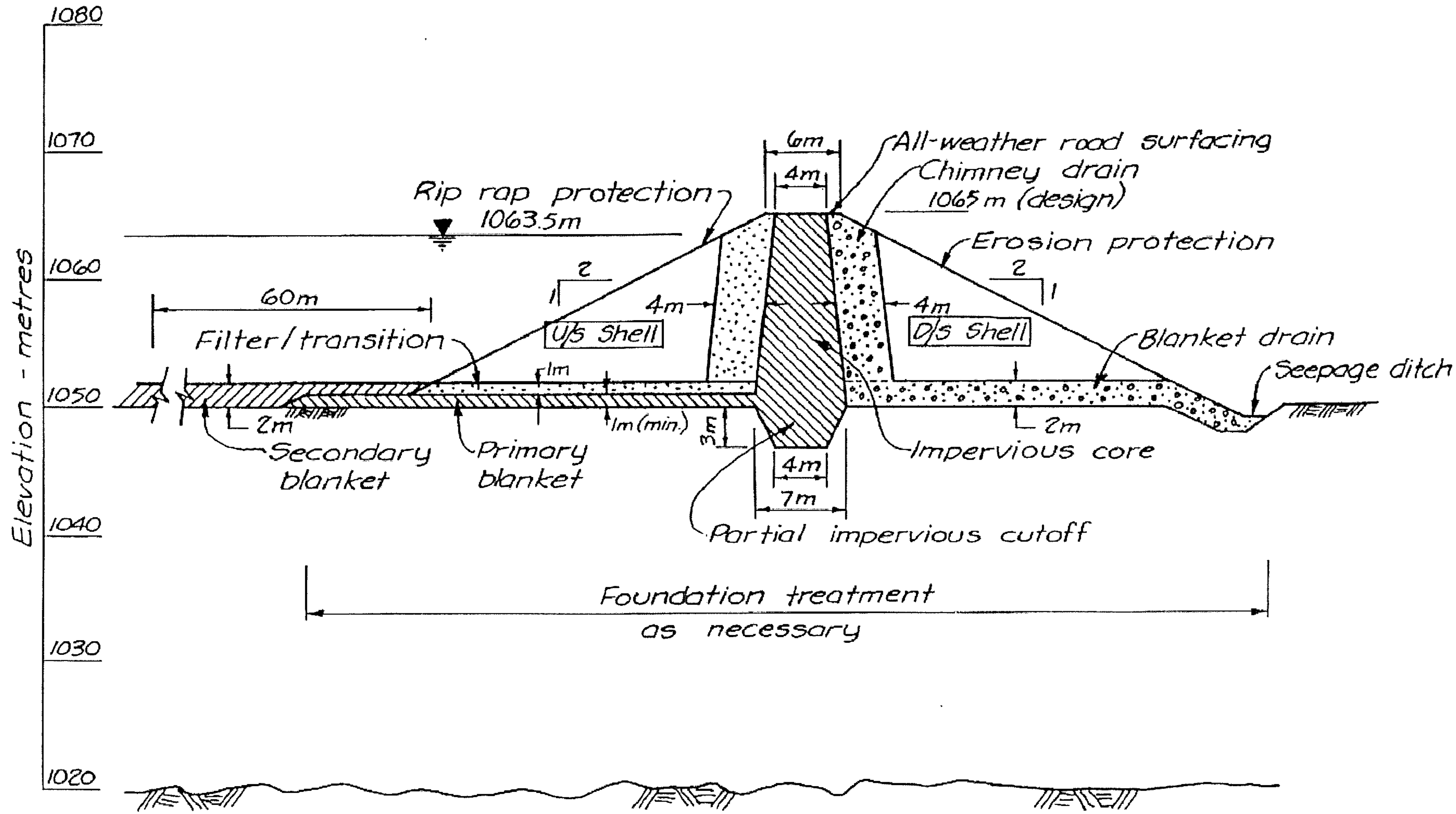
ENVIRONMENTAL ASSESSMENT REPORT

## INTERMEDIATE DAM SECTION

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 7




SOURCE OF FIGURE:
GOLDER GEOTECHNICAL CONSULTANTS LTD., 1980
REPORT TITLED "DOWN-VALLEY TAILINGS CONTAINMENT FACILITY
REPORT TO CYPRUS ANVIL MINING LTD." JUNE 6, 1980 3 VOLS.

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-07.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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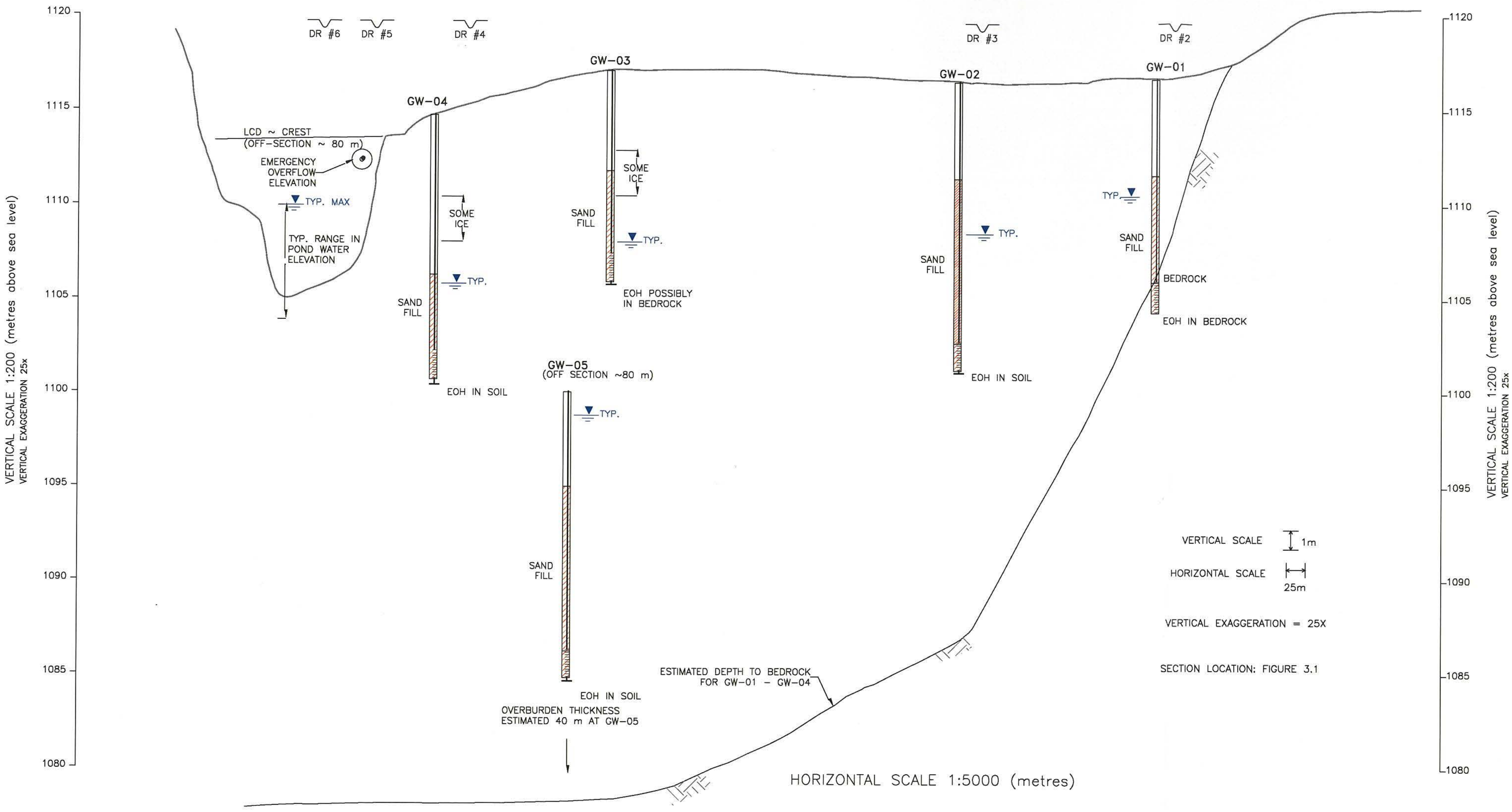
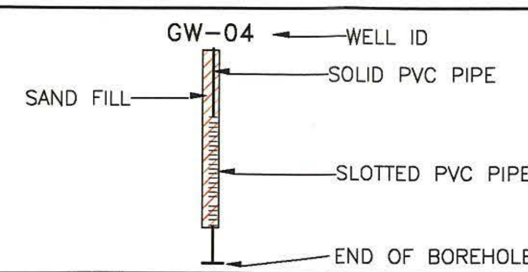
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**CROSS VALLEY DAM SECTION**

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 8




| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-09.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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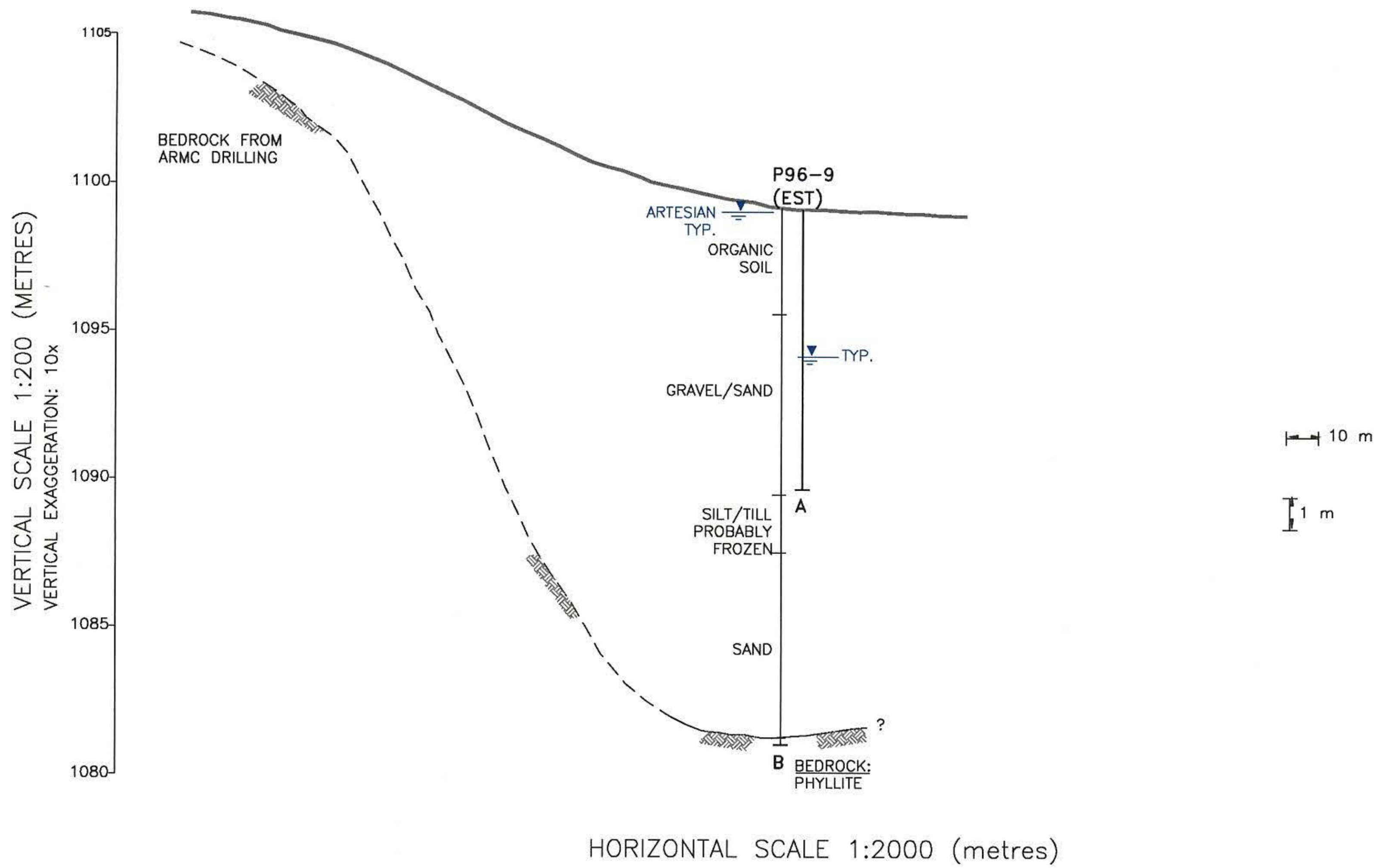
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

# VANGORDA ROCK DUMP PERIMETER SECTION

Gartner Lee | Deloitte & Touche

VOLUME 1
FIGURE NO. 10




SOURCE OF FIGURE:
SKETCH BY ERIC DENHOLM, GARTNER LEE LIMITED

MEASURED GROUNDWATER ELEVATION (m)
STRATIGRAPHY BOUNDARY
INTERPRETED STRATIGRAPHY BOUNDARY

P96-9 (EST)

NOTES:
1. SECTION LOCATION: FIGURE 3.3
2. ELEVATIONS ARE IN METRES ABOVE SEA LEVEL

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-11.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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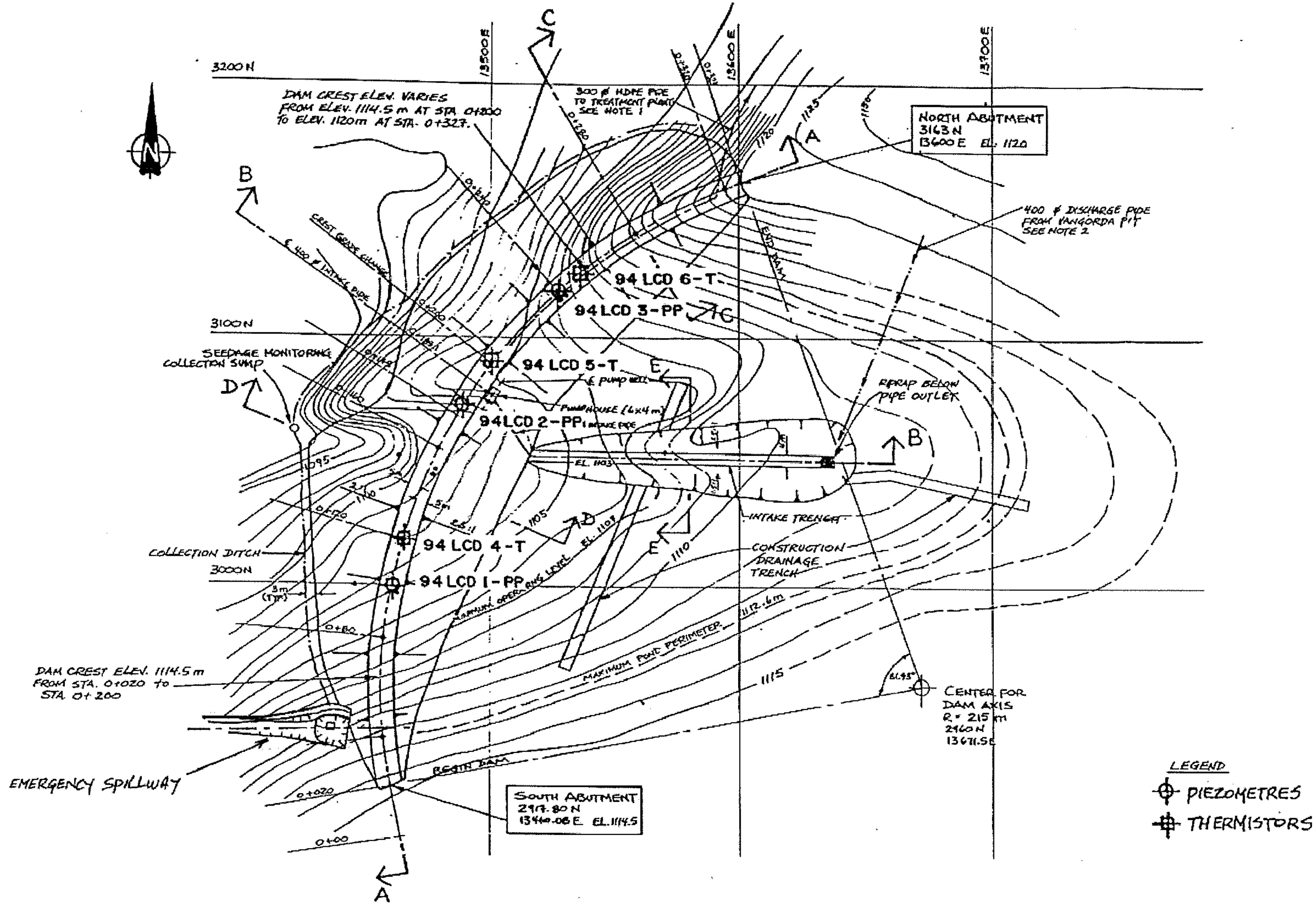
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**GRUM ROCK DUMP TOE SECTION**

