# 3.9. CASE STUDY - VOISEY'S BAY

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Voisey's Bay
Mine/Mill Project
PROJECT DESCRIPTION REPORT
Voisey's Bay Nickel Company Ltd.
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## EXECUTIVE SUMMARY

Voisey's Bay Nickel Company Ltd. (VBNC) is proposing to develop a nickel-copper-cobalt mine and mill (the "project") at Voisey's Bay, Labrador. The indicated mineral resource has been estimated at approximately 150 million tonnes. The life of the project is expected to be longer than 20 years. It is envisioned that approximately 500 persons will be employed throughout the operational life of the project.

The project is located in northern Labrador, 35 km southwest of Nain and 79 km northwest of Utshimassits (Davis Inlet). It is within an area subject to on-going aboriginal land rights negotiations. The climate is subarctic with short summers and long winters. The surrounding terrain is rugged, with elevations ranging to 400 m above sea level. Most of the project area is located in a sheltered north-south oriented valley connecting Anaktalak Bay, to the north, with Voisey's Bay to the south. The valley is largely forested, while upland areas consist predominantly of barren rock.

The project includes open pit and underground rnining operations, the construction and/or operation of storage and disposal areas for waste rock and overburden, site roads, an airstrip, a concentrator, a tailings impoundment area, an accommodations and services complex, a port site, maintenance and storage areas, a sewage treatment system, a power supply and distribution system and a water supply and distribution system. The ore deposit will be mined by conventional open pit and underground mining. The ore will be processed to nickel-cobalt and copper concentrates using conventional milling processes. The concentrate will be shipped to a smelter off site.

The project will be constructed and operated to manage environmental effects. Mine waste will be managed to minimize Acid Rock Drainage (ARD). The site will be reclaimed progressively during operations and upon cessation of the project.

VBNC has been conducting environmental baseline studies in anticipation of the requirement for an environmental assessment pursuant to the current statutory obligations.

This document has been prepared to support a referral by the federal Department of Fisheries and Oceans (DFO) to the Minister of Environment for the purpose of initiating the environmental assessment process. It has been anticipated that the DFO will be the Responsible Authority pursuant to CEAA and provisions under the Fisheries Act, due to the loss of aquatic habitat resulting from the infilling of the tailings basin and deposition of potentially acid generating rock under water. VBNC is fully prepared and committed to conduct a complete environmental assessment of the project.

The project has been subject to significant public interest, therefore, it is expected that it will be referred to the public hearing process.

### Location and Overview of Project

The proposed project site is located in northern Labrador, approximately 35 km southwest of the community of Nain, and approximately 79 km northwest of Utshimassits (Davis Inlet) and 330 km north-northwest of Happy Valley-Goose Bay (Figure 1). The project site is within an area subject to on-going aboriginal land rights negotiations.

The proven ore body is a massive sulphide mineral deposit containing nickel, copper and cobalt, with a total potential mineral resource from all sources of approximately 150 million tonns. The deposit consists of three ore reserves known as the Ovoid, the Eastern Deeps, and the Western Extension. The Ovoid will be mined using open pit techniques. The Western Extension and Eastern Deeps will be mined by underground techniques. Exploration will continue throughout the life of the mine.

The major elements of the project are:

- open pit and underground mining facilities;
- mine waste rock storage and disposal areas;
- water diversion and drainage systems;
- concentrator;
- tailings facility;
- tailings and water reclaim recycle systems;
- permanent site roads;
- permanent airstrip;
- port site (shipping dock, concentrate storage building);
- fire-protection and potable water systems;
- diesel power plant and power distribution system; and
- accommodations and service complex; and 1 communications system.

The open pit will be mined using conventional methods. The waste rock will be stored near the open pit, or under a water cover, depending on its potential to generate acid. An estimated 13.7 million tonnes of overburden will be removed and stored near the open pit. Approximately 20.5 million tonnes of non-acid generating waste rock will be stored in surface facilities; 1 million tonnes is categorized as mineralized (i.e., potentially acid generating) and will be placed under a water cover.

**Project Description**

Underground deposits will be mined by blasting, followed by load-haul-dump operations. Approximately 15.5 million tonnes of waste rock from the underground mine will be produced. Fifteen million tomes is considered potentially acid generating and will be placed under water cover, whereas the remaining 0.5 million tonnes will be stored above ground.

Ore will be transported to the concentrator, and processed into nickel-cobalt and copper concentrates using crushing, grinding, and differential froth flotation processes. The concentrator will be designed based on an initial production rate of 15,000 tonnes per day of ore. Concentrates will be transported to storage facilities at the port site at Anaktalak Bay and shipped for smelting.

The tailings produced during the concentrating process are potentially acid-generating and will be disposed under a permanent water cover to inhibit acid generation and leaching of metals. The preferred tailings basin site is a pond approximately 12 km northeast of the plant site. It has sufficient capacity to accommodate the tailings associated with the projected mineral resource. Decant water will be reclaimed, and excess water treated before discharge into Kangeklualuk Bay.

Potable and fire-fighting water will be obtained from groundwater wells in the Reid Brook basin. Power will be supplied by diesel power generation units. The airstrip will be located north of Camp Pond.

Approximately 700 persons will be employed during project construction, and an estimated 500 during operations. The expected life of the project is longer than 20 years. Workers will be transported to the site by air. Living accommodations will be provided on-site. No town site is planned.

Upon cessation of operations, the site will be decommissioned and reclaimed to approach predevelopment conditions. Decommissioning and reclamation will be undertaken following environmental management practices established by industry and government.

The proposed project is described to the extent it can be defined at the current stage of development. Exploration is ongoing and results to date have been very successful, so that the proven reserves may be expected to increase. This could affect the rate of production, the location of proposed mining infrastructure, and the life of the operation. Ongoing feasibility and design efforts will result in refinements of project features.

**Environmental Setting**

Most of the project area is located in a sheltered north-south oriented valley connecting Anaktalak Bay with Voisey's Bay. The surrounding terrain is tugged, with elevations ranging to 400 m above sea level. The project is within an area of overlapping land claims by the Inuit and Innu. The Voisey's Bay area is used by both the Innu and the Inuit for hunting, trapping, fishing and the collection of wood. The nearest communities are Nain (35 km northeast) and Utshimassits (79 km southeast).

VBNC has conducted environmental baseline studies in the Voisey's Bay area since 1995. The results of the 1996 environmental baseline program are not available. The project area is described using the results of the 1995 field studies and review of the literature.

Atmospheric Environment

The climate of the project area is subarctic, with short summers and long winters. Temperatures and rainfall in the project area are typical for the north coast of Labrador. The mean annual temperature is -3°C, ranging from a mean monthly temperature of -19°C in January to 10.2°C in July and August. The average mean annual precipitation for Voisey's Bay is 920 mm. Wind patterns are consistent with a coastal climate for the north coast of Labrador, with predominantly west and northwest winds. The highest wind speeds occur in the winter, with mean hourly speeds of 23 to 25 km/hr.

Terrestrial Environment

Terrestrial studies have been conducted in the project area Surveys include caribou, furbearers, avifauna black bear, soils and vegetation chemistry, and ecological land classification. The project area is located on the boundary of the High Subarctic Tundra and the Coastal Barrens land regions. Local physiography consists of low lying vegetated valleys, and uplands with exposed bedrock and little or no vegetation. Discontinuous, or isolated, patches of permafrost occur in the project area

Dominant woody species include fir, spruce, and birch, which are found in association with dwarf shrub, lichen, and sphagnum. The dominant plant community on the upper slopes is alpine heath. Alder thickets are found on scree slopes and the top of Discovery Hill. Several wetland plant communities occur in the project area. Bogs and fens are the most common and are found south of Discovery Hill. Swamps are found throughout the project area along streams and rivers. Salt marshes are found at Voisey's Bay and Anaktalak Bay.

Wildlife species occurring in the Voisey's Bay area of coastal Labrador are typical of northern coastal, sub-arctic and boreal habitats. The lower vegetated slopes of river valleys provide shelter and food for furbearing mammals, small mammals, moose, caribou, raptors, and songbirds. The upper slopes provide habitat for caribou, game birds, and some raptors. Ponds and streams support waterfowl and furbearing mammals, whereas the coast provides habitat for shorebirds and seabirds. Wolves and black bears occur throughout the project area

During summer, there is a wide variety of birds occurring and breeding throughout the project area In the spring and fall, staging and migratory concentrations of birds occur along the coast line and offshore islands where estuaries and protected areas provide suitable habitat for feeding, molting and staging. Raptors, waterfowl, terrestrial birds, shorebirds and seabirds occur in the area.

Freshwater Environment

Freshwater studies have focused on Reid Brook, its tributaries, pond and stream systems related to proposed tailings basin sites, and the unnamed brook draining into Analctiak Bay. The two largest drainage systems in the project area are the Reid Brook and the Kogluktokoluk Brook systems. The project area primarily drains to Voisey's Bay through Reid Brook. Water also drains to Anaktalak Bay through an unnamed brook. Several eastern ponds drain into Kangeklualuk Bay. Groundwater generally occurs near the surface in low-lying areas, and within unconsolidated material and bedrock.

