

Partial reports only
- reserve until
complete reports
can be obtained

**GRANULAR RESOURCE
EVALUATION**

WHALE COVE, N.W.T.

DRAFT

DRAFT

**Granular Program
Technical Services Division**

**Department of Government Services
and Public Works**

**Government of the Northwest Territories
Yellowknife**

February, 1993

EXECUTIVE SUMMARY

The hamlet of Whale Cove is one of the smaller Inuit settlements in the Keewatin Region of the N.W.T. and is presently experiencing a period of rapid growth.

To ensure that the community's long term granular material needs are met, the Granular Program, Department of Government Services and Public Works, has undertaken investigative field work, source sampling and testing, analysis of granular needs and reviewed economic and political factors to develop resource management options.

Numerous abandoned borrow sites and seven active and potential sources of gravel were investigated as well as three potential quarry sites. A fundamental conclusion, is that there are insufficient quantities of all grades of naturally occurring 'pitrun' material within close proximity to the settlement and that available material is of poor quality consisting mostly of sand. Identified reserves are limited in quality, volume, and are inaccessible with existing community equipment.

It is suggested that the most practical, economical, and timely method of supplying required grades of granular material for community infrastructure projects, is for the implementation, by the Granular Program, of a large scale, multi-phase drill, blast, crush, and stockpile operation in close proximity to the community.

Further, given the historical high costs of a quarry and crush operation and the immediate need for all grades of granular material, this large scale production project should be implemented as soon as appropriate capital funds have been identified and that sufficient quantities of material be produced to satisfy the community's granular needs the next five years.

This recommended plan of action will guarantee the community a long term supply of quality granular materials.

2.4 PERMAFROST

Permafrost is widespread throughout the study area. Frozen ground was encountered at 0.7 meters below ground surface. The active layer ranged from 0.7 to over 2.5 meters on south facing slopes. Annual thaw varies but is higher than the regional average due to the moderating effects of the ocean. As noted by the permafrost distribution map, Whale Cove lies within the continuous permafrost zone thus periglacial processes and associated landforms are common. Patterned ground such as steps, polygons, stone circles, ice lensing, thermokarsts and beaded drainage are indigenous to the region.

2.5 ENVIRONMENTS OF DEPOSITION

The most widespread type of granular material found in the study area is related to post glacial deposition in the form of glacial till. As mentioned, the till is widely scattered in very small pockets surrounded by exposed bedrock ridges as noted below.

|

|

PHOTO 3: Typical till deposit near the community.

There appears to be no large volume till deposits within the study area that would be cost-effective to develop. Also, nearly all of the till deposits have been wave-washed; as a result, the till tends to be low in 'fines' and stony.

The only other major source of granular material are the marine sands and silts deposited by the retreating sea during post-glacial times. Although larger than the local till deposits, these stranded beach deposits consist almost entirely of silty sand. A typical marine deposit is noted below; the deposit is located northwest of the community adjacent to the airport road.

|

|

PHOTO 4: Silty sand beach deposit.

By far, the largest granular sources are the eskers and moraines located between 20 - 30 kilometers north of the community. However, the rugged rocky terrain makes access almost impossible; also, these deposits are expected to consist of sub-marginal material, mostly silt, sand, and some fine gravel.

Finally, a less common type of deposit found in the study area is related to the mechanical breakdown of large rock outcrops in situ. The resulting material (referred to as detritus) contains large angular cobbles and gravels, is seldom more than 0.5 meters in depth and often covers a large land area. Often the frost-shattered rock form small talus slopes adjacent to rock ridges. However, these deposits are small, poor quality, and are seldom cost-effective to develop.

