DRAFT

GRANULAR RESOURCE EVALUATION

IGLOOLIK, N.W.T.

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Techncial Services Division

Department of Government Services
and Public Works

Government of the Northwest Territories
Yellowknife

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DRAFT

EXECUTIVE SUMMARY

Igloolik is a rapidly growing community of over 900 people and one of the oldest Inuit settlements in the Baffin/Keewatin regions. The Hamlet has recently been impacted by major capital projects that will require all grades of naturally occurring sand and gravel in the area.

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

Eight active and potential sources of gravel were investigated as well as a potential quarry site. A fundamental conclusion, is that the community is self-sufficient in all grades of granular material assuming that proper management of exiting and potential sources is implemented in terms of the optimum and best use of identified sources.

To aid in the management of these resources, it is suggested that the Hamlet establish a reserve on Source 6 as the primary community borrow source and that all existing sources be depleted before developing future sites.

It is further recommended that the Granular Program, Department of Government Services and Public Works, mobilize a power screener when one becomes available, to aid in the processing of select grades.

Also, in light of the close proximity of large amounts of good quality embankment class material, production projects normally implemented by the Program are not necessary at this time.

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

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 referred to when reviewing this section.

4.1 ACTIVE SOURCES

The active designation is used for sources that are currently being worked or have been worked in the past and contain significant volumes of useable material. There are a large number of such sources within four kilometers of the community.

4.1.1 Source 1 / Community Pit

Source 1 is located a kilometer north of the community , west and adjacent to the road to the solid waste site and sewage lagoon. The deposit is bounded by this road to the east and the steep vertical face of the bedrock escarpment to the west and north. The source area is seen below.

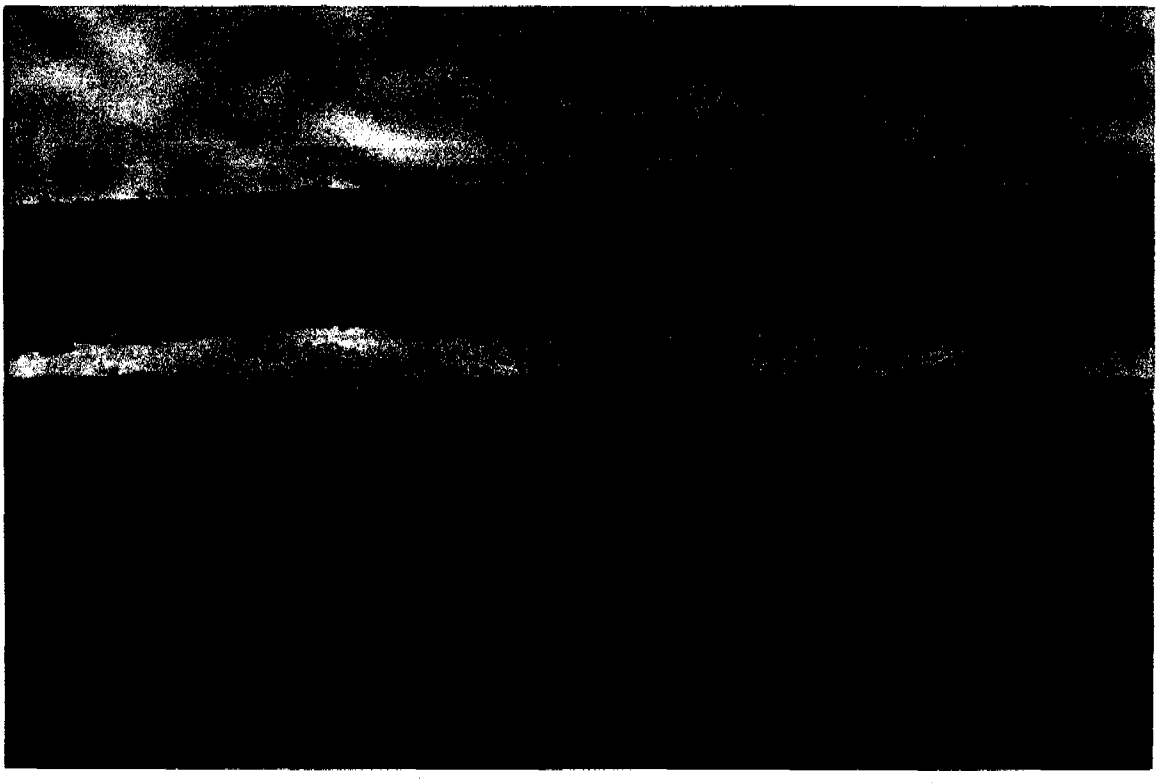

PHOTO 7: Source 1 / View is northwest from road.