The local hydrologic regime is dominated by a single long peak in the spring, followed by average flows through the summer and early fall until freeze-up in November. Minimum flows occur in March (10% of mean annual flow), whereas peak flows occur in June (400% of mean annual flow). Freeze-up can occur in October and last until June. Preliminary water quality analyses indicate that the streams and ponds in the project area are relatively pristine with low levels of nutrients.

The streams that were surveyed provide a range of fish habitat types, with good rearing and limited spawning habitat available. Pools, riffles, and steadies are the predominant fish habitat types, with some low-grade rapids and falls.

Fish habitat suitability varies throughout the streams in the project area Although there is potential habitat for limited salmonid spawning in Reid Brook, there was no evidence of egg deposition or salmon-type redds. Brook trout, Arctic char, and lake trout were also collected in the Reid Brook system; brook trout were collected in the unnamed brook and Camp Pond. The presence of Atlantic salmon, nine spine stickleback, and lake and round whitefish have been reported (in existing literature) in the vicinity of the project.

Substrate types are diverse and consist of cobble, boulder, sand, gravel, sand/clay, silty sand, silt/clay, and sand with boulders. The banks of Reid Brook are predominantly sand and clay; are vegetated along gentle slopes, and bare along steep slopes. Where Reid Brook flows through wetlands, its banks are predominantly peat material. The banks of the unnamed brook are predominantly silty sand, cobble and boulder. and are vegetated.

Marine Environment

Water, sediment, plankton, and benthic samples were collected in Anaktalak, Voisey's, Kangeklualuk, and Nain Bays; intertidal/subtidal studies focused on Anaktalak Bay. The intertidal beach of Anaktalak Bay ranges from 20 to nearly 200 m wide. Intertidal habitat includes predominantly sandy sediment, with some cobble and boulder. Intertidal flora and fauna are sparse, being mostly restricted to hard substrates. The subtidal substrate consists of fine sandlsilt, pea gravels, dead mussel and clam shells, and clay.

The marine habitat near Edward's Cove, Anaktalak Bay, supports a small number of fish including shellfish, sculpins, banded gunnels, winter flounder, Greenland cod and Arctic shannies, and marine plant species. Numbers of individuals are low, and the local stocks do not contribute to any subsistence or commercial fishery. Although the fishery in the Nain area exploits Arctic char, Atlantic salmon, brook trout, and Atlantic cod, none of these species were observed or collected from Anaktalak Bay.

Marine mammals that are harvested locally and may occur in the project area include ringed, harp, harbour, and gray seals, beluga whales, minke whales, and dolphins. Numerous

seals were observed in Anaktalak Bay. Other marine mammal species that may occur in the region are humpback and right whales, harbour porpoise, killer whale, walrus, narwhal, and sperm whale.

The ice climate near the project area is typical for the north coast of Labrador. Landfast sea ice begins to develop in November and gradually extends seaward to the outer edge of the offshore islands as the winter progresses. The mean fast ice thickness for the region peaks at 1.07 m in late April; the maximum thickness typically peaks at 1.35 m in early May. Freshwater ice in the ponds at the project area will have about the same or slightly greater ice thickness.

Historic Resources

An initial Stage 1 Historic Resources Overview Assessment was conducted in 1995; the Voisey's Bay region had not been intensively surveyed prior to the 1995 assessment undertaken for VBNC. Twenty-six archaeological and six ethnographic sites were located in coastal, or formerly coastal areas. Archaeological studies for 1996 have focused on exploration sites, proposed project development (infrastructure) areas and regional sites.

Archaeological results substantiate the historic use of coastal resources at Voisey's Bay and Anaktalak Bay, winter travel through the Reid Brook Valley, hunting, fishing, trapping and limited habitation in the interior.

Socioeconomic Environment

The communities along the north coast of Labrador are of predominantly aboriginal composition. The majority of residents of Nain, the closest community, are Inuit. Other smaller communities to the south consist of Innu, Inuit and non-aboriginal residents. The languages most commonly used in Nain and Hopedale are English and Inuktitut whereas the majority of residents in Utshimassits consider Innu-aimun as their native language.

The Innu and Inuit have traditionally used the Voisey's Bay area for fishing, hunting, trapping, gathering activities and burial sites. While resource harvesting activities may provide food and a source of income, these activities have a cultural and spiritual significance and are an essential aspect of their way of life. Fishing occurs in Voisey's Bay. Small game hunting is conducted north and west of the Bay during the fall, winter and spring. Seals are hunted throughout the Bay during the spring and fall. The surrounding shores are used for waterfowl hunting during the fall and wood harvesting at various times during the year

**Exploration and Indicated Resources**

The original mineral discovery at Voisey's Bay was made in late 1993 by Archean Resources Ltd. while conducting a regional exploration program under contract to Diamond Fields Resources Inc. (DFR). The property was staked in early 1994 after surface samples from a gossan returned anomalously high copper and nickel values. Exploration drilling is continuing throughout the property to further delineate the resource.

Exploration History and Status

Geophysical surveys at Voisey's Bay delineated a large, strongly conductive zone which was drill tested by Archean Resources Ltd. in late 1994. Four holes totaling 415 m were drilled, one of which included a massive sulphide intercept of 33 m. The original property consisting of 288 claims expanded to 1,978 claims in the fall of 1994. This staking targeted surrounding areas with a similar geologic setting. VBNC is the registered holder of these claims. The property covers an area of approximately 49,450 hectares or 495 km2. On January 15, 1996, VBNC registered a proposal to develop advanced exploration infrastructure at the Voisey's Bay site in

accordance with the Newfoundland Environmental Assessment Act. The registration document The Voisey's Bay Mineral Development Advanced Exploration Infrastructure Registration has been withdrawn. Exploration is continuing to define the geometry, extent, and nature of mineralization in the Voisey's Bay discovery area The average number of on-site personnel has been approximately 200. As of September, 1996, 11 drill rigs were being used at the site. About 340 diamond drill holes have been completed, with a total drilling meterage of about 135,000 m. Environmental protection measures that have been in place during exploration include the preparation and implementation of an Environmental Protection Plan (EPP). The EPP outlines the procedures to be used for carrying out site activities, and is designed to be revised as required. The company has also prepared a drilling log form which includes pre and post-operational inspections of active drill sites. Exploration at the project site will continue throughout the life of the mine to delineate and define reserves. For example, during the next four years VBNC proposes to spend an estimated $20 million on exploration activity. This activity is required to identify additional mineral resources, define ore zones, continue regional exploration, help determine mining methods, and characterize waste rock and ore. VBNC will obtain the appropriate exploration permits and approvals.

## Regional Geology

A contact zone running north-north-east through the Voisey's Bay discovery gossan marks the suture along which two continents collided over 1,800 million years ago. Rocks of the Archean Nain Province lie to the east of the suture and Paleoproterozoic rocks of the Churchill Province lie to the west. The suture zone was intruded by massive volumes of magma between 1,350 and 1,290 million years ago. These intrusions are collectively called the Nain Plutonic Suite which is an assemblage of igneous rocks with compositions ranging from felsic to mafic. Granite (felsic), anorthosite, diorite and troctolite (mafic) are the predominant rock types. The Voisey's Bay ore mineralization is hosted within troctolite intrusions. The Nain Plutonic Suite has a surface expression 275 km long in the north-south direction and 100km wide in the east-west direction.

The Reid Brook intrusion is a layered intrusive complex contained within the Nain Plutonic Suite. The intrusion is composed of predominantly mafic lithologies which are believed to have been emplaced at depths of 6 km to 15 km.

The Voisey's Bay deposits occur in two main environments within the Reid Brook intrusion. The Ovoid and the Westem Extension are hosted by a troctolite dyke (or sheet) whereas the Eastem Deeps mineralization occurs at the focus or entry line between the troctolite dyke and the main body of the troctolite intrusion. Thus the dyke is believed to represent part of the feeder system for the Reid Brook intrusion, suggesting that other mineralized feeder/conduits may be present.

Regional exploration is being conducted by Archean Resources Ltd. for VBNC at Nain Bay South, Nain Bay Islands, Newark Island, Kiglapait South, and Kiglapait North.

## Ore Body Geology and Indicated Resources

The proven ore body is a massive sulphide mineral deposit containing nickel, copper and cobalt, with a total indicated mineral resource from all sources of approximately 150 million tonnes. The deposit consists of three ore reserves known as the Ovoid, the Eastern Deeps, and the Western Extension. The geology surrounding the ore reserves is illustrated in an interpretive, longitudinal section in Figure 2.

The principal sulphide minerals in the ore zone are pyrrhotite (iron sulphide), chalcopyrite (copper-iron sulphide), and pentlandite (iron-nickel sulphide also consisting cobalt). Sulphide content in the troctolite ranges from absent to massive. The strongly disseminated to semimassive zones consist principally of pyrrhotite, pentlandite, chalcopyrite with plagiozlase,

olivine and accessory pyroxene, biotite, very little hornblende and iron/titanium oxides (ilmenite). The massive sulphide zones contain over 95% coarsely crystalline sulphide. The mineralization in the massive zone is predominately composed of pyrrhotite, pentlandite, chalcopyrite and magnetite.