**6.2 TABLE 2: COMPARISON OF GRANULAR RESOURCE SOURCES
WHALE COVE**

Source	Distance from community	Access	Material Type and Quality	Quantity cu. m.	Cost/cu/m Load, haul, place & compact	Environmental Impact
1 Active	1.5	Excellent	Silty Sand High 'fines' content	2,000	\$15.00	Moderate Drainage and erosion control procedures necessary
2 Active	1.1	Good Seasonal	Cobbles to coarse gravels	1,500 - 2,000	\$16.00	Minimal
3 Active	3.5	Excellent	Gravelly Sand	3,000	\$16.00 - \$18.00	Minimal
4 Semi- Active	3.7	Excellent	Silty sand some gravel	2,000	\$ 16.00 - \$18.00	Severe at present Proper pit management and land reclamation necessary
5 Active	3.9	Excellent	Clean sand	1,000	N/A	Minimal
6 Stockpile	6.2	Excellent	Crushed 19mm	4,800	N/A	Minimal
7 Potential	6.7	Good Seasonal	Gravelly Sand Some oversize	5,000 Probable 10,000 Prospective	\$30.00 Class D Estimate	Severe if Environmental guidelines are not implemented and followed
8 Potential	7.1	Poor - Fair Seasonal	All Grades Cobbles to coarse sand, low 'fines' content	15,000 Probable 20,000 Prospective	\$35.00 Class D Estimate	Severe Wild Life Habitat and Denning Area

**TABLE 2 CONTINUED: RESOURCE COMPARISON
WHALE COVE**

Source	Distance from community	Access	Material Type and Quality	Quantity cu. m.	Cost/cu/m 20,00 cu.m. blast rock minimum	Environmental Impact
Rock Quarry Q1	3.5	Excellent	Blasted Rock Size to grade	60,000 +	\$30 - \$35 For 250 mm \$40 - \$45 For 25 mm +LH & P Costs	Minimal
Rock Quarry Q2	1.3	Good	Blasted Rock Size to grade	50,000 +	As Above *Class D Estimates	Moderate Depending on distance from lake
Rock Quarry Q3	1.5	Excellent	Basted Rock Size to grade	35,000 +	\$30 - \$32 For 250 mm \$40 - \$42 For 25 mm + LH & P Costs	Minimal

7. RECOMMENDATIONS

The following recommendations are based on an analysis of identified granular resources and the economic, political and other factors influencing gravel supply within the study area:

General

- the community is **not** self-sufficient in any grade of granular material; active sources are near depletion and existing material is of poor quality; potential pitrun sources can not satisfy even the short term needs of the community and are not cost-effective to develop, thus it is recommended that a multi-phase rock quarry and crushing operation be implemented by the Granular Program, Department of Government Services and Public Works, for the production and stockpiling of sufficient quantities of both select and common grade material.
- further, it is recommended that the above mentioned project be implemented during FY 93/94 to ensure that granular materials are available for planned community infrastructure projects over the next five years.

Resource Management

- the Municipal Council direct, by resolution, that Source 1 and Source 3 be used till depletion but that development of all other active sources be terminated and land reclamation and pit restoration procedures be implemented and enforced.
- the Municipal Council direct, by resolution, that Q3 be selected as the preferred site for the proposed quarry, crush, and stockpile of granular material.

These recommendations have been prepared and presented through the quantitative assessment of identified granular sources and development costs as discussed in the various sections of the report. The recommendations represent a "best-case" scenario for satisfying the long term granular requirements of the community and should be evaluated by community officials in order to confirm preferred alternatives.

It is hoped that the foregoing report will contribute to the continual growth of the community by the timely and economical development of community granular resources.

4. GRANULAR SOURCES

This section provides an overview of the various active, abandoned, and potential sources within the study area. Each source is described in terms of location, genesis, volume, engineering properties, and development considerations. See Appendix A for laboratory analysis of samples. Note: The Source Location Map in Appendix B should be used as a reference.

4.1 ABANDONED SOURCES

Over the years, large quantities of granular material have been required for use in community infrastructure projects. As a result, numerous abandoned and/or depleted borrow sources exist within and around the community. In some cases material still exists in these deposits; however, generally the remaining borrow material should be used for the restoration and reclamation of each borrow site. As well, ground truthing of these sources indicated that the remaining material is often at or below the water table and is poorly drained and frost susceptible. Within the community of Whale Cove and along access routes, small ponds have developed in a number of these abandoned borrow pits as noted below; this pit is located just north of the community towards the airport and was abandoned over ten years ago.

1

1

PHOTO 5: Numerous abandoned borrow pits are located around the community.

More common are old side borrow pits that were used either for the construction of the airport road or for subsequent maintenance of community roads. These abandoned borrow sources tend to be very wet with remaining material poorly drained and consisting mostly of silty sand. A typical view of abandoned side borrow pits adjacent to the airport road are noted below.