Gartner Lee | Deloitte & Touche

VOLUME 1
FIGURE NO. 12




GENERAL ARRANGEMENT PLAN

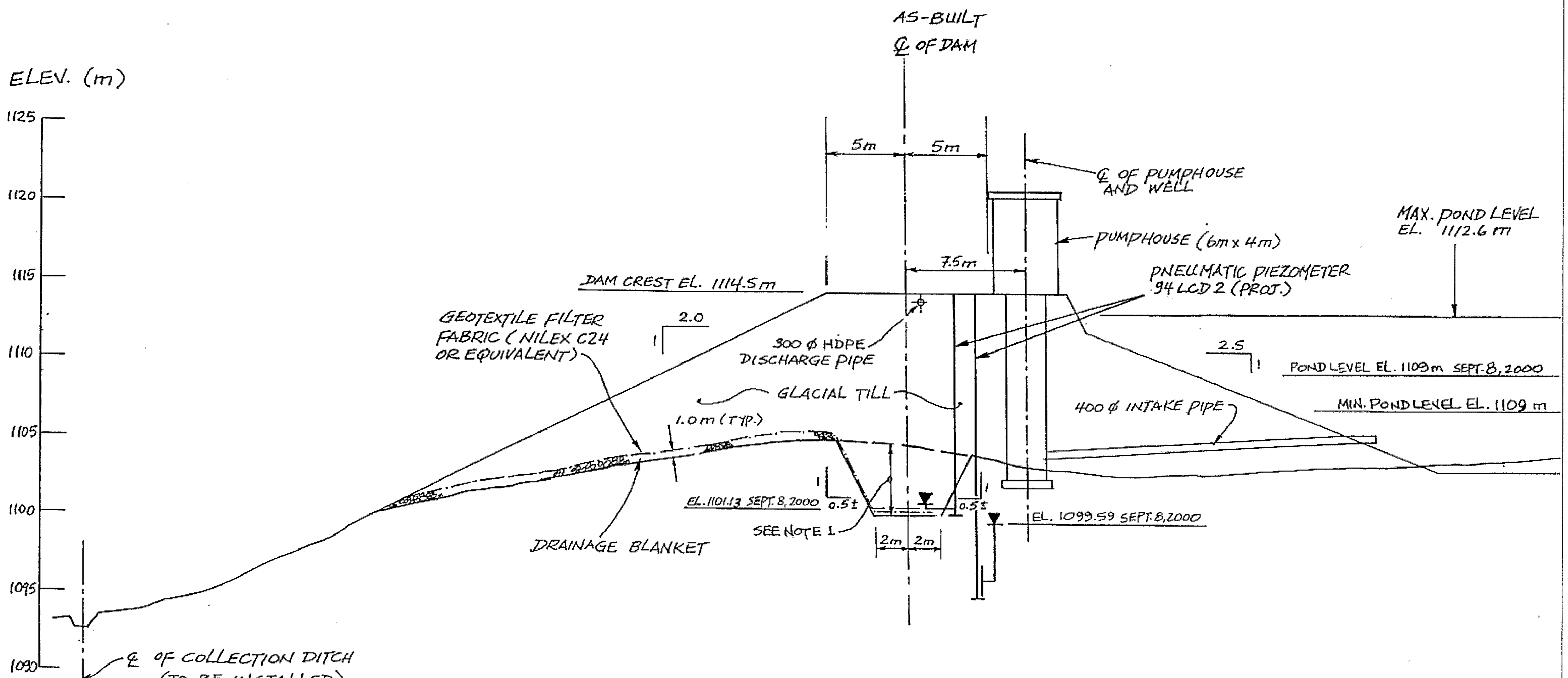
SOURCE OF FIGURE:
DRAWING SHOWN BELOW DRAWN FROM REPORT BY STEFFEN, ROBERTSON KIRSTEN (CANADA) INC. (SRK, 2002)

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-12.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION (INTERIM RECEIVER)
2004 TO 2008 WATER LICENCE RENEWAL ENVIRONMENTAL ASSESSMENT REPORT

LITTLE CREEK DAM PLAN

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 13




SECTION B-B (STA. 0+190)

SOURCE OF FIGURE:
DRAWING SHOWN BELOW DRAWN FROM REPORT BY STEFFEN, ROBERTSON KIRSTEN (CANADA) INC. (SRK, 2002)

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-13.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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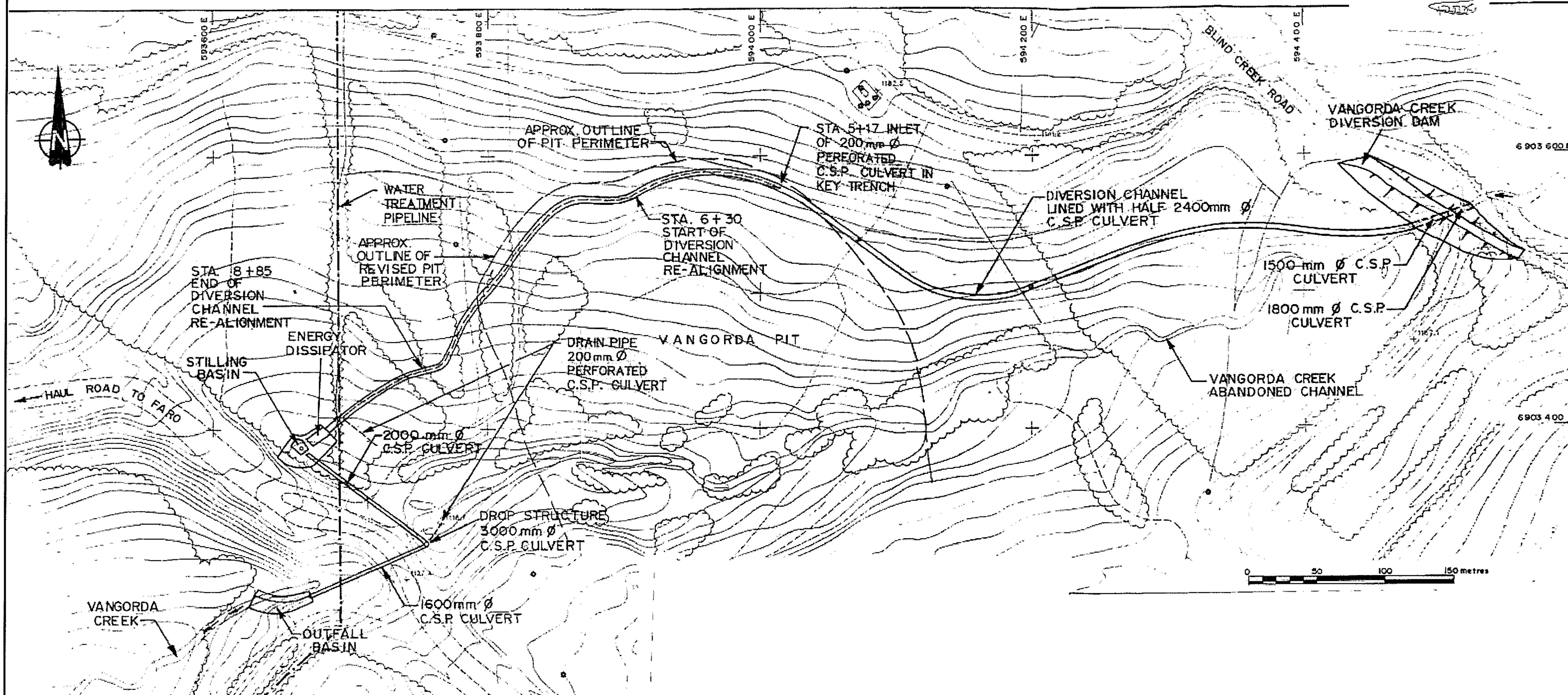
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**LITTLE CREEK DAM SECTION**

Gartner Lee | Deloitte & Touche | VOLUME I FIGURE NO. 14




SOURCE OF FIGURE:
DRAWING SHOWN BELOW DRAWN FROM REPORT BY STEFFEN, ROBERTSON KIRSTEN (CANADA) INC.
REPORT NO. 60647 DATED MAY 1992
"CONSTRUCTION REPORT VANGORDA CREEK DIVERSION REALIGNMENT VANGORDA PLATEAU DEVELOPMENT"

| CURRAGH RESOURCES INC. | VANGORDA CREEK DIVERSION | APRIL 1992 / 60647 |
|---|---|---|
| GENERAL ARRANGEMENT | | 2 |
| STEFFEN ROBERTSON & KIRSTEN, Consulting Engineers | | |

**NOTES:**

1. BASE TOPOGRAPHIC PLAN IS TAKEN FROM CURRAGH RESOURCES LTD. 1:2000 SCALE DRAWING ENTITLED " FARO PLATEAU ".
2. LOCATION OF WATER TREATMENT PIPELINE IS TAKEN FROM COMINCO ENGINEERING SERVICES LTD. CONSTRUCTION DRAWING P682-B-130 Rev. 1 ENTITLED " VANGORDA DEWATERING PROJECT, W.T. PLANT TO VANGORDA SUMP – PLAN AND SECTIONS " DATED 90/08/07.
3. LOCATION OF VANGORDA CREEK DIVERSION RELOCATION IS TAKEN FROM SURVEY DATA PROVIDED BY CURRAGH RESOURCES. APRIL 1992.

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-14.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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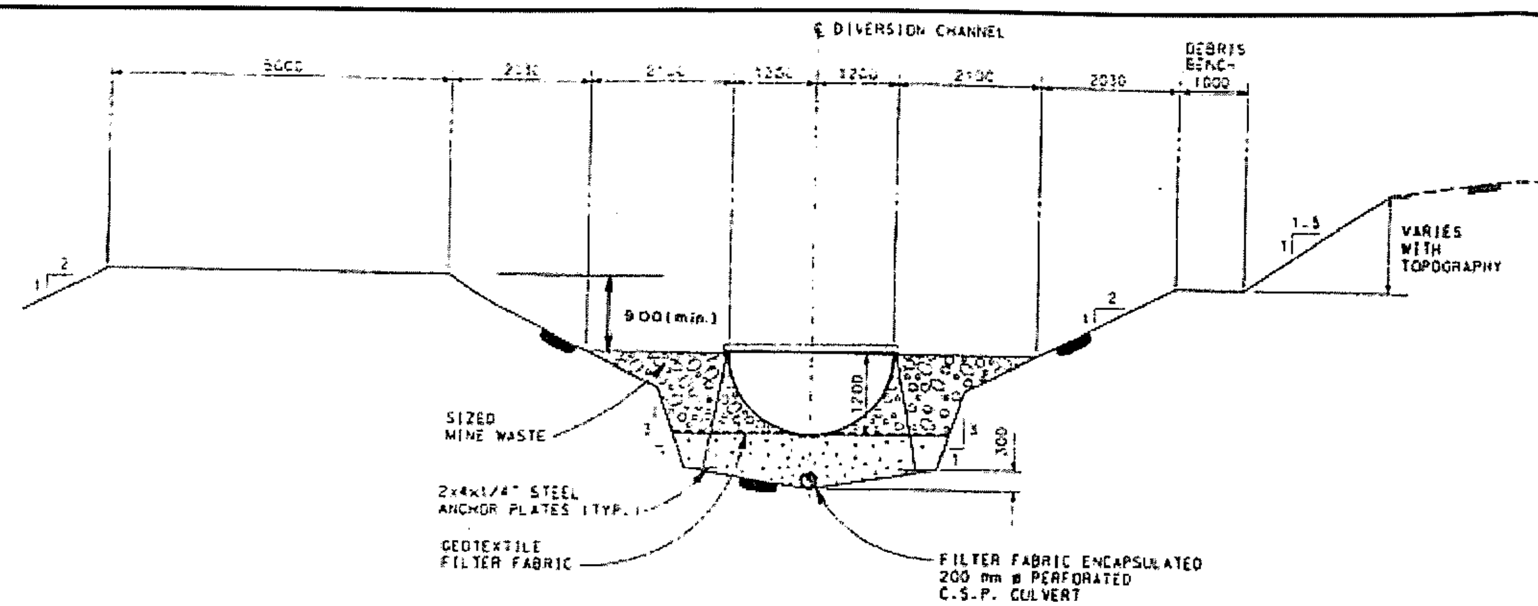
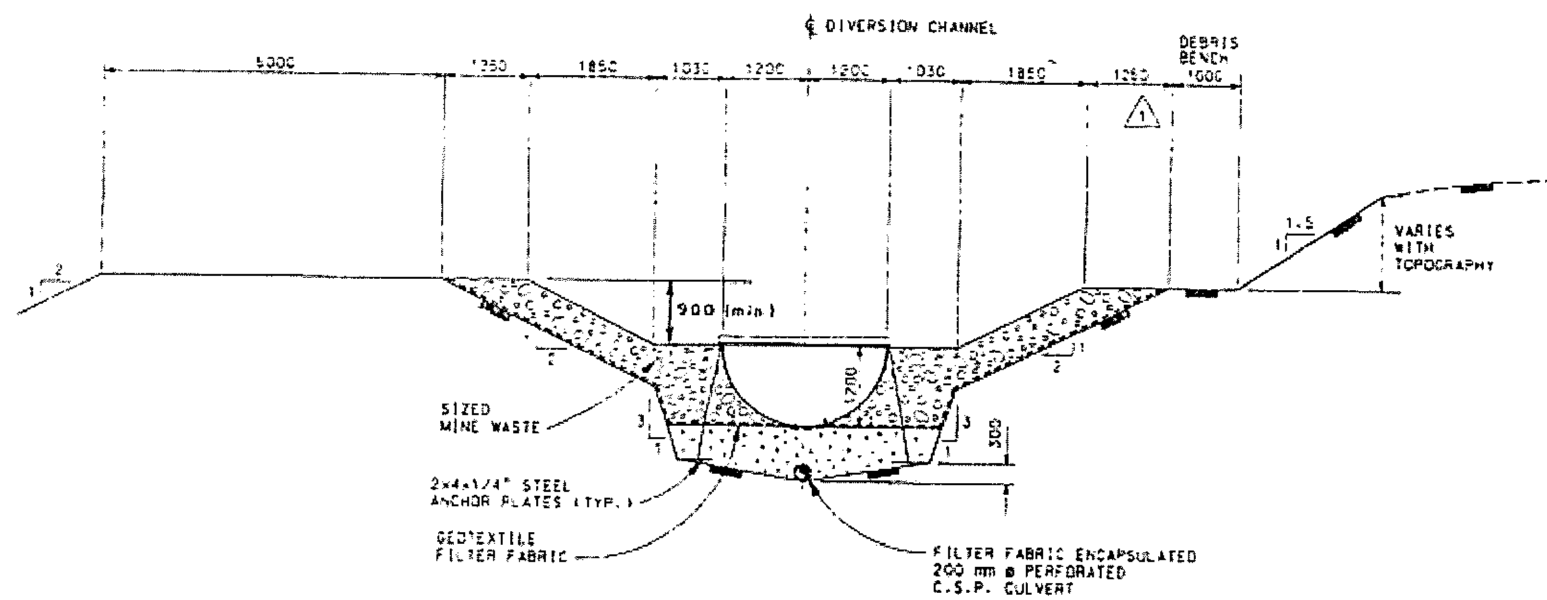
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