The Ovoid ore reserve is a bowl-shaped deposit which measures 500 m by 250 m and is over 100 m thick at the centre. The deposit ranges from about 15 to 30 m below the surface. The Ovoid is composed almost entirely of coarsely crystalline massive sulphide minerals. The Ovoid is believed to represent a depression on the bottom of a troctolite sheet, where sulphide magma settled during the emplacement of the troctolite.

The Eastern Deeps deposit is situated southeast of the Ovoid. The deposit is lenticular in shape and lies at the base of a large troctolitic intrusion. The ore zone occurs as an upper disseminated sulphide zone and a basal massive sulphide zone. Drilling results indicate that the ore zone ranges from about 500 to 950 m below the surface. The deposit is approximately 1500 m long, 100-200 m wide and 50-100 m thick.

The Western Extension is situated west of the Ovoid. The ore occurs as thin lenses of massive sulphide in a narrow sheet of steeply dipping host troctolite. Drilling results indicate the ore zone ranges from about 200-500 m in depth. The mineralized zone is approximately 1600 m long, 50 m wide, and 20-70 m thick.

Currently, the amount of proven reserves is 32 million tonnes, the indicated resource is 118 million tonnes, and the total potential resource is 150 million tonnes.

Exploration Infrastructure

The existing infrastructure at Voisey's Bay consists of the Voisey's Bay Camp, located southwest of Carnp Pond, and the Anaktalak Bay Camp, located at Edward's Cove at Anaktalak Bay. The Voisey's Bay Camp, which supports drilling operations, includes a dining facility, warehouse, generator facility, sleeping tents, administration offices, a drill maintenance/supply facility, core shack, helicopter landing pads, a dock, nursing station, fire station, a washroom facility and fuel/propane storage. Water is supplied to the camp from a drilled well. Propane is contained in steel cylinders at both camps. Other fuel (including gasoline for small engines, diesel for electric generators and heating oil for tent stoves) is stored in 205 L drums which have been placed on large platforms and contained within inflatable, impervious dykes. Solid waste is burned two to three times a week in an approved incinerator and ash is flown to the municipal landfill site in Nain periodically. The solid waste is stored in a bear-proof bin adjacent to the cookhouse between burning periods.

The Anaktalak Bay Camp consists of a series of interconnected trailers forming a single enclosed structure. The site is equipped with a water supply from a drilled well, a water treatment facility, and a sewage treatment plant and tile field. Solid waste is burned daily. Non-combustible solid waste and ash from the incinerator are flown to Nain periodically for disposal. Up to 11 helicopters have operated out of the camp and provided transportation to and from the site for both persons and supplies as well as transportation within the project area Helicopter fueling takes place from bulk storage facilities at the Anaktalak Bay Camp. Other camp features include storage buildings for equipment, a garage, an office trailer, a bulk fuel storage area (ten 71,000 L self contained dyked tanks), helicopter pads for refueling, a heliport, and storage for oil spill response equipment. Construction equipment stored at this location includes a loader, an excavator, a pickup and an all terrain vehicle (ATV).

In the summer of 1996, the Sir John Franklin (an icebreaker) was moored in Anaktalak Bay. This vessel provides temporary accommodation and office space for environmental and engineering field staff.

## Planning and Environmental Management

VBNC is committed to the concept of sustainable development, and to minimize any potentially adverse impact of its operations on the environment. Technically proven and economically feasible protective measures will be implemented throughout exploration, mining, processing, manufacturing and decommissioning phases of the proposed project.

### Corporate Rationale

VBNC is proposing to develop an economically significant nickel, copper and cobalt mine at Voisey's Bay. The Project will generate considerable economic benefits for the local and provincial economies of Newfoundland and Labrador and a sound financial return for Inco's shareholders, assuming positive conclusions from the feasibility study

For the people of Newfoundland and Labrador, the Project's development will result in increased training and employment opportunities and associated wages and benefits. It will also contribute to a growth in business opportunities arising from the increased demand for goods and services which will ultimately help to attract new investment into the Province. For Inco's shareholders, the Voisey's Bay Project will satisfy its corporate objective of growing with the nickel market by substituting company-owned Voisey's Bay nickel for nickel currently purchased world-wide from non-Inco sources at little to no profit.

The demand for base metals is cyclical, being driven largely by the level of industrial production in the developed and newly developing economies of Asia In 1995, Inco produced 400 million pounds of nickel and purchased an additional 200 million pounds to supply the company's customers. By the end of year 2000, annual production is expected to increase to 750 million lbs. Voisey's Bay will eventually account for 270 million lbs. of that output.

### Environmental Management

VBNC is committed to the concept of sustainable development, which requires balancing the need for economic growth with good stewardship in the protection of human health and the natural environment. VBNC will strive to minimize any potentially adverse impact of its operations and products on its employees, customers, the general public and the natural environment. VBNC will seek not only to meet but, if possible, surpass standards set by relevant legislation, by diligent application of technically proven and economically feasible protective measures throughout exploration, mining, processing, manufacturing and decommissioning phases of its operations.

VBNC will assess, plan, construct, operate and decommission projects or facilities in compliance with all applicable legislation. In the absence of legislation, VBNC will apply cost-effective best management practices to advance environmental protection and to minimize risks to health and safety and the environment. VBNC will assist government and the public in the development of equitable, cost-effective, and realistic laws for the protection of the environment and the enhancement of occupational health and safety.

VBNC will establish a program to review environmental performance. Monitoring programs will be developed to evaluate operational risks to human health and safety and the environment. Sound risk management principles will be applied to ensure compliance with relevant requirements of government, the company, and local residents.

Scientific knowledge and technologies will be used to continuously improve the safe, efficient use of processes and products. VBNC will encourage all employees to continuously improve the workplace and minimize negative impacts on the natural environment. Training sessions will be made available for all employees with respect to VBNC's environmental policy, the Environmental Management Plan (EMP), the Environmental Protection Plan, the Oil Pollution Emergency Plan and other relevant environmental protection measures.

## Public Consultation

VBNC has provided project information to the Innu Nation, Labrador Inuit Association (LIA), federal, provincial and municipal governments and residents of Labrador and Newfoundland throughout the development of the Voisey's Bay mine and mill proposal. Consultation has taken place through open houses, workshops and meetings.

Two workshops focusing on 1996 environmental baseline studies were held in St. John's and Goose Bay in May 1996. Federal and provincial officials and members of the Innu Nation and LIA attended the workshops.

VBNC held a series of open houses to discuss ongoing exploration and project development issues. VBNC visited Nain, Hopedale, Postville and Makkovik in July 1996. Open houses were held in Rigolet and Goose Bay in August. A total of 208 people attended the open houses and 43 issues surveys were completed and returned.

VBNC will continue to provide information to the public during its ongoing exploration and project planning. Information exchanged during such initiatives will assist issues scoping and project decision making.

The Voisey's Bay Camp and proposed plant site, and Anaktalak Bay Camp are located in flat areas adjacent to water for access and safety reasons. Water provides plane access at both camps and for fire-fighting purposes should the need arise.

Local physiography precludes the use of certain sites in the area. The selection of a port site requires a deep water harbour. Kangeklualuk Bay is not a feasible site due to its relatively shallow depth and narrow channel width.

## Transportation

Transportation of concentrate, supplies and mine personnel to and from the site will be by air or sea Ore and waste rock will be transported from mining operations to the mill and storage facilities. Concentrates will be transported to the port site, where they will be shipped off site for further processing. Marine shipping is the most economical means of transporting large volumes of concentrate.

Mine employees and camp supplies will be transported to the site by regularly scheduled charter aircraft. Employees will be flown to and from a number of communities in Labrador.

## Shipping

To date, three shipping routes are being considered to ensure the passage of bulk carriers between the outer islands of the Labrador coast and the proposed port site at Edward's Cove. The potential northern route follows a portion of "the Strathcona Run", the existing shipping route to Nain. Criteria for route selection include water depth, channel width, and alignment of shoals. Helicopter reconnaissance and aerial photography have been completed for the three routes. Detailed bathymetry and soundings will be completed by the end of 1996 for the Northern Route, with the remainder to be completed in 1997.

Three shipping season options are being considered. Seasonal shipping would consist of shipping during the ice-free season. Extended shipping would enable shipping to continue during early ice formation and during ice break-up. Year-round shipping would involve continuous shipping throughout the ice season. VBNC would prefer to ship concentrate during the greatest number of months possible. However, VBNC acknowledges the importance of ice for winter travel, habitat, and harvesting and will continue to consult with local residents and government regulators regarding an appropriate shipping season.

Power Generation

There is no transmission line grid or proximate hydroelectric source servicing the Voisey's Bay area. Consequently, on-site diesel power generation is the most feasible power supply for the project. On-site diesel power generation will provide a reliable and continuous source of electricity.