PHOTO 6: Abandoned side borrow pits.

The abandoned M.O.T. pits located along the old airport road were used during the production of the existing crushed stockpile located about 1.5 Km southeast of the airport. Several other depleted borrow areas and old test pits (from the 1986 investigation) were noted along the old airport road that is no longer in use. Also, depleted pits were noted just north of the community airstrip. Generally, these abandoned and depleted pits are between 7 - 8 Km from the community. The old airport road has been abandoned; although seasonal, the road is becoming difficult to traverse even in summer.

It is difficult to determine the amount of material remaining within the numerous abandoned borrow pits that are scattered throughout the source area especially along the old airport road and just north of the existing airstrip. Field observations show that the remaining sandy, poorly drained material would be of little value to the community, involve long haul distances with limited volumes; remaining material could be better used for land reclamation and pit restoration.

4.2 ACTIVE SOURCES

The active designation is used for sources that are currently being worked and still contain significant volumes of useable material. Presently, there are only a few such sources in close proximity to the community.

4.2.1 Source 1 / Community Pit # 1

This active borrow source is located about 1.6 Km southwest of the community just east of the existing solid waste site. Access is excellent by way of the all season road to the community sewage lagoon and solid waste site. The road terminates at the source. A view of Source 1 is seen below.

|

|

PHOTO 7: Source 1 - mostly sand and silt.

The source is a remnant of a terraced beach ridge system that was formed as the sea gradually dropped to its' present level. The deposit covers a lateral area about 50 m x 60 meters situated between bedrock with an average thickness of 2.0 meters. The deposit becomes shallow and discontinuous near the bedrock outcrops and access road. The natural drainage pattern of the surrounding terrain has funnelled surface water into this area. As a result the material is poorly drained and very wet especially during spring thaw.

Test results show that the material is poorly graded and consists of 26 % fine gravel, 53 % medium to fine sand, and 21 % 'fines', mostly in the silt size range

This source is still used extensively by the community and as a result only about 2,000 m³ of material remain within the deposit.

4.2.2 Source 2 / Tank Farm Area

Source 2 is not a specific deposit but represents a large land area located south of the existing tank farm and extending southeast along the shoreline of Wilson Bay, that contains remnant storm beaches, till pockets, and weathered rock fragments. Although, the entire area is over 300 x 500 meters, approximately 60 % of the surface area is composed of rock outcrops. Along the shoreline surficial deposits have accumulated as narrow linear ridges or as small, shallow, irregular shaped pockets between bedrock ridges. In either case, the deposits are often less than 1.0 meters thick, discontinuous, shallow, and well drained. A typical view of the source area is noted below.

|

|

PHOTO 8: Source 2 - till deposits and storm beaches.

The area has excellent access by several ATV trails that have been upgraded, in part, to form a primitive road complex. The community has used this area extensively as a source of common grade material, thus numerous abandoned borrow areas and test pits are located throughout the various gravel pockets and ridges. The narrow storm ridges located along the coastline are still used occasionally by the community for road construction.

An abandoned test pit and source material is seen below. Although the photo may appear to indicate a sizeable quantity of material, the actual area of this small till pocket, located directly behind the tank farm, is about 15 x 25 meters with an average thickness of less than 0.8 meters.

|

|

PHOTO 9: Source 2 material - gravel, cobbles, boulders.

The material consists of over 10 % oversize in the boulder range, 60 % gravel to cobbles, 28 % coarse sand, and less than 2 % 'fines'. Generally, the material is rounded and poorly graded, overburden is minimal, and no evidence of permafrost.

Approximately , 1,500 - 2,000 m³ of material remain scattered throughout the source area in small gravel pockets between rock outcrops and as narrow, parallel, beach ridges along the coastal margins southeast of the community.

4.2.3 Source 3 / Private Sector Pit

This active source is located approximately 3.5 Km north of the community adjacent to and east of the airport road. No land use designation exists that classifies this source as 'private sector', however, the deposit has been used extensively by the local contractor who has developed the pit over the years and implemented a small screening operation on site.