# VANGORDA CREEK DIVERSION FLUME PLAN

Gartner Lee | Deloitte & Touche | VOLUME I FIGURE NO. 15




TYPICAL SECTION ON ROCK CUT
FROM STA. 6+30 TO 7+50
TO STA. 7+90 TO 8+30




TYPICAL SECTION ON SOIL CUT
FROM STA. 7+50 TO 7+90
TO STA. 8+30 TO 8+85

SECTION A/06
SCALE: 1:50

SOURCE OF FIGURE:
DRAWING SHOWN BELOW DRAWN FROM REPORT BY STEFFEN, ROBERTSON KIRSTEN (CANADA) INC.
REPORT NO. 60647 DATED MAY 1992
"CONSTRUCTION REPORT VANGORDA CREEK DIVERSION REALIGNMENT VANGORDA PLATEAU DEVELOPMENT"

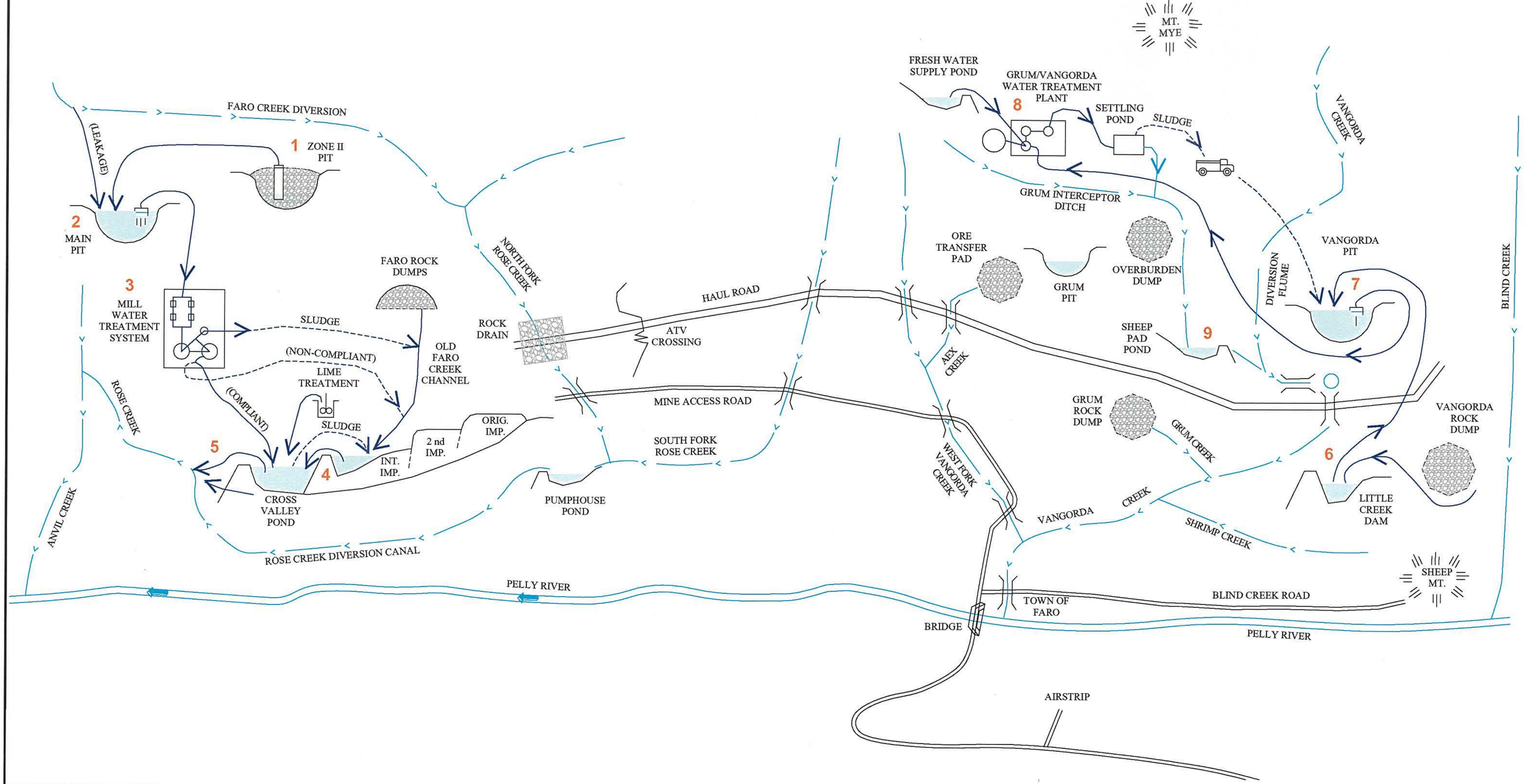
| | | |
|---|---|---|
| CLIENT: CURRAGH RESOURCES INC | TITLE | 1003509.DGN |
| LOCATION: FARO, YUKON TERRITORY | VANGORDA CREEK DIVERSION TYPICAL SECTIONS AND DETAILS SHEET 2 | PROJECT No 5444, DIVISION No 25 |
| KILBORN | | DRAWING NUMBER 100-35-09 REV 2 |

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-15.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
(INTERIM RECEIVER)
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

## VANGORDA CREEK DIVERSION FLUME SECTIONS

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 16




**PROPOSED ACTIVITIES:**

1 PUMP ZONE II PIT
2 PUMP MAIN PIT
3 MILL WATER TREATMENT SYSTEM
4 INTERMEDIATE POND LIME TREATMENT
5 DISCHARGE WATER TO ROSE CREEK
6 PUMP LITTLE CREEK DAM
7 PUMP VANGORDA PIT
8 GRUM/VANGORDA WATER TREATMENT PLANT
9 DISCHARGE WATER TO VANGORDA CREEK

| DRAWING INFORMATION: | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-20.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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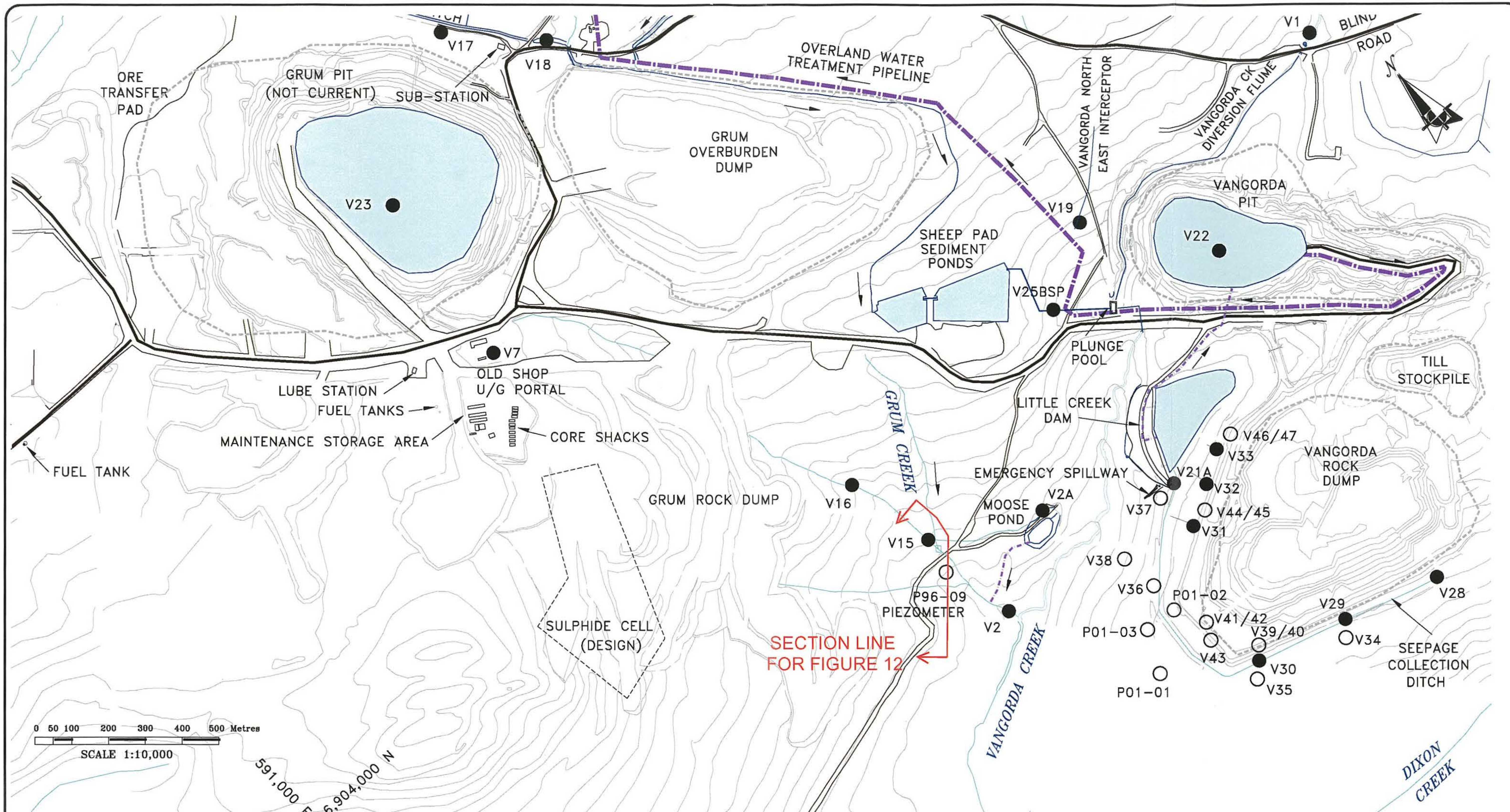
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**SUMMARY OF PROPOSED CARE AND MAINTENANCE ACTIVITIES FARO AND VANGORDA PLATEAU SITES**

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 17




LEGEND:

| | | | |
|---|---|---|---|
| (solid double line) | ROADS | (purple dash-dot line) | WATER TREATMENT PIPELINE |
| (light blue line) | EXISTING SURFACE DRAINAGE | (blue fill) | SURFACE WATER |
| (dash-dot line) | PRE-MINE DRAINAGE | ○ | GROUND WATER SAMPLING LOCATION |
| —— E —— | EFFLUENT PIPELINE | ● | SURFACE WATER SAMPLING LOCATION |
| (dashed line) | PIPELINE | | |

SOURCES OF INFORMATION:

1. DIGITAL COPY OF 1:50,000 TOPOGRAPHIC MAP SUPPLIED BY SRK CONSULTING.
2. FARO MINE DETAILS ADAPTED FROM DRAWINGS BY ROBERTSON GEOCONSULTANTS INC.

DRAWING INFORMATION:

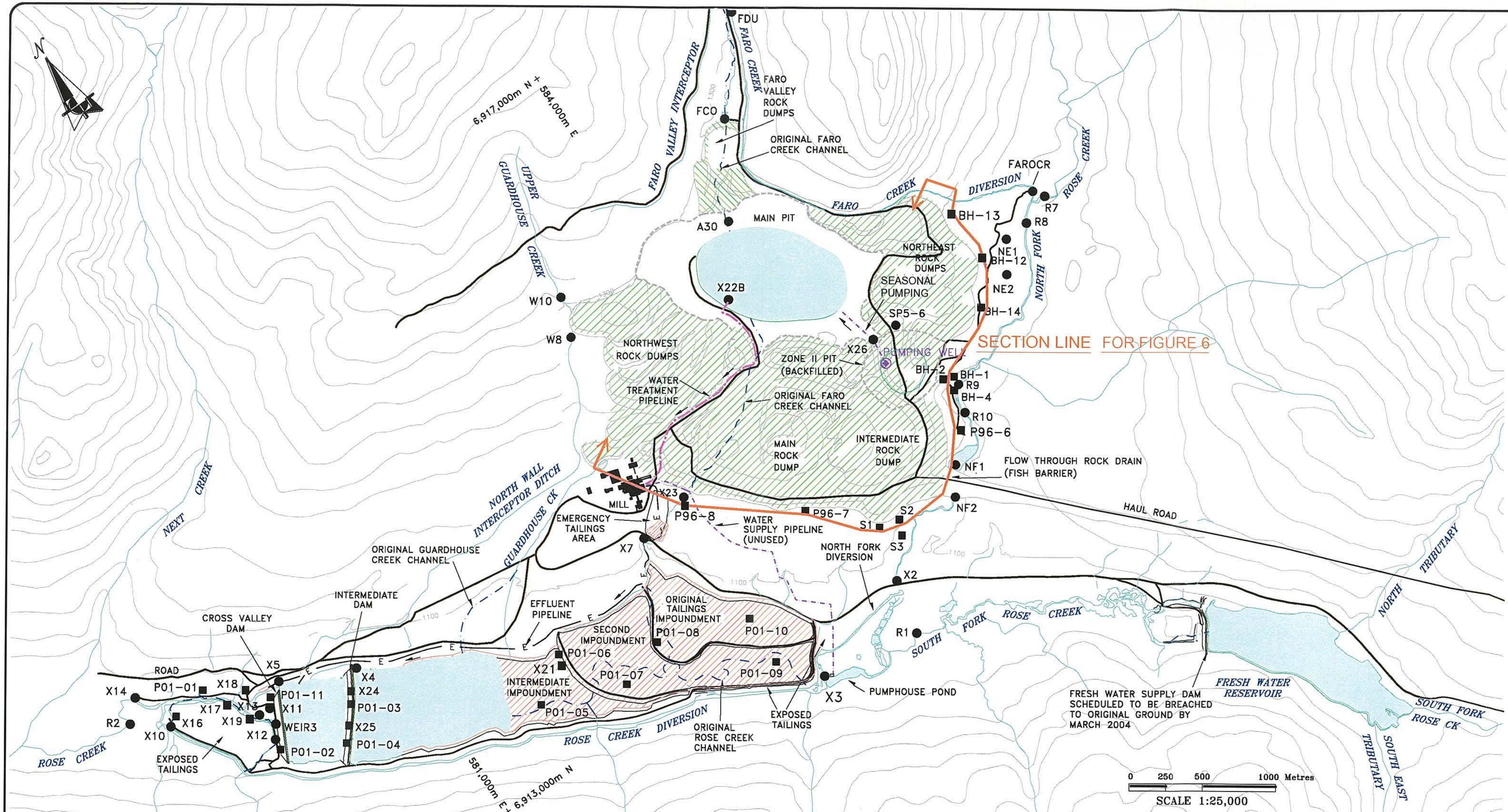
| | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-10.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION (INTERIM RECEIVER)
2004 TO 2008 WATER LICENCE RENEWAL ENVIRONMENTAL ASSESSMENT REPORT

**GRUM ROCK DUMP DETAIL**

Gartner Lee | Deloitte & Touche

VOLUME 1 FIGURE NO. 11




LEGEND:

- ROADS
- EXISTING SURFACE DRAINAGE
- PRE-MINE DRAINAGE
- E EFFLUENT PIPELINE
- PIPELINE
- WATER TREATMENT PIPELINE
- SURFACE WATER
- WASTE DUMPS
- TAILINGS IMPOUNDMENT
- GROUNDWATER SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- SECTION LINE FOR FIGURE 6

SOURCES OF INFORMATION:

1. DIGITAL COPY OF 1:50,000 TOPOGRAPHIC MAP SUPPLIED BY SRK CONSULTING.
2. MAP COORDINATES ARE UTM NAD83 ZONE 8; CONTOUR INTERVAL 100 FT.
3. FARO MINE DETAILS ADAPTED FROM DRAWINGS BY ROBERTSON GEOCONSULTANTS INC.