Tailings Management

Tailings management will be undertaken in the most environmentally sound and technically feasible manner. On-land and submarine tailings disposal options have been considered. However, there are associated legislative constraints with submarine disposal, and it is therefore not considered suitable for this project. The selection of a single on-land facility is preferred.

The initial phase of the tailings basin site selection process involved the establishment of the significant siting criteria/constraints. These criteria have been identified as being critical with respect to mitigating the environmental risk associated with the construction, operation and decommissioning of the tailings basin. In summary, these criteria include:

- avoidance of the Reid Brook watershed;
- submerged tailings deposition and permanent water cover;
- large storage capacity/expansion capabilities;
- minimal overall environmental impact;
- no impact on potential ore bodies;
- good topographic and hydrogeological containment, safe simple closure to ensure future integrity;
- cost-effective design, construction, operation, and decommissioning;
- aesthetically acceptable location; and
- receipt of regulatory approval without significant delays to the overall project.

Eight on-land candidate sites were identified which satisfy these criteria (Figure 3). Sites 4, 5, 7, and 8 have sufficient capacity to contain the tailings without excessive dam construction. Based on engineering and environmental considerations, Sites 4 and 5 are considered to be more suitable with Site 4 identified as the preferred site for tailings disposal.

In summary, the following characteristics represent the principle advantages of Site 4:

- excellent topographic containment (seepage will be confined to a small discharge area);
- no discharges to the Reid Brook/Voisey's Bay system;
- very large storage capacity/dam volume ratio-resulting in relatively small dam construction;
- excellent potential for expansion with similar storage capacity/dam volume ratio;
- inherently safe closure because of good topographic containment and small dams; and
- ample room to incorporate additional freeboard to handle unforeseen events during operation and closure.

Mineralized Waste Rock Management

Current estimates indicate that approximately 16 million tonnes of potentially acid generating waste rock will be generated. Four alternatives were considered for the submerged disposal of the potentially acid generating waste rock:

- lake deposition;
- submarine disposal;
- flooded valley deposition; and
- temporary stack construction and subsequent disposal in flooded open pit.

The site selection process involved the establishment of significant siting criteria/constraints. These criteria are similar to those outlined above for the tailings basin site selection process. In addition, the following criteria have also been identified as being critical with respect to monitoring the environmental risk associated with the construction, operation and decommissioning of the mineralized waste rock disposal facility:

- disposal facility locations should be close to the open pit to minimize haul distances;
- the area disturbed by mining operations should be minimized; and
- the disposal facility must be developed within the controlled mine drainage areas.

Submarine and flooded valley disposal have been rejected. Submarine disposal of mine waste rock in Anaktalak Bay was eliminated due to regulatorv constraints. A single flooded valley deposition option outside the Voisey's Bay/Reid Brook watershed was considered. However, selection of this site would require the construction of a large dam, and, therefore. has also been eliminated.

Mineralized waste rock could be stored in a temporary stack. This facility would allow for the collection and treatment of runoff water during the operating life of the mine, followed by permanent disposal in the flooded open pit.

The lake deposition option was chosen to be the most feasible based on environmental and engineering considerations. Three sites for lake waste rock deposition include:

- disposal in Headwater (Kapashtuetisht) Pond (6 km east of the Ovoid);
- co-disposal within the tailings basin; and
- disposal underwater near the open pit (i.e., Camp Pond).

The preferred site for disposal of mineralized waste rock is Headwater Pond. Although this lake is located within the boundaries of the Reid Brook/Voisey's Bay watershed, the drainage can be redirected eastwards into the Throat Bay or Kangeklualuk Bay drainage systems. Preliminary bathymetric surveys indicate that the lake is deep (in excess of 30 m) and has a natural volume of some 14 million m3. The lake is principally bounded by bedrock, including steep ridges to the north and south. The mine waste rock would be placed in Headwater Pond from a haul road developed along the northern shore.

The co-disposal of waste rock within the tailings basin has been considered. On the basis of a primary engineering assessment, this basin (Site 4) may have a limited capacity (>10 million tonnes) for waste rock.

Mineralized waste rock could be submerged in the deeper parts of a bermed off area of Camp Pond. The southern section of Camp Pond could be separated from the main pond by means of a dam structure. Based on the present lake elevation, approximately 1 million tonnes of waste rock could be stored at this location.

## Construction

During the construction phase of the mine/mill, project management and administration will occur on site and in Nain, Goose Bay and St. John's. Site roads, the plant site, a port facility, the tailings facility/pipeline, waste rock disposal facilities, and an accommodations and services complex will be constructed during this phase. Stripping and placement of overburden and waste rock at the open pit will also take place during project construction.

## Pre-Stripping-Ovoid

Approximately 10 million tonnes of overburden and 500,000 tonnes of waste rock will have to be removed prior to commencement of operation. An additional 4 million tonnes of overburden will be removed in the first two years of open pit operation. Since the overburden material consists of glacial deposits, blasting will not be required for most of the pre-stripping.

The overburden will be stockpiled at two sites near the open pit. An area immediately south of the pit is proposed to be used for containing the pre-stripping material, and a smaller facility north of the pit will accommodate overburden material removed during pit development. In addition, a small stockpile for peat and organic materials removed from the development area will be established near the south overburden storage facility. This area will be seeded to preserve material if not immediately used. These organic materials will be used for surface preparation in areas to be re-vegetated during reclamation activities.

The south overburden stockpile will be regraded and revegetated early in the mine life when pre-stripping operations have been completed. The overburden material in the north stockpile may be used to regrade and cover other structures during site reclamation.

Runoff from the south overburden storage facility, the peat/organics stockpile, a portion of the open pit perimeter ditch, and the east mine waste rock storage facility will be directed to a sedimentation pond and ultimately, into the Reid Brook system depending on water quality. Runoff from the north overburden storage facility, plant facility, and a portion of the open pit perimeter ditch will be directed to the surge pond. The surge pond will temporarily contain surface run off (storm water) within the area north of the open pit. It will be subsequently directed to either the submerged waste rock disposal facility or into the south sedimentation pond.

## Pits and Quarries

Fill will be obtained from pits and quarries to be developed in the general vicinity of the infrastructural components. Borrow material and quarried rock will be accessed at several sites near the proposed access road and airstrip. A crusher and sorting equipment may be located at the borrow pit near the Anaktalak Bay Camp.

Samples of quarried rock will be removed from each quarry and investigated for acid rock drainage (ARD). If the quarry rock is found to be acid-generating, appropriate control measures for runoff will be implemented. Only non-acid generating rock will be used for construction. VBNC will comply with conditions in the Permit to Quarry from the Newfoundland Department of Mines and Energy.

## Plant Site

The plant site will consist of a concentrator and accommodations/services complex. Several alternatives are currently being considered for the location of the plant site. The preferred location is situated on gently sloping terrain and is bounded by the northeast slope of Discovery Hill, Camp Pond to the south and a stream bed to the north. Other plant site locations being investigated include areas closer to the Eastern Deeps ore body and near Anaktalak Bay.

At the preferred site, geotechnical borehole information indicates that it is in a non-permafrost zone. All plant site structures will be founded either in the dense glacial till zone or bedrock. Shallow foundations will be constructed using rigid insulation and will have an equivalent burial depth of 3 m to satisfy frost penetration criteria.

The accommodations complex will be constructed on a terrace near the concentrator. The terrace will be developed in a cut cross-section. The proposed excavation will be in materials requiring sideslope stabilization and erosion protection measures. The accommodations complex will consist of prefabricated residential modular units.

The services complex and near-by cold storage facility will be constructed of pre-engineered buildings. The services complex will provide facilities for maintenance of the mine and plant mobile equipment, warehousing and other storage, and offices for mine and administration personnel. The plant site will cover an area of five hectares

## Proposed Tailings Basin Facility

The proposed tailings impoundment is located 12 km northeast of the plant site. The construction of the tailings facility will include the following elements:

- construction of the main access road/pipeline from the mine/mill area, and
- construction of dams and secondary access roadways and surface water diversion channels around the tailings facility.

### Roadway/Pipeline Routing Studies

A routing study has been conducted and a suitable route for the roadway/pipeline has been selected.

Engineering design of the pipeline and roadway has not been completed. Typical pipeline and access roadway alignments are designed based on a 10 percent maximum grade. A system for spill protection for the pipeline will be incorporated into the design. The materials for pipeline construction are typically either steel or high density polyethylene. Insulation (heat tracing) for the pipeline is being considered.

### Surface Water Diversion Requirements

The diversion of surface water around the tailings basin is required for the purposes of miring unnecessary water inflow, and minimizing water treatment, while maintaining a suitable water cover.

### Dam Construction Requirements

Eight dams are required for the development of the Phase I tailings basin. All dams are very small structures compared to the large basin capacity. The basin capacity/dam volume storage capacity ratio is about 90:1. Seven of these dams will be earthen structures, whereas one dam is planned to be a low head concrete weir with the emergency spillway over the crest.

### Borrow Materials

Construction materials will be required for road and dam construction. Potentially suitable borrow materials have been identified near the proposed structures. Additional field investigations are currently being conducted.