At the time of the investigation (July 1991) the community was actively removing material from this source for use as general fill.

The deposit is a combination of talus slope material from the adjacent escarpment and marine beach gravel and sand. The source area is about 300 meters long and 50 meters wide. The deposit area between the community road and the escarpment has been nearly depleted. The surface of the southern area is relatively flat and has been extensively developed by the community as a source of embankment class material. As seen below, only a few stockpiles remain ; the view is looking southwest from the top of the escarpment; note the road to the solid waste site in the background.

PHOTO 8: Source 1 / Developed southwest section.

Extraction is no longer possible below the present contour of the pit floor. Ground water and/or frozen ground is at or near the surface. The talus slopes of the escarpment provide most of the remaining recoverable granular material at this source with small, isolated pockets of coarse, beach ridge material, less than a meter thick, located near the base of the escarpment .

The northern section of the deposit is also near depletion with a number of small stockpiles scattered over the depleted area. The stockpiled material consists of 3 % oversize, 51 % cobbles to gravel, 24 % sand, and 12 % 'fines. The material is slightly plastic with a plasticity index of 2.2. The material near the escarpment is similar but contains a higher percentage of oversize and less 'fines'. A view of the stockpiled material is seen below.

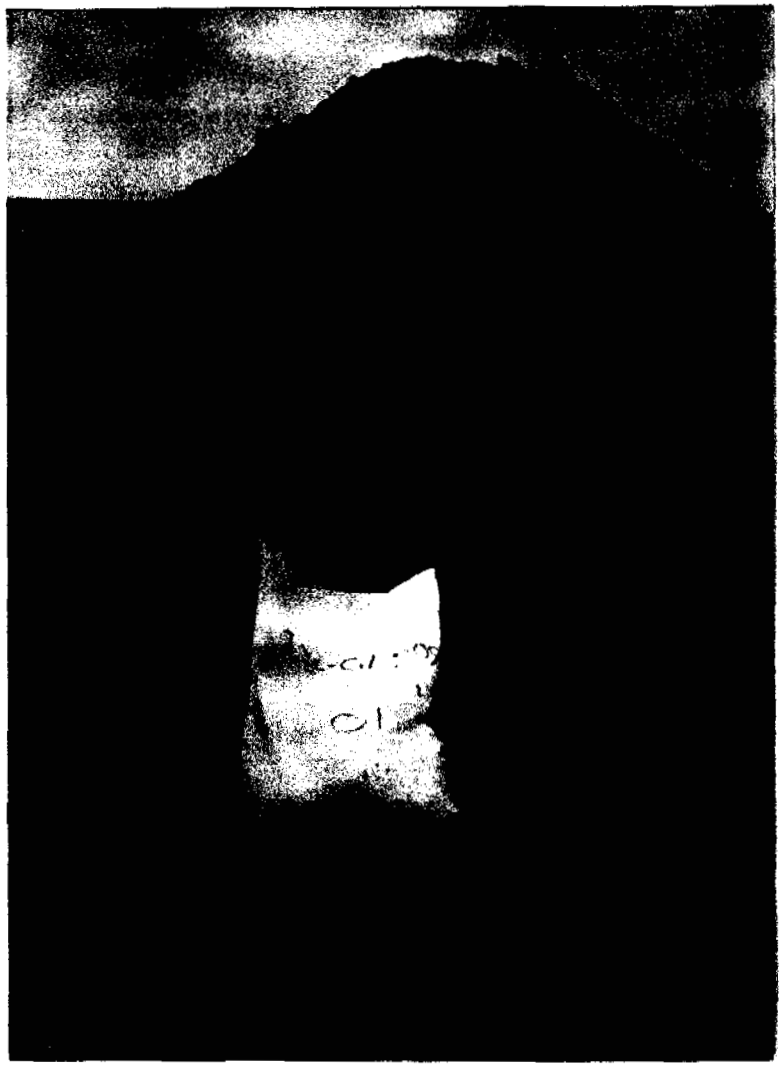

PHOTO 9: Source 1 material - cobble to silt sizes

Source 1 has a probable recoverable volume near 10,000 m^3 of all grades of granular material, mostly as several small stockpiles scattered throughout the borrow area and in the talus slopes adjacent to the escarpment.