DRAWING INFORMATION:

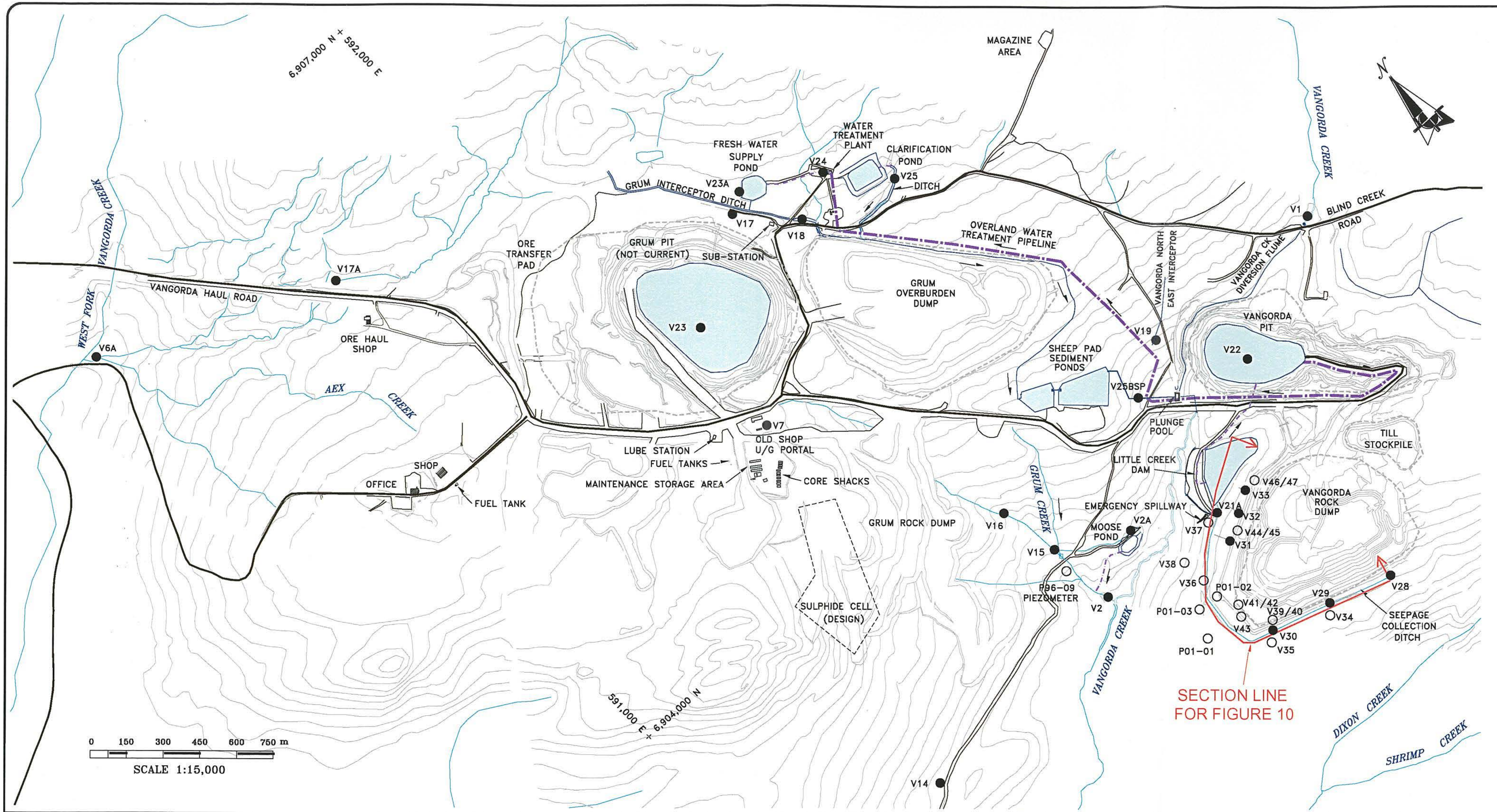
| | |
|---|---|
| REVIEWED BY: | LH/ED |
| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-04.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORTATION
(INTERIM RECEIVER)
2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**FARO MINESITE DETAILS**

Gartner Lee
Deloitte & Touche

VOLUME 1
FIGURE NO.
5




LEGEND:

| | |
|---|---|
| ROADS | WATER TREATMENT PIPELINE |
| EXISTING SURFACE DRAINAGE | SURFACE WATER |
| PRE-MINE DRAINAGE | ○ GROUND WATER SAMPLING LOCATION |
| EFFLUENT PIPELINE | ● SURFACE WATER SAMPLING LOCATION |
| PIPELINE | |

DRAIN #1 = V28
DRAIN #2 = V29
DRAIN #3 = V30
DRAIN #4 = V31
DRAIN #5 = V32
DRAIN #6 = V33

GROUNDWATER WELLS = V34 TO V38
PIEZOS. IN TOE BERM = V39 TO V47

SOURCES OF INFORMATION:
1. DIGITAL COPY OF 1:50,000 TOPOGRAPHIC MAP SUPPLIED BY SRK CONSULTING.
2. FARO MINE DETAILS ADAPTED FROM DRAWINGS BY ROBERTSON GEOCONSULTANTS INC.

DRAWING INFORMATION:

| | |
|---|---|
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| DRAWN BY: | CPW |
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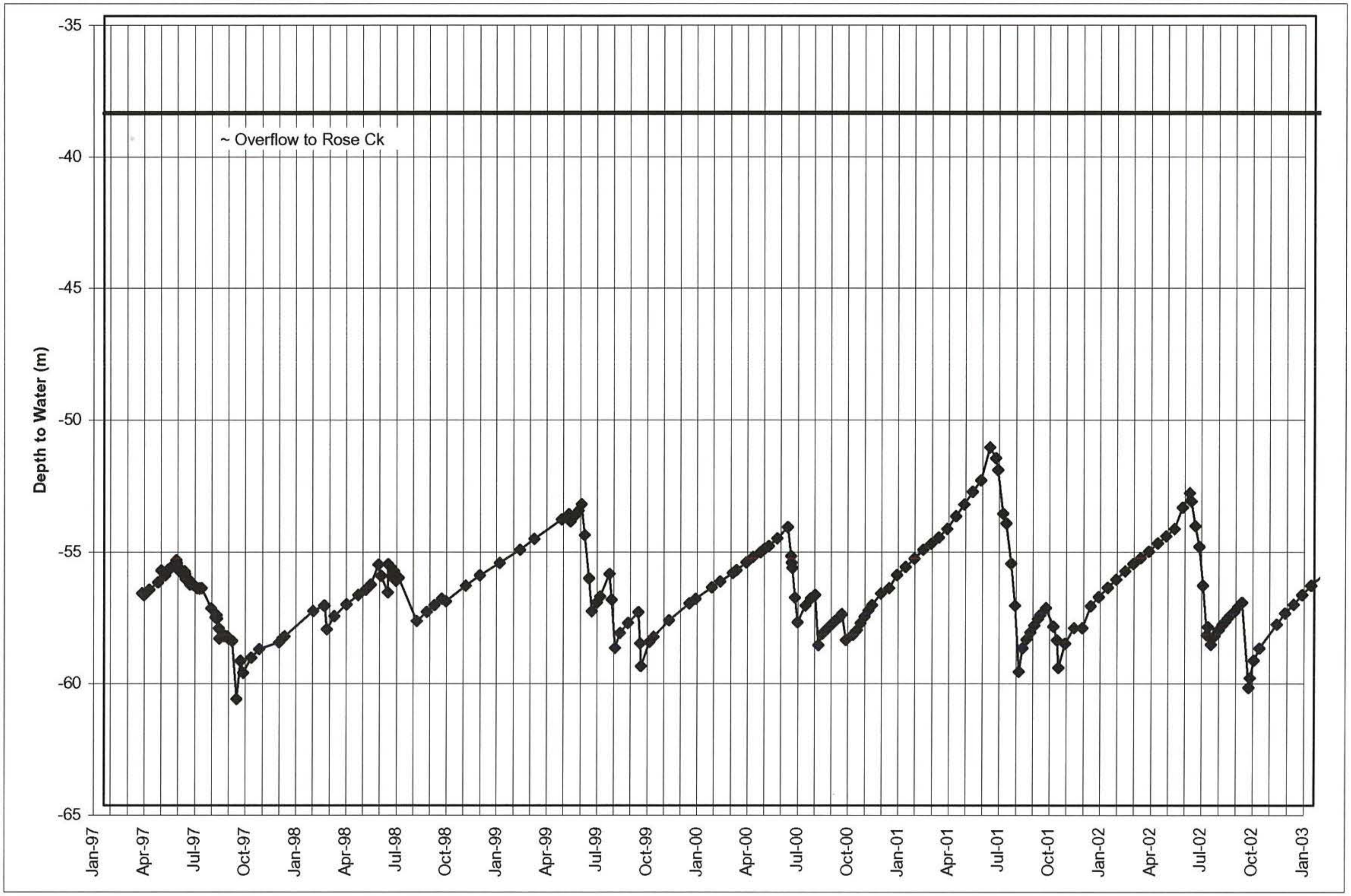
ANVIL RANGE MINING CORPORATION (INTERIM RECEIVER)
2004 TO 2008 WATER LICENCE RENEWAL ENVIRONMENTAL ASSESSMENT REPORT

**VANGORDA ROCK DUMP DETAIL**

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 9




Volume 1
Project Number: 22307
Date: April, 2003

Figure 18. Zone II Pit Water Elevations, 1997 to 2002

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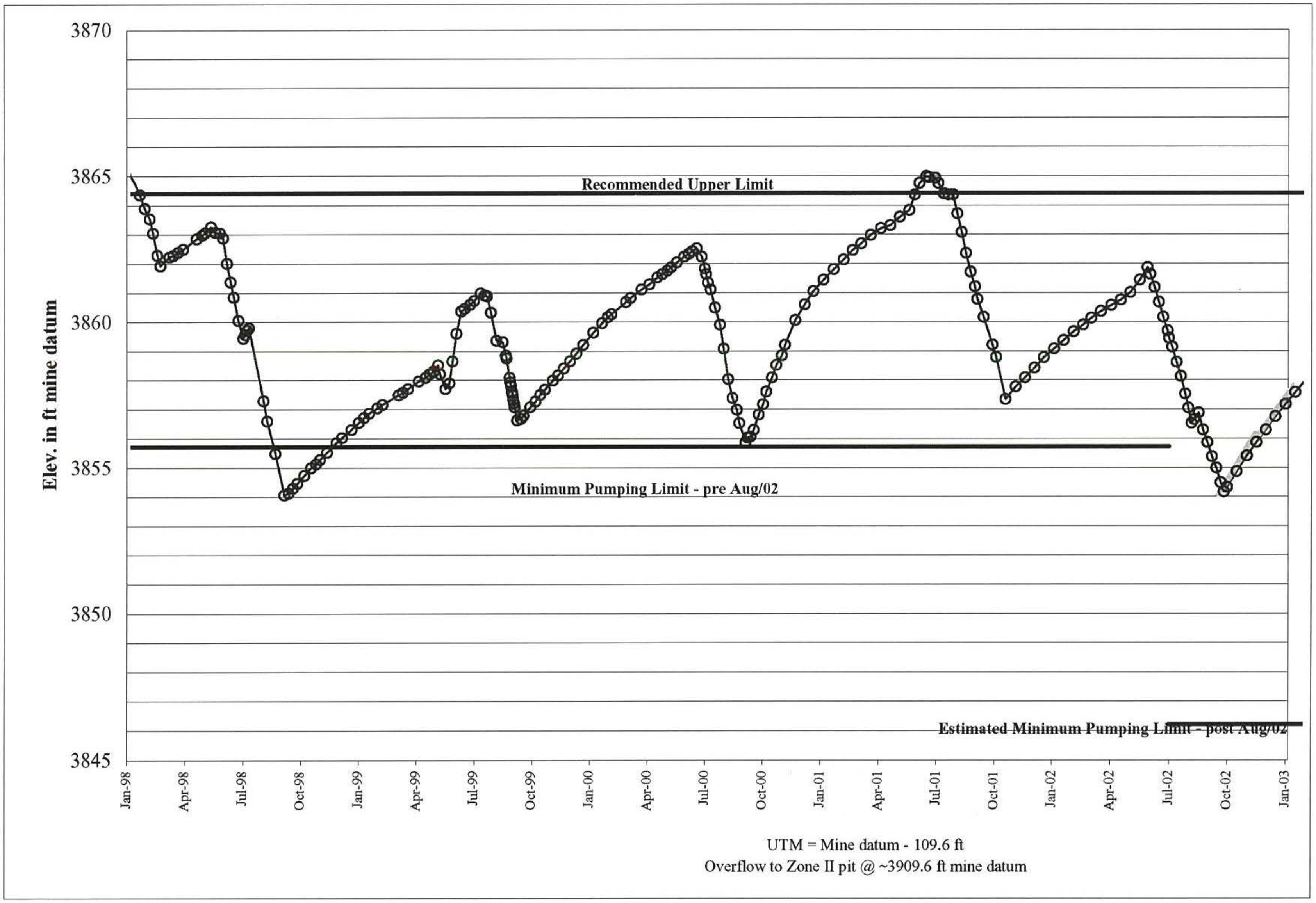


Volume 1
Project Number: 22307
Date: April, 2003

Figure 19. Main Pit Water Elevations, 1998 to 2002

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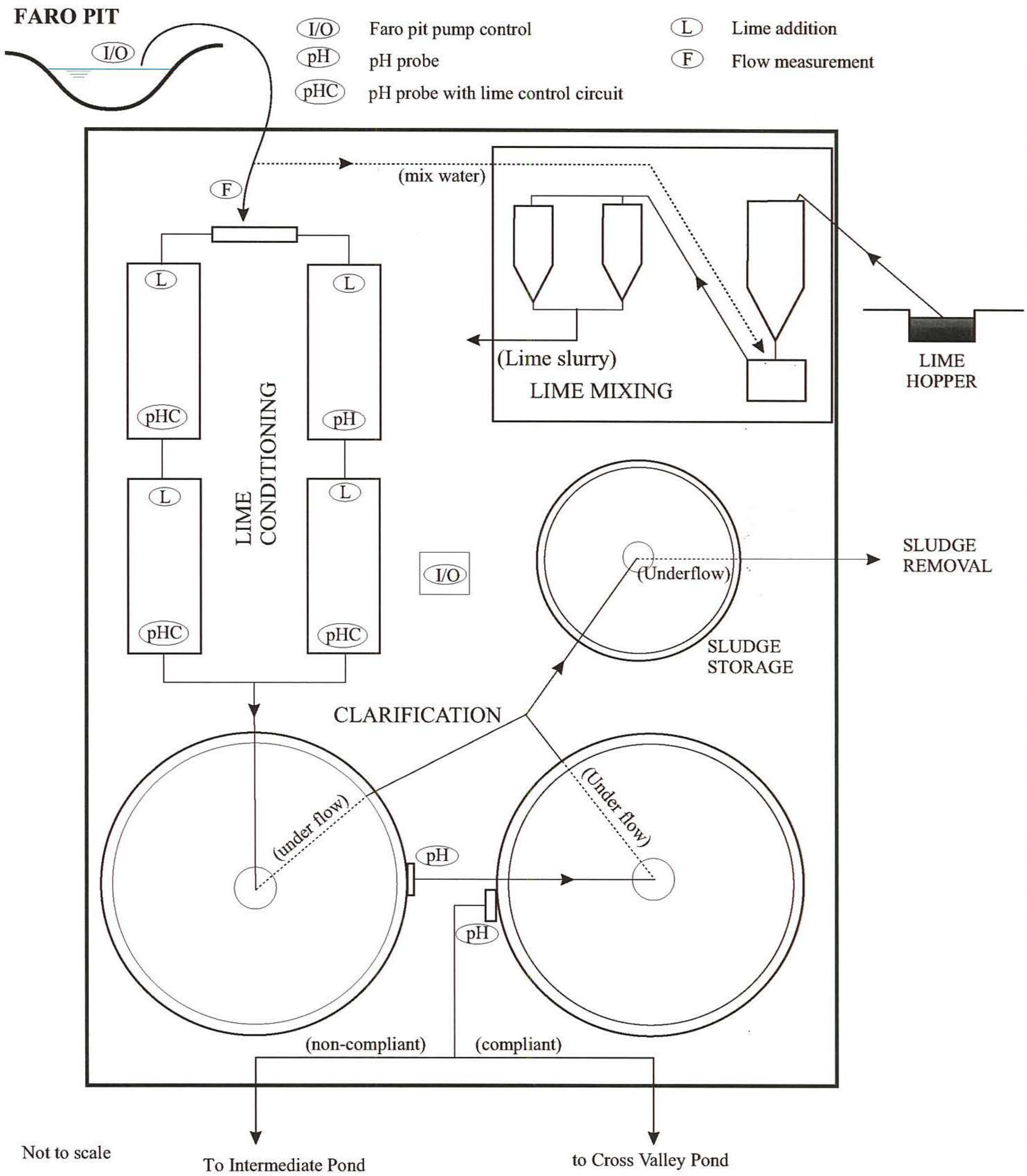