The pit is surrounded by bedrock ridges, has an irregular shape 100 x 50 meters, and is a mixture of till overlain by beach sand and gravel. A view of the source area, seen below, is west from the top of a bedrock ridge; note the grizzly screener and airport road in the background.

|

|

PHOTO 10: Source 3 - private sector pit.

The continuous piling and moving of material during excavation and screening, note the loader, has resulted in a heterogeneous mixture of the coarse till and the fine beach sands and gravel. As a result the material is well graded, angular to rounded, with boulder size material mixed with fine sand. The airport road and a small 40 meter long entrance trail provides seasonal access to the source area.

Due to poor pit design, erosion and drainage problems are prevalent throughout the deposit with very wet, poorly drained material situated between well drained ridges and stockpiles. In many areas the water table is at or near the pit floor or removal has reached bedrock preventing further excavation. Thickness of the deposit varies due to the stockpiling and constant movement of material but maximum expansion has occurred to the north and east of the deposit area where bedrock ridges prevent further development. Test holes show that the deposit continues past the existing southern boundary with an undisturbed area about 20 x 30 meters and an average depth of about 2.0 meters before bedrock is reached. Overburden is minimal and permafrost was not evident within the undisturbed area and the small stockpiles and gravel ridges.

Source material is viewed below; this stockpile is located adjacent to the bedrock outcrop (just visible behind the piled material) that indicates the eastern boundary of the deposit.

|

|

PHOTO 11: Sand and gravel material of Source 3.

The material consists of 42 % in the gravel to boulder size range, 56 % medium grained sand, and less than 2 % 'fines'. Generally, the stockpiled material is poorly graded, well drained, angular to sub-rounded with little or no organics.

Approximately 3,000 m³ of sandy gravel remain within the undisturbed areas of the deposit and in the several small stockpiles scattered randomly throughout the source area.

4.2.4 Source 4 / Beach Deposit

This large source is located about 3.7 Km north of the community, just west and adjacent to the airport road. Source 3 is located only 200 meters south of this deposit on the east side of the road. The deposit is part of a complex system of raised beach terraces that overlie pockets of glacial till in some areas of the source or bedrock in other sectors. Constant removal of material with out proper contouring or pit design followed by random stockpiling with little or no restoration has resulted in sever erosion and litter. The source is over 400 meters long, north to south and 100 wide. There are no well defined boundaries delineating the source area.

Presently, existing pit boundaries define the maximum surface area of the source as the deposit has gradually thinned and merged with poorly drained peat terrain to the south, rock outcrops to the north and west, and the airport road to the east. Access is excellent along the airport road with direct entrance onto the pit floor from the road. A partial view of the source area is seen below; the view is west from the airport road.

|

|

PHOTO 12: Source 4 - mostly sand; Poor pit management.

The entire source appeared unfrozen with little or no permafrost. The deposit has an average thickness of about 2.0 meters, within undisturbed areas, but thins considerably near rock ridges and outcrops; vegetation is minimal. However, only a small portion of the deposit still remains undisturbed.

The material is predominately coarse sand with fine gravel; large boulders and cobbles are scattered throughout the source area. Test results indicate the material consists of 20 % fine gravel, 75 % coarse to medium sand, and 5 % 'fines', mostly silt. Poor drainage and erosion control has resulted in numerous ponds developing over the pit floor. Undisturbed material is wet and poorly graded. A view of the material is seen on the following page; note poor drainage.

PHOTO 13: Source 4 material - mostly sand with some gravel.

About 2,000 m³ of sand with some gravel remain within the deposit, mostly located in numerous ridges and stockpiles adjacent of poorly drained borrow pits.

4.2.5 Source 5 / Sand Pit(s)

Source 4 is located about 4.0 Km north of the community just east of the airport road. The deposit is located at the base of a large bedrock ridge. A narrow access road leads from the airport road for about 300 meters and terminates at the source.

The material consists of 99 % sand and 1 % fines, is well drained, unfrozen and well graded. This source is representative of several abandoned sand pits located along the airport road. At some sites, small sand stockpiles are located within the depleted borrow pit.

Source 4 still contains about 1,000 m³ of medium to fine grained, clean sand.