4.1.2 Source 2 / North and South

Source 2 is a large deposit located directly west of the settlement, adjacent to the airport road, that is still used on occasion by the community as a source of embankment class material.. The deposit is bounded to the north by a standing body of water and peat terrain, to the east by the elevated airport road, and to the west and south by near surface bedrock and poorly drained, low-lying terrain. The eastern boundary of the deposit is seen below; the view is looking southeast towards the elevated airport road.

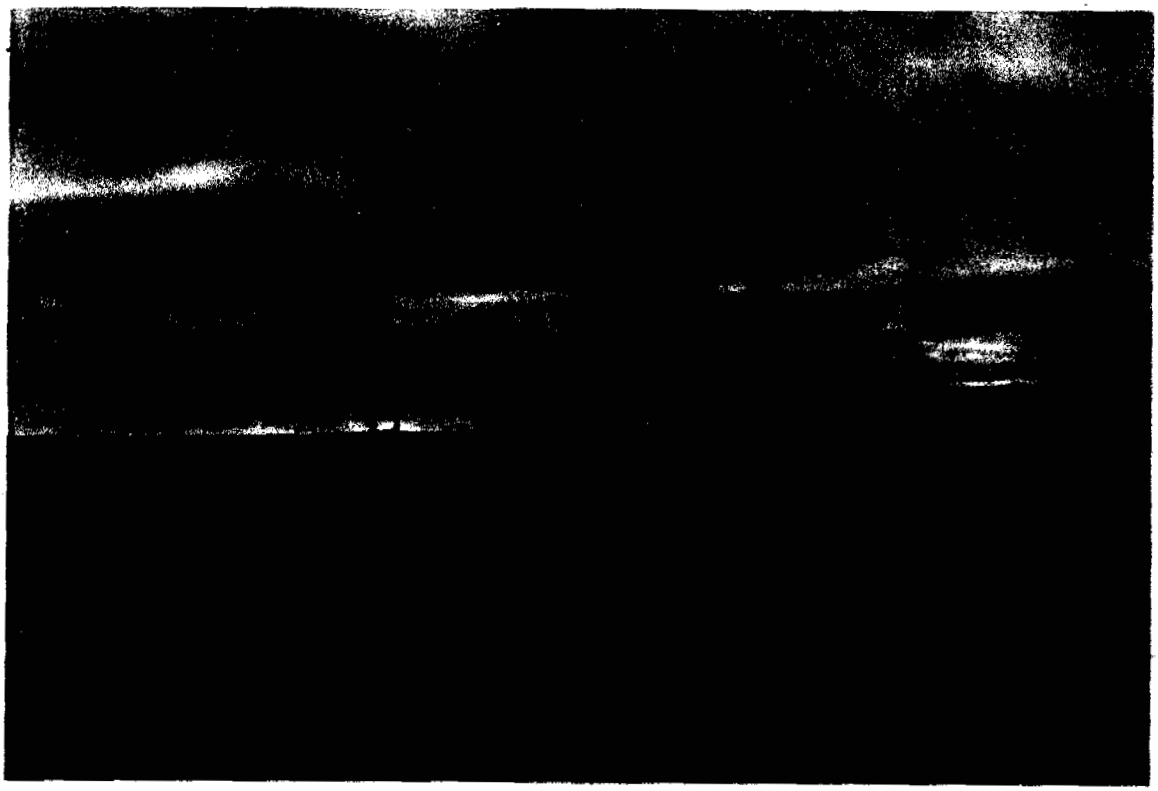

PHOTO 10: Source 2 borrow area.