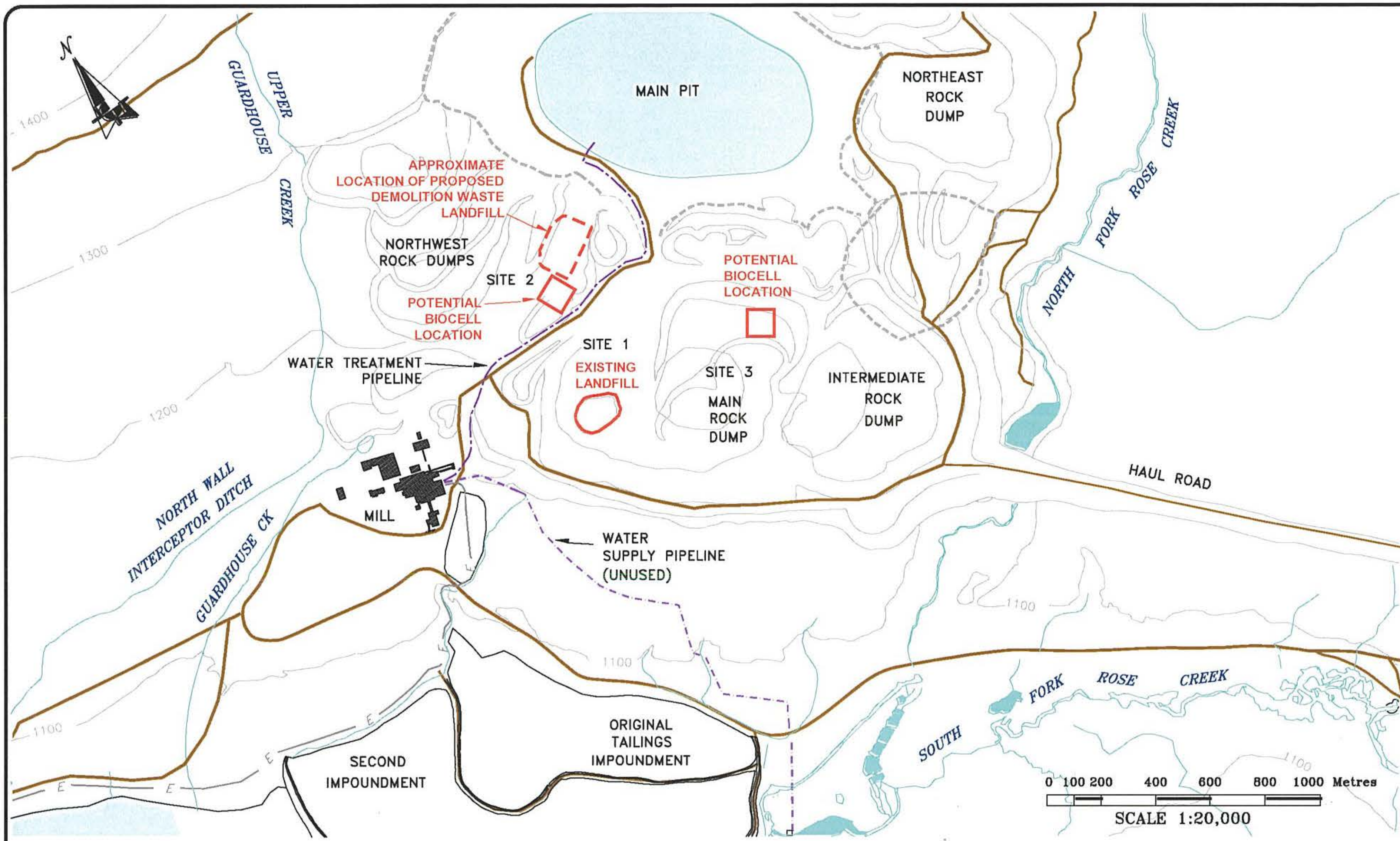

Not to scale

Project Number: 22307
Date: April, 2003
Volume 1

Figure 20. Schematic Flowsheet - Mill Water Treatment System

Gartner Lee

22307-D6-VOL1-Fig20.CDR




LEGEND:

| | |
|---|---|
| (brown line) | ROADS |
| (blue line) | EXISTING SURFACE DRAINAGE |
| —— E —— | EFFLUENT PIPELINE |
| - · - · - · - | PIPELINE |

COORDINATES ARE UTM NAD83 ZONE 8
CONTOUR INTERVAL 100 m

| DRAWING INFORMATION: | |
|---|---|
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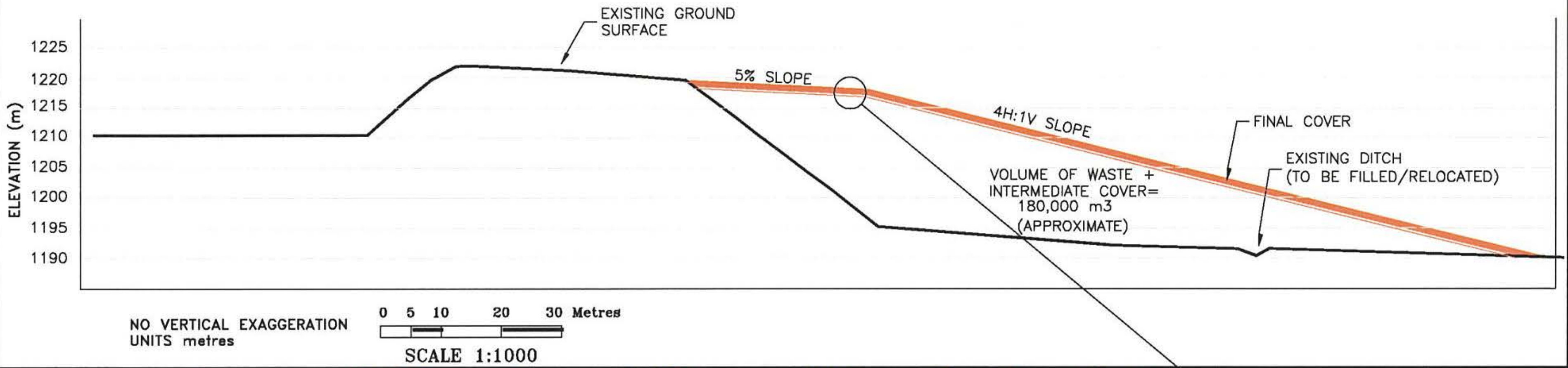
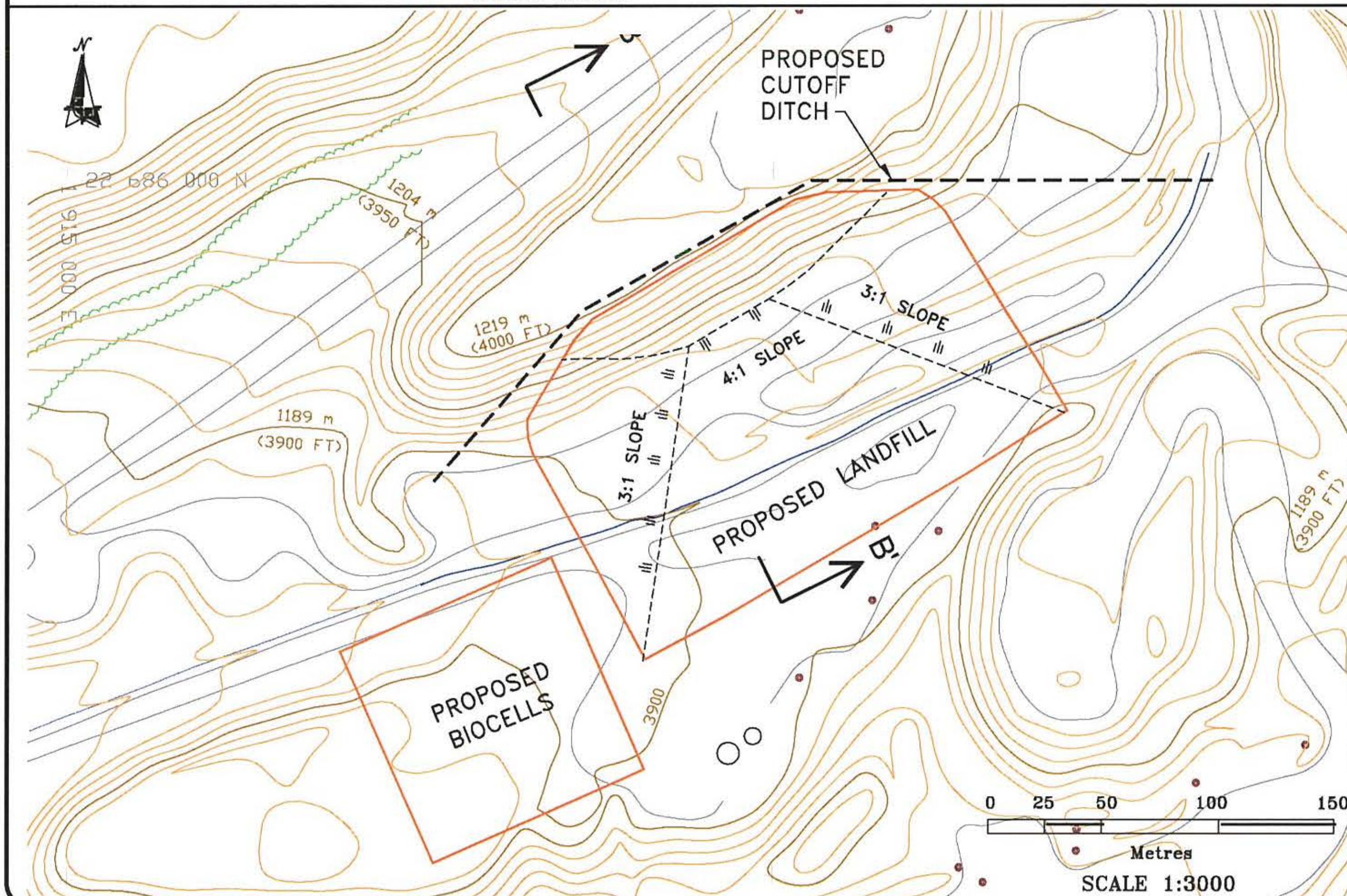
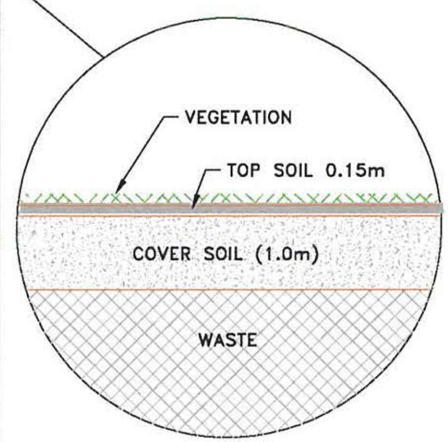
ENVIRONMENTAL ASSESSMENT REPORT

**POTENTIAL LANDFILL AND BIOCELL LOCATIONS - FARO SITE**

Gartner Lee | Deloitte & Touche | VOLUME 1 FIGURE NO. 21

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ANVIL RANGE MINING CORPORATION
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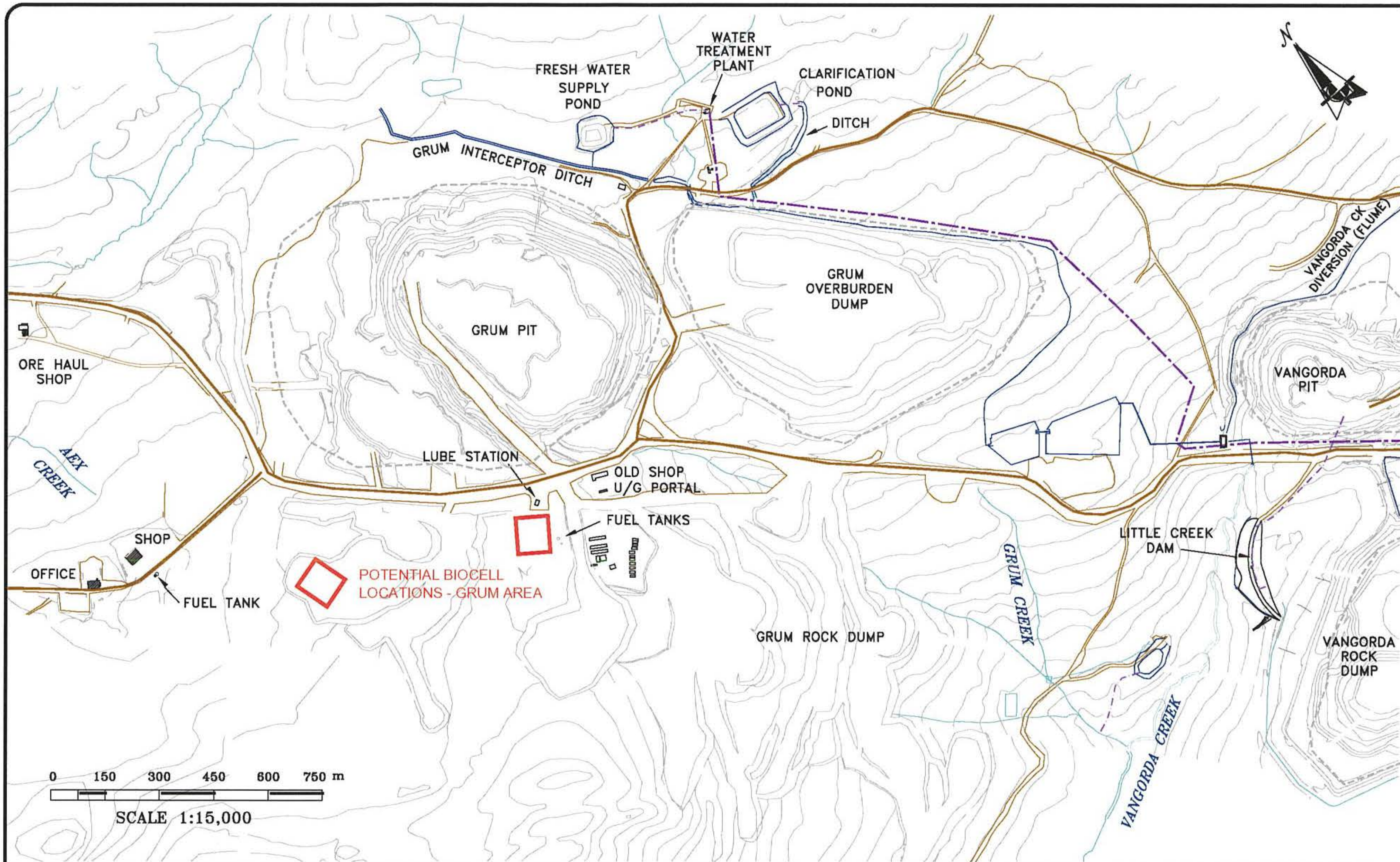
ENVIRONMENTAL ASSESSMENT REPORT