## Proposed Mineralized Waste Rock Disposal Area

The preferred disposition site for mineralized waste rock is at Headwater Pond, 6 km east of the Ovoid open pit. Roads, dams, and surface water diversions will be required for this facility.

## Project Operation

### Mines

The initial mining will be in the Ovoid using a conventional open pit truck and loader operation. The expected life of the open pit is seven years. The Eastern Deeps and Western Extension ore bodies will be developed as an underground mining operation once the ore from the Ovoid is approaching depletion.

### Open Pit Mining-Ovoid Deposit

The pit optimization design process will determine cutoff grades and mine design. All walls in the pit will be double-benched, with berms typically ranging from 9 m to 10 m in width depending on the wall orientation. Pit ramps will likely be designed to be 25 m wide. This would allow a running surface of 16.5 m, which will accommodate haul trucks, and an additional 8.5 m for the construction of berms and drainage ditches. Grades on ramps will be designed at approximately 10%. Once overburden stripping is completed, the open pit ore will be blasted and then excavated. Ore will be hauled to a primary crusher, and transferred by conveyor to the concentrator. Unmineralized waste rock will be transported to the east mine rock storage facility. Mineralized waste rock will be hauled and deposited under water.

Water will enter the pit from precipitation and groundwater seepage. A pit water management system consisting of collection ditches and sump pumping will be required to ensure unimpeded mining operations year-round. This will be discussed in Section 4.3.6. A system of collection if ditches will be maintained around the pit to prevent flooding of roads, ramps and benches. The ditches will be designed for peak runoff in the spring. All mine water will be either conveyed to the sump and be pumped to a surge pond for treatment and discharge to the concentrator for use as process water, or transferred to the submerged waste rock disposal facility. Batch treatment of water may enable discharge of water to the concentrator. '

The proposed mine plan assumes year-round mining operations with no seasonal shut downs. The mine will operate seven days each week to accommodate a rotating work force associated with a fly-in/fly-out shift schedule. u

### Camp Pond Fish Studies

Camp Pond was surveyed in 1995 and 1996. It is about 12 m deep and has a soft bottom. A gillnetting survey in 1995 indicated that the population was predominately brook trout, with only one Arctic char netted. Data from 1996 collections have not yet been analyzed. Camp Pond Brook (from outflow of Camp Pond to confluence with Reid Brook) provides rearing habitat for salmonids and appeared to be quite productive based on fish observations and sampling.

### Camp Pond Hydrological Studies

Hydrometric data collection stations is located at the southwest end of Camp Pond and in Camp Pond Brook below Carnp Pond. The station at Camp Pond Brook is a water level station; the Camp Pond Brook station monitors streamflow

### Underground Mining

Underground mining techniques will be required to access the Eastem Deeps and Westem Extension. Explosives will be used to blast the ore, which would be excavated by Load, Haul, Dump (LHD) units, crushed and delivered to the surface, then transported to the mill. Waste rock will be produced during construction of the mine shafts and lateral development. The total quantity of waste rock for each ore zone will be less than the quantity produced by the open pit. Many underground mines use a backfill system where a portion of the process plant tailings or waste rock are placed underground to fill mined-out areas. One backfill technique incorporates a "paste" backfill which allows for the disposal of high sulphide tailings as fill. This technique

significantly reduces the total volume of tailings requiring disposal, and will be considered for the underground operations. Planning studies for mine development and tailings management are evaluating scenarios which may use backfilling methods.

Explosives Handling

Facilities for storing the primary blasting agent and mixing the explosives will be provided 2 km away from the plant site along the access road. Magazines for detonating caps, blast hole primers and explosives for secondary blasting will be located approximately 800 m southeast of the pit. Three months inventory will be kept on site.

Process Reagents

Process reagents will be received and stored in an outdoor laydown area adjacent to the concentrator. Mixing and holding facilities will be inside the concentrator building. Chemical reagents will be used in the process plant to control pH and to cause the separation of nickel-cobalt, copper and gangue minerals. These reagents will include pebble lime, soda ash, sodium sulphite, xanthate, a flocculant, and a frother. All of these reagents are in common use in existing flotation concentrators in Canada and around the world.

Pebble lime will be stored in a lime silo. Milk-of-lime slurry at 15% solids will be used in the process. The lime slurry will be stored in a stock tank. The lime slurry will be circulated in a loop around the concentrator and will be tapped off at the required addition point to adjust pH in the flotation circuits.

Soda ash will be stored in a silo. Dry soda ash will be used in the process for copper-nickel separation.

Sodium sulphite and xanthate will be mixed in separate tanks to produce a 5% and 10% solution respectively, and will then be stored in holding tanks. A pine-oil frother will be used as received.

Flocculant will be fed to a flocculant mixing system and will be mixed to a 0.05% solution. It will be stored in a holding tank and delivered to the thickeners.

Runoff from the site will be controlled, collected, monitored and, if required, treated and recycled back to the mill.

### 4.3.2 Concentrator (Mill)

The nickel-copper-cobalt ore will be processed on site by crushing, grinding and differential froth flotation, producing two concentrate products (nickel-cobalt and copper) and tailings. Initially, the concentrator will be designed to process 15,000 tonnes of ore per day. Once the Ovoid is depleted, concentrator throughput is likely to increase because of lower ore grades from the Eastern Deeps and Western Extension.

Concentrator unit operations will include primary crushing, ore storage and reclaim, grinding, flotation, thickening, filtering and concentrate storage. The concentrate products will be stored at the port site for shipment to smelters, while the tailings will be pumped to the tailings basin. Water will be re-claimed from the tailings basin for re-use in the process. Surface runoff water and open pit water will be collected and may be used for process water in the concentrator.

Crushing and Grinding

Ore will be delivered to a primary crusher in haul trucks. The ore will be crushed to produce suitably sized material for the grinding circuit. The crushed ore will be transported by a feed conveyor to a storage bin adjacent to the concentrator. A dry baghouse-type dust collector will extract dust from the transfer points. The grinding circuit will consist of a semi-autogenous mill inline with a ball mill. The grinding process breaks the ore down to produce smaller particles in preparation for flotation.

Flotation and Concentrate Dewatering

A flotation process will be used to separate high-grade concentrates, containing nickel-cobalt and copper from a waste (tailings) stream. The flotation process is a physical separation process and does not chemically alter the composition of the ore. The flotation circuit will be designed to maximize metal recoveries into a copper concentrate and a nickel-cobalt concentrate.

Both concentrates will be partially dewatered in thickeners and then filtered to reduce moisture content. The concentrates will then be transported to the concentrate storage building located at Anaktalak Bay.

The tailings slurry will be pumped by pipeline to the tailings disposal area.

Acid Rock Drainage Potential

Acid Rock Drainage (ARD) is a chemical oxidation process which occurs when metallic sulphide minerals are exposed to an oxidizing environment in the presence of water. Chemical oxidation of metallic sulfides will result in the formation of acid, and therefore the potential acidification of natural drainage waters. A portion of the rock extracted during the mining process at the Voisey's Bay site will contain metallic sulphides. The excavated overburden may also contain metallic sulphides.

Preliminary laboratory testing has been carried out to assess the ARD potential of both the waste rock and overburden within the area of the proposed open pit. Future laboratory testing is planned to assess the ARD potential within the Eastern Deeps and Western Extension areas. The results of the testing carried out to date has been used to develop the conceptual engineering design for the disposal of these materials.

Laboratory analysis consists of the determination of the mineralogical composition of representative rock and soil samples from the study area In particular, the percent composition of metallic sulfides, carbonates and clays are accurately evaluated. The presence of carbonate and clay minerals have the potential to buffer or reduce the effect of acid generation. This assessment will result in the development of the neutralization potential/acid potential ratio (NP/AP ratio) for each sample. The following discussion summarizes the ARD testing results to date.

Overburden

The overburden above the Voisey's Bay Ovoid pit area is essentially composed of sand and gravel glacial till. Seventy-six composite samples have undergone acid-base account (ABA) testing. The results indicate that there is no acid generating potential from the overburden materials in the vicinity of the Ovoid open pit area.

Waste Rock

A total of 487 composite samples, representing about 3,300 m of drill core, have been analyzed from the Ovoid open pit area. Waste rock from this area has been classified into two major rock units: (i) troctolite (Reid Brook intrusive); and (ii) gneiss. Based on a review of the samples collected from the disseminated sulfide zone within the Ovoid, it is apparent that potentially acid generating troctolite is located along the edges of the economic mineralization of the Ovoid.

Examination of gneiss samples has indicated some mineralogical variability. The gneiss is primarily non-mineralized in sulphur. Approximately 85% of the samples contained less than 0.5% total sulphur. These samples were associated with an NP/AP ratio of greater than 1 and an AP of less than 5 kg $CaCO_3$ equivalent per tonne. It is apparent that the gneiss is very homogeneous away from the orebody and is not a potential acid generating source.

Based upon the above results, it has been concluded that waste rock tonnages calculated within the sulphide boundaries of the Ovoid mineralization provide a good indication of the total

quantity of mineralized waste rock. Using the present design of the Ovoid pit, this results in approximately 1 million tonnes of mineralized waste requiring special management. Engineering studies are currently on-going to assess the ARD potential within the Eastern Deeps and the Western Extension mineralized zones.