The deposit is a raised marine beach ridge that lies adjacent to the western slope of the airport road and continues westward eventually merging into the peat and bog terrain of the coastal plain. Source 2 is an elongated ridge, narrower to the south, that slopes northwest leading down to the standing body of water marking the northern most boundary of the source. The deposit covers an area 600 meters long and varies in width between 250 and 400 meters. The deposit varies in thickness becoming shallow and discontinuous to the south and west.

Over the years, this deposit has been used extensively by the community as a source of granular borrow. A series of access roads, most of which are now part of the existing pit floor, traverse diagonally across the source area separating the elongated ridge into northern and southern segments. The northern area is about 250 m x 400 m and is near depletion. A view of this area is seen below.

PHOTO 11: Source 2 - north section.

This area is relatively flat with groundwater near or at the surface. Frozen ground was encountered at 0.4 meters below the surface. Several small stockpiles remain scattered over the borrow area. The relatively flat nature of the pit floor provides excellent access; pit boundaries and extraction depth have been maximized in this area of the deposit.

The southern area of Source 2 is situated at a slightly higher elevation. This area has also been excavated but not to the same degree as the area to the north. The southern segment of Source 2 is about 300 meters long and 250 meters wide. The average thickness under undisturbed portions of Source 2, mostly located in the southern area of the deposit, is about 1.0 meters and decreases laterally to the south and west. However, material has been 'pushed-up' to over 2.5 meters above the surrounding terrain. Frozen ground was encountered at 0.5 meters below the surface within the undisturbed areas. Ice lensing was noted in several old test pits.

Excavation has occurred at random, especially in the southern section of the deposit, leaving numerous small stockpiles and ridge walls of coarse gravel and sand. Existing boundaries can be extended to the west for another 30 meters. A view of the southern area of Source 2 is seen below.

PHOTO 11: Source 2 - south section

The average thickness under undisturbed portions of Source 2, mostly located in the southern area of the deposit, is about 1.0 meters and decreases laterally to the south and west. However, material has been 'pushed-up' to over 2.5 meters above the surrounding terrain. Frozen ground was encountered at 0.5 meters below the surface within the undisturbed areas. Ice lensing was noted in several old test pits.

Material composition is variable throughout the deposit. As the northern area is at a lower elevation and overlies lacustrine sediments from the nearby lake, the material tends to be poorly drained, poorly graded, and on average consists of 43 % gravel sizes, 45 % sand, and 12 % 'fines'. One sample contained over 17 % "fines'. Oversize was minimal, less than 1 %. Overburden was thin and limited to the present pit boundary.

Situated at a slightly higher elevation and underlain by bedrock, the southern area is better drained, the material is coarser and contains a lower percentage of 'fines'. Also, portions of this area are still undisturbed thus pit boundaries can be extended west and south. A view of the material is seen below.

