# ENVIRONMENTAL REGISTRATION DOCUMENT FOR THE PROPOSED WHITE ROCK QUARTZ MINE

**Prepared for:**

**The Nova Scotia Department of Environment and Labour**

**By:**

**MGI Limited on behalf of Black Bull Resources Inc.**

**August 2002**

**023405**

C0655-001

August 15, 2002

Nova Scotia Department of the Environment
P.O. Box 2107
Halifax, Nova Scotia
B3J 3B7

Attention: Mr. Chris Daly
Environmental Assessment Coordinator

**Re: Environmental Registration Document, White Rock Quartz Mine, Black Bull Resources Inc.**

Dear Mr. Daly:

In accordance with Part IV of the Environment Act, Black Bull Resources Inc. (Black Bull) is registering the White Rock Quartz Mine to be considered for Environmental Assessment Approval on August 15, 2002. We believe that the project is technically sound and incorporates principles of community involvement and environmental protection that will enable an Environmental Assessment Approval to be granted subject to appropriate conditions.

Please be advised that this project is fully (100%) privately funded (ref. Section 9(1)I), Environment Act.

Sincerely,
Black Bull Resources Inc.

John Keating
President, CEO

**023406**

**PREFACE**

This Environmental Registration Document is submitted by Black Bull Resources Inc. (Black Bull), a publicly traded Canadian company, "BBS" on TSX Venture Exchange in support of a provincial environmental assessment registration for a proposed surface quartz mine and associated processing facilities. The document has been prepared utilizing the comments, advice and expertise of a number of different agencies and persons including:

**Technical Consultants**

MGI Limited (MGI) - Management of Permitting Process, Hydrogeology, Environmental Monitoring
Atcon Construction Inc. (Atcon)- Mine Layout and Reclamation Planning
ADI Environmental Management Ltd. (ADI) – Surface and Wastewater Management
Dillon Consulting Ltd. (Dillon) - Terrestrial and Aquatic Habitat Evaluations
William Alexander and Associates Limited (WAA) - Public and First Nations Consultation
Confederacy of Mainland Mi⌐kmaq (CMM) – First Nations Knowledge Study
DalTech Minerals Engineering Centre (Daltech) – Mineral Evaluation and Processing Lab Services
W.G. Shaw and Associates (W.G. Shaw) - Initial Surface Water Monitoring and Digital Mapping
Cultural Resource Management Group (CRM) - Archaeological and Heritage Resource Surveys
Ruth Newell - Terrestrial Habitat Survey - Plant Communities
Heather Stewart – Terrestrial Habitat Survey – Plant Communities
Fulton Lavender - Avian Communities
John Gilhen – Herpitiles
Sprytech Biological Services – Aquatic Invertebrates
Tom Neily - Plant Communities
Mineral Research Laboratory - Quartz Processing Bench Scale Testing

**Technical and Stakeholder Organizations**

Clyde River Protection Association (CRPA)
Tobeatic Wilderness Committee (TWC)
Tusket River Environmental Protection Agency (TREPA)
Ecology Action Centre (EAC)

**First Nations**

Confederacy of Mainland Mi⌐kmaq (CMM)

**Government Departments and Community Agencies**

Federal Level

Department of Fisheries and Oceans (DFO)
Canadian Environmental Assessment Agency (CEAA)
Environment Canada (EC)
Natural Resources Canada (NRCan)

Provincial Level

Nova Scotia Department of Natural Resources (NSDNR)
Nova Scotia Department of Environment and Labour (NSDEL)
Nova Scotia Department of Transportation and Public Works (NSDTPW)

Municipal Level

Municipality of the District of Argyle
Municipality of the County of Shelburne
Town of Shelburne
Town of Yarmouth
South West Shore Development Authority
Port Authority – Shelburne
Port Authority – Yarmouth

**Local Communities**

Valuable input was also received from local communities via the following means:
Community Newsletters – Four in total, most recently March and June 2002
Project Overview Presentations - Shelburne and Yarmouth Town Councils and Shelburne and Argyle Municipality Councils – July 2002
Public Information Sessions – July 10, 11, 12, 2002 – Argyle, Yarmouth and Shelburne, respectively.

Contact with persons from the following Nova Scotia communities has been recorded via the informal and formal public consultation undertaken by Black Bull and its consultants:

Tusket, N.S.
Yarmouth, N.S.
Little Brook, N.S.
Annapolis Royal, N.S.
Sandy Cove, N.S.
Lower Wedgeport, N.S.
Surette's Island, N.S.
Dartmouth, N.S.
Lockeport, N.S.
Central Argyle, N.S.
East Kemptville, N.S.
Halifax, N.S.
Bridgewater, N.S.
Carleton, N.S.
West Pubnico, N.S.
Meteghan River, N.S.
Shelburne, N.S.
Kingston, N.S.
Hartz Point, N.S.
Middle Ohio, N.S.
Port Joli, N.S.
Barrington Passage, N.S.
McGarys Post Office, Shelburne County, N.S.
Cape Sable Island, N.S.
East Jordan, N.S.

Black Bull and its consultants wish to acknowledge the contribution and input of all of the above and extend thanks to each of them.

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**EXECUTIVE SUMMARY**

This Environmental Registration Document has been prepared by MGI Limited on behalf of Black Bull Resources Inc. (Black Bull) to provide details on a proposed surface quartz mine and quartz processing plant at the company's White Rock property in Yarmouth County, Nova Scotia. Information contained within this document has been gathered from extensive environmental baseline assessments, formal and informal public consultation, public domain documents, consultants reports, and liaison with regulatory agencies. Black Bull is a mineral resource development company with sound technical and financial resources to complete this undertaking as described. The company has maintained an open and fully consultative approach since commencing work on the property in 1998.

The proposed mine operation would be a drill/blast/haul type operation where materials would be extracted from two pits along the trend of the deposit and taken to processing facilities on-site. Test mining was completed during the fall of 2000 under a bulk sample approval. Control of surface water within and exterior to the extraction areas will be achieved through the use of ditching and settling ponds located at key areas of the site. Disturbed areas will be minimized and surface water controlled within the extraction areas and recycled.

Crushed, screened and washed quartz products will be produced during the first year. The quartz processing plant will be constructed and commissioned during the second year of operation. First year production is anticipated at 100,000 tonnes of quartz material increasing to 250,000 tonnes per annum in the third year. Other materials (e.g. overburden, quartz-kaolin breccia, granite) encountered during the extraction of quartz will be stockpiled on-site with engineered drainage and sediment/erosion controls. Exploration and drilling will continue to define additional reserves from other mineralized zones on the property.

Quartz products will be delivered from the mine site in bulk or packaged form according to customer specifications and product size. Black Bull and/or the customer will be responsible for transportation to the customer. Products will be transported by truck to Shelburne or Yarmouth for direct loading or stockpiling at sites designated by Port Authorities prior to loading on to a barge, or ship that can be sent to markets in eastern Canada, the United States or Europe. Orders may also be transported by truck directly to the local or regional customers for secondary processing.

Baseline environmental surveys have been ongoing at the site since April of 2000 for components of the local environment such as surface water, terrestrial and aquatic habitats, groundwater, rare and endangered plants and animals and archaeological and cultural resources. An environmental screening was completed by the Nova Scotia Museum for the project area to assist with identifying issues requiring evaluation during the environmental baseline studies. First Nation's involvement in the project has been extensive including the completion of a Mi'kmaq Knowledge Study to supplement data collected by other consultants to the project team. All of the collected data was used in the development of monitoring, mitigation and avoidance plans for the special features identified which may require protection based on legislation or input from stakeholder groups.

Public consultation has been a key component of the Black Bull approach to the project with informal meetings, public information sessions and community newsletters forming part of the

overall public consultation program. Black Bull intends to continue this approach to public consultation through a Community Liaison Committee (CLC) which will be formed prior to initiating the surface mine development. Black Bull has created an interactive website for public information exchange. www.blackbullresources.com

The White Rock Quartz Mine will employ approximately 40 persons from the local area at full production with an estimated payroll of 2 million dollars per year. Annual third party benefits are expected to be in the 8 million dollar range based on typical multiplier effects for mining projects. Opportunities for new downstream industries or manufacturing that use quartz products will provide additional investment and employment in the Southwest region.

The project includes a reclamation and decommissioning plan with the creation of new aquatic areas of fish and plant habitat in formerly flooded extraction areas and water storage areas. Reclamation activities at the site will include site decommissioning and will be carried out with input from the CLC and approved by the provincial government.

As an indication of our commitment to the White Rock Mine project and to the people of Nova Scotia, Black Bull has committed to the following programs as part of our development and mine operations. Black Bull Resources Inc. will:

- Start a Community Liaison Committee.
- Undertake a Traffic Impact Study.
- Develop an Artifacts Protection Plan.
- Post a Reclamation Bond.
- Post an Environmental Bond.
- Purchase land for dedication to public park.
- Initiate a Rare Plant Stewardship Program (*Listera Australis*).
- Develop a Land Management Plan with 1$^{st}$ Nations and DNR.
- Develop a monitoring program for air, dust, noise, water, plants and animals.
- Develop an Environmental Protection Plan.
- Create 6.4 ha of new aquatic habitat for fish/plants.
- Reclaim 3.0 ha of old road un-reclaimed since 1980.
- Work with South West Shore Development Authority to develop additional industry and employment opportunities.

# 1.0 INTRODUCTION AND REGISTRATION

## 1.1 Introduction

The purpose of this document is to register a proposed quartz mineral development project known as the White Rock Mine located at Flintstone Rock, Yarmouth County (Figures 1-1 and 1-2). Exploration, advanced exploration and bulk sample programs have been underway at the site since 1995 in compliance with applicable legislation for exploration activities. Black Bull Resources Inc. (Black Bull) is the project proponent having optioned the property from CAG Enterprises Limited (CAG) in 1997. The exploration claims (#03039, 03039A, 02428, 02429, 02431 and 03486) are held by Black Bull.

Black Bull has contracted Atcon Construction Inc. (Atcon) to prepare mine design and carry out mining operations at the White Rock Quartz Mine. Atcon is an Atlantic Canada based civil and mining contractor with experience in design, operating and reclamation of surface mines.

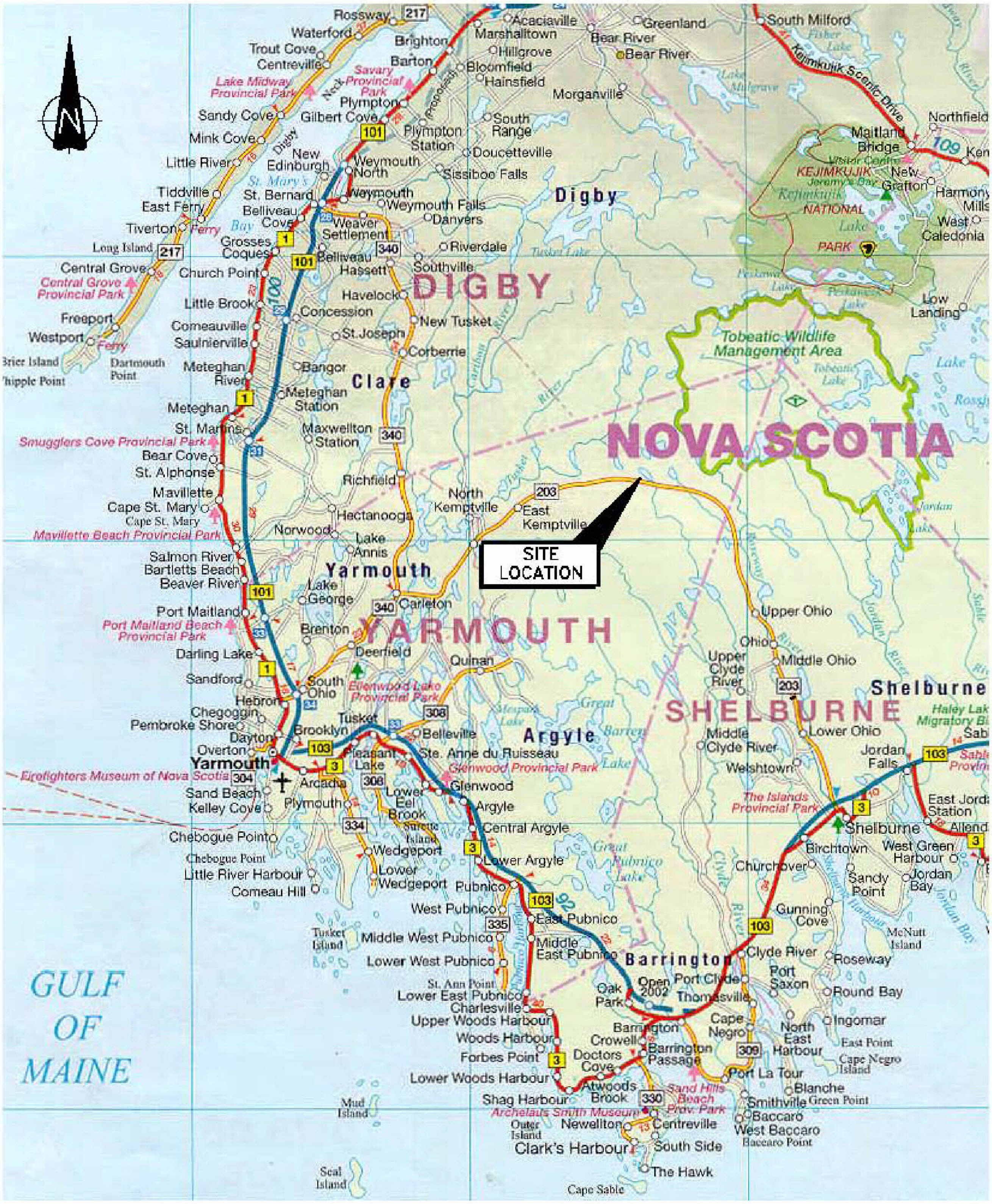
The collection of environmental baseline data including an Environmental Screening by the Nova Scotia Museum (Appendix A), public consultation and preparation of this document have all been performed to comply with legislation associated with the Environment Act. Black Bull seeks to have the project reviewed in accordance with the Nova Scotia Environment Act and associated Environmental Assessment legislation administered by the Nova Scotia Department of Environment and Labour (NSDEL).