**PROPOSED LANDFILL AREA PROFILE - FARO SITE**

Gartner Lee | Deloitte & Touche

VOLUME 1
FIGURE NO. 22




LEGEND:

- ROADS
- EXISTING SURFACE DRAINAGE
- PRE-MINE DRAINAGE
- PIPELINE
- WATER TREATMENT PIPELINE

| DRAWING INFORMATION: | |
|---|---|
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ENVIRONMENTAL ASSESSMENT REPORT

**POTENTIAL BIOCELL LOCATION - GRUM SITE**

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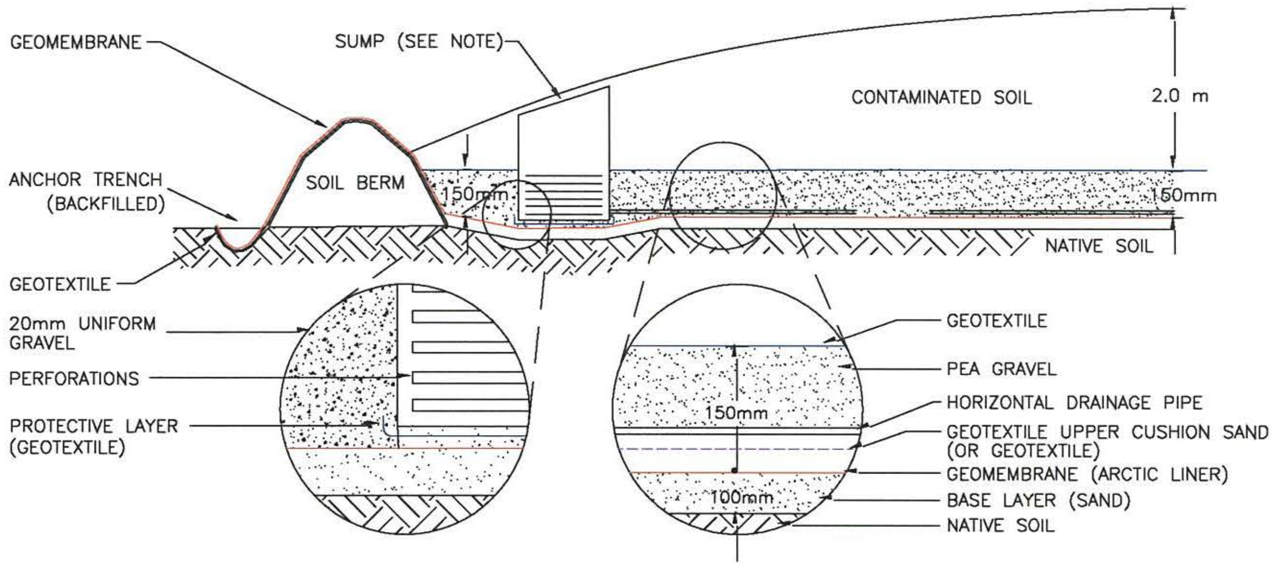
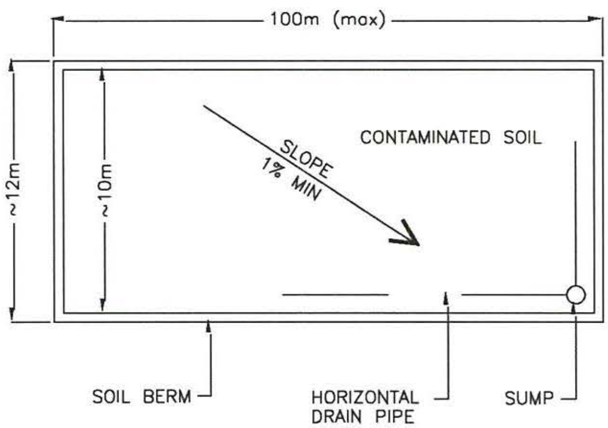
VOLUME 1
FIGURE NO. 23




NOTE: BASE LAYER SAND LOWERED AT SUMP LOCATION

SECTION VIEW OF TYPICAL SOIL BIOTREATMENT CELL

NOT TO SCALE




PLAN VIEW OF TYPICAL SOIL BIOTREATMENT CELL

NOT TO SCALE

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| DRAWN BY: | CPW |
| DATE ISSUED: | APRIL, 2003 |
| PROJECT NUMBER: | 22-307 |
| FILE NAME: | 22307-D6-V1-19.DWG |
| REVISION: | 0 |

ANVIL RANGE MINING CORPORATION
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2004 TO 2008 WATER LICENCE RENEWAL
ENVIRONMENTAL ASSESSMENT REPORT

**CONCEPTUAL DESIGN OF TYPICAL SOIL BIOTREATMENT CELLS**

Gartner Lee | Deloitte & Touche

VOLUME 1
FIGURE NO. 24

# Appendices

# Appendix A

## Conformity with the March 10, 2003 Information Guidelines

**Appendix A. Environmental Assessment Report Conformity with the DIAND March 10, 2003 Information Guidelines**

| DIAND Information Guidelines | | Environmental Assessment Report | | |
|---|---|---|---|---|
| Section | Topic to Address | Volume | Section | Heading |
| 1.2 | Scope of the Project | 1 / 2 / 3 | 1.1 | Introduction to the Environmental Assessment Report |
| 1.3 | Traditional Knowledge | 2 | 2.11 | Valued Ecosystem and Cultural Components |
| | | 3 | 6.3 | Traditional Use |
| 2.1.1 | Project Overview | 1 | 2.1.1 | Project Overview |
| 2.1.2 | Project Purpose and Need | 1 | 2.1.2 | Project Purpose and Need |
| 2.1.3 | Timing Considerations | 1 | 2.1.3 | Timing Considerations |
| 2.1.4 | Project Proponent | 1 | 2.1.4 | Project Management |
| 2.1.5 | Regulatory History | 1 | 2.1.6 | Regulatory History |
| 2.2.1.1 | Project Background | 1 | 2.1 | Project Summary |
| 2.2.1.2 | Project Location | 1 | 3 / 4 | Description of Facilities - Faro and Vangorda Mine Sites |
| 2.2.1.3 | Overall Project Facilities | 1 | 3 / 4 | Description of Facilities - Faro and Vangorda Mine Sites |
| 2.2.2.1 | Care and Maintenance Plan | 1 | 5 | Description of Care and Maintenance Activities |
| 2.2.2.2 | Proposed new construction/activities | 1 | 6 | Proposed New Activities |
| 2.2.2.3 | Adaptive Management Program | 1 | 7 | Adaptive Management Plan |
| 2.2.2.4 | Proposed Water Licence Amendments | 1 | 9 | Proposed Amendments to the Water Licence |
| 2.2.2.5 | Proposed Studies | 1 | 10 | Proposed Studies |
| 2.2.3 | Accidents and Malfunctions | 1 | 8 | Accidents and Malfunctions |
| 2.2.4 | Project Schedule | 1 | 11 | Project Schedule |
| 2.2.5 | Environmental Monitoring and Protection Plans | 1 | 12 | Environmental Monitoring and Protection |
| 2.3 | Environmental Setting | 2 | 2 | Existing Environment |
| 2.3.1.1 | Climate | 2 | 2.1 | Meteorology |
| 2.3.1.2 | Terrain | 2 | 2.2 | Terrain |
| 2.3.1.3 | Regional Geology/Geochemistry | 2 | 2.3 | Geology |
| 2.3.1.4 | Geological Hazards and Seismicity | 2 | 2.4 | Geological Hazards and Seismicity |
| 2.3.1.5 | Water Resources | 2 | 2.5 | Water Resources |
| 2.3.1.5.1 | Hydrology | 2 | 2.5.2 | Hydrology |
| 2.3.1.5.2 | Water Quality | 2 | 2.5.4 / 2.5.5 | Surface Water Quality / Groundwater Quality |
| 2.3.1.5.3 | Hydrogeology | 2 | 2.5.3 | Hydrogeology |
| 2.3.1.6 | Aquatic Resources | 2 | 2.6 | Aquatic Resources |
| 2.3.1.6.1 | Fish Resources | 2 | 2.6.4 | Fish |
| 2.3.1.6.2 | Benthic Invertebrates | 2 | 2.6.3 | Benthic Invertebrates |
| 2.3.1.6.3 | Stream Sediments | 2 | 2.6.2 | Creek Sediment Quality |
| 2.3.1.7 | Terrestrial Resources | 2 | 2.7 | Terrestrial Resources |
| 2.3.1.7.1 | Soils | 2 | 2.7.2 | Soils / Terrain |
| 2.3.1.7.2 | Vegetation | 2 | 2.7.3 | Vegetation |
| 2.3.1.7.3 | Wildlife | 2 | 2.7.4 | Wildlife |
| 2.3.1.8 | Socio-economic and Cultural Conditions | 2 | 2.8 | Socio-economic Conditions |
| 2.3.1.9 | Heritage Resources/Traditional Land Use | 2 | 2.9 / 2.10 | Traditional Use / Heritage Resources |
| 2.3.1.10 | Valued Ecosystem and Cultural Components (VECC's) | 2 | 2.11 | Valued Ecosystem and Cultural Components |
| 2.3.2 | Mine Site Characterization | 2 | 3 | Site Characterization |
| 2.3.2.1 | Geochemistry and Acid Rock Drainage | 2 | 3.4 | Rock Dumps |
| 2.3.2.2 | Site Surface Water Quality and Water Balance | 2 | 3.2 | Contaminant Loading |
| 2.3.2.3 | Site Groundwater Quality | 2 | 3.3 | Rose Creek Tailings Facility |
| 2.3.2.4 | Site Soil Quality | 2 | 3.1 | Soil Quality |
| 3.1.2 | Scope of the Assessment | 3 | 2 | Scope of the Project and Assessment |
| 3.2 | First Nations and Public Consultation | 3 | 3 | First Nations and Public Consultation |
| 3.3.1 | Methods Used to Predict Effects | 3 | 4 | Methods Used to Predict Effects |
| 3.3.2 | Effects on Environmental Components | 3 | 5 | Effects on Environmental Components |
| 3.3.3 | Effects of Environmental Changes on Human Health | 3 | 6.1 | Human Health |
| 3.3.4 | Effects of Environmental Changes on Socio-economic Conditions | 3 | 6.2 | Sicio-economic Conditions |
| 3.3.5 | Effects of Environmental Changes on Physical and Cultural Heritage | 3 | 6.3 / 6.4 | Traditional Use / Heritage Resources |
| 3.3.6 | Effects of the Environment on the Project | 3 | 7 | Effects of the Environment on the Project |
| 3.3.7 | Effects of Possible Malfunctions or Accidents | 3 | 8 | Effects of Possible Malfunctions or Accidents |
| 3.4 | Mitigation Measure and Residual Effects | 3 | 5 / 6 | discussed by component |
| 3.5 | Determination of Significance | 3 | 5 / 6 | discussed by component |
| 3.6 | Cumulative Effects Analysis | 3 | 9 | Cumulative Effects Analysis |
| 3.7 | Monitoring and Follow-Up Program | 3 | 5 / 6 / 10 | discussed by component / Monitoring and Follow-up Plan |

# Appendix B

## Summary of Proposed Care and Maintenance Activities

## Summary of Proposed Care and Maintenance Activities

| Location | Physical Works or Activity | Class (Monitoring, Mtce, Action) | Timing | Rationale | Current Licence Requirement | EAR Reference |
|---|---|---|---|---|---|---|
| Zone 2 Pit | Dewatering into Faro Main Pit | Action | Summer - intermittently | Water is non-compliant - metal leaching from rock dumps and pit walls | Y | 5.2.1.1 |
| Main Pit | Dewatering to Mill Water Treatment Plant | Action | Summer - 3 months (typically) | Water is non-compliant - metal leaching from rock dumps and pit walls | N | 5.2.1.2 |
| Mill Water Treatment System | Treat water pumped from Faro Main Pit and discharge to Rose Creek, Cross-Valley Pond or Intermediate Pond | Action | Summer - 3 months (typically) | Achieve compliance with water licence | N | 5.2.1.3 |
| Mill Water Treatment System | Sludge disposal into Intermediate Pond | Action | As required | Ensure performance; secure storage and established practice | N | 5.2.1.4 |
| Intermediate and Cross Valley Ponds seepage | Lime treatment of water from the Intermediate Pond and discharge to Cross Valley Pond | Action | Summer - intermittently | Achieve compliance with water licence | Y | 5.2.4.1 |
| Intermediate and Cross Valley Ponds seepage | Release of water from Cross Valley Pond to Rose Creek | Action | Summer - intermittently | Achieve compliance with water licence | Y | 5.2.4.1 |
| Intermediate and Cross Valley Ponds seepage | Sludge disposal into Intermediate Pond | Action | As required | Ensure performance; secure storage and established practice | N | 5.2.4.2 |
| Main Pit | Monitor water elevation | Monitoring | ongoing | Ensure water elevation does not rise above desired range | Y | 5.2.1.2 |
| Rock Dump seepage to North Fork Rose Creek | Ongoing surface and groundwater water quality monitoring | Monitoring | Surface - Annual during freshet; groundwater - semi-annual spring and fall | Assess seepage water quality | Y | 5.2.2.1 |
| Rock Dump seepage to Rose Creek Tailings Facility | Ongoing surface and groundwater water quality monitoring | Monitoring | Surface - Annual during freshet; groundwater - semi-annual spring and fall | Assess seepage water quality | Y | 5.2.2.2 |
| Rock Dump seepage to Upper Guardhouse Creek | Ongoing surface water quality monitoring | Monitoring | Annual during freshet | Assess seepage water quality | Y | 5.2.2.3 |
| Plant Site seepage to Rose Creek Tailings Facility | Surface water quality monitoring | Monitoring | Annual during freshet | Assess seepage water quality | Y | 5.2.3 |
| Intermediate and Cross Valley Ponds seepage | Monitor discharge volume and water level in ponds | Monitoring | discharge - during release; water levels - weekly | Water balance requirement | Y | 5.2.4.1 |
| Intermediate and Cross Valley Dams | Geotechnical monitoring | Monitoring | Annual inspection by professional engineer; Semi-annual reading of instrumentation | Assess performance | Y | 5.2.4.3 |
| Intermediate and Cross Valley Dams | Monitor seepage flow from Cross Valley Dam | Monitoring | Monthly | Assess stability of dam | Y | 5.2.4.3 |
| Tailings Impoundment | Investigation of source areas of contamination, pathways and impact on terrestrial environmental receptors | Monitoring | 2003 to 2005; mitigation report by end 2005 | To identify source areas, pathways and receptor impacts | N | 5.2.4.5 |
| Rose Creek Valley Aquifer | Groundwater quality monitoring | Monitoring | Semi-annual (spring and fall) | Assess seepage water quality | Y | 5.2.4.7 |
| Main Pit Northeast Wall | Monitor Pit Wall stability | Monitoring | As required | Assess stability with respect to integrity of diversion channel | N | 5.2.5.2 |
| North Fork Rose Creek | Surface water quality monitoring (R7) | Monitoring | Quarterly | Trigger for contingency | N | 5.2.6.1 |
| North Fork Rose Creek | Benthic community monitoring (R7) | Monitoring | 2004, 2006, 2008 | Receiving environment - reference monitoring | Y | 5.2.6.1 |
| North Fork Rose Creek | Continuous flow monitoring | Monitoring | Continuous | Water balance requirement | N | 5.2.6.1 |
| North Fork Rose Creek | Rock drain performance monitoring at haul road | Monitoring | Monthly | Assess performance | Y | 5.2.6.1 |