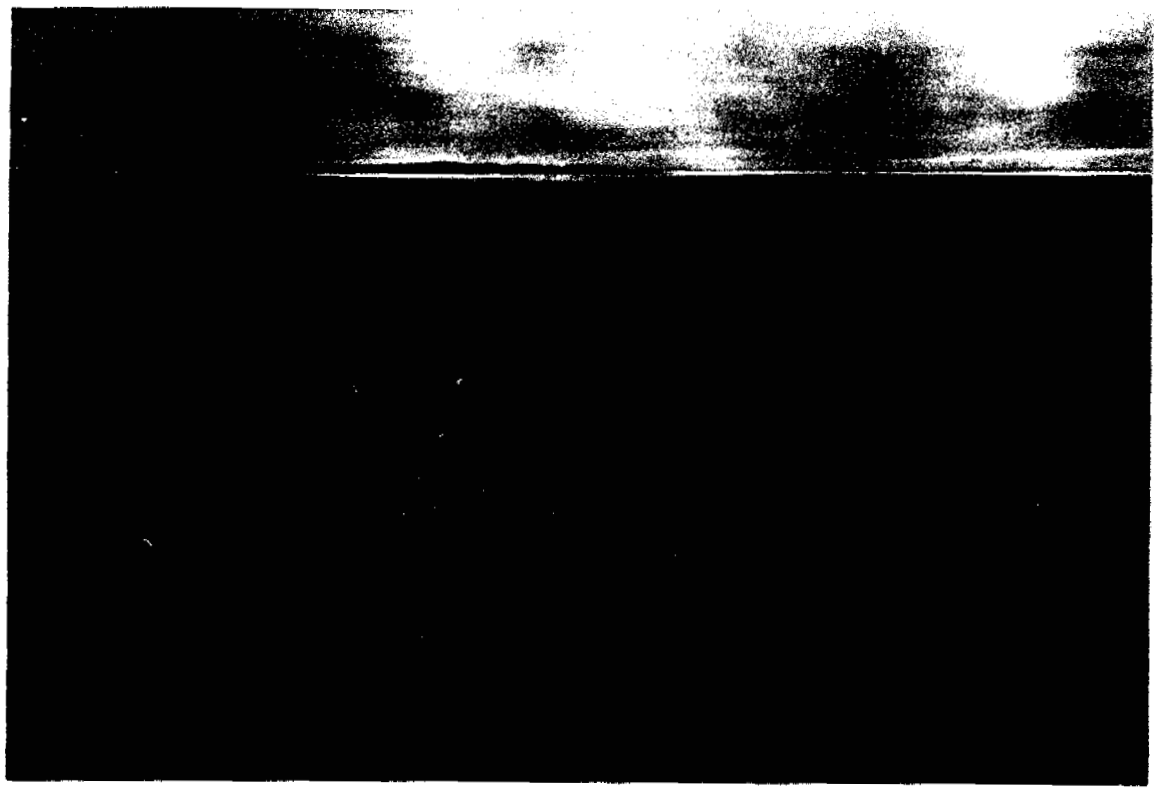

PHOTO 12: Source 2 material -- gravel to cobbles.

The material consists of 52 % gravel sizes, 45 % sand, and 3 % 'fines'. Oversize is minimal. Overburden is thin and discontinuous over undisturbed areas. Several small stockpiles are scattered over the source area.

Source 2 has a remaining recoverable volume in excess of 7,000 m^3 of all grades of granular material.

4.1.3 Source 3 / Southwest Borrow Site

Source 3 is a small borrow area situated 3.2 kilometers southwest of the community about 100 meters west of the reservoir road. Access is by the existing road to the water reservoir and a trail over the raised beach ridge west of the road.

The deposit is part of a poorly developed beach ridge that parallels the reservoir road. Material thickness is extremely shallow over the areal extent of the ridge, less than 0.5 meters, except at the southern terminus where the borrow area is located. Source 3 is seen below; the view is southwest.