## 1.2 Registration

| | |
|---|---|
| Name of Undertaking: | White Rock Quartz Mine |
| Location of Undertaking: | Flintstone Rock, Yarmouth County, Nova Scotia |
| Proponent: | Black Bull Resources Inc. (BBS:TSXV) |
| Project Contact: | Mr. John Keating, President, CEO |
| Head Office: | #303 Sun Tower<br>100 West Pender Street<br>Vancouver, B.C. V6B 1R8 |
| Contact methods: | Telephone: 604-688-9500<br>Fax: 604-688-9550<br>E-mail: blackbullresources@telus.net<br>Website: www.blackbullresources.com<br><br>Please note: Black Bull has a local office at:<br>157 Water Street<br>Shelburne, Nova Scotia<br>BOT 1W0 |

Contact persons for the purposes of Environmental Registration:

Proponent – Mr. John Keating – see above for contact methods




| A member of the Family of Companies | TITLE<br>Regional Site Location | DATE<br>Aug. 2002 | PROJECT NO.<br>20232G |
|---|---|---|---|
| | PROJECT<br>Environmental Registration Document<br>White Rock Quartz Mine<br>Flintstone Rock, Nova Scotia | SCALE<br>1:640,000<br>DRAWN<br>SYC | FIGURE NO.<br>1-1 |

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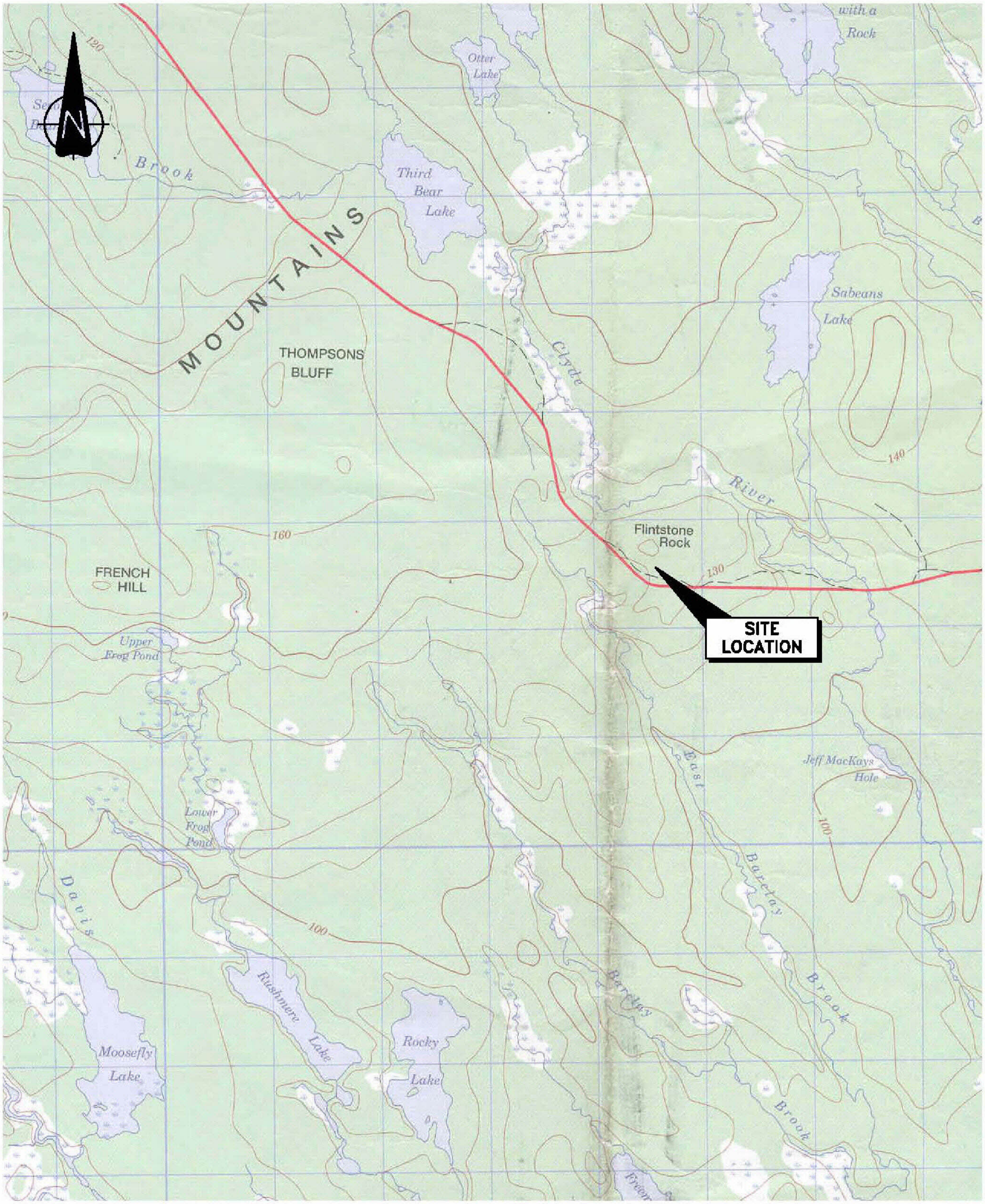



| TITLE | DATE | PROJECT NO. |
|---|---|---|
| Site Location | July 2002 | 20232G |
| PROJECT: Environmental Registration Document<br>White Rock Quartz Mine<br>Flintstone Rock, Nova Scotia | SCALE: 1:50000<br>DRAWN: SYC | FIGURE NO. 1-2 |

MGI — A member of the Family of Companies

CADFILE No. CADFILE_NO

023420

Project Consultant – Mr. Peter Oram, P.Geo.,
MGI Limited
31 Gloster Court
Dartmouth, N.S. B3B 1X9
Telephone – 902-468-1248
Fax – 902-468-2207
E-mail: peter.oram@mgi-limited.com

Black Bull has not received public funding for quartz production at the White Rock Property. Black Bull is working with the Industrial Research Assistance Program on a research project in the United Kingdom for kaolin. The U.K. laboratories were chosen for the research due to their many years of international experience in evaluating primary kaolin deposits.

Project approvals will be sought in accordance with the requirements of the following provincial legislation and the regulations made pursuant to them. Other legislation not listed here may apply:

- Nova Scotia Environment Act;
- Nova Scotia Special Places Act; and
- Nova Scotia Wildlife Act.

Black Bull understands the requirement for and will seek to secure the following specific approvals prior to operation of the White Rock Mine:

Future Approvals

Industrial Approval – NSDEL
Mining Permit –NSDNR
Mineral Lease – NSDNR
Milling Permit - NSDNR
Crown Land Lease (Surface) – NSDNR
On-site Sewage Disposal System Approval – NSDEL
Signage and Road Access Authorization - Nova Scotia Department of Transportation and Public Works (NSDTPW)
Water Withdrawal Approval (Groundwater Supply for Domestic Purposes) – NSDEL
Building Permit (Municipality of Argyle)

Black Bull currently holds the following approvals/permits:

Current Approvals

Letter of Authority to Bulk Sample Silica and Kaolin, Yarmouth County - NSDNR
Excavation Permits Nos. E-146 and E-152 – Flintstone Rock - NSDNR
Permit for Mineral Exploration on Crown Land - NSDNR
Industrial Approval for CAG Enterprises Ltd. to conduct a Bulk Sample – NSDEL
Excavation Permit No. E-143 - NSDNR
Excavation Permit No. E-146 – NSDNR (Renewed in May 2002)

Copies of each of the above noted, current approvals are located in Appendix B for review/reference.

# 2.0 PROJECT OVERVIEW AND SITE HISTORY

## 2.1 Location and Property Overview

The White Rock Property is located in east central Yarmouth County, Municipality of Arygle, Nova Scotia, approximately 45 kilometres northwest of the deep water port at Shelburne and approximately 60 kilometres east of the Port of Yarmouth. The site can be reached via Highway #203, a paved all season public road. The site location on a regional scale is presented in Figure 2-1.

### 2.1.1 Site Use History

Historical use of the land was investigated by Cultural Resource Management Group (CRM) and by the Confederacy of Mainland Mi'kmaq (CMM). Both consultants noted that First Nations land use was recognized as a given based on proximity of First Nation communities within 65 kilometres of the site (Bear River and Acadia). However no physical evidence of occupation of the land has been determined to date. Documentation (written and anecdotal) and physical evidence of recent land use (last 100 years) for blueberry harvesting, hunting, recreational use and shelter (Aggies Rock) was found. The Birchtown Historical Society has also investigated the general location with no evidence of occupation.

### 2.1.2 Site Ownership

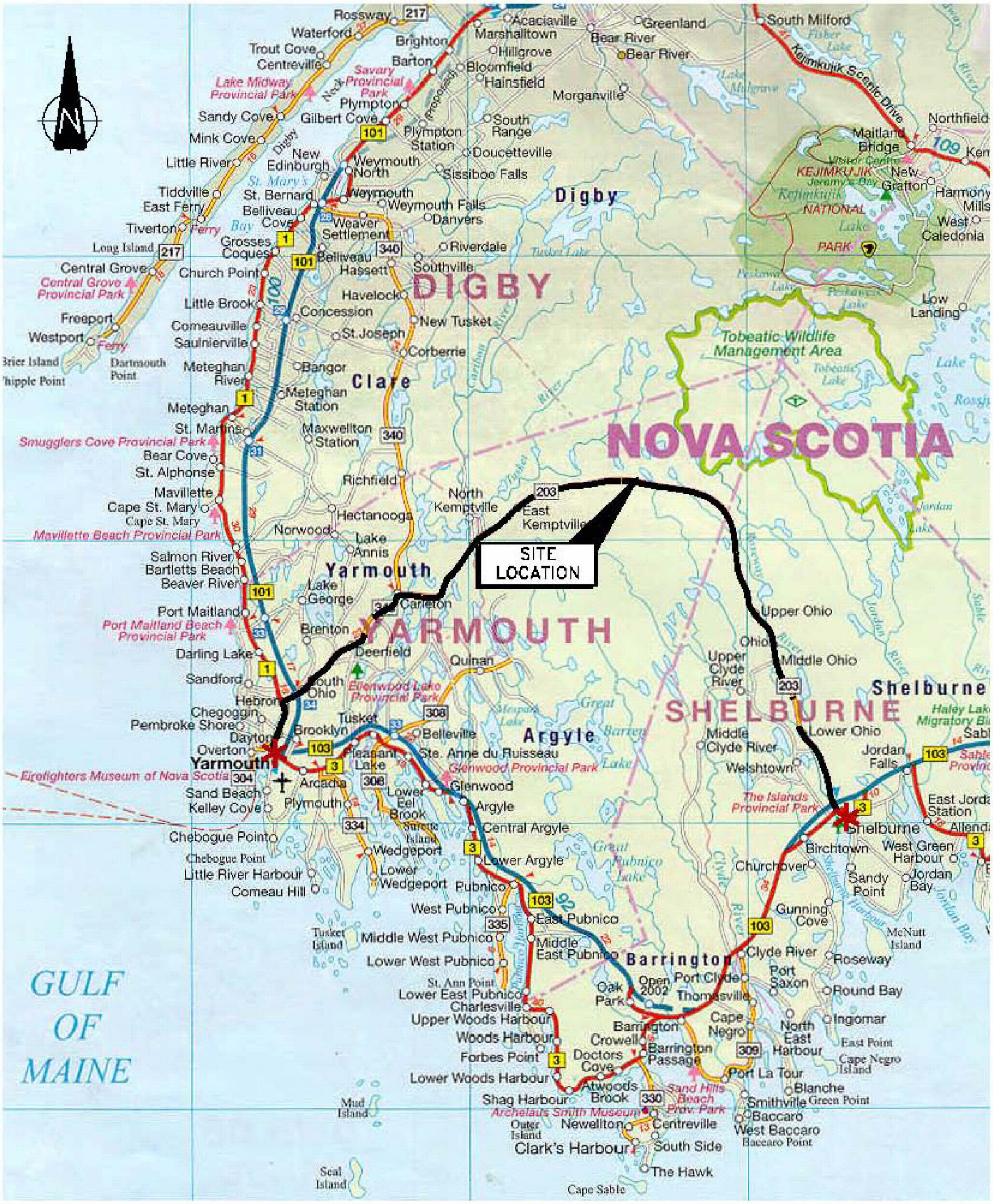
The proposed mining and surface lease area for the project are provincial Crown Land administered by the Nova Scotia Department of Natural Resources.

### 2.1.3 Mineral Exploration History

During the late 1970s and early 1980s, the area was included in regional base metals exploration surveys conducted by a number of companies, including Shell Canada Ltd.'s Minerals Division (Shell), Billiton Canada Ltd. (Billiton) and Esso Minerals Ltd. The regional surveys included geological mapping, regional till geochemistry, airborne geophysical surveys and were followed up by limited auger and diamond drilling. Within the present Black Bull claim block area, Shell drilled seven (7) diamond drill holes to depths of 20 to 90 metres. Several of the holes are reported to have intersected large intervals of quartz and kaolinite breccia. The claim block was also included in a 1:50,000 scale regional mapping project conducted by the NSDNR (South Mountain Batholith Project, Wentworth Lake map sheet, NS DNR, Map 94-03). Additional NSDNR work was completed for uranium presence in 2000, Appendix C.