Tailings Management

Tailings are produced as a slurry, and will be conveyed from the concentrator by pipeline to the disposal area On the basis of the projected ore production rate, approximately 4 million tonnes of tailings will be produced annually.

Tailings Characteristics

The tailings will have a high sulphide content (up to 90% pyrrhotite) and will be acid generating. To reduce acid generation, the plan for long-term storage and disposal must inhibit oxidation. This can best be achieved by permanent storage of the tailings under water. Elevated metal concentrations, sulphates and thiosalts may also be present in the tailings slurry and the decant water may require treatment prior to discharge.

Proposed Tailings Basin Facilities

The proposed tailings facility is presented in Figure 5. The tailings basin is situated within a bedrock dominated basin, within the barren uplands, about 12 kilometres northeast of the proposed mine site. The site consists of a two lake system, with the main lake basin being aligned approximately east-west, and the east lake being aligned approximately north-south. The bedrock ridges surrounding the basin rise steeply approximately 100 to 200 m above the level of the lakes. At the south outlet of the east lake, the system drains to Kangeklualuk Bay, a marine bay situated approximately 3 km downstream.

The surface water elevation of the lakes forming the tailings basin is approximately 142 m above sea level. The main lake is approximately 3 kilometers in length and covers an area of about 1.3 km2. Preliminary bathymetric data suggests that this lake has an average depth of about 13 m, with maximum depths in the order of 40 m.

The east lake immediately downstream of the tailings basin will be used as the polishing pond, if required, for the initial phase of the development, as discussed below. This lake is approximately 2 m in elevation below the tailings basin. It is approximately 1.5 km in length with a surface area of about 0.4 $km^2$. Preliminary bathymetric data suggests that this lake has a maximum depth in the order of 30 m.

Water management within the basin is a critical operational consideration. In order for the basin to operate under maximum efficiency, the water levels must be controlled such that a minimum water cover is maintained above the tailings during operation; and large volumes of surface water, which could require treatment prior to discharge, will be prevented from entering the basin.

The tailings basin will be developed in two phases, with the initial phase of operation lasting for about ten years. The purpose of this phased development plan is to minimize both darn construction requirements and the costs associated with long-term operation and post-closure maintenance.

A conceptual two-phased plan to develop this tailings basin is summarized below.

- Phase I will consist of the development of the main pond as the tailings basin, and the use of the eastern pond as a polishing pond, if required. Small perimeter dams will be required to divert water, to contain tailings and to maintain water cover within the basin. Secondary access roadways will be required between all of these dam locations for both construction and future maintenance purposes. In addition, perimeter hydraulic control (dam) structures will be required at north and south potential outflow areas of the eastern (polishing) pond.

Diversion of surface water around either the southern perimeter or north of the basin will be required.

- Phase II will consist of the expansion of the tailings basin to incorporate the eastern pond, if required. This expansion will allow for an increase in basin capacity without substantially increasing the height of the existing dam structures. As a result of this expansion, this concept may require the construction of a new polishing pond, south of the existing pond.

Tailings Basin Fish Studies

Water quality, fish and fish habitat studies have been undertaken to assess the environmental conditions in the proposed tailings basin. Habitat surveys have been conducted on the main stream and tributaries associated with the proposed tailings facility. There are several major barriers that are impassable to upstream fish migration along this waterway. Electrofishing surveys in the streams collected brook trout. The pond fish survey indicated that land-locked Arctic char and brook trout present in the ponds within the proposed tailings facility. The small pond west of headwaters of Kangeklualuk Bay (below the fish barriers) is potentially used by anadromous Arctic char.

Stream habitat surveys were conducted for each stream reach on this system. Bathymetric surveys have been completed for the two main ponds within the proposed tailings watershed. These shorelines have been videotaped to allow estimation of fish habitat.

Electrofishing surveys were carried out throughout the proposed tailings facility watershed. For each of the studied ponds in the proposed tailings facility watershed, netting and trapping efforts were made to capture fish and collect fish for species presence, relative abundance estimates, and morphometric measurements.

Fish sacrificed from those collected from the two ponds were used for body burden studies, along with morphometric and life history measurements including length, weight, sex, maturity, health conditions, for aging (scales, and otolith), and identification of stomach contents. Morphometric and life history measurements (length, weight. and if possible. sex, maturity, and health condition) were collected from all fish caught.

1996 Hydrology Program

Two hydrometric stations were established in the 1996 open water season to collect streamflow data in the area of the proposed tailings basin. One station is located upstream of the proposed tailings pond, and the other is located downstream of the proposed tailings pond. Data from these stations will be related to streamflow data collected at other stations in the project area, and to longer term Environment Canada stations in northern Labrador.

Spring runoff observations were also made near these locations to record the progression of spring snowmelt and runoff in the 1996 season. A Sacramento gauge was set up in the basin just southwest of the upstream hydrometric station to measure total precipitation.

Waste Rock Management

During the development of the Ovoid zone there will be three types of waste that require placement and storage. The ratio of waste rock generated during the development of an underground mine is typically less than an open pit operation. In the absence of a selected mining method, an allowance of 15 million tonnes of potentially mineralized waste rock has been made for the development and mining of the Eastem Deeps and Western Extension.

The non-mineralized waste rock that is non-acid generating will be placed in the east mine rock storage facility immediately east of the open pit. Mine waste rock will typically be hard and competent gneiss. The waste rock deposition will be designed with relatively flat slopes to increase stability. The waste rock disposal area will be progressively reclaimed (i.e., reclamation concurrent with operations). Run off from the stockpile will be collected and directed to the south sedimentation pond. The upstream portion of the drainage basin will be

diverted into Reid Brook.

Mineralized waste rock with a sulphur content over 0.5% will be segregated as potentially acid generating waste and will be submerged to prevent acid generation. The most effective long-term management method for the acid generating portion of waste rock depends on the volume which will require disposal. Of the options being considered, the preferred option is to dispose of this waste rock in Headwater Pond (refer to Section 4.1.8)

Headwater Pond Fish Studies

Water quality, fish and habitat studies have been undertaken to assess the environmental conditions in Headwater Pond and the Reid Brook drainage basins. Electrofishing at the outlet of Headwater Pond and pond fishing (including gilnetting, fykenets and char traps) has been conducted in Headwater Pond watershed. Arctic char (including young-of-the-year) and brook trout were collected.

Stream habitat surveys have been conducted for the outflow stream of Headwater Pond. Pond bathymetry was surveyed and the shore line videotaped to provide an estimate of usable fish habitat. A limited number of fish samples were collected from the pond for baseline body burden of metals and for morphometric (length, weight, condition and sex/maturity where possible), feeding, and aging studies. All fish were released live as soon as possible (excluding those required for body burden, or biological sampling).

All fish were released live as soon as possible (excluding those required for body burden or biological sampling).

A fall spawning survey is being conducted in the Reid Brook watershed to investigate stream spawning activity by Arctic char and brook trout.

Hydrological Studies

Two hydrometric stations were established in the Camp Pond catchment area in June 1995. One station records water levels in Camp Pond; the other station is a flow monitoring station in Camp Pond Brook, downstream of the outlet of Camp Pond. Preliminary comparison of the data from these stations suggests that the runoff pattern and overall volume is similar to that of other basins gauged by Environment Canada in northern Labrador.

Spring runoff observations were also made at several locations in the Camp Pond Brook basin, and temporary data loggers were set up to record open water levels in the 1996 season.

Port Site and Concentrate Storage

A concentrate storage facility will be located near Anaktalak Bay, adjacent to the marine terminal. The facility will be fully enclosed with separate areas for nickel-cobalt and copper concentrates. The size of the storage building will be a function of shipping season length and daily production of concentrate. Both copper and nickel concentrates will be delivered from the concentrator to the unloading station which will include a hopper and belt feeder. The transfer conveyor from the concentrate unloading station will discharge onto a tripper conveyor running the length of the concentrate storage building.

The concentrate will be conveyed from the station to the concentrate storage building. A dry baghouse-type dust collector will be provided at the station to collect dust during transfer.

Concentrate will be reclaimed by front-end loaders and dumped into one of two transfer hoppers. A hopper discharge belt feeder will empty the hopper and discharge the material onto the reclaim conveyor. Each hopper and belt feeder can be positioned at any point along the reclaim conveyor. The reclaim conveyor will discharge onto the shiploader feed conveyor. The concentrate will be sampled automatically at the transfer point, and the tonnage being loaded onto the ship will be weighed by a conveyor-mounted electronic weigh scale. The shiploader feed conveyor will discharge onto a radial shiploader, which will load the concentrate vessels.

Surface water runoff will be directed to a sedimentation pond at the port site.