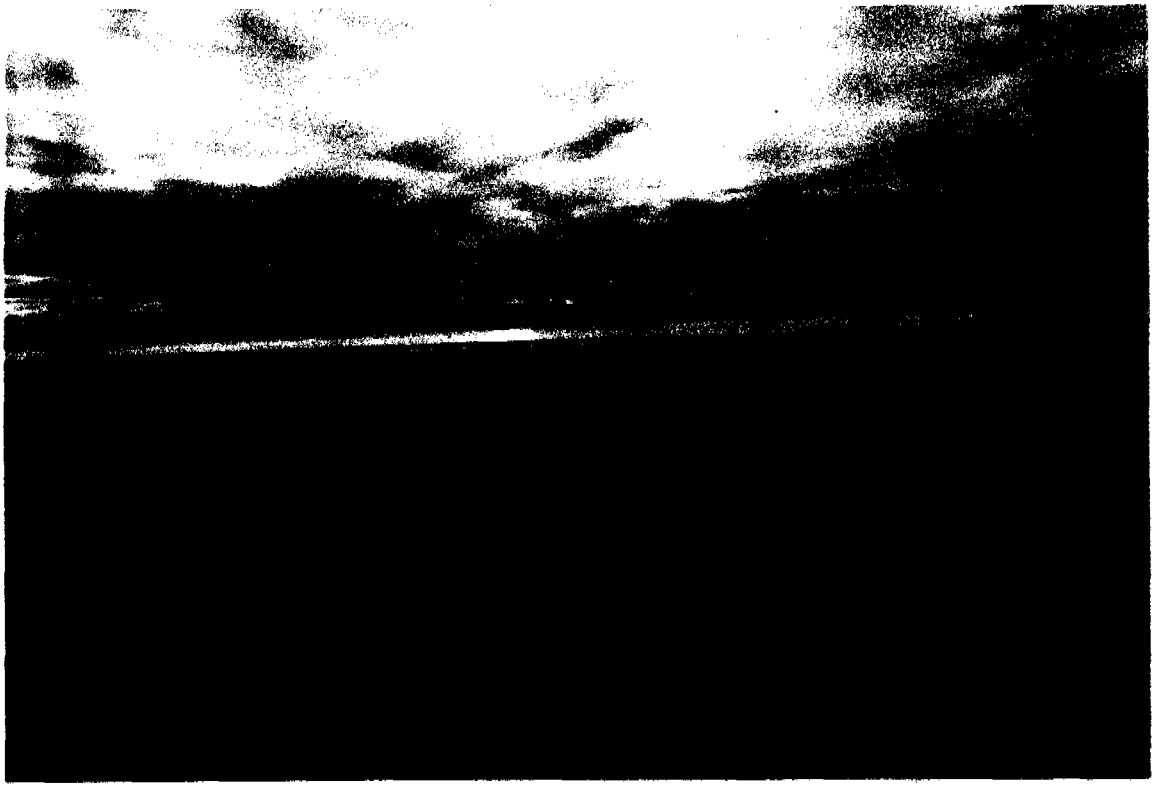

PHOTO 13: Source 3 borrow area.

The borrow area is about 50 m x 70 m with an average depth of 1.5 meters and slopes gradually to the west and south to merge into low-lying, peat terrain. To the east the deposit is bounded by the reservoir road; the ridge continues to the north but the unconsolidated material becomes shallow with bedrock near or at the surface. Colluvial deposits of organic silts and clays are present on the ridge slopes to the north and west. The depth of the active layer is not known due to the difficulty in penetrating the very coarse, unconsolidated layer of cobbles and gravel.

The material is well drained, well graded, flat to semi-rounded fragmented, argillaceous limestone, typical of most of the beach ridges located within the study area. Approximately 500 m^3 of material has been 'pushed-up' to form a small stockpile. A view of the material is seen on the following page.