CAG Enterprises Ltd. conducted geological mapping and a shallow (<15m) 9 hole core drilling program in 1996. The drilling program confirmed the presence of quartz mineralization in the Flintstone Rock and Barclay Brook areas as reported by Shell in 1982.

In 1998, Black Bull carried out a test pit program and trenching surveys. The work confirmed the presence of a large hydrothermal alteration system that contains high purity quartz and kaolin. Black Bull then completed 30 diamond drill holes on the property in 1999, outlining quartz mineralization over a strike length of 1200 metres and having a vertical depth in excess of 150 metres.

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| TITLE | DATE | PROJECT NO. |
|---|---|---|
| Proposed Product Transport Routes | Aug. 2002 | 20232G |
| **PROJECT** | **SCALE** | **FIGURE NO.** |
| Environmental Registration Document<br>White Rock Quartz Mine<br>Flintstone Rock, Nova Scotia | 1:640,000 | 2-1 |
| | **DRAWN** | |
| | SYC | |

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Black Bull continued evaluation of the mineralized alteration zone in 2000. Work included drilling nine (9) triple tube HQ drill-holes, 25 kms of Induced Potential/Resistivity surveys, trenching, and extracting a 7034 tonne bulk sample of quartz breccia, which included an unexpected lense of approximately 300 tonnes of kaolinite.

The bulk sample of quartz breccia was extracted using drill, blast and haul methods. Extraction areas were secured and slopes reduced to facilitate plant growth and animal access and egress after the extraction program and site access was restricted. The drill program was conducted in accordance with the Mineral Resources Act including drill hole abandonment. To date six (6) holes were converted to monitor wells.

Exploration work to date has identified a drill inferred geological resource of 16 million tonnes of quartz breccia along a 1.6 km strike length. More detailed drilling totaling 68 holes within this zone has outlined a mineable quartz resource of approximately 2.7 million tonnes and a mine plan has been prepared for this zone.

### 2.1.4 Environmental Baseline Studies

Environmental baseline studies to support this undertaking have been completed over the past two years. Black Bull continues to supplement existing data with additional detail for key environmental aspects of the project. Section 4 and referenced Appendices provide detail on the environmental baseline studies completed for this proposed undertaking. Table 2-1 provides an overview of completed studies. These will be supplemented in the future by ongoing studies designed to monitor any effects the mine's operation may have on the environment.

**TABLE 2-1: SITE DATA COLLECTION SUMMARY – WHITE ROCK MINE**

| ACTIVITY | CONSULTANT | PROJECT TIME FRAME(S) |
|---|---|---|
| Surface Water Monitoring | W.G. Shaw and Associates Ltd. | April 2000 – December 2000 |
| | MGI Limited | April 2001 – July 2002 |
| Groundwater Monitoring | MGI Limited | December 2001 – July 2002 |
| Fisheries Habitat Evaluation | Dillon Consulting Ltd. | October – November 2000<br>May – August 2001 |
| Plant and Animal Presence, Species at Risk & Habitat Evaluations | Dillon Consulting Ltd. with sub-consultants:<br>1. Ruth Newell – Plants/Animals<br>2. Fulton Lavender – Birds/Animals<br>3. Heather Stewart – Plants<br>4. John Gilhen – Reptiles/Amphibians<br>5. Tom Neily - Plants | September – November 2000<br>May – August 2001<br>June 2002 |
| Archaeological and Cultural Resource Survey | Cultural Resource Management Group Ltd. | October – November 2000 |
| Surface and Wastewater Management | ADI Environmental Management Inc. | March 2002 – July 2002 |
| First Nations Knowledge Study | Confederacy of Mainland Mi'kmaq | June – August 2001 |
| Mineral Processing Evaluations – Quartz | Daltech – Minerals Engineering Centre<br>Mineral Research Laboratory, North Carolina State University | 1997 – July 2002<br><br>2001 – July 2002 |
| Mine Design and Quartz Processing | Atcon Construction | April 2001 – July 2002 |

## 2.2 Description of Undertaking

Black Bull has defined a resource of quartz at the company's White Rock property in Yarmouth County, Nova Scotia. The company plans to extract quartz rock from two extraction areas (immediately adjacent to each other) for direct sale to customers. The company will also process the quartz into value added products. Product will be processed on-site and transported by truck directly to the customer or to the Ports of Shelburne and Yarmouth for transport via ship to markets, Figure 2-1.

Production of quartz products will involve a simple process of blasting, crushing, size sorting, washing, storing and shipping of material. Secondary on-site processing of the quartz is also planned to produce value-added products for use in specialty glass and other applications. This processing involves the washing of sand sized quartz particles in a series of flotation cells where other minerals are separated and removed from the quartz, resulting in a higher purity, higher value quartz product.

Crushed, screened and washed quartz products will be produced during the first year. The quartz flotation plant will be constructed and commissioned during the second year of operation. First year production is anticipated at 100,000 tonnes of quartz material increasing to 250,000 tonnes per annum in the third year. Mineable reserves of 2.7 million tonnes outlined to date support a ten-year operation. Future exploration and drilling within the claim block may continue to prove up additional reserves. Permitting would be undertaken to extend the life of the operation if extraction of the additional reserves is economically and technical feasible. Other materials (e.g. overburden, quartz-kaolin breccia, granite) encountered during the extraction of quartz will be stockpiled on-site with engineered drainage and sediment erosion controls.

The physical whiteness, brightness and hardness of Black Bull's quartz combined with a chemical pureness of greater than 98% $SiO_2$ make it unique and attractive for a wide range of applications, such as glass, ceramics, abrasives, construction and engineered stone. Quartz products will also be produced in any size from fine sand to lump and even large blocks for landscaping or other architectural purposes.

## 2.3 Alternatives to the Undertaking

The company is not aware of alternate locations of quartz available for extraction with the quality and quantity of the White Rock Mine property. The nature of mineral deposits makes extraction specific to certain geologic settings and therefore the location of the undertaking is fixed.

## 2.4 Physical Description of Property

The claim block contains 105 claims for a total of 1650 hectares or approximately 4200 acres. The proposed surface lease contains approximately 560 hectares or 1400 acres within which mining and associated activities would occur on approximately 37 hectares or 90 acres as outlined in this registration. Detailed surveying of lease boundaries will be conducted prior to granting of the leases in accordance with applicable legislation for leasing of provincial Crown Land.

## 2.5 Public Consultation

Black Bull has sought and obtained input on the project from local communities, public interest groups and others at open houses in Argyle, Yarmouth and Shelburne held on July 10, 11 and 12, 2002. Black Bull has also made presentations to local town and municipal councils. Black Bull has addressed the interests or concerns raised during these meetings, see Section 5.

Discussions with key regulatory, First Nations, public interest, and community groups will continue to occur on a regular basis throughout the life of the project. Black Bull will invite interested parties to participate on its Community Liaison Committee (CLC) that will be established following Environmental Assessment approval and prior to commencing production.

## 2.6 Schedule

Planning of this undertaking has been on-going since 1999 in various stages. This undertaking is proposed to be completed over a 10-12 year period. There will be a development period for site infrastructure such as settling ponds and other environmental controls, a 10 year extraction period and a 1 – 2 year active reclamation/decommissioning period to establish final environmental controls, remove infrastructure and complete revegetation programs and establish final access points. Refer to Section 3.0 for detailed information on the development sequence. Site development work would begin within one month of receipt of all necessary approvals including the Crown Land (surface) lease. Based on a favourable Environmental Assessment review in the Fall of 2002 and subsequent favourable reviews for Industrial Approval, Mining Permit and all required leases Black Bull will initiate site development work.

***Project Schedule Overview***

| | |
|---|---|
| Environmental Assessment Approval | Fall 2002 |
| Mineral Lease | Winter 2002 |
| Crown Land Surface Lease | Winter 2002 – Spring 2003 |
| Industrial Approvals | Spring 2003 |
| Mining Permit | Spring 2003 |

# 3.0 DETAILED PROJECT DESCRIPTION

## 3.1 Corporate Policies

Black Bull's mission is to be a leading producer of value added quartz products in an environmentally sound and socially responsible manner. The company will create a safe work environment and promote the highest standards of personal and professional integrity in order to achieve environmental excellence, community support, and a strong competitive position in the marketplace. Black Bull will maintain a "local purchase – local hire" policy and an Environmental Health and Safety Policy to govern all areas of the operation.

Training, innovation and research will form an integral part of the company's development strategy. Black Bull will work with community schools and colleges such as Nova Scotia Community College to develop and implement training programs. Technology to process quartz into value-added products will provide opportunities for local employment and enhance access to international markets for White Rock products. The development of a local customer base will also be a priority. In this regard, Black Bull will work with local communities, the South West Shore Development Authority, the province and the federal government to attract secondary or "downstream" industry into the region.

## 3.2 Design Considerations

The overall design of the project was founded upon consideration of safety, environmental compatibility, efficiency, and resource optimization. The mine plan and infrastructure have been planned to minimize disturbed areas. Information from previous studies and reports, along with input from stakeholders, the public and government departments at meetings were used during the development of the project.

## 3.3 Mining and Processing

The project comprises the mining, crushing, screening, processing, bagging, storage and shipping of industrial mineral products (quartz, also referred to as $SiO_2$) from the White Rock Quartz Mine. The open pit mine will produce 100,000 tonnes of lump, aggregate and sand sized quartz in the first 12 months (1 year) of operation. Quartz production is forecast to increase to 200,000 tonnes in Year 2 and reach a targeted production level of 250,000 tonnes per year in Year 3.

In Year 1, it is anticipated that the mine will crush products for three to five months. As annual production increases, and the quartz processing plant is commissioned, quartz is expected to be mined for 7 to 10 months per year. Quartz will be processed and shipped throughout the year in accordance with customer requirements. Trucking will be subject to spring weight restrictions as per NSDTPW requirements. It is anticipated that coarse material will be shipped as a bulk product. Finer material will be shipped as packaged products to meet specific market requirements. It is expected shipments of packaged products will increase in the future.

Blasted quartz from the mine will be crushed and screened to produce various product sizes. Spray washing of crushed material will be conducted as required. Water accumulating from precipitation or groundwater seepage into the mine area will be used for washing and processing materials.

Extensive recycling of water will be undertaken, with up to 80-90% recovery as indicated by bench scale testing.

Excavation of overburden will be conducted in sequential phases to minimize the extent of exposed till and reduce the potential for erosion and sediment transport. Sediment control fencing will be installed down-slope of areas that generate sediment discharge. Grubbing and overburden materials will be used on-site for berms, site grading and reclamation activities.

In the development of the mine layout and mining plan, zones identified as containing high purity quartz were optimized and other materials avoided whenever possible. Operating efficiencies for the movement of product were considered in the layout of ramp slopes, traffic patterns and similar issues. A grade of 10% was used for ramp design.

Fuel storage for the day to day requirements of the equipment will be in accordance with provincial regulations. Materials to contain fuel spills will be kept on-site, and mobile equipment will be fuelled at a central location. Mobile equipment will be refueled by delivery truck. If on-site storage is necessary for the processing plant, it will be in accordance with applicable regulations.

Materials for blasting (explosives) will be delivered to the site when required and on-site storage will not occur.

### 3.3.1 Mine Layout and Site Infrastructure

The mine consists of two individual pits (Pit "A" and Pit "B") as shown on Figure 3-1. Geological data from the exploration programs were used as the basis for the development of the mine layout and mining plan. Drillhole data were used to generate geological cross-sections and plans with the cross sections showing individual geological units and drillhole analyses for $SiO_2$ content. In general, the individual geological units are oriented in a southwest to northeast direction, and dip (i.e. slope) to the southeast at an angle of 40-50 degrees. An analytical result of 95 percent $SiO_2$ or higher for quartz was used to establish the extent of the area to be mined. In the area between Pit A and Pit B, the quartz unit does not have a continuous width of acceptable quality material and it was decided to develop the site as two individual pits.

The footprint of the mine is shown on Figure 3-1. Surface topography at the site has an overall slope from the north and northwest toward the south and southeast generally at a low slope (less than 2%). The surface topography in the vicinity of the mine is shown on Figure 3-2. Field surveys of surface topography were conducted to provide accurate data in the development area. The limit of survey is shown on Figure 3-2.

Several additional components of the site infrastructure are shown on Figure 3-1. These include designated locations for crushing and screening, product stockpiles, unprocessed rock storage, overburden storage, weigh scales, sediment ponds, storm water collection ponds, water treatment, quartz processing and quartz fines storage area. In addition, the site will also have washhouse facilities, bagging and storage areas, a first aid station, maintenance area, office, power distribution system, water supply and a sewage handling system associated with the quartz processing plant. These are discussed in subsequent sections of the document. A conceptual cross-section of the mine is shown in Figure 3-3.