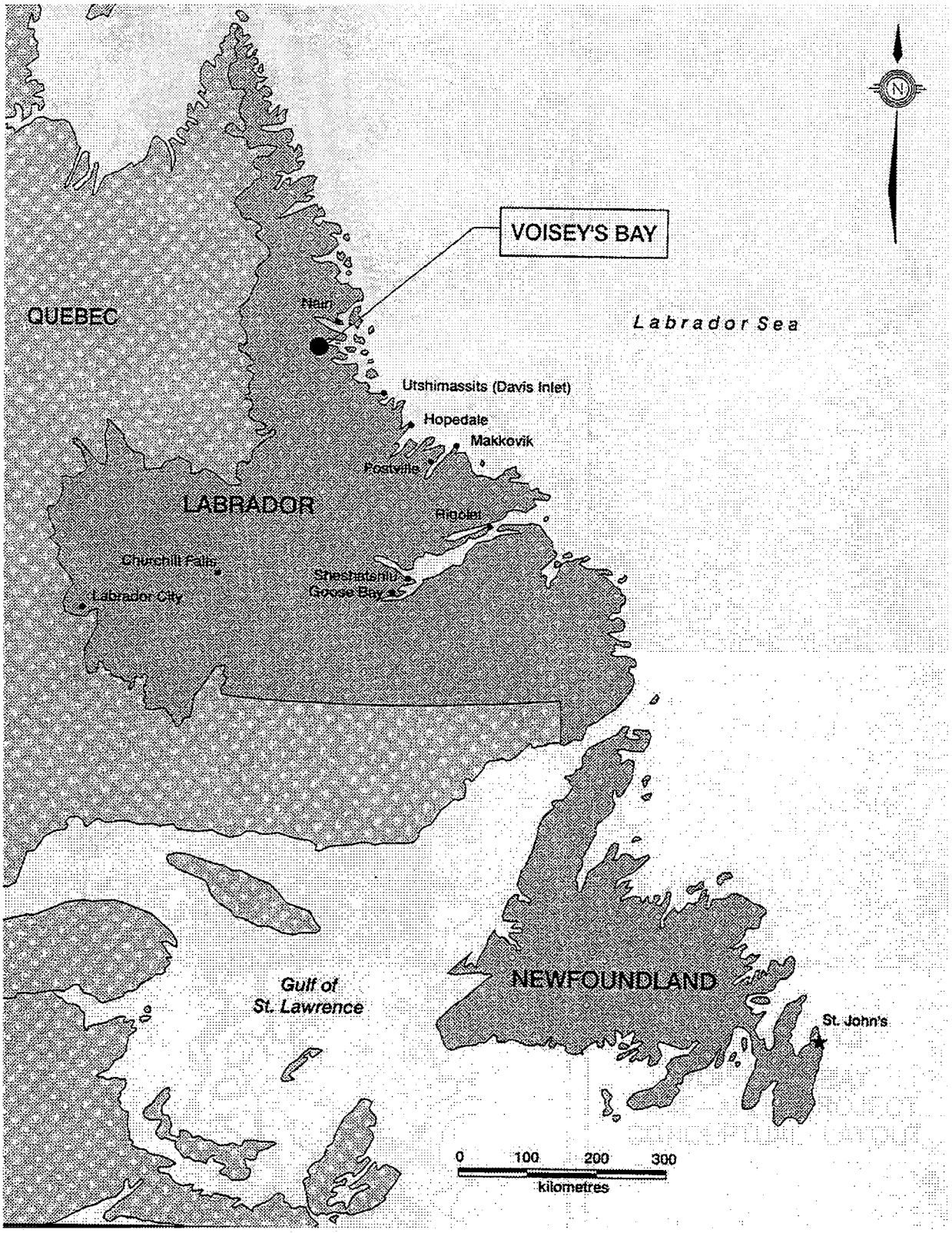


**Figure 1. Location of Voisey's Bay**

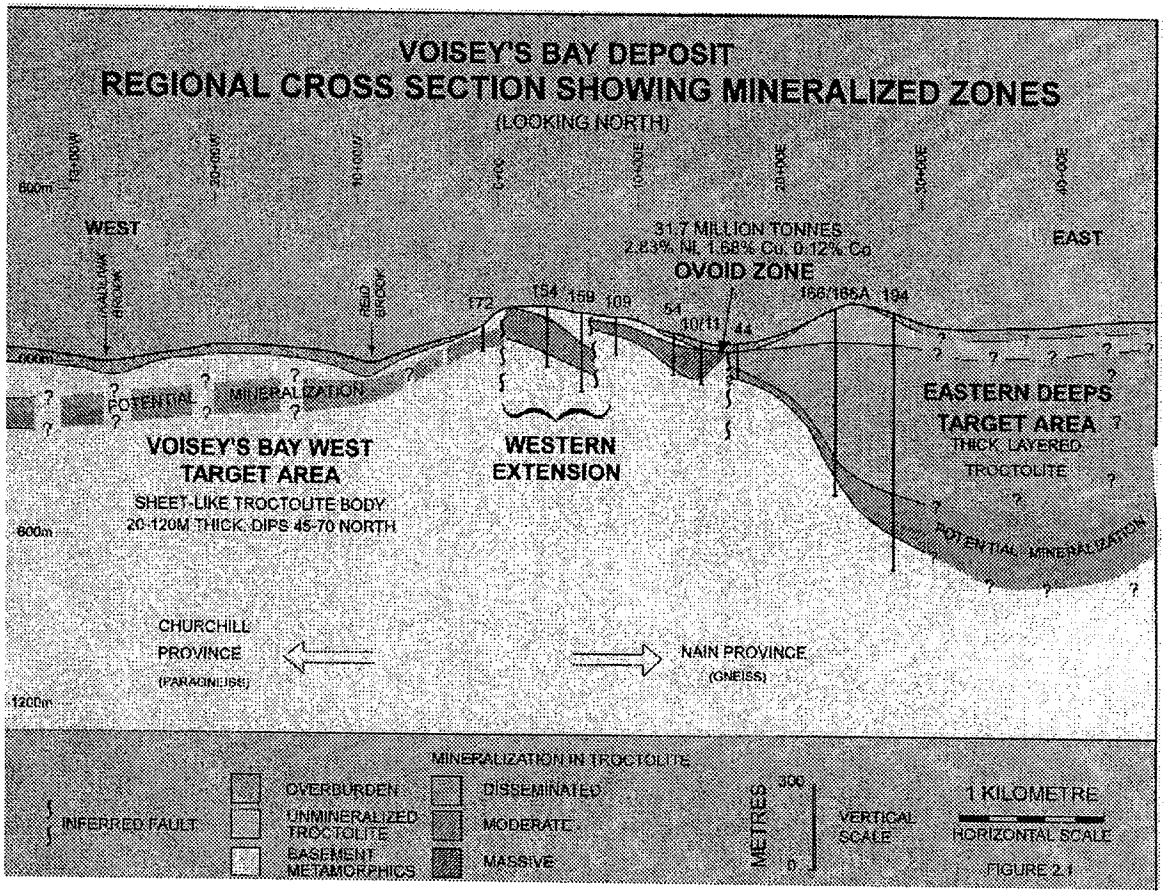


**Figure 2. Regional Cross Section Showing Mineralized Zones**

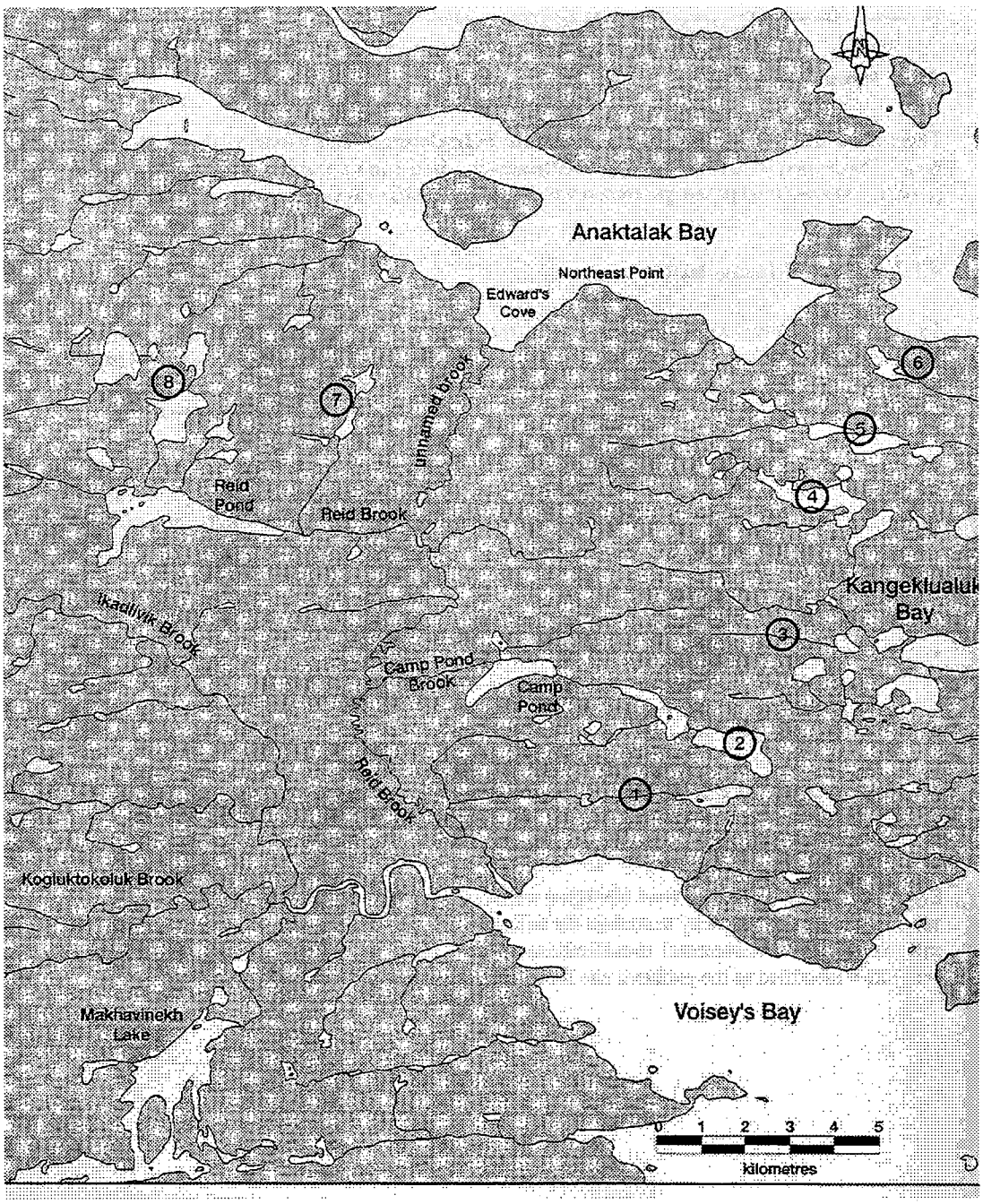