## Summary of Proposed Care and Maintenance Activities

| Location | Physical Works or Activity | Class (Monitoring, Mtce, Action) | Timing | Rationale | Current Licence Requirement | EAR Reference |
|---|---|---|---|---|---|---|
| South Fork Rose Creek | Bridge and culvert monitoring | Monitoring | ongoing | Assess performance | N | 5.2.6.2 |
| South Fork Rose Creek | Monitor haul road drainage | Monitoring | ongoing | Assess potential sediment sources into creeks | N | 5.2.6.2 |
| South Fork Rose Creek | Benthic community monitoring (R1) | Monitoring | 2004, 2006, 2008 | Receiving environment monitoring | Y | 5.2.6.2 |
| Pumphouse Pond | Monitor spillway | Monitoring | ongoing | Assess performance | Y | 5.2.6.3 |
| Rose Creek Diversion Canal | Geotechnical monitoring | Monitoring | Annual inspection by professional engineer; Semi-annual reading of instrumentation | Assess performance | Y | 5.2.6.4 |
| Rose Creek downstream of Mine Facilities | Continuous flow monitoring | Monitoring | Continuous | Water balance requirement | N | 5.2.6.5 |
| Rose Creek downstream of Mine Facilities | Benthic community monitoring (R2, R3, R4) | Monitoring | 2004, 2006, 2008 | Receiving environment monitoring | Y | 5.2.6.5 |
| Rose Creek downstream of Mine Facilities | Surface water quality monitoring | Monitoring | semi-annual to monthly, depending on site | Receiving environment monitoring | N | 5.2.6.5 |
| Anvil Creek | Surface water quality monitoring (R5, R6) | Monitoring | 2004, 2006, 2008 | Receiving environment monitoring | Y | 5.2.6.6 |
| Anvil Creek | Benthic community monitoring (R5, R6) | Monitoring | 2004, 2006, 2008 | Receiving environment monitoring | Y | 5.2.6.6 |
| Zone 2 Pit | Associated maintenance | Mtce | As required | Ensure performance | Y | 5.2.1.1 |
| Main Pit | Associated maintenance | Mtce | As required | Ensure performance | N | 5.2.1.2 |
| Mill Water Treatment System | Associated maintenance | Mtce | As required | Ensure performance | N | 5.2.1.4 |
| Mill Water Treatment System | System improvements | Mtce | Opportunistic | Improved performance | N | 5.2.1.4 |
| Plant Site seepage to Rose Creek Tailings Facility | Maintenance of surface water control ditches | Mtce | As required | Ensure performance | N | 5.2.3 |
| Intermediate and Cross Valley Dams | Maintenance | Mtce | As required | Ensure performance | Y | 5.2.4.3 |
| Original and Second Tailings Impoundments and Dams | Maintenance of Second Impoundment Dam | Mtce | As required | Maintain road access | Y | 5.2.4.4 |
| North Wall Interceptor Ditch | Maintenance | Mtce | As required | Ensure performance | Y | 5.2.4.6 |
| Faro Creek Diversion | Maintain diversion channel | Mtce | As required | Ensure performance | Y | 5.2.5.1 |
| North Fork Rose Creek | Rock drain maintenance | Mtce | As required | Ensure performance | Y | 5.2.6.1 |
| South Fork Rose Creek | Bridge and culvert maintenance | Mtce | As required | Ensure performance | N | 5.2.6.2 |
| South Fork Rose Creek | Maintain haul road drainage | Mtce | As required | Prevent sediment load into creek | N | 5.2.6.2 |
| Pumphouse Pond | Spillway maintenance | Mtce | As required | Ensure performance | Y | 5.2.6.3 |
| Rose Creek Diversion Canal | maintenance | Mtce | As required | Ensure performance | Y | 5.2.6.4 |
| Vangorda Pit | Dewatering to Grum/Vangorda Water Treatment Plant | Action | Summer - 1 month (typically) | Water is non-compliant - metal leaching from developed areas and pit walls | N | 5.3.1.1 |
| Water treatment system | Treat water pumped from Vangorda Pit and discharge to Grum Interceptor Ditch | Action | Summer - 1 month (typically) | Achieve compliance with water licence | Y | 5.3.1.2 |
| Water treatment system | Sludge disposal into Vangorda Pit | Action | As required | Ensure performance; secure storage and established practice | N | 5.3.1.3 |
| Little Creek Dam | Dewatering to Vangorda Pit | Action | Summer - intermittently | Water is non-compliant - metal leaching from Vangorda Rock Dump | N | 5.3.2.1 |
| Vangorda Pit | Monitor water elevation | Monitoring | ongoing | Ensure water elevation does not rise above desired range | N | 5.3.1.1 |

## Summary of Proposed Care and Maintenance Activities

| Location | Physical Works or Activity | Class (Monitoring, Mtce, Action) | Timing | Rationale | Current Licence Requirement | EAR Reference |
|---|---|---|---|---|---|---|
| Grum Pit | Monitor water elevation | Monitoring | ongoing | Ensure water elevation does not rise above desired range | N | 5.3.1.4 |
| Grum Pit | Monitor water quality | Monitoring | quarterly | To determine water treatment requirement | Y | 5.3.1.4 |
| Little Creek Dam | Geotechnical monitoring | Monitoring | Annual inspection by professional engineer; Semi-annual reading of instrumentation | Assess performance | Y | 5.3.2.1 |
| Vangorda Rock Dump seepage | Groundwater quality monitoring | Monitoring | Semi-annual spring and fall | Assess seepage water quality | N | 5.3.2.2 |
| Grum Creek | Ongoing surface and groundwater quality monitoring | Monitoring | Surface - quarterly and annual during freshet; groundwater - semi-annual spring and fall | Assess seepage water quality | Y | 5.3.2.3 |
| Grum and Vangorda Rock Dumps | Geotechnical monitoring | Monitoring | Annual inspection by professional engineer; Semi-annual reading of instrumentation | Assess stability | Y | 5.3.2.4 |
| Grum Overburden Dump | Monitor erosion potential | Monitoring | ongoing | Assess potential sediment sources into Sheep Pad Pond | N | 5.3.2.5 |
| Grum Ore Transfer Pad | Surface water quality monitoring (V17A) | Monitoring | quarterly | Assess seepage water quality | N | 5.3.2.6 |
| Grum Interceptor Ditch | Monitor erosion potential | Monitoring | ongoing | Assess potential sediment sources into Sheep Pad Pond | N | 5.3.3 |
| Vangorda Creek Diversion | Geotechnical monitoring | Monitoring | Annual inspection by professional engineer | Assess stability | Y | 5.3.4.1 |
| Vangorda Creek Diversion | Surface water quality monitoring (V1) | Monitoring | quarterly | Receiving environment - reference monitoring | Y | 5.3.4.1 |
| Vangorda Creek Diversion | Monitor stream sediment quality and benthic community monitoring (V1) | Monitoring | 2005, 2007 | Receiving environment - reference monitoring | Y | 5.3.4.1 |
| Main Stem Vangorda Creek | Surface water quality monitoring (V27) | Monitoring | spring, summer, fall | Receiving environment monitoring | Y | 5.3.4.2 |
| Main Stem Vangorda Creek | Monitor stream sediment quality and benthic community (V27) | Monitoring | 2005, 2007 | Receiving environment monitoring | Y | 5.3.4.2 |
| AEX Creek | Surface water quality monitoring (V6A) | Monitoring | Quarterly | Receiving environment monitoring | Y | 5.3.4.3 |
| Haul Road | Monitor haul road drainage | Monitoring | ongoing | Assess potential sediment sources into creeks | N | 5.3.4.4 |
| West Fork Vangorda Creek | Surface water quality monitoring (V5) | Monitoring | quarterly | Receiving environment monitoring | Y | 5.3.4.5 |
| West Fork Vangorda Creek | Monitor stream sediment quality and benthic community (V5) | Monitoring | 2005, 2007 | Receiving environment monitoring | Y | 5.3.4.5 |
| Lower Vangorda Creek | Monitor flow | Monitoring | Continuous | Water balance | N | 5.3.4.6 |
| Lower Vangorda Creek | Surface water quality monitoring (V8) | Monitoring | quarterly | Receiving environment monitoring | Y | 5.3.4.6 |
| Lower Vangorda Creek | Monitor stream sediment quality and benthic community (V8) | Monitoring | 2005, 2007 | Receiving environment monitoring | Y | 5.3.4.6 |
| Vangorda Pit | Associated maintenance | Mtce | As required | Ensure performance | N | 5.3.1.1 |
| Water treatment system | Associated maintenance | Mtce | As required | Ensure performance | N | 5.3.1.2 |
| Little Creek Dam | Maintenance | Mtce | As required | Ensure performance | Y | 5.3.2.1 |
| Vangorda Creek Diversion | Maintain diversion channel | Mtce | As required | Ensure performance | Y | 5.3.4.1 |
| Haul Road | Maintain haul road drainage | Mtce | As required | Prevent sediment load into creek | N | 5.3.4.4 |
| Mine Access Road | maintenance | Mtce | As required | Ensure performance | N | 5.4 |
| Mine access points | restrict public access to potentially unsafe areas | Action | Continuous | Ensure public safety | N | 5.4 |
| Haul Road | maintenance | Mtce | As required | Ensure performance | N | 5.4 |

## Summary of Proposed Care and Maintenance Activities

| Location | Physical Works or Activity | Class (Monitoring, Mtce, Action) | Timing | Rationale | Current Licence Requirement | EAR Reference |
|---|---|---|---|---|---|---|
| Haul Road | Maintain ATV access ramp | Mtce | As required | Provide controlled public passage | N | 5.4 |
| Mine Sites | Provide safe transortation and storage for materials | Action | As required | Environmental protection, public health, protection of assets | N | 5.5 |
| Mine Sites | Securing and safely storing highly contaminated soils | Action | As required | Progressive reclamation - Environmental protection | N | 5.6 |
| Mine Sites | Removal of buildings that represent a health or safety hazard and placement in existing landfill | Action | As required | Progressive reclamation - Public safety | N | 5.6 |
| Mine Sites | Materials salvage | Action | As required | Progressive reclamation - Asset management | N | 5.6 |
| Faro/Vangorda Plateau | Tear down / demolition of buildings | Action | 2004 - 2008 | progressive reclamation | N | 6.1 |
| Demolition Waste Landfill | Site establishment - excavate surface water control ditches | Action | 2004 - 2008 | disposal of demolition debris from bulding tear down | N | 6.1 |
| Demolition Waste Landfill | Site operations | Action | 2004 - 2008 | disposal of demolition debris from bulding tear down | N | 6.1 |
| Bioremediation Cell | Site establishment - berm and liner | Action | 2004 - 2008 | remediaiton of hydrocarbon contaminated soil | N | 6.2 |
| Bioremediation Cell | Site operations - place soil and operate | Action | 2004 - 2008 | remediaiton of hydrocarbon contaminated soil | N | 6.2 |
| Oxidized fines near the Crusher Stockpile | Consolidate and cover with compacted silt or clay | Action | 2004 | Reduces water treatment requirements; human and environmental protection | N | 6.3.3 |
| Oxidized fines near the Vangorda Rock Dump | Cover with compacted silt or clay | Action | 2004 | Reduces water treatment requirements; human and environmental protection | N | 6.3.4 |

# Appendix C

## Proposed Site Water Monitoring Protocol

**ANVIL RANGE MINE COMPLEX 2004 TO 2008 WATER LICENCE RENEWAL**
**WATER MONITORING PROTOCOL - FARO SITE**

**Codes:** C=continuously; W=weekly; WD=weekly when discharging; M=monthly; SF=spring and fall; WS=winter and summer; A=annually freshet
OTHER=minimum: field pH, field temperature, field conductivity, TSS, SO4, NH3 plus possible oter site specific parameters
For Groundwater Samples: "OTHER" to include purge volume, purge rate, purge time and sampling time
For flows read by staff gauge or weir: staff gauges to be verified by survey and/or manual flow measurement at least once per year