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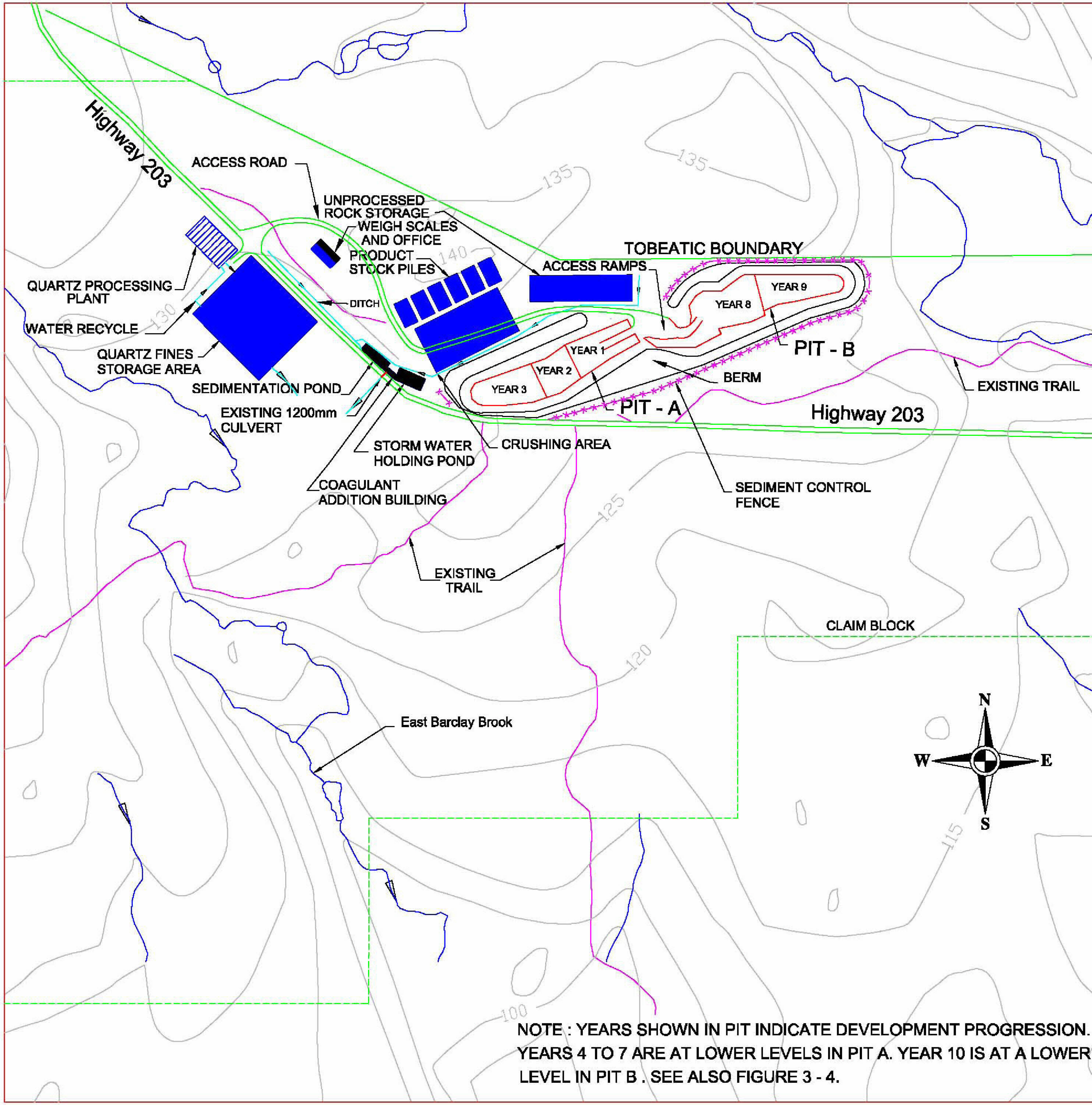



# WHITE ROCK QUARTZ PROJECT

YARMOUTH COUNTY, NOVA SCOTIA

## SITE LAYOUT

## FIGURE 3 - 1

SCALE
Scale
0 250 500
Meters

DRAWN BY
M. CARR

DATE
AUG. 08,2002

DRAWING NAME
SITE DRAWING

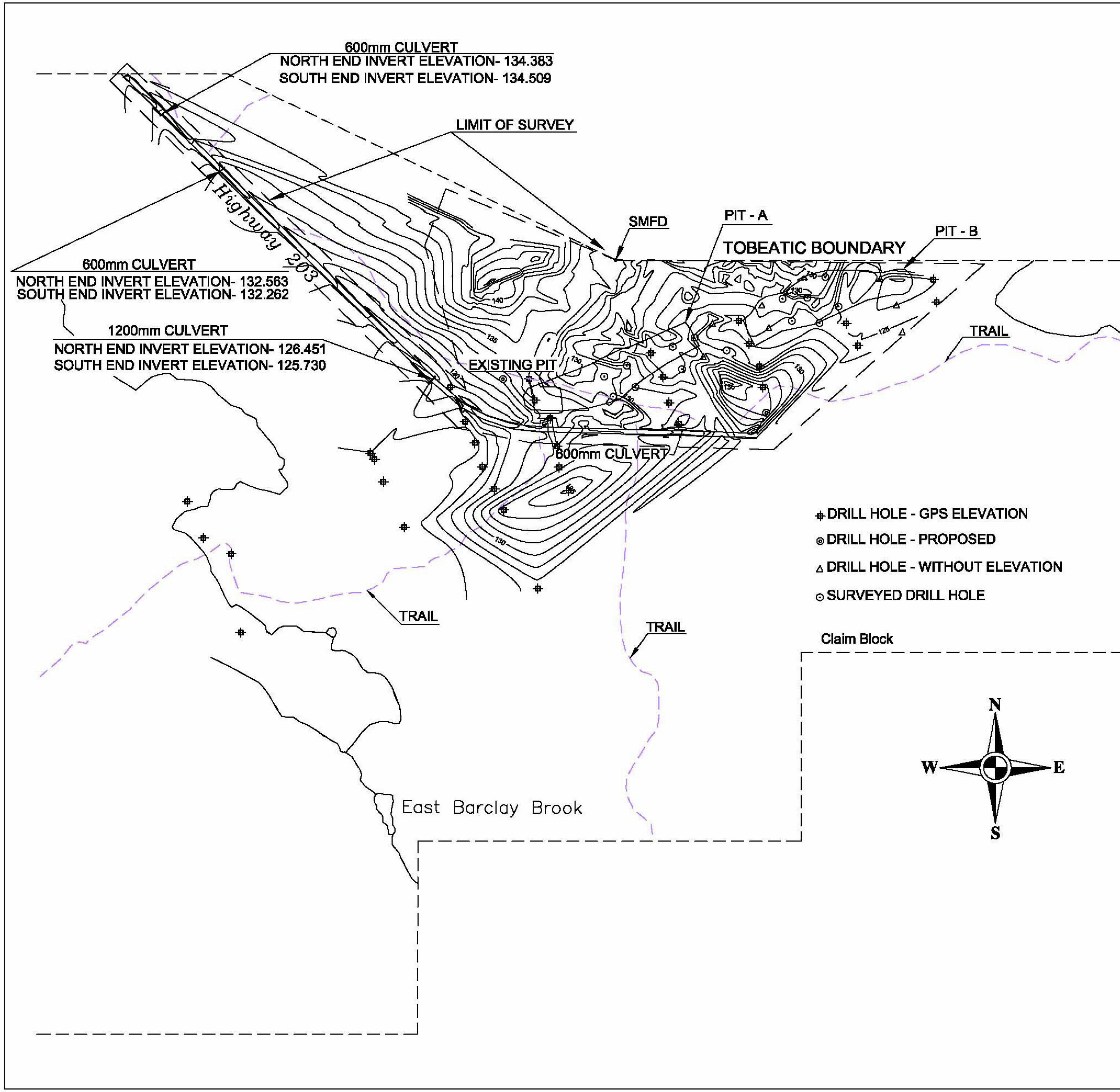
CHECKED BY
D. KEYS

NOTES
PRELIMINARY

ATCON
CONSTRUCTION INC.

023429

C0655-026




# White Rock Silica Project

Yarmouth County, Nova Scotia

## Surface Elevations

Contour Interval = 1m

**FIGURE 3-2**

SCALE

Scale

0 250 500

Metres

DRAWN BY
M. CARR

DATE
JUNE 24, 2002

DRAWING NAME
SURFACE1

CHECKED BY
D. KEYS

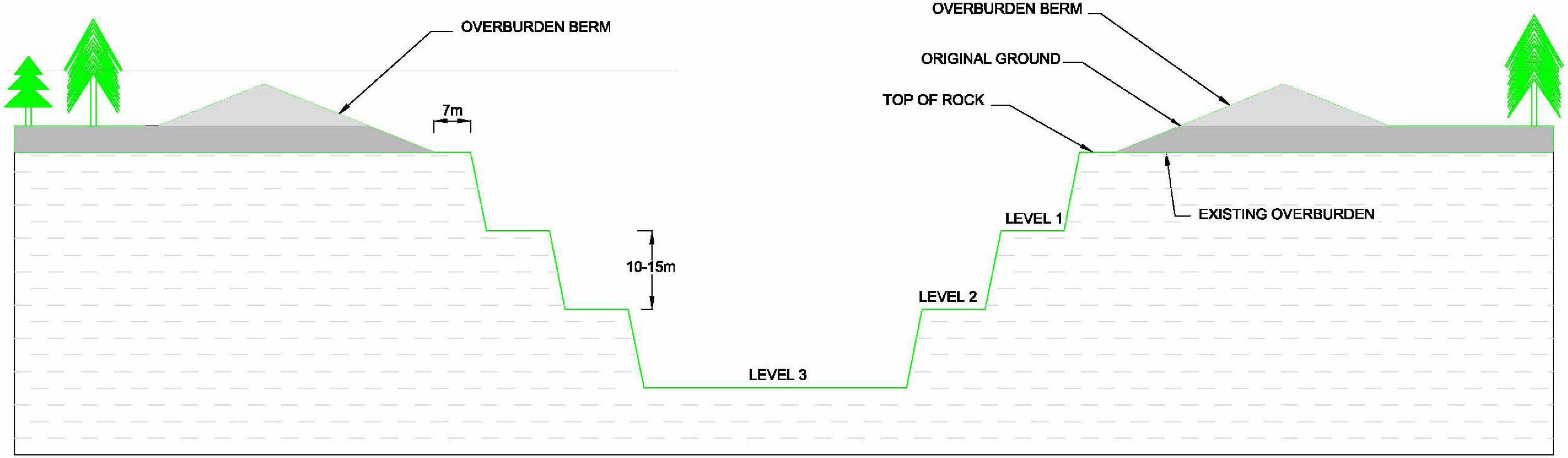
NOTES

PRELIMINARY

ATCON
CONSTRUCTION INC.

023430

# CONCEPTUAL CROSS SECTION OF MINE




PRELIMINARY

| | | | |
|---|---|---|---|
| ATCON CONSTRUCTION INC. | TITLE **WHITE ROCK QUARTZ PROJECT** | SCALE: N.T.S. | DRN. BY: M. CARR |
| | | DATE: JULY 08, 2002 | CHK. BY: D. KEYS |
| | YARMOUTH COUNTY, NOVA SCOTIA | DWG. NAME: PITXSEC | FIGURE 3-3 |

### 3.3.2 Development Sequence

Site infrastructure will be established in Year 1. This would include drainage and sediment/erosion controls, pads for the crusher setup, areas for stockpiling of crushed products, and a weigh scale and office facilities. Surface water management system and associated facilities would also be developed. Pit A is planned for development initially. In Year 1 overburden would be removed from the northeast end of Pit A. Blasting operations would be undertaken and an operating face and access ramp would be established. In Year 2 and 3, additional areas of overburden would be removed for the continued development of Pit A. Construction of the quartz processing plant is planned to commence in Year 2 and take approximately 6 months to complete. In Year 4 and 5, a new bench (Level 2, 110 m elevation) would be established at a lower elevation in Pit A. Level 3 (100 m elevation) in Pit A would be initiated in Year 6 and Level 4 in Year 7. The general development sequence is shown in Figure 3-4.

Development of Pit B is anticipated to commence in late Year 7 and Year 8. The access ramp for Pit B will use existing of infrastructure developed for Pit A where possible. Overburden removal and development of Level 1 would be undertaken in Year 8. Additional overburden would be removed in Year 9, to complete the full areal extent of development of Pit B. Mining of the 110m elevation in Pit B would be undertaken in Years 8 and 9. The 100m elevation would be mined in Year 10.

The detailed project schedule for activities associated with the development/operation phases of the project are outlined below.