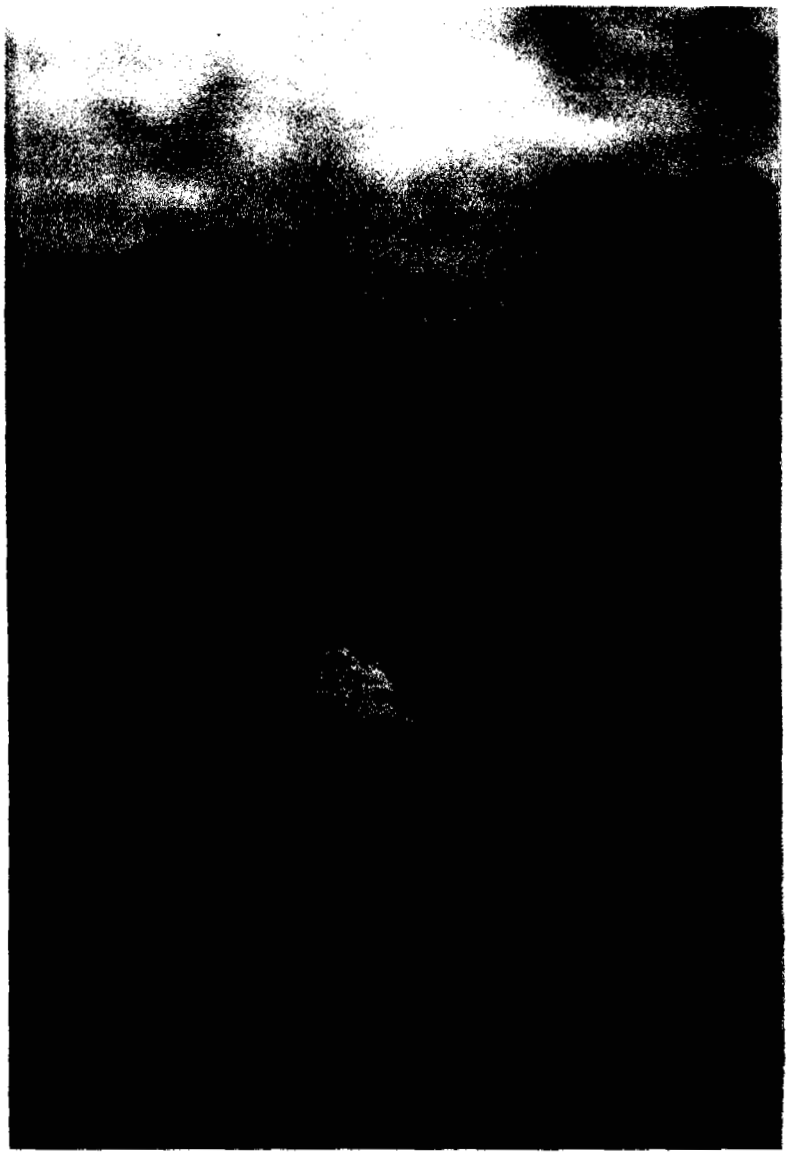

PHOTO 14: Fragmented limestone/dolomite.

The material consists of 3 % oversize, 87 % cobbles to gravel sizes, 8 % sand, and 2 % 'fines'. Overburden is minimal. Source 3 has a remaining recoverable volume of about 3,000 m^3 of common grade material.

4.1.4 Source 4 / Reservoir

Source 4 is a non-specific area surrounding the new water reservoir located about 3 kilometers southwest of the community. The source area is heterogeneous mixture of material excavated from the drained lake and beach ridge and colluvium material that has been 'pushed-up' into several piles surrounding the reservoir.

The material is typical of marine deposits located in the area and consists of 80 % cobbles to gravel and 15 % coarse sand. The 'fines' content is estimated at 5 %. The material is well drained and poorly sorted. Boulder to gravel size material has been placed along the western slopes of the reservoir road. The material, seen below, is very coarse with large rock slabs in excess of 1 meter; the view is to the southeast.

PHOTO 15: Large oversize material of Source 4.

The area surrounding the reservoir and adjacent to the road has a remaining recoverable volume of approximately 5,000 m^3 of common grade material.

4.2 ABANDONED SOURCES

Over the years, large quantities of granular material are required for use in community infrastructure projects and for the construction of existing airstrips. As a result, numerous abandoned and/or depleted borrow sources exist within and around most community's. In some cases material still exists in these deposits and generally the remaining borrow material is used for the restoration and reclamation of each borrow site. In the case of Igloolik, depleted borrow areas have been incorporated into the community infrastructure such as new subdivisions or the water reservoir. The existing sources that have been discussed have been used extensively over the years by the community to supply needed granular materials. Some of these sources could be considered abandoned but all still contain significant volumes of granular material. For this reason, with respect to the availability of granular material for use in community infrastructure projects, these sources have been considered as 'active' as designated above.

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 a number of economically viable potential sources in close proximity to the settlement of Igloolik.

4.3.1 Source 5 / Old Airport Site

This source includes a group of wide, sub-parallel, raised, marine beach ridges located within an area 800 meters long and 500 meters wide. The deposit is 1.5 to 2.5 kilometers northwest of Igloolik and accessible via an all season road (a continuation of the sewage lagoon and solid waste site access road). The source area includes the old airport runway, now abandoned, located on one of the raised ridges. These series of ridges begin about 500 meters northwest of the present shoreline of Turton Bay and are oriented in a northwest - southeast direction. Post-glacial marine wave action and eolian processes have merged ridges together to form a continuous undulating plain of fragmented, sub-rounded to sub-angular, granular material that cover an estimated 40 hectares of terrain. The material has accumulated to about 1.5 meters above the surrounding terrain.

The source area is seen below; the view is southeast from the top of the escarpment.

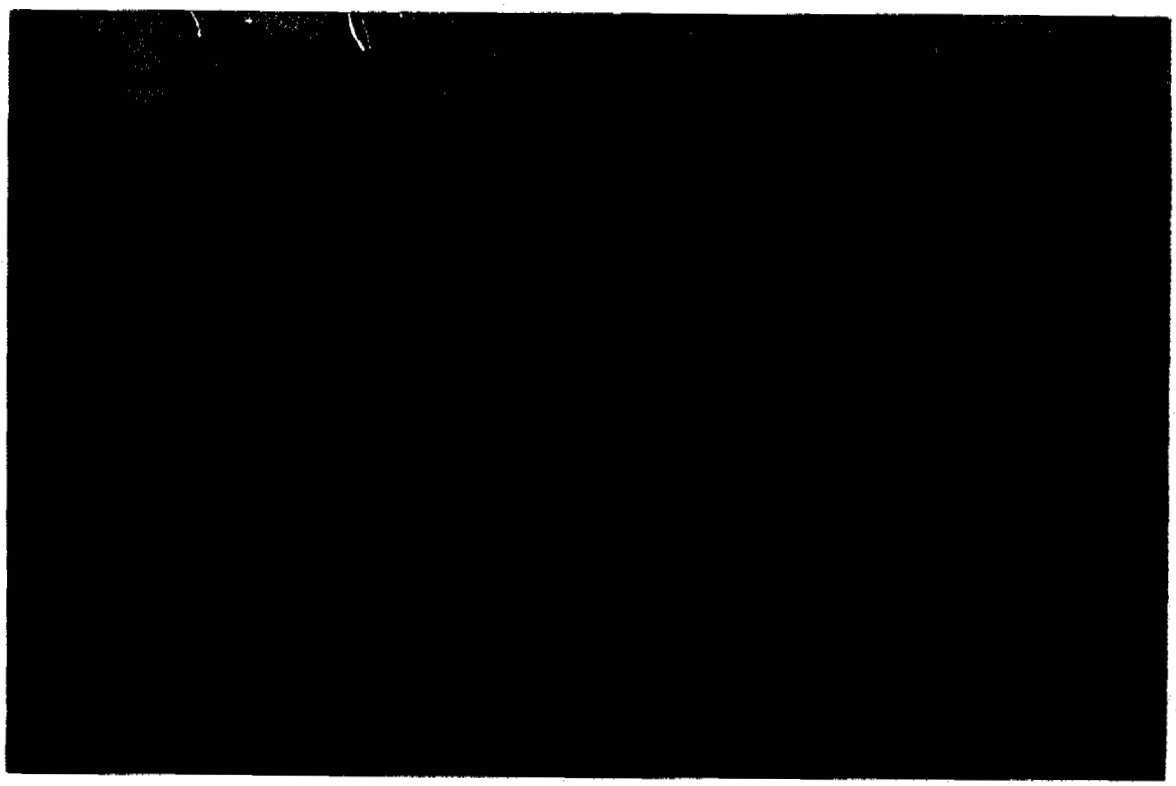

PHOTO 16: Source 5 - marine beach ridges.

The source area is bounded to the east by the old airstrip and coastal plain beyond, and to the southwest by the bedrock escarpment. The terrain to the north and west is formed of gently sloping, parallel, marine ridge deposits that eventually merge with the flat peat covered, poorly drained areas of the island.

The old airstrip begins just north of the solid waste site along one of the lower beach ridges about 600 meters inland from the shore of Turton Bay. The beach ridge was only surface graded; no major work was done to upgrade the airstrip. A view of the abandoned airstrip is seen on the following page..

PHOTO 17: Old airstrip adjacent to escarpment.

On average the beach ridge material consists of 61 % cobbles to gravel size fragments, 30 % coarse sand, and 9 % 'fines'. The sand content is higher, up to 53 % along the abandoned airstrip probably due to grading of the runway (the argillaceous limestone/dolostone fragments easily break down under minimal pressure). The active layer is shallow; frozen ground was encountered within 0.5 meters of the surface. Ice lensing was noted in old test pits. The average depth of the unconsolidated material is about 1.0 meters but wind and post-glacial wave action increased the thickness of some ridges to about 1.5 meters above the surrounding terrain Adjacent to the base of the escarpment, frost-shattered debris has covered the beach ridge material. As a result, the beach ridge near the escarpment is covered