| Sample | Location | Sample | ICP-T | ICP-D | OTHER | HARDNESS | FLOW/LEVEL | COMMENT |
|---|---|---|---|---|---|---|---|---|
| **Routine Surface Samples** | | | | | | | | |
| X2 | N. Fork at access road | M | Y | Y | Y | Y | M | |
| X3 | pumphouse pond | M | Y | Y | Y | Y | N | |
| X4 | Intermediate Pond at spillway | M | Y | Y | Y | N | M | |
| X5 | Cross Valley Pond surface outflow | WD | Y | Y | Y | Y | WD | |
| X5P | Cross Valley Pond at spillway | M | Y | Y | Y | N | M | new sample to differentiate periods of no discharge |
| X11 | Cross Valley Dam N. seep | WS | Y | Y | Y | N | W | |
| X12 | Cross Valley Dam S. seep | WS | Y | Y | Y | N | W | |
| WEIR3 | Cross Valley Dam central seep | WS | Y | Y | Y | N | W | |
| X13 | Cross Valley Dam total seepage | M | Y | Y | Y | Y | W | |
| X14 | Rose Creek d.s. mixing zone | WD | Y | Y | Y | Y | C | |
| X22B | Faro Main pit at pumping barge | M | Y | Y | Y | N | M | |
| X23 | Old Faro Creek at toe of rock dumps | M | Y | Y | Y | N | M | |
| X26 | Faro Zone 2 pit pumped discharge | MD | Y | Y | Y | N | M | |
| R1 | S. Fork u.s. pumphouse pond | WS | Y | Y | Y | Y | WS | |
| R2 | Rose Creek d.s. mixing zone | - | - | - | - | - | - | excluded because it duplicates X14 |
| R3 | Rose Creek mid length | WS | Y | Y | Y | Y | WS | |
| R4 | Rose Creek u.s. Anvil Creek | WS | Y | Y | Y | Y | WS | |
| R5 | Anvil Creek d.s. Rose Creek | WS | Y | Y | Y | Y | WS | can use calculation |
| R6 | Anvil Creek u.s. Rose Creek | WS | Y | Y | Y | Y | WS | |
| FAROCR | outlet of Faro Creek diversion | M | Y | Y | Y | N | N | |
| R7 | N. Fork u.s. Faro Creek diversion | M | Y | Y | Y | N | C | |
| R8 | N. Fork d.s. Faro creek diversion | M | Y | Y | Y | N | N | |
| R9 | N. Fork adjacent Zone 2 rock dumps | M | Y | Y | Y | N | N | |
| R10 | N. Fork d.s. Zone 2 rock dumps | M | Y | Y | Y | N | N | |
| **Groundwater Samples** | | | | | | | | |
| X16 | d.s. Rose Creek Tailings Facility | SF | N | Y | Y | N | SF | |
| X17 | d.s. Rose Creek Tailings Facility | SF | N | Y | Y | N | SF | |
| X18 | d.s. Rose Creek Tailings Facility | SF | N | Y | Y | N | SF | |
| X21-96 | Rose Creek Tailings Facility | SF | N | Y | Y | N | SF | P96-5 |
| X24-96 | Rose Creek Tailings Facility | SF | N | Y | Y | N | SF | P96-4 |
| X25-96 | Rose Creek Tailings Facility | SF | N | Y | Y | N | SF | P96-3 |
| P01-01 to 11 | Rose Creek Tailings Facility | SF | N | Y | Y | N | SF | |
| TH86-26 | u.s. Rose Creek Tailings Facility | SF | N | Y | Y | N | SF | or another similar location |
| BH1 | Zone 2 rock dumps | SF | N | Y | Y | N | SF | |
| BH2 | Zone 2 rock dumps | SF | N | Y | Y | N | SF | |
| BH4 | Zone 2 rock dumps | SF | N | Y | Y | N | SF | |
| BH12 | NE rock dumps | SF | N | Y | Y | N | SF | |
| BH13 | NE rock dumps | SF | N | Y | Y | N | SF | |
| BH14 | NE rock dumps | SF | N | Y | Y | N | SF | |
| P96-6 | Main/Int rock dumps | SF | N | Y | Y | N | SF | |
| P96-7 | Main/Int rock dumps | SF | N | Y | Y | N | SF | |
| P96-8 | Main/Int rock dumps | SF | N | Y | Y | N | SF | |
| S1 | Main/Int rock dumps | SF | N | Y | Y | N | SF | |
| S2 | Main/Int rock dumps | SF | N | Y | Y | N | SF | |
| S3 | Main/Int rock dumps | SF | N | Y | Y | N | SF | |
| **Annual Seep Samples** (to include these locations at a minimum plus other observed freshet surface seeps at toe of rock dumps) | | | | | | | | |
| FDU | Faro creek diversion u.s. end | A | Y | Y | Y | N | A | |
| FDL | Faro Creek Diversion | A | Y | Y | Y | N | A | |
| FCO | Old Faro Creek u.s. Faro Valley dump | A | Y | Y | Y | N | A | |
| A30 | Flow to Main pit from Faro Valley dump | A | Y | Y | Y | N | A | |
| A25 | Main Pit northwest wall | A | Y | Y | Y | N | A | |
| SP5/6 | Internal surface flow on Faro rock dump | A | Y | Y | Y | N | A | |
| NE1 | N. seep to N. Fork from NE dumps | A | Y | Y | Y | N | A | |
| NE2 | Central seep to N. Fork from NE dumps | A | Y | Y | Y | N | A | |
| NE3 | S. seep to N. Fork from NE dumps | A | Y | Y | Y | N | A | |
| NF1 | u.s. side rock drain | A | Y | Y | Y | N | A | |
| NF2 | d.s. side rock drain | A | Y | Y | Y | N | A | |
| W5 | east dump | A | Y | Y | Y | N | A | |
| W8 | Upper Guardhouse Creek d.s. NW dump | A | Y | Y | Y | N | A | |
| W10 | Upper Guardhouse Creek u.s. NW dump | A | Y | Y | Y | N | A | |
| GDHSECK | Guardhouse Creek at Intermediate pond | A | Y | Y | Y | N | A | |
| IDSEEP | Intermediate Dam toe seep, S. side | A | Y | Y | Y | N | A | |
| X7 | seep d.s. emergency tailings area | A | Y | Y | Y | N | A | |

**ANVIL RANGE MINE COMPLEX 2004 TO 2008 WATER LICENCE RENEWAL**
**WATER MONITORING PROTOCOL - VANGORDA PLATEAU SITE**

**Codes:** C=continuously; WD=weekly when discharging; M=monthly; SF=spring and fall; SSF-spring, summer andf fall; Q=quarterly
OTHER=minimum: field pH, field temperature, field conductivity, TSS, SO4, NH3 plus possible oter site specific parameters
For Groundwater Samples: "OTHER" to include purge volume, purge rate, purge time and sampling time
For flows read by staff gauge or weir: staff gauges to be verified by survey and/or manual flow measurement at least once per year

| Sample | Location | Sample | ICP-T | ICP-D | OTHER | HARDNESS | FLOW/LEVEL |
|---|---|---|---|---|---|---|---|
| **Routine Surface Samples** | | | | | | | |
| V1 | Main Stem u.s. VG pit | Q | Y | Y | Y | Y | Q |
| V2 | Grum creek to VG Creek | M | Y | Y | Y | Y | M |
| V2A | Grum Creek to Moose Pond | M | Y | Y | Y | N | M |
| V4 | Shrimp Creek | SSF | Y | Y | Y | Y | N |
| V5 | West Fork at gravel pit | M | Y | Y | Y | Y | Q |
| V6A | AEX Creek | Q | Y | Y | Y | Y | Q |
| VGMAIN | Main Stem at Town of Faro | M | Y | Y | Y | Y | N |
| V8 | Lower VG Creek | M | Y | Y | Y | Y | C |
| V14 | Grum rock dump N. toe seep | SF | Y | Y | Y | N | SF |
| V15 | Grum rock dump central toe seep | M | Y | Y | Y | N | M |
| V16 | Grum rock dump S. toe seep | SF | Y | Y | Y | N | SF |
| V17A | creek from Grum ore transfer pad | SF | Y | Y | Y | N | SF |
| V19 | VG pit NW diversion ditch | SF | Y | Y | Y | N | SF |
| V20 | VG pit NE diversion ditch | SF | Y | Y | Y | N | SF |
| LCD | Little Creek Dam pond at old pumphouse | SF | Y | Y | Y | N | M |
| V22 | VG pit at pumping barge | Q | Y | Y | Y | N | M |
| V23 | Grum pit at haul road | Q | Y | Y | Y | N | M |
| V24 | influent to water treatment plant | WD | Y | Y | Y | N | WD |
| V25 | effluent from clarification pond | WD | Y | Y | Y | Y | WD |
| V25BSP | Grum Interceptor Ditch below Sheep Pad Pond | WD / M | Y | Y | Y | Y | WD / M |
| V27 | Main Stem u.s. Shrimp Creek | SSF | Y | Y | Y | Y | N |
| V29 | VG dump drain #2 | SF | N | Y | Y | N | SF |
| V30 | VG dump drain #3 | SF | N | Y | Y | N | SF |
| V31 | VG dump drain #4 | SF | N | Y | Y | N | SF |
| V32 | VG dump drain #5 | SF | N | Y | Y | N | SF |
| V33 | VG dump drain #6 | SF | N | Y | Y | N | SF |
| **Groundwater Samples** | | | | | | | |
| V37 | VG rock dump, GW94-01 | SF | N | Y | Y | N | SF |
| V38 | VG rock dump, GW94-02 | SF | N | Y | Y | N | SF |
| V39 | VG rock dump, GW94-03 | SF | N | Y | Y | N | SF |
| V40 | VG rock dump, GW94-04 | SF | N | Y | Y | N | SF |
| P96-9 | Grum rock dump | SF | N | Y | Y | N | SF |
| P01-01 to 03 | Vangorda rock dump | SF | N | Y | Y | N | SF |
| **Annual Seep Samples** (to include observed freshet surface seeps at toe of rock dumps that are not included above) | | | | | | | |

# Appendix D

## Proposed Site General Monitoring Protocol

# SITE GENERAL MONITORING PROTOCOL

## SUMMARY

This inspection guide outlines the effort to be spent on routine environmental inspections of the Faro and Vangorda Plateau minesites during the period of shut down in excess of work required to comply with the terms of the water licences or other legal requirements.

These inspections will assist in demonstrating diligent management of the minesites and are intended to meet the intent of the Mining Association of Canada Guide for Management of Tailings Facilities, September 1998.

The weekly inspections are intended to provide observations of critical facilities sufficient to ensure that unusual or emergency events can be managed in a timely fashion.

The monthly inspections are to be performed in addition to the weekly inspections and are intended to provide a more rigorous inspection of the earth dams and dykes and a routine inspection of several other facilities which are not included in the weekly schedule.

Many of the facilities listed here will undergo more frequent inspection particularly during the spring season or during periods of active pumping and treatment of water.

The inspections as described here will typically be performed and documented by the environmental technicians. The inspections may, however, be performed and documented by any person working under the direction of the site manager who is reasonably knowledgeable regarding the environmental and geotechnical aspects of the minesites.

The inspections will be documented in a log book specific for this purpose. Unless specifically documented otherwise, it will be assumed that the person who has signed off on the inspection has conducted the inspection per this guide and that all facilities were observed with no concerns.

## SITE GENERAL MONITORING PROTOCOL

FARO MINESITE - WEEKLY (Page 1 of 2)

1. EMERGENCY TAILINGS AREA AND DITCH TO INTERMEDIATE POND
   - observe pipeline and ditch from mine access road below millsite
   - is the pipeline performing acceptably?
   - does the ditch downstream side dyke appear stable?
   - is ditch flow channeling appropriately?

2. TREATED EFFLUENT PIPELINE FROM MILL
   - observe pipeline from access roads
   - is the pipeline performing acceptably?
   - is the pipeline flow discharging appropriately?

3. ORIGINAL AND SECOND DAMS
   - observe from the roads on the north and south sides
   - do the structures appear "normal"
   - is there any water presence/flow?

4. INTERMEDIATE DAM
   - observe from the roads on the north and south sides
   - is the pond water level acceptable?
   - are the spillway and syphons functioning appropriately?
   - is the lime treatment system functioning appropriately?-any visible damage?
   - does the dam appear stable (i.e. erosion, cracking, bulging, wet spots)?

5. CROSS VALLEY DAM
   - observe from the roads on the north and south and west (downstream) sides
   - is the pond water level acceptable?
   - are the spillway and syphons functioning appropriately?
   - does the dam appear stable (i.e. erosion, cracking, bulging, wet spots)?
   - does seepage appear "normal" (three streams)?

6. ROSE CREEK DIVERSION CANAL
   - drive length of canal including lower section and observe dyke, backslope and bottom
   - is any cracking or sloughing visible along backslope?
   - is any significant erosion or are any significant depressions apparent in the dyke?
   - is water channeling appropriately?

7. PUMPHOUSE POND
   - observe the pumphouse pond from the canal dyke road
   - is flow visible exiting the pumphouse pond (winter) and is it channeling appropriately?

8. NORTH FORK ROSE CREEK BELOW MINE ROAD CROSSING
   - observe the creek culvert crossing from mine access road
   - is flow channeling appropriately?
   - is the diversion structure below the road performing acceptably?

# SITE GENERAL MONITORING PROTOCOL

## FARO MINESITE - WEEKLY (Page 2 of 2)

### 9. FARO MAIN PIT

- observe the pit & pumping station from the pumping station
- does the pit NE wall appear "normal"
- does the inflow via the Faro Valley rock dump appear "normal"?
- is the pumping station functioning appropriately?
- is there any physical damage visible to the pumping barge or pipeline?

### 10. FARO ZONE II PIT

- observe the Zone II pit from the access road near the pump installation
- are the pump and pipeline operating appropriately?
- is there any visible physical damage to the pump/pipeline installation?

### 11. NORTH FORK OF ROSE CREEK ROCK DRAIN

- observe the rock drain from the edges of the Vangorda haul road
- does the pond on the upstream side of the drain appear acceptable/normal?
- does the stream exiting the downstream side of the drain appear acceptable/normal?
- does the rock dump adjacent to the upstream pond appear stable (i.e. bulging, sloughing)?
- is there any apparent deformation of the roadway over the rock drain (i.e. settlement, depressions, sideslope erosion/deformation, check against angle of hydro poles)?

### 12. MINE ACCESS ROAD WATER CROSSINGS

- observe water crossings during drive to from Town of Faro to Faro minesite
- are ditches and culverts performing acceptably?

# SITE GENERAL MONITORING PROTOCOL

## FARO MINESITE - MONTHLY (Page 1 of 1)

1. EMERGENCY TAILINGS AREA, DITCH TO INTERMEDIATE POND AND MILL EFFLUENT PIPELINE
   - detailed inspection of pipelines and ditches by driving and/or walking

2. INTERMEDIATE AND CROSS VALLEY DAMS
   - perform detailed inspection of crests and toes by driving and/or walking each
   - note any significant cracking, erosion, sloughing, etc.
   - record seepage flow estimates or weir staff gauge readings and pond levels
   - record any significant observations

3. FARO MAIN AND ZONE II PITS
   - measure and record in-pit water levels

4. FARO CREEK DIVERSION
   - drive the length of the diversion channel at least as far upstream as the Faro Valley rock dump
   - is water flow channeling appropriately (i.e. flow over top of ice, ice jam)?
   - is leakage from the channel excessive or visibly increased?
   - are there visible indications of increased wall instability along the crest of the NE pit wall?

5. NORTH FORK OF ROSE CREEK ROCK DRAIN
   - record upstream pond level (typ. by photograph)

# SITE GENERAL MONITORING PROTOCOL

## VANGORDA PLATEAU MINESITE - WEEKLY (Page 1 of 1)

1. VANGORDA HAUL ROAD DRAINAGE PUSHOUTS
   - observe the critical drainage pushouts above or near creeks
   - is water flow causing sedimentation into any creeks?
   - have any new pushouts been made in critical locations?
   - have any previously filled pushouts in critical locations been re-opened?

2. SHEEP PAD PONDS
   - observe the ponds from the haul road or drive onto the pond dykes
   - are the pond water levels acceptable?
   - do the dykes appear stable (i.e. erosion, cracking, bulging, wet spots)?
   - is the outflow channeling appropriately? (viewed from the road above the plunge pool)

3. LITTLE CREEK DAM
   - drive the crest of the dam
   - is the pond level appropriate/acceptable?
   - does the dam appear stable (i.e. erosion, cracking, bulging, wet spots)?
   - is there any visible damage to the pumphouse?

4. VANGORDA CREEK DIVERSION
   - drive along the diversion flume
   - is the flume performing acceptably?
   - is water channeling appropriately (i.e. flow over top of ice, ice jam)?
   - are there signs of excessive or new damage or deformation to the flume or channel?
   - are there signs of instability of the rock and soil slopes overlooking the flume?

5. WATER TREATMENT PLANT
   - observe the Clarification Pond dyke from the Blind Creek road and drive around the treatment plant
   - is the water level in the Clarification Pond acceptable?
   - are the plant building and storage sheds secure?
   - does the dyke appear stable (i.e. erosion, cracking, bulging, wet spots)?

6. FRESHWATER SUPPLY POND
   - drive to and/or around the pond
   - is the water level acceptable?
   - does the dyke appear stable (i.e. erosion, cracking, bulging, wet spots)?

7. MOOSE POND
   - drive to the pond
   - is there any accumulated water?
   - is inflow water channeling appropriately?

8. WEST FORK OF VANGORDA CREEK CROSSING OF ACCESS ROAD
   - observe the creek crossing from the access road
   - are the ditch and culvert performing acceptably?

## SITE GENERAL MONITORING PROTOCOL

VANGORDA PLATEAU MINESITE - MONTHLY (Page 1 of 1)

1. SHEEP PAD PONDS, LITTLE CREEK DAM, CLARIFICATION POND AND GROUCHO POND
   - estimate and record the pond water levels
   - inspect the crests and toes of the dam/dykes for signs of deterioration and document any seepage observed

2. GRUM CREEK/MOOSE POND
   - inspect the Moose Pond diversion. -is water channeling appropriately?
   - is the Grum Creek road crossing functioning acceptably?
   - is any water accumulating in the Moose Pond?

3. VANGORDA ROCK DUMP
   - drive the toe of the dump
   - do the till berm and rock benches appear stable and secure?

4. GRUM AND VANGORDA PITS
   - record estimates of water levels and other significant observations

5. VANGORDA CREEK DIVERSION FLUME
   - is the inlet to the culvert at the upstream end of the flume performing acceptably?
   - is the outflow structure at the downstream end of the flume performing acceptably?