Upon receipt of the necessary approvals and permits the following mining schedule is anticipated:

| | |
|---|---|
| Year 1 | Develop site infrastructure (crushing area, water management system and related components).<br>Remove and stockpile overburden on northeast portion of Pit A.<br>Extract, crush and stockpile 100,000 tonnes of quartz products.<br>Ship quartz products to customer |
| Year 2 | Remove overburden on additional portion of Pit A.<br>Extract, crush and stockpile 200,000 tonnes of quartz.<br>Construct quartz processing plant and quartz fines storage area (south side of highway). |
| Year 3 | Complete overburden removal for Pit A.<br>Extract, crush and stockpile 250,000 tonnes of quartz. |
| Years 4 & 5 | Extract and crush quartz from Level 2 in Pit A.<br>Extract, crush and stockpile 250,000 tonnes of quartz. |
| Year 6 | Extract quartz from Level 3 in Pit A.<br>Extract, crush and stockpile 250,000 tonnes of quartz. |
| Year 7 | Complete mining of Level 3 and Level 4 in Pit A.<br>Extract, crush and stockpile 250,000 tonnes of quartz.<br>Initial development of Pit B. |

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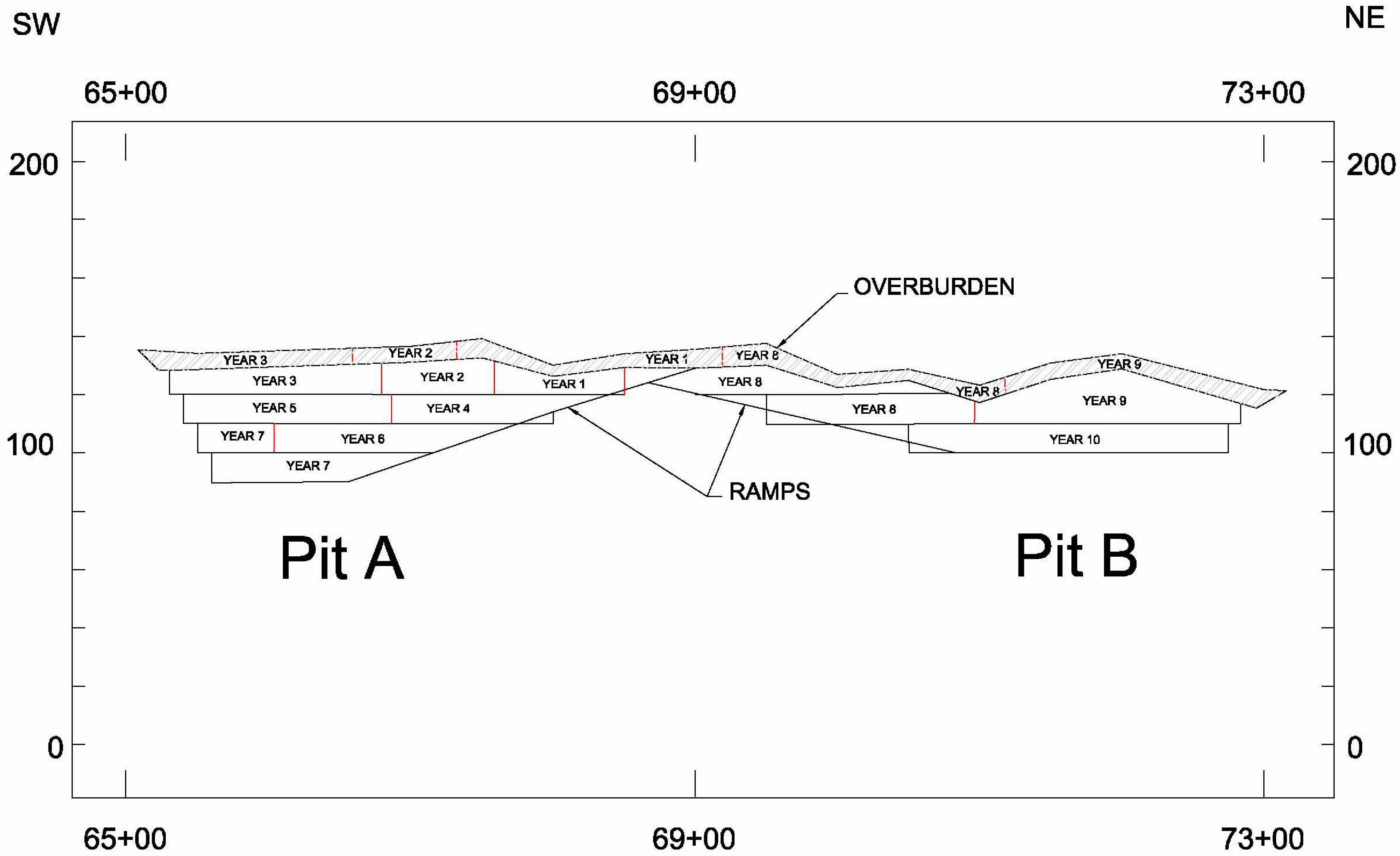



VERTICAL EXAGGERATION = 2 X
VERTICAL SCALE IS ELEVATION IN METERS.
HORIZONTAL SCALE IS GRID REFERENCE IN METERS.

YEARS INDICATE DEVELOPMENT SEQUENCE

| | | | |
|---|---|---|---|
| ATCON CONSTRUCTION INC. | **WHITE ROCK QUARTZ PROJECT** | SCALE 0 100 200 | DRN. BY MIC |
| | Yarmouth County, Nova Scotia | DATE JUNE 27, 2002 | CHK. BY D.KEYS |
| | | DWG. LONGITUDINAL SECTION | FIGURE 3-4 |

**023433**

Year 8 Continue development of Pit B.
Remove overburden from southwest end of Pit B.
Develop ramps, extract and crush quartz.
Extract, crush and stockpile 250,000 tonnes of quartz.

Year 9 Remove overburden from remainder of Pit B.
Extract and crush quartz.
Extract, crush and stockpile 250,000 tonnes of quartz.

Year 10 Remove quartz from lower level in Pit B.
Extract, crush and stockpile 250,000 tonnes of quartz.

Year 11 Reclaim Pit A and Pit B in accordance with Final Reclamation Plan.

Year 12 Complete site decommissioning.

### 3.3.3 Project Personnel and Equipment

Operation of the mine and processing plant will require a number of people in various functions. It is anticipated that 10-15 people will be needed for the mine operation and an additional 10-15 for the processing plant (Table 3-1). These will include supervisors, drillers, crusher operators, equipment operators and a weigh scale attendant. Approximately 10 additional managerial, office, maintenance, trucking and port facility staff will be required. Environmental compliance, health and safety and similar responsibilities would be assigned to site staff with assistance when needed from independent consultants.

**TABLE 3-1: ANTICIPATED PROJECT PERSONNEL**

| PROJECT PERSONNEL | |
|---|---|
| STAFF | NUMBER |
| Supervisor (Mine Operations) | 1 |
| Supervisor (Processing Plant Operations) | 1 |
| Driller | 1 |
| Blaster | 1 |
| Crusher Operators | 3-6 |
| Equipment Operators (Mine) | 3-5 |
| Equipment Operators (Processing Plant) | 6-10 |
| Shipping/Bagging Staff | 2 |
| Maintenance Staff (Processing Plant) | 1-2 |
| Weigh Scale Attendant | 1 |
| TOTAL | 20-30 |

Table 3-2 provides a general list of equipment that would initially be used on the White Rock Mine project:

**TABLE 3-2: SITE EQUIPMENT**

| Equipment Type | Number of Units |
|---|---|
| Wheel Loaders | 2-3 |
| Track-Type Excavator | 1 |
| Track-Type Bulldozer | 1 |
| Hydraulic Drill | 1 |
| Jaw Crusher | 1 |
| Cone Crusher | 1 |
| Screening Plant | 1-2 |
| On-site Trucks | 1-3 |
| Weigh Scales | 1 |
| Diesel Generator | 1 |
| Site Office Trailer | 1 |
| Storage Trailers | 1-2 |

Additional trailers for product quality control testing, staff lunch areas and training/meetings would be used in the initial years of operation with permanent facilities to be constructed in conjunction with the quartz processing plant.

Table 3-3 provides a general list of equipment that would be used for the quartz processing plant based on bench scale tests.

**TABLE 3-3: PROCESSING PLANT EQUIPMENT**

| Equipment Type | Number of Units |
|---|---|
| Belt Feeder | 1 |
| Rod Mill | 1 |
| Pump | 5 |
| Screen | 1 |
| Hydro-cyclones | 4 |
| Conditioner | 2 |
| Flotation Cell Circuits | 2 |
| Filter Belt | 1 |
| Dryer | 1 |
| Dust Collector | 1 |
| Bag House | 1 |

### 3.3.4 Clearing, Grubbing and Overburden Removal

Clearing and grubbing will be carried out as required, to build the necessary infrastructure and to keep in step with the progression of the mining operation. Overburden removal will occur mainly in Year 1, 2, and 3 for Pit A, and Years 8 and 9 for Pit B.

Based upon drill program data for the site it has been determined that there is generally 4 m to 6 m of overburden (sand, silt and boulders) covering the top of the bedrock (Figure 3-3). Water well drilling has indicated there may be some pockets of material up to 18 m thick, although evidence from 68 exploration drill holes indicates an average thickness of 4-6 metres.

The sequential clearing, grubbing and overburden removal process will involve:

- cutting and removing any marketable timber,
- installing sediment control fences where needed on the down slope edge of each area, and
- removing the overburden to the bedrock surface.

The overburden will be placed in berms along the perimeter of Pits A and B (Figure 3-3) or used to construct pads for processing areas. Overburden berms will be stabilized with hydroseed or an equivalent material to minimize potential for erosion. Standard seed mixes are proposed, however, Black Bull is prepared to evaluate the viability of alternate seed varieties to achieve slope stabilization in consultation with provincial authorities. Unconsolidated overburden will be removed a minimum of 7m away from the edge of the pits. The overburden will slope back from this point (i.e. the toe of the slope) and will be approximately 2.5:1 to 3:1.

The slope of the overburden is important from a safety perspective and is also an operational consideration. Erosion of soil from the berms into the pit has the potential to interfere with product quality and is a water management issue. Based on this combination of issues, the berms will have a sufficiently low slope to minimize the potential for erosion, based on the characteristics of the overburden at the site. The berm size will reflect the topographic conditions at the site and would typically have a wider footprint in topographically low areas and a narrower footprint in high areas.

### 3.3.5 Blasting

It will be necessary to blast and process approximately 30,000 - 35,000 tonnes of bedrock three times in the first year in order to meet the proposed production volume of 100,000 tonnes of finished products. It is estimated that there would be about 8 blasts in Year 3 of the project for the 250,000 tonnes per year production rate.

The initial step in the blasting process is to drill holes into the bedrock in accordance with a predetermined layout. The drillhole depths are based on the thickness of the bench to be removed. A typical depth would be about 10 metres but this may vary, particularly on the first bench, to account for irregularities in the surface of the rock. The drillhole pattern (i.e. the spacing between drillholes) is typically in the order of 2 to 3 metres (e.g. 3 m x 3 m, 2 m x 3 m, etc.) but may vary depending on the characteristics of the rock.

Non-electric blasting methods will be used for the project. In preparation for blasting, each drillhole in the selected area would be ‘loaded’. This would involve placing a detonator in the hole and adding explosives to a predetermined level. The drillhole would then be ‘collared’ to ground surface using crushed rock, sand or other appropriate material. The detonator for each hole would be connected to other detonators in a suitable configuration for the blast. The method of connection would result in a ‘delay’ (measured in milliseconds) between blastholes, which results in each hole functioning as a separate blast.

The methods used for collaring the holes, as well as the use of delays between holes, involve up-to-date procedures that will minimize flyrock and noise. The collaring procedure will ‘contain’ energy within the blasthole. This results in reduced flyrock, and minimizes noise impacts, while providing the operational benefit of improved breakage.

All blasting operations will be carried out in accordance with Nova Scotia Health and Safety Regulations, under the direct control of a certified Blaster. Explosives will be delivered to the site as required for each blast. Standard safety procedures will include a site inspection prior to blasting to ensure the area is clear and that all persons are at a safe distance. Environmental inspections will also be completed prior to blasts to protect wildlife as outlined in Section 6.0. A warning horn will be sounded immediately before the blast. When blasting is conducted in proximity to Highway 203, the Blaster will determine if it is necessary to stop traffic briefly (approximately 15 minutes) as a safety precaution. The Blaster will conduct a post-firing inspection of the site before giving permission for activities to resume.

### 3.3.6 Crushing and Screening

The crushing and screening unit will be set up on an operating area of about 2 ha near Pit A (Figure 3-1). Quartz from the working face will be transported to the crusher using large loaders or trucks. The quartz will be dumped into a vibrating feeder to the primary crusher (jaw crusher). It is projected that the feed rate into the primary crusher will be between 50 and 350 tonnes per hour depending on the required product size.

After the primary crusher, the quartz will be fed to a triple deck screen to remove the 6 to 8 inch material and the 4 to 6 inch product. The 4-inch minus material will be fed by conveyor belt to a secondary crusher that will reduce the quartz to aggregate size. It is anticipated that a cone crusher will be used for this operation.

Conveyors from the secondary crusher will carry the quartz to the secondary screening plant. This unit will consist of a triple deck screen, or equivalent, with conveyors. The oversize fraction from the plant will return to the crusher, and the fine fraction will be screened into different sizes to meet customer specifications. The finished products will be taken to stockpiles. Table 3-4 gives an overview of the outputs from the various stages of the operation.

The crushing and screening plant will be powered by electricity, which will be produced by a 750-kilowatt portable, self-contained, trailer mounted diesel generator. The generator unit is mounted in a highway trailer with a fuel storage capacity for 14 hours of operation. The generator may eventually be eliminated in favor of connecting to a conventional power supply. If necessary fuel will be stored on-site in accordance with applicable legislation.

**TABLE 3-4 OUTPUT SIZES OF CRUSHING OPERATIONS**

| Operation | Input | Output | Estimated Percentage of Total Output | Comments |
|---|---|---|---|---|
| Primary Crusher | Shot Rock (blast material from Mine) typically 24 inch minus | 8 inch minus | | Output size can be reduced to as small as 4.5 inches when smaller product sizes are required |
| Primary Screen | 8 inch minus from primary crusher | 6 to 8 inch<br>4 to 6 inch<br>4 inch minus | 20%<br>10% | |
| Secondary (Cone) Crusher | 4 inch minus from primary screen | 4 inch minus | | Size and percentage distribution can be altered as required by adjusting cone in crusher |
| Secondary Screen | 4 inch minus | 2 to 4 inch<br>¾ to 2 inch<br>¼ to ¾ inch<br>¼ inch minus | 10%<br>15%<br>25%<br>20% | Screen sizes can be altered as required to address specific customer requirements |

### 3.3.7 Further Beneficiation

Classification of sand size material (1/4 inch minus) may be necessary to meet specifications for certain markets. This process may involve several of the following equipment types depending on the specifications of the product:

Water Scalping – Classifying Tank
Collecting – Blending Flumes
Fine Material Washer-Classifier-Dehydrator Unit(s)
Cyclones

A Coarse Material Washer unit could also be used for larger aggregate (up to 2 ½ inch material), if necessary to meet market requirements. Log washers and scrubbers are also available for material washing.