**Figure 3. Potential Tailings Impoundment Sites**

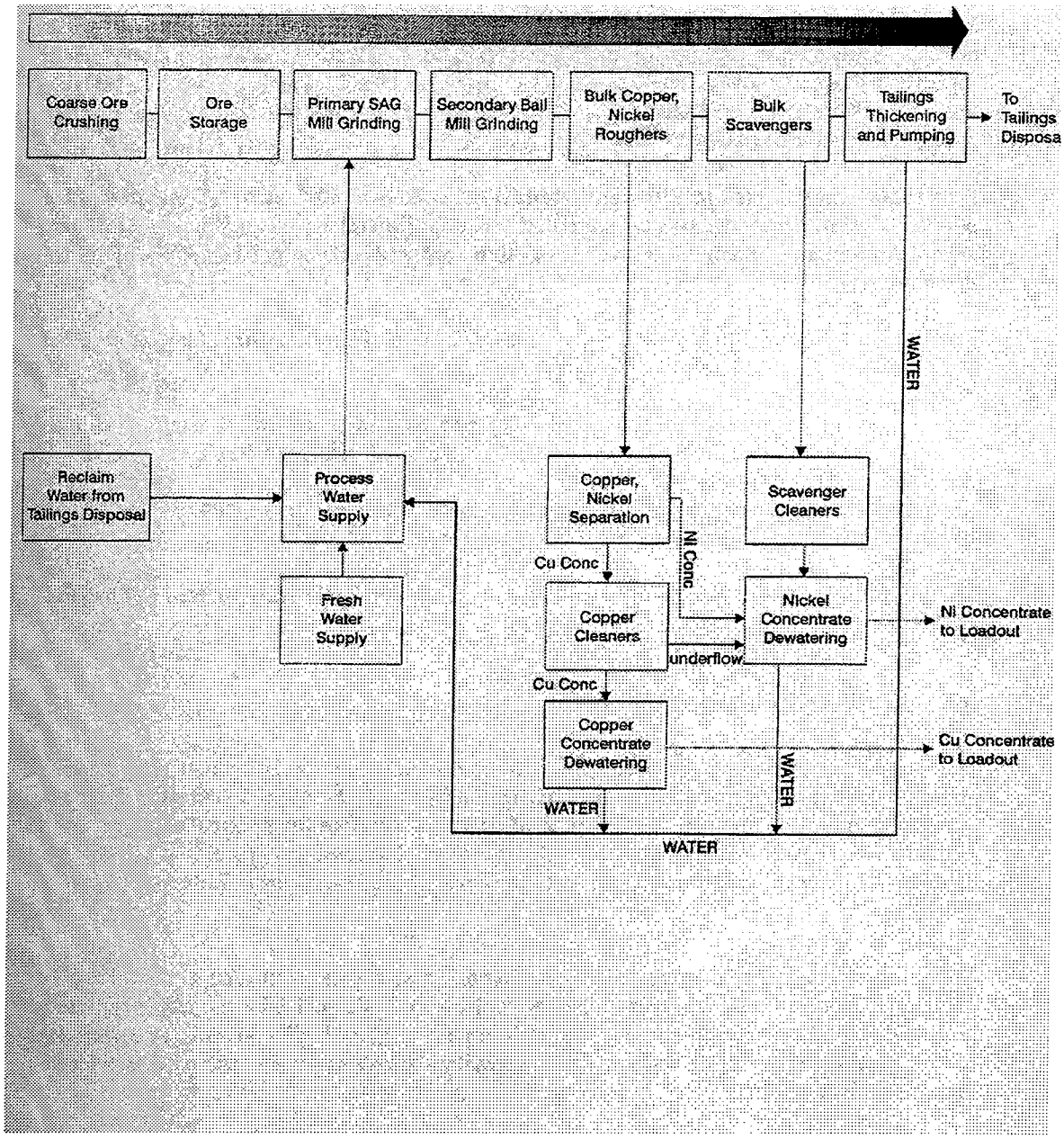


**Figure 4. Conceptual Mill Process Flow Sheet**

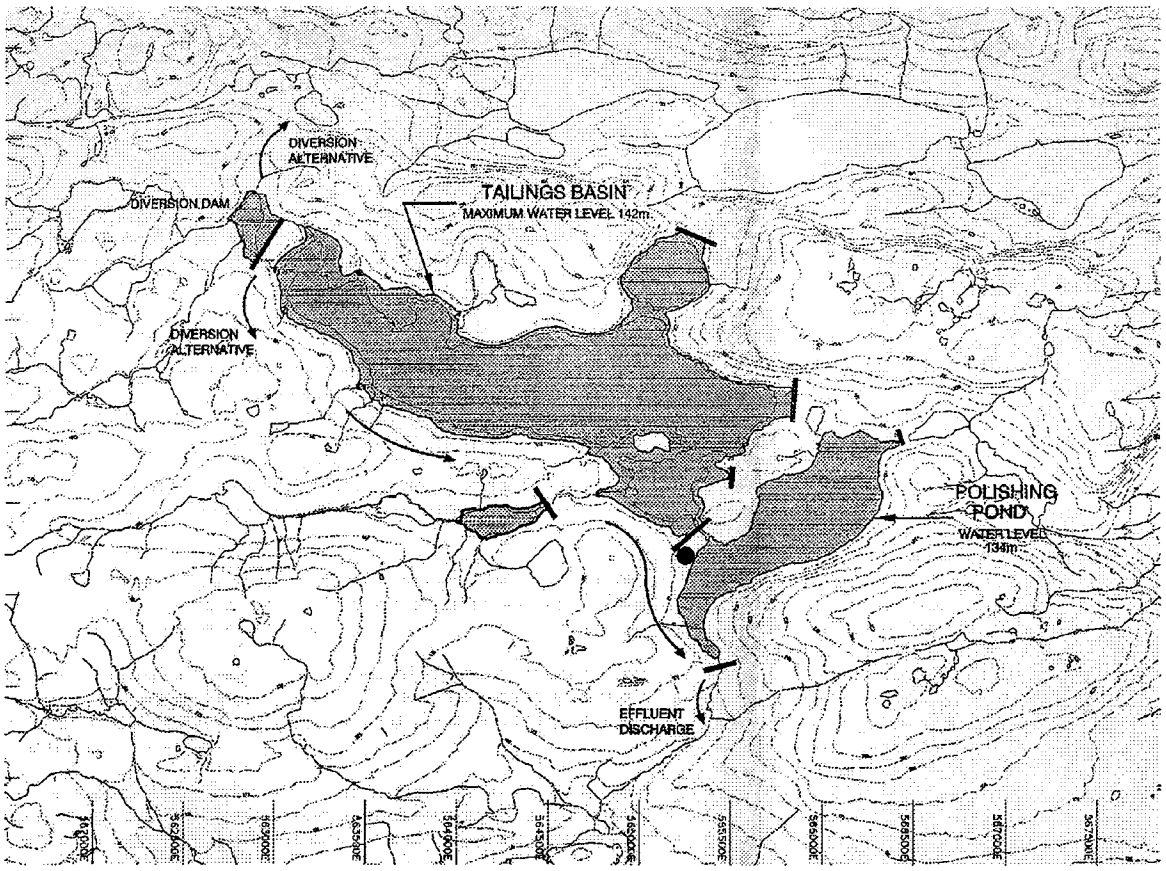


**Figure 5. Tailings Basin Layout**