4.2.6 Source 6 / Crushed Stockpile - Arctic Airports.

Arctic Airports, Department of Transportation, maintains a crushed stockpile located about 6.0 Km north of the community just east of the airport road. The old crushing site is located just south of the stockpile on the west side of the road. The material is frozen below 1.5 meters of the surface. A view of the stockpile is seen below.

|

|

PHOTO 14: Crushed Stockpile

The material consists of 42 % gravel, 55 % sand sizes, and 3 % 'fines', is well drained, and angular with a fractured face count of 69 %. Approximately 4,800 m³ of crushed gravel remain in the stockpile.

4.3 POTENTIAL SOURCES

These are granular sources that are not being used at present, but contain significant volumes of naturally occurring good quality material. Normally these sources have to be developed upon initial identification through pit planning and design procedures and concludes with pit operations and restoration. There are few economically viable potential sources in close proximity to the community.

4.3.1 Source 7 / Airport

This potential source is located southeast of the community airport, one kilometer northeast of the crushed stockpile; the area is situated approximately 300 meters east of the airport road and covers about 2 hectares of shallow, poorly drained surficial sand and gravel. A number of small ponds are located within the source area. Access is seasonal by way of a narrow primitive ATV trail that leads east from the airport road and terminates about 100 meters from the source area.

Deposit boundaries are undefined as the source becomes discontinuous and merges with low lying, poorly drained, bog and peat terrain that surrounds the deposit. The area is a combination of an isolated post glacial beach ridge with small, scattered pockets of wave washed bouldery till. A view of the source area is seen below, note the crushed stockpile observed in the background.

|

|

PHOTO 15: Source 7 - southeast of community airstrip.

Cobble and boulder size material cover the surface. A thin organic layer of peat cover about 50 % of the source. The area is poorly drained with old test pits containing ground water and wet, marshy areas situated between small, well drained sections of sand and gravel. Frozen ground or bedrock was encountered between 0.8 and 1.2 meters below the surface. This source is similar to the abandoned and/or depleted borrow areas just north of the airstrip. The material consists of 20 % cobbles and coarse gravel, 78 % coarse sand, and 2 % 'fines', is poorly graded and shallow.

With an average depth of less than one meter, Source 7 contains an estimated recoverable volume of between 5,000 - 7,000 m³ of poorly drained, granular material consisting mostly of sand with some gravel. However, as source boundaries were difficult to delineate, the deposit may have a prospective volume of over 10,000 m³ of sandy material.

4.3.2 Source 8 / Island

Source 8 is an island located about 7.0 Km northwest of the community in Wilson Bay. The source area consists of numerous raised beaches formed on top of an esker-esker-delta complex with a distinct northwest-southeast orientation. Field observations were restricted to the eastern side of the island. A 500 meter ice road would be required to access the east shore of the island from the mainland and another kilometer of road would have to be constructed over land to access the old airport road. The old airport road would then have to be upgraded.

Parallel linear ridges of coarse sandy gravel are located along the eastern shore of the island that migrate inland. Similar beach ridges were found on the eastern shore of Wilson Bay but these were limited in volume, completely frozen, and shallow. The material consists of about 50 % cobbles to coarse gravel and 48 % fine gravel to sand with the 'fines' estimated at less than 2 %. The material is rounded to sub-rounded, well drained, and frozen below 1.2 meters. The majority of the coarse material was in the cobble to coarse gravel range, 25 - 100 mm.

Source 8 contains a probable recoverable volume of between 15,000 - 20,000 m³ of fair to good quality gravel. Further field sampling and test pits were planned, however, the community passed a resolution of council prohibiting the development of this source due to environmental reasons and traditional concerns. Owing to the large land area still to be examined at the time, the planned investigation of the island was terminated.

4.3.3 Remote Sources / Eskers, moraines, beach ridges.

A comprehensive terrain analysis of the study area followed by field reconnaissance showed that the sources in close proximity to the community mostly consisted of small pockets of bouldery till and post-glacial beach ridges. For the most part these sources can be accessed by existing roads or by the construction of winter roads over land and ice. Further, the same analysis indicated a large number of potential granular sources located between 20 - 30 kilometers north of the community airport and on islands within and along the shore of Wilson Bay.