In a water scalping-classifying tank unit, a slurry containing sand is fed into the tank. As the slurry flows to the opposite end, solids settle to the bottom. Due to the weight difference of the different sand sizes, the material is automatically classified as it settles. Coarse material drops out first near the feed end and material is progressively finer along the length of the tank.

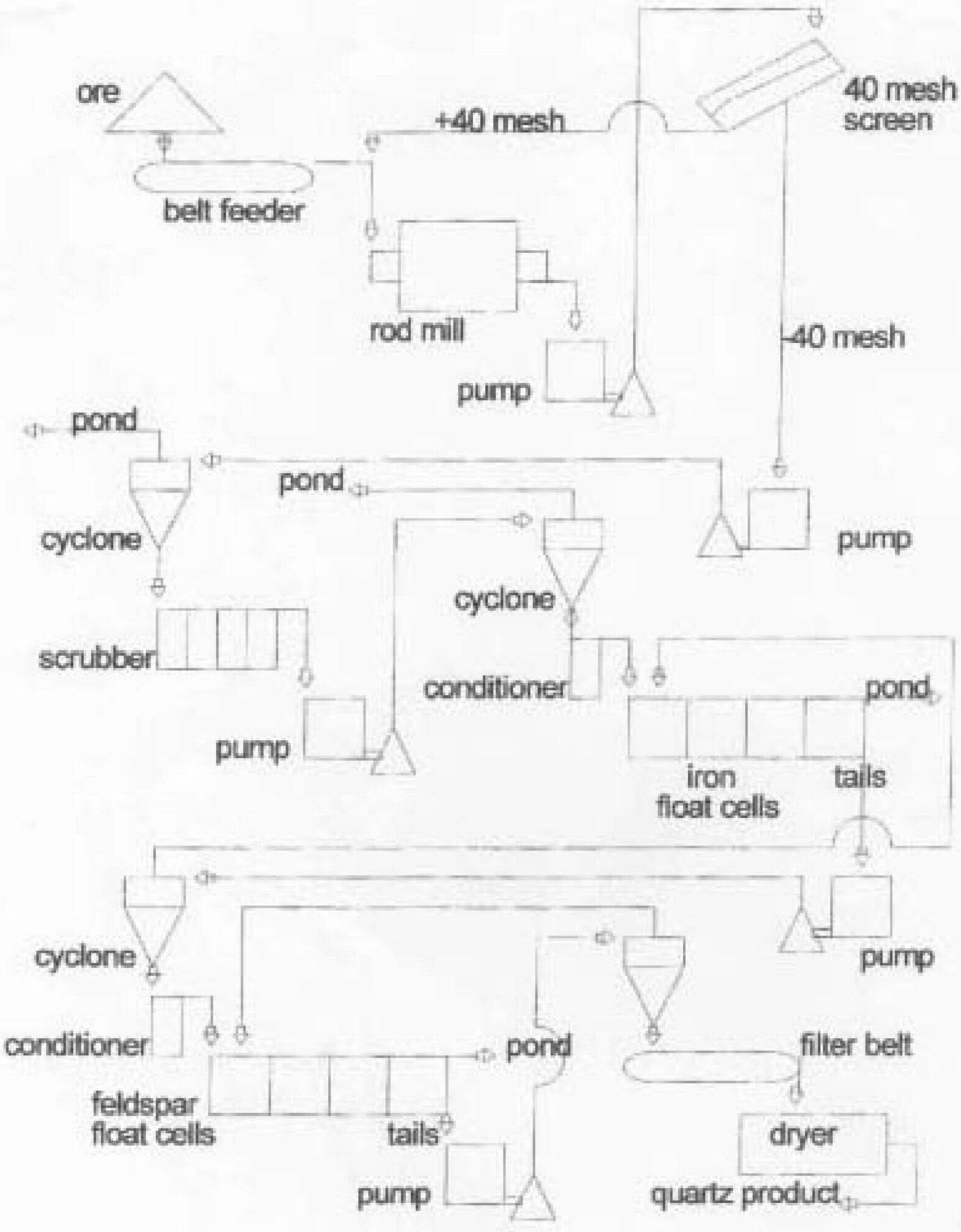
A collecting-blending flume can be used for selective reblending. These units can be electronically controlled to produce standard specifications. The individual sizes can be used separately, or reblended to produce specific products with a defined distribution of grain sizes.

A fine material washer-classifier-dehydrator unit can process material up to 3/8 inch in size. The unit has three combined functions. The primary action is removal of free water from the sand product. The second function is the washing of the sand particles by a tumbling action that grinds grain against grain and removes unwanted minerals coating the sand particles. The third function is to provide classification control of the product (i.e. removal of material finer than a selected mesh size). A settling area is used to retain the finer mesh particles. The type of classification can be varied by control of the rotational speed, adjustment of the volume of water introduced, and by changing the length of the overflow weir.

A single screw classifier-washer unit (36 inch shaft) with a rated operating capacity of 100 tonnes per hour could process 20 percent of the total production (i.e. the ¼ minus fraction from Table 3-3) with 500-1500 hours of operation (depending on the product specifications). It is anticipated that these units would not operate during the winter months.

### 3.3.8 Quartz Processing Plant

Schematic 1 provides a flow diagram showing the quartz processing plant. The plant building is anticipated to be a 60 m x 150 m x 15 m steel frame building on a concrete pad. It will contain a quartz processing line, reagent and chemical storage, offices, finished product storage and a maintenance/repair shop. The quartz processing plant will use proprietary technology to produce approximately 50,000 tonnes per year of high purity quartz product. The crushing plant will supply minus 3/4" material for feed to the processing plant by truck via a perpendicular, level, highway crossing. The feed rate will be controlled by a belt feeder discharging to a conveyor belt.




**Schematic 1 - Quartz Processing Plant Flow Diagram**



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The conveyor belt will transfer the ore to a rod mill where the ore will be ground to minus 40 mesh. The rod mill circuit will consist of a rod mill, pump and 40 mesh vibrating screen. Rod mill discharge will be pumped to the 40 mesh screen. The oversize (plus 40 mesh material) from the screen will return to the rod mill for further grinding and the undersize (minus 40 mesh material) will be pumped to a hydro-cyclone.

The hydro-cyclone is designed to remove fine material (minus 200 mesh) that would interfere with the flotation process. The minus 40 mesh material, from the rod mill, is pumped to the hydro-cyclone. The underflow from the cyclone (minus 40 mesh by plus 200 mesh material) discharges to the scrubber. The overflow from the cyclone contains most of the material smaller than 200 mesh and will be pumped to the quartz fines storage area.

The plus 40 mesh by minus 200 mesh material is scrubbed in an attrition scrubber (essentially four multi-bladed blenders). The scrubbing action cleans the surfaces of the particles enabling them to be more efficiently and selectively floated. The scrubber discharge is pumped to a second hydro-cyclone to remove the fines that were scrubbed off of the surfaces of the material. The underflow of the cyclone proceeds to the flotation circuit and the overflow goes to the quartz fines storage area.

The flotation circuit is comprised of an iron conditioner, iron removal flotation cells, pump, cyclone, feldspar conditioner and feldspar removal flotation cells. The scrubbed 40 mesh by 200 mesh material is discharged into the iron conditioner where flotation reagents are introduced (see Section 3.4.4). The reagent attaches itself to the surface of the iron bearing minerals and discharges to the flotation cells. The flotation cells are tanks filled with water with a specialized impeller that keeps the material agitated. Air bubbles are injected through the impeller. The air bubbles attach themselves to the reagent on the surface of the iron minerals causing them to float. The floated material is skimmed off of the flotation cell. This floated material is then pumped to the quartz fines storage pond.

The material that does not float (called tails), sinks to the bottom of the cell and discharges from the bottom of the cell. The tails are pumped to a cyclone to remove most of the water. The overflow from the cyclone is re-circulated to the head of the iron float cell and used as make-up water for the iron float. The underflow from the cyclone is discharged to the feldspar conditioner where flotation reagents are added. The feldspathic material is floated and sent to the quartz fines storage area. The solids from this float are the purified quartz product.

The quartz is pumped to a final cyclone to remove water. The water overflow from the cyclone is re-circulated to the feldspar float. The underflow is discharged to a filter to remove additional water (also re-circulated). The filtered material at approximately 8% moisture, is fed to a dryer where the moisture content is reduced to near 0% moisture. The dried quartz is then prepared for shipment.

After drying, the final products are packaged in 18 kg – 25 kg bags, bulk "super-sacks" (500 kg/1,000 kg) or loaded directly into enclosed bulk trucks or containers to prevent the product from being contaminated. Storage space is available in the processing plant for the packaged products.

### 3.3.9 Product Storage

The quantities of crushed and processed quartz to be stored on the site will be a function of market demand and rates of production of various product sizes. Mined quartz will be stockpiled according to size fraction and quality. The angle of repose for stockpiled material from the mine is expected to be approximately 30 degrees. Based on this slope, a stockpile with a footprint size of 90m long by 30m wide and a height of 9m would have a capacity of about 12600 cubic metres (20,000-22,000 tonnes). At this height the top of the stockpile would have a width of about 6m.

Proposed locations for six stockpiles with a total capacity of over 120,000 tonnes are shown on Figure 3-1. An allowance has been made for a 10m wide space between stockpiles for access purposes. The total area required for the six stockpiles is about 2.4 ha. The quartz will be washed during the crushing and screening operation and stockpiled material will not be a source of dust.

The quartz products will be shipped from the stockpile area (or the crushing operation) by truck. Covered outdoor storage at the mine site may also be necessary for some high specification products. Large fabric structures will provide protection from the elements as required. Interior storage areas are also available within the quartz processing plant building. A weigh scale will be installed at the site to record the tonnage and grade of material on each truck leaving the site.

### 3.3.10 Unprocessed Rock Storage

During the operation of the mine, it is anticipated that occasional zones or unexpected lenses of material will be encountered which are not suitable for processing. This material will be stockpiled in an unprocessed (i.e. blasted rock) state. While the extraction layout has been planned so that these areas are avoided whenever possible, it is expected that some material will be encountered during construction of access ramps and mining. The material will include occasional lenses of quartz-kaolinite material, granitic rocks adjacent to the deposit, and low quality quartz.

An 'unprocessed rock storage' area will be built for this material, location is shown on Figure 3-1. Runoff from this area will be controlled as part of the surface water management system. The mine plan currently anticipates material of this nature will be encountered in Year 3 as access ramps are deepened in Pit A. The total volume of unprocessed rock from Pit A has been calculated to be 45,000 $m^3$ in-situ. An allowance has been made for storage of an additional 10,000 $m^3$ in case unexpected lenses of quartz-kaolinite material is encountered within the quartz unit of Pit A. During development of Pit B it is expected that any unprocessed rock would be placed in the unprocessed rock storage area or other suitable locations such as Pit A.

The storage area is expected to be a minimal source for wind erosion of dust due to the shot rock origin of the material (i.e. large pieces mixed with some finer material), the relatively low profile of the stockpiles, and the development of a wetted 'crust' on the stockpiled material.

## 3.4 Site Water Management

### 3.4.1 Water Uses and Recycling

Water will be used in the crushing/classification area and in the quartz processing plant. The estimated quantities of water for these uses are given in Figure 3-5 and identified as "streams". Approximately 11.4 cubic metres/hour ($m^3/h$) (50 USgpm) of water will be required for washing and dust control in the crushing area (stream 10). Approximately 68.1 $m^3/h$ (300 USgpm) of water will be required for the washing and classification of quartz into specific size fractions (stream 13). The future quartz processing plant will require approximately 204 $m^3/h$ (900 USgpm) of water for process use (stream 16).

Each of these three sources of process water will be recycled after the removal of silt and colloidal size particulate. The degree of recycling will be approximately 80 % or greater based on industrial practice for similar quartz operations. Hence, the net demand for "makeup" water in the crushing and classification area will not exceed approximately 15.9 $m^3/h$ (70 USgpm) as indicated in Figure 3-5 (i.e. streams 9 and 12). The quartz processing plant will have a net demand of approximately 45.4 $m^3/h$ (200 USgpm) (stream 15). This demand could be considerably lower based on the results of ongoing test work that could increase recycling rates. Thus, the maximum demand for "makeup" water will not exceed approximately 61.3 $m^3/h$ (270 USgpm).

Potable water for the work force will be provided by a local well or by bottled water.

### 3.4.2 Sources of Water Discharges

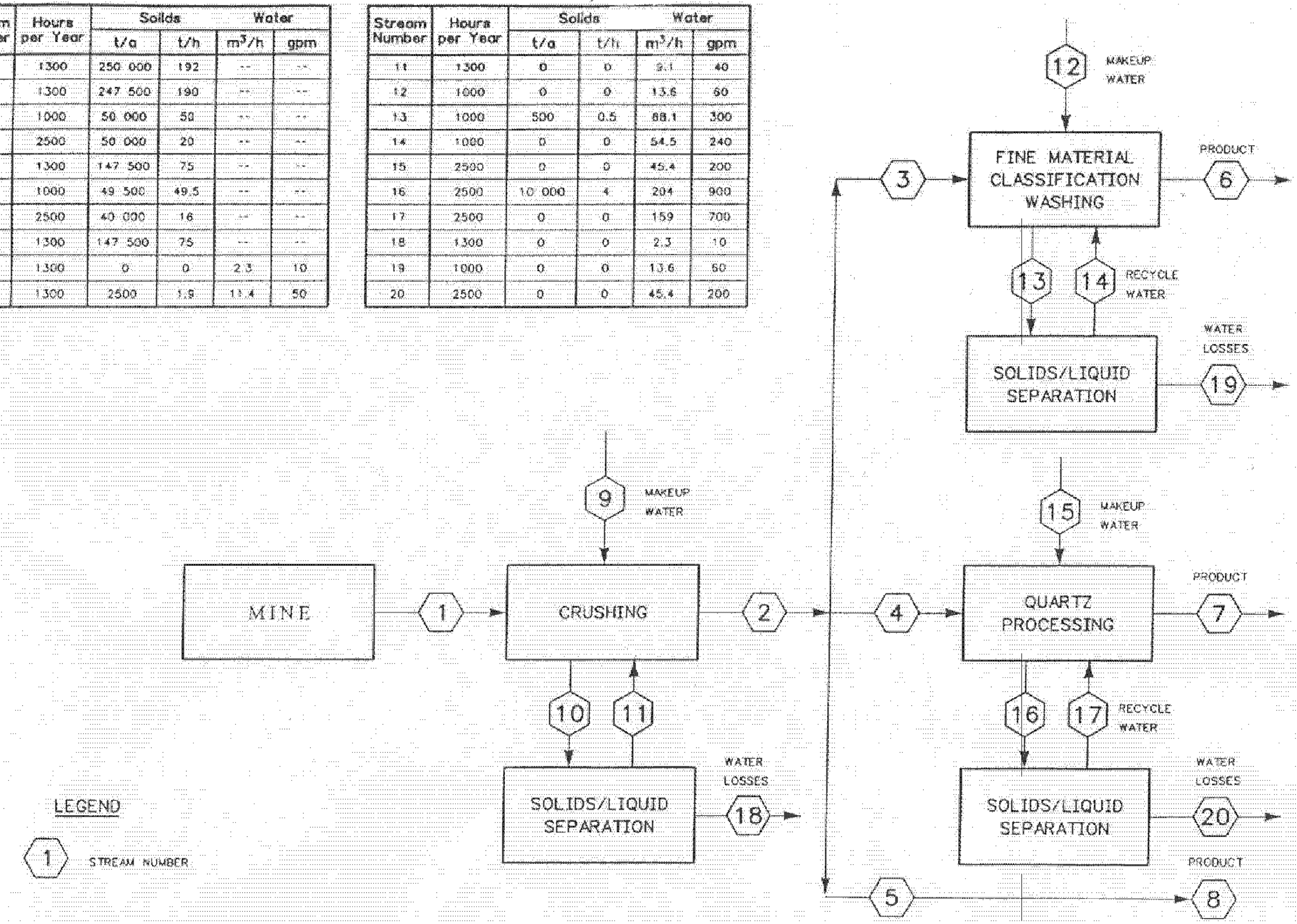
Sources of water discharges from the mining operation will include losses (evaporization and wetting of materials) from the processing of the ore, (see Section 3.3) and surface runoff from the mine and processing areas. Surface runoff will result from direct precipitation and snow melt which contacts Pit A and B and related facilities. Such runoff will contain silt and colloidal size particulate collected during contact with active working areas. Care will be taken to ensure that such runoff does not become contaminated with fuels, lubricants, hydraulic fluids, residuals from the use of explosives for blasting, and any other chemical reagents used at the site.

The active areas of the mine site will occupy approximately 15 ha. The mean annual runoff from this area, due to precipitation and snow melt, will be in the order of 400 $m^3$/day. Stormwater volumes, due to storm precipitation events, will be considerably greater, see Section 3.4.3.

The quartz processing plant, on the south side of the highway, will occupy approximately 2 ha, resulting in a mean annual runoff in the order of 53 $m^3$/day. Stormwater volumes are considered in Section 3.4.4.

| Stream Number | Hours per Year | Solids | | Water | |
|---|---|---|---|---|---|
| | | t/a | t/h | $m^3/h$ | gpm |
| 1 | 1300 | 250 000 | 192 | -- | -- |
| 2 | 1300 | 247 500 | 190 | -- | -- |
| 3 | 1000 | 50 000 | 50 | -- | -- |
| 4 | 2500 | 50 000 | 20 | -- | -- |
| 5 | 1300 | 147 500 | 75 | -- | -- |
| 6 | 1000 | 49 500 | 49.5 | -- | -- |
| 7 | 2500 | 40 000 | 16 | -- | -- |
| 8 | 1300 | 147 500 | 75 | -- | -- |
| 9 | 1300 | 0 | 0 | 2.3 | 10 |
| 10 | 1300 | 2500 | 1.9 | 11.4 | 50 |

| Stream Number | Hours per Year | Solids | | Water | |
|---|---|---|---|---|---|
| | | t/a | t/h | $m^3/h$ | gpm |
| 11 | 1300 | 0 | 0 | 9.1 | 40 |
| 12 | 1000 | 0 | 0 | 13.6 | 60 |
| 13 | 1000 | 500 | 0.5 | 68.1 | 300 |
| 14 | 1000 | 0 | 0 | 54.5 | 240 |
| 15 | 2500 | 0 | 0 | 45.4 | 200 |
| 16 | 2500 | 10 000 | 4 | 204 | 900 |
| 17 | 2500 | 0 | 0 | 159 | 700 |
| 18 | 1300 | 0 | 0 | 2.3 | 10 |
| 19 | 1000 | 0 | 0 | 13.6 | 60 |
| 20 | 2500 | 0 | 0 | 45.4 | 200 |




FLOW DIAGRAM - SOLIDS/PROCESS WATER (FIGURE 3-5)

### 3.4.3 Water Management System - Mine Area

The proposed water management system for Pit A and B and associated facilities on the north side of Highway 203 is shown in Figure 3-1. Process and surface runoff from the active areas will be collected and treated for the removal of suspended and colloidal solids. The system will be designed for severe storm precipitation runoff conditions and the expected rates of process water from the ore crushing, washing, and classification areas. The water management system will consist of collection channels, a stormwater holding pond, coagulant addition building, and a sedimentation pond. Clarified water will be recycled from the sedimentation pond for use as process water in the crushing/classification area and in the quartz processing plant.

The water collection and sedimentation system has been designed to manage the runoff from a storm event with a duration of 24 hours and return period of 25 years, approximately 127 mm of runoff (5 inches) based on long term storm intensity data for the Yarmouth weather station (source: Environment Canada, Atmospheric Environment Service, "Short Duration Rainfall Intensity for Yarmouth," based on data from 1971 to 1996). The holding pond will have sufficient capacity to capture the runoff from all active areas except the open pits. The holding pond, as indicated in Figure 3-6, will have an emergency overflow such that any flows in excess of the holding pond capacity will be directed into Pit A. Water collected in the open pits will be stored in the pits until the holding pond has been cleared of water collected from the other areas.

Water will be pumped from the holding pond into the sedimentation pond for the removal of suspended and colloidal solids, as indicated in Figure 3-6 for stormwater management, and as indicated in Figure 3-7 for "normal" operating conditions. A NSDEL approved coagulant will be metered into the discharge from the holding pond to enhance the removal of colloidal solids. The sedimentation pond, with a surface area of approximately 1600 $m^2$, will provide highly conservative sedimentation conditions at the design storm treatment rate of approximately 103 $m^3/h$. The applied clarification overflow rate will not exceed 0.06 $m^3/m^2/h$ (ie. 40 Usgpd/$ft^2$). The volume of the sedimentation pond (4000 $m^3$) was selected to provide storage for an approximate 3-5 day supply of treated water to be used as process water. A stormwater treatment rate of 103 $m^3/h$ will enable treatment of the holding pond volume within a 72 hour period. A treatment rate of approximately 118 $m^3/h$ will enable the treatment of more "normal" volumes of runoff and process water within a 10 hour operating day, as indicated in Figure 3-7.

The typical type of explosive to be used at the site (i.e. ANFO) contains ammonium nitrate. This is a common component of domestic fertilizer and is soluble in water. The ammonium nitrate is converted to gaseous products during the explosive reactions and residual ammonium nitrate would typically occur in only trace amounts. A qualified supplier will transport the explosives to the site and on-site storage will not be required. Careful use of the explosives, including immediate recovery of any spillage, will minimize losses of soluble ammonium nitrate to mine and surface water. The limited frequency of blasting operations will also assist in minimizing the potential for contact of residuals with water.

Accumulated sediment will be removed from the north side ponds during summer low-flow periods. Sediment will be placed in the quartz fines storage area and/or into areas of the open pits where mining is complete. Recovered sediments could be reprocessed or placed in Pit A.

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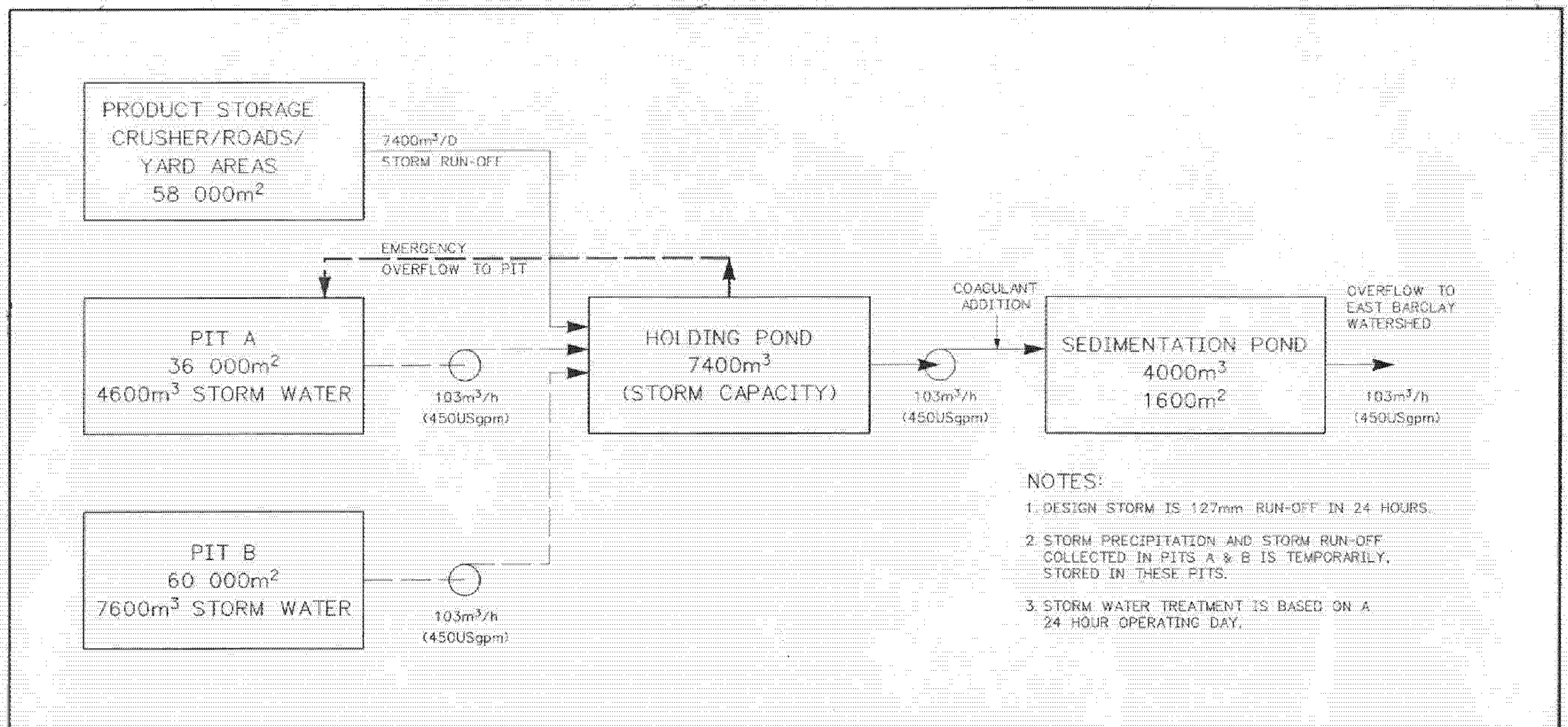


FLOW DIAGRAM - DESIGN STORM RUN-OFF CONTROL (FIGURE 3-6)

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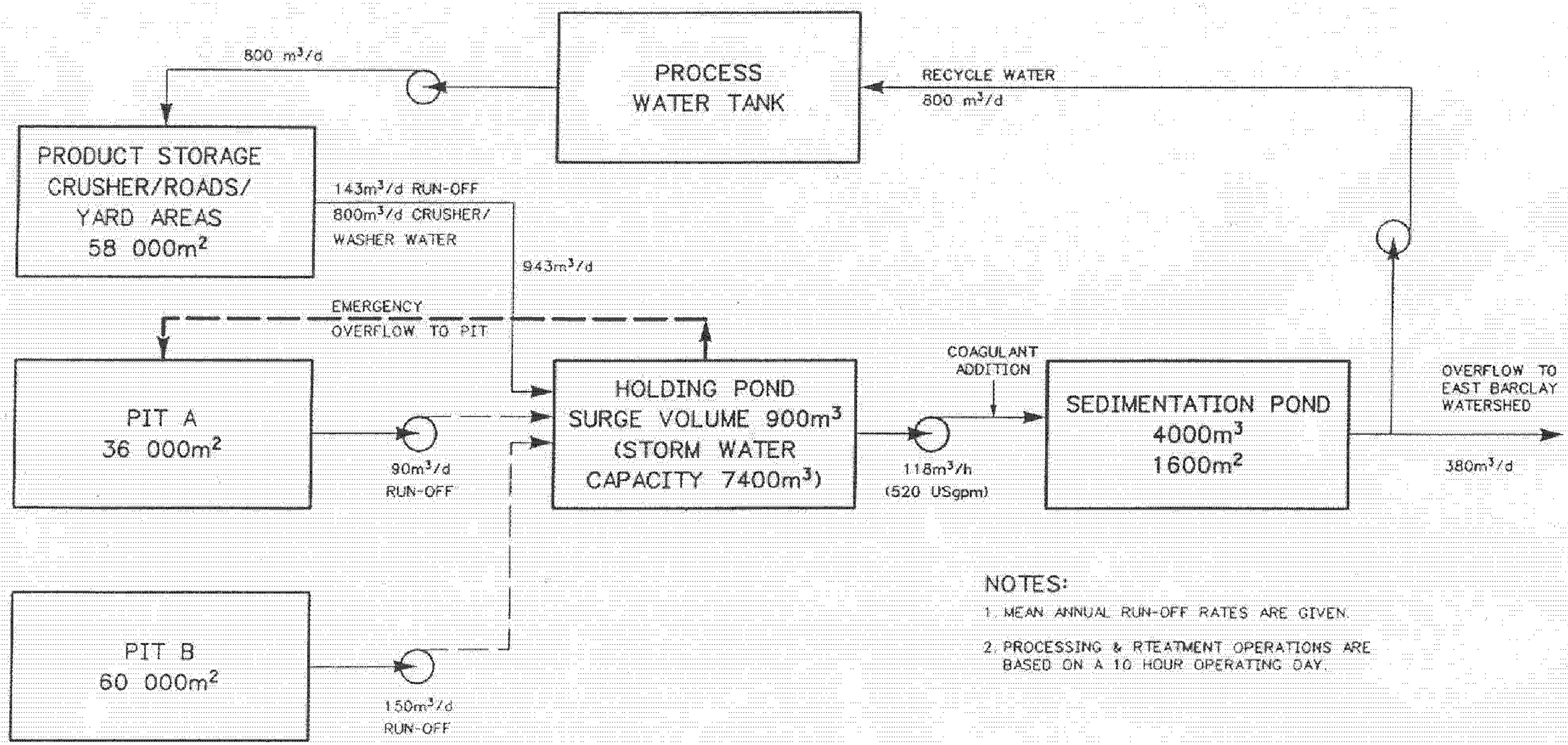



FLOW DIAGRAM - WATER CONTROL (FIGURE 3-7)

### 3.4.4 Water Management System – Processing Plant Area

Approximately 50,000 tonnes per year of crushed and washed quartz will be moved to the quartz processing plant located on the south side of Highway 203. This quartz will be processed in the plant to produce a high quality quartz product for use in the manufacture of specialty products, including glass. The flotation process will remove residual iron and other impurities. Bench scale testing was conducted at the Minerals Research Laboratory associated with North Carolina State University in Asheville, North Carolina. This testing concluded quartz will meet high purity requirements suitable for value added quartz markets.

Crushed quartz will be processed at approximately 20 tonnes/hour (t/h) to produce 16 t/h of product and 4 t/h of quartz fines, containing those materials removed from the ore. The fines will be discharged into the quartz fines storage area. A preliminary list of process reagents and dosages for the processing of quartz is given in Table 3-5. Each of these reagents is commonly used for the beneficiation of ores by froth flotation to separate economic from the non-economic fractions. Approximately 90 percent by weight (wt%) of the surface active organic reagents will adsorb onto the quartz solids to enable froth flotation; the remaining 10 wt% will enter the water phase. All reagents will be stored, handled, and disposed of in accordance with applicable regulatory requirements. The reagent materials will be kept in secured areas within the quartz processing plant.

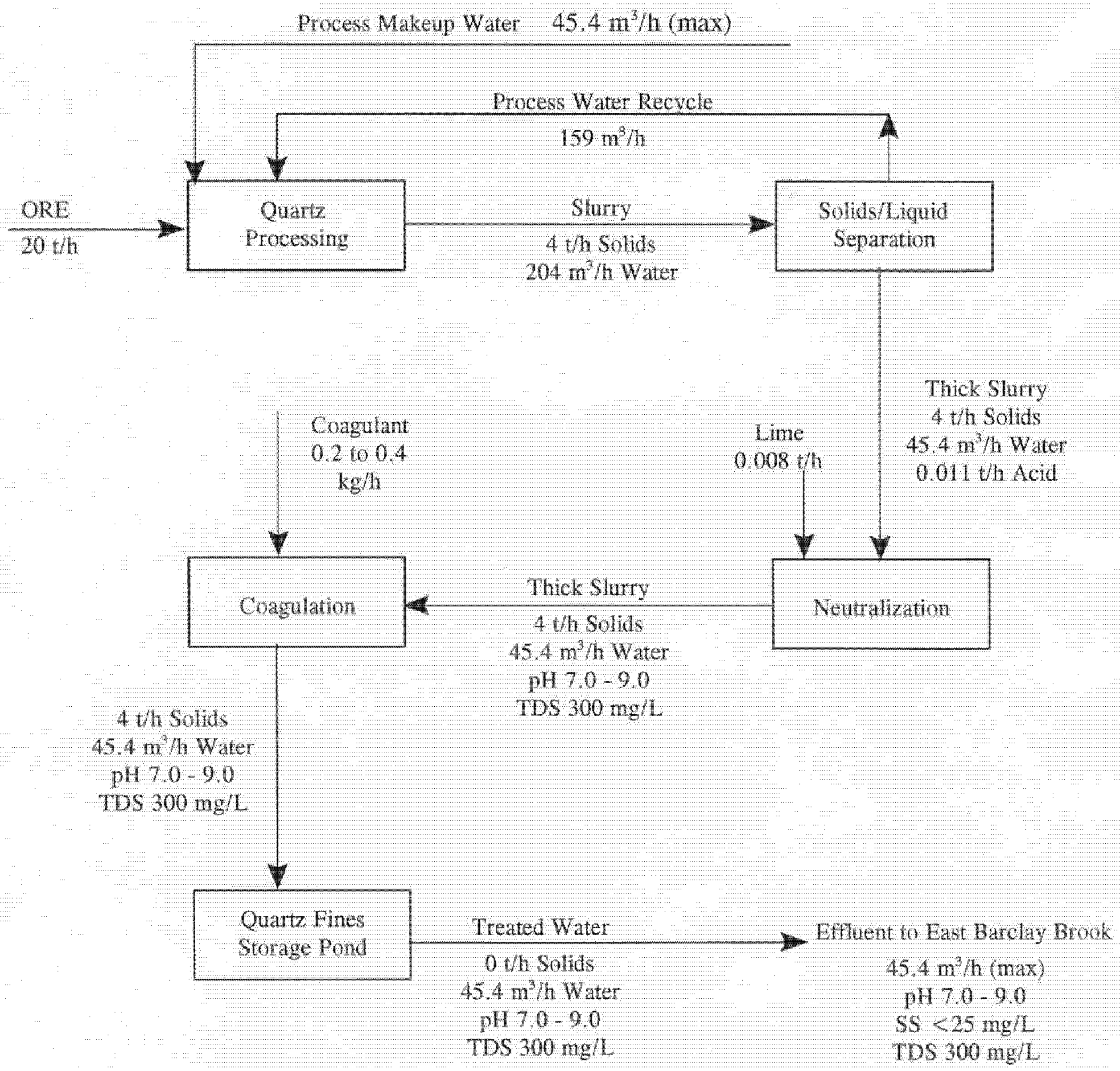
**TABLE 3-5: QUARTZ PROCESSING - REAGENTS AND DOSAGES**

| Reagent | Dosage kg/t of ore |
|---|---|
| Sulphuric Acid | 0.5 |
| Hydrochloric Acid | 1.5 |
| Caustic Soda | 0.1 |
| Hydrated Lime | 0.4 |
| Petroleum Sulfonate | 1 |
| Acetate Amine | 0.4 |
| Methylisobutal Carbinol | 0.05 |

The plant will generate approximately 204 $m^3$/h of process effluent containing 4 t of fine sand - size quartz. The preliminary flow diagram for the treatment of this process effluent is shown in Figure 3-8. The slurry (mixture of solids and liquids) will be discharged into a clarifier/thickener for the removal of solids to produce water for recycle to the process. Approximately 159 $m^3$/h of the water will be recycled from the clarifier/thickener to the process plant. The remaining 45.4 $m^3$/h of thickened slurry (i.e. at approximately 8 wt% solids content) will be neutralized by the addition of hydrated lime, in at least two neutralization tanks in series. A selected coagulant will be metered into the discharge from the neutralization tanks to enhance the removal of colloidal solids. The neutralized slurry will then be discharged into the quartz fines storage pond for the removal of solids and stabilization (oxidation) of the organic reagent residuals. The treated water will be discharged from the quartz fines storage area as effluent.

A storm runoff capacity of approximately 2500 $m^3$ will be provided for the 2 ha site by surge capacity in the quartz fines storage area. This will enable containment of runoff and direct precipitation from the design storm event (i.e. 1:25 year) of 127 mm.

**Figure 3-8**
**Flow Diagram - Solids/Process Water Management**
**Quartz Processing Plant**




Note: Acid is t/h as $CaCO_3$

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### 3.4.5 Construction Sequence

Sediment control fences will be installed at appropriate locations in conjunction with the start of construction work. The water collection and sedimentation system will be constructed to ensure control of surface drainage quality throughout the development and operating phases of the mining operation. The holding and sedimentation ponds, and the coagulation system will be installed prior to the construction of collection channels.

### 3.4.6 Design Standards

All drainage channels will be designed to maintain stable conditions to minimize erosion for the estimated peak flowrates of storm drainage. Channels with unstable slopes will be rip-rapped to minimize erosion. All side-slopes will be stabilized with vegetation as appropriate. Similarly, all berms for the sedimentation ponds will be designed to ensure stable slopes and vegetated or rip-rapped, as appropriate, to minimize erosion. Each of the ponds will be equipped with an overflow structure. Each overflow structure will have a baffle to enable the collection and periodic removal (i.e. skimming) of any floating substances such as leaves or other organic debris. The coagulant addition and metering system will be located within a heated shelter.

### 3.4.7 Water Supply

Based on the information given in Figure 3-5, the annual requirements for water will be approximately 17,000 $m^3$, for quartz crushing operations on the north side of Highway 203, and 114,000 $m^3$ for operation of the quartz processing plant on the south side of Highway 203. Ongoing test work indicates that the annual volume of water for operation of the quartz processing plant may be less than currently indicated.

An assessment of precipitation data for the Yarmouth climate station indicates that the annual yield of water, as surface runoff from the active mining and associated areas (approximately 17 ha), will be in the order of 124,000 $m^3$ (source: Environment Canada, Atmospheric Environment Service, “Climate Normals for the Yarmouth Climate Station”, from 1940 to 1990). Hence, surface water to be collected at the site has the potential to meet 95% of the expected annual water requirements for the mining and quartz processing operations (131,000 $m^3$). The remaining 5% (7,000 $m^3$) can be supplied from groundwater entering the pit with no additional effects.

A water storage reservoir will be required to capture runoff from periods of precipitation and snow melt. The greater the water requirements, the greater the required capacity of a storage reservoir. A summary of water requirements and estimated reservoir capacities is given in Table 3-6. Reservoir capacities were estimated from annual mass curves for water supply and water use. The water supply mass curves were developed from long term monthly precipitation data for the Yarmouth climate station, with allowances for infiltration and evaporation/transpiration. The mass curves for water use were developed from the estimated monthly operating hours for the mining operation.

Initially, a water reservoir capacity of approximately 6000 $m^3$ will be provided by an allowance for this volume within the storm water holding pond. This will provide a reliable water supply for the crushing and classification operations. A need for increased capacity, due to installation of the quartz processing plant, will be provided by water storage capacity (46000 $m^3$, Table 3-6) available within the quartz fines storage area.

**TABLE 3-6: WHITE ROCK PROJECT**
**WATER SUPPLY - USE OF SURFACE RUNOFF FROM MINE SITE**

| Source of Water Demand (Figure 3-5) | Flow Diagram Stream Number (Figure 3-5) | Water Demand per Hour of Operation (Figure 3-5) | Typical Operating Hours per Day | Peak Daily Water Demand | Operating Hours per Year (Figure 3-5) | Annual Water Demand | Water Supply Source | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Surface Water From Site | Groundwater From Site | Water Storage Reservoir Capacity |
| | | $m^3/h$ | h/d | $m^3/d$ | h | $m^3/a$ | $m^3/a$ | $m^3/a$ | $m^3$ |
| Crushing/Dust Control | 9 | 2.3 | 10 | 23 | 1300 | 2990 | -- | -- | -- |
| Classification/Washing | 12 | 13.6 | 10 | 136 | 1000 | 13600 | -- | -- | -- |
| Total for North Side Operations | 9+12 | 15.9 | -- | 159 | -- | 17000 | 17000 | 0 | 6000 |
| Quartz Processing | 15 | 45.4 | 24 | 1090 | 2500 | 114000 | -- | -- | -- |
| Total for North Side and South Side Operations | 9+12+15 | 61.3 | -- | 1250 | – | 131000 | 124000 | 7000 | 46000 |

**Notes:** $m^3/h$ cubic metres per hour
h/d hours per day
$m^3/a$ cubic metres per annum