Ribbed moraines, eskers and esker outwash deposits and large raised marine beaches are types of granular deposits distributed throughout the study area but the high cost to access these deposit over the rough and rocky terrain prohibit the economical development of these sources. However, knowledge of their existence is part of the granular resource inventory of the region.

4.4 ROCK QUARRIES

Large rock outcrops and ridges provide numerous potential sites for large scale drill and blast quarry operations. The location of the rock quarry would be dictated by the economic haul distance, season, method of access and geotechnical criteria.

As was mentioned, the bedrock of the study area consists primarily of granite hills and ridges that cover approximately 80 % of the land surface. At the surface, the bedrock is badly weathered and jointed with large frost-shattered boulders and cobbles size material at the base of the rock hills and ridges. However, the rock is very hard and massive and dense with depth.

The following are representative areas suitable for one or more quarry sites but, as noted above, there are numerous areas suitable for a quarry operation throughout the study area. Economic factors will ultimately dictate the choice of a specific site.

4.4.1 Q1 / Airport Road

This site is located adjacent to Source 2 about 3.5 kilometers north of the community, east of the airport road. A rock ridge defines the eastern boundary of this source and represents an extensive area suitable for a drill and blast operation. A partial view of the ridge is seen below.

PHOTO 16: Q1 - adjacent to Source 3 along the airport road.

The airport road and the pit floor of Source 3 provides excellent access. The ridge is part of a complex system of linear rock ridges that have a distinct north-south orientation. On average the ridge is about 12 meters above the surrounding terrain. Just a portion of the ridge that lies adjacent to the deposit could provide in excess of 60,000 m³ of blasted rock.

The rock is hard and dense with a sloping frontal wall that could provide good to fair access for drilling equipment. Source 3 can provide the necessary 'blend' material as well as adequate space for stockpiling material.

4.4.2 Q2 / Old Water Lake Road

This site is located on the east side of the old water lake road less than 1 Km south of community. Access is excellent by the old road to Water Lake. A narrow rock ridge parallels the road and terminates at the lake. There are two possible quarry sites along this ridge, one is situated along the recently abandoned solid waste site and the other is directly adjacent to the lake. A view of the ridge near the abandoned solid waste site is seen below.

|

|

PHOTO 17: Q2 - proposed site along Old Water Lake Road.

The ridge varies in width and averages 8 meters above the surrounding terrain. Either site could provide in excess of 40,000 m³ of blasted rock. The rock is hard, blocky, and frost shattered with small scree slopes along the frontal wall.

4.4.3 Q3 / Solid Waste Site

This area is located near the new community solid waste site adjacent to Source 1 about 1.5 Km southwest of the community. Access is excellent by way of the all season road to the community sewage lagoon and the recently constructed solid waste site. The road terminates at the most active of community borrow sources (Source 1). The site area is noted on the following page. A view of the area is seen below looking directly north towards Source 1 from the ridge.

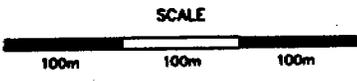
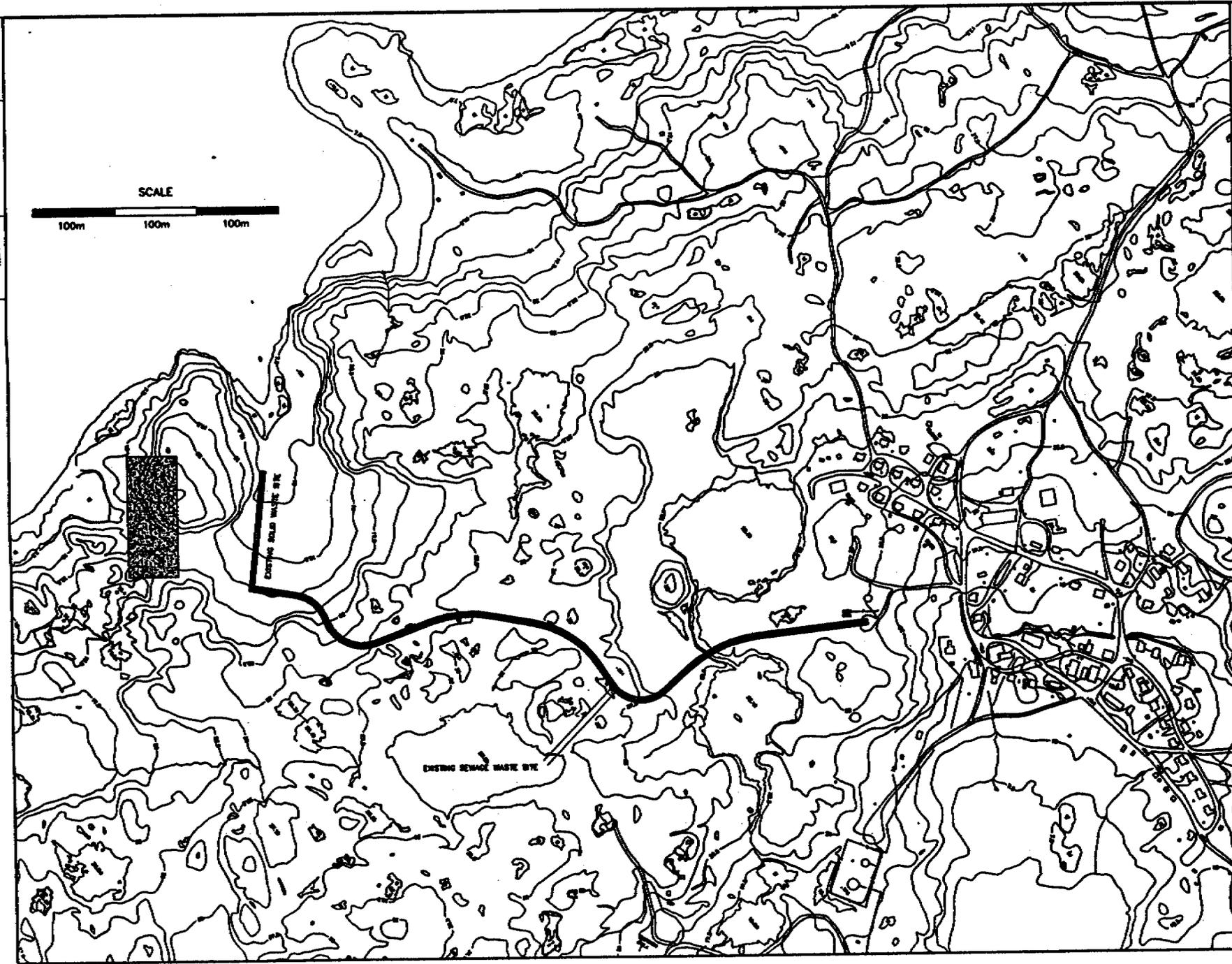
|

|

PHOTO 18: Q3 area - note Source 1 in background.

The area consists of a number of ridges and rock outcrops that are part of a complex ridge system that comprise most of the land mass southwest of the community. A series of rock ridges are located about 150 meters south of Source 1, across poorly drained tundra, as viewed above.

As mentioned, Source 1 contains sufficient 'fines' for use as a 'blend' and is situated within 150 meters of the ridge complex. There is adequate space for one or more stockpiles between the proposed quarry site and the access road; however, as this area is poorly drained especially during spring runoff, the stockpiles pad(s) has to be a minimum of one meter in thickness and should be oriented to prevent snowdrifting.



1. THE QUARRY AND CRUSH PLANT SITE IS LOCATED AS SHOWN ON THIS PLAN.

QUARRY SITE

EXISTING ACCESS ROAD

DEPARTMENT OF PLANNING, ENGINEERING, SERVICES AND PUBLIC WORKS

QUARRY & CRUSH OPERATION
WHALE COVE, N.W.T.

SITE LOCATION PLAN

DATE: 1998
SCALE: 1:500
SHEET: 01 OF 02

A partial view of a suitable quarry site about 150 meters directly south of Source 1 and the solid waste site access road is noted below; the rock is hard and dense but blocky and jointed at the surface.

|

|

PHOTO 18: Q3 - near community solid waste site and Source 1.

Access to any part of this ridge complex is excellent. Sloping frontal walls provide good access for drilling equipment. There are a number of acceptable sites among the numerous rock ridges within this area that could provide over 50,000 m³ of blasted rock per site. Site selection would depend on the volume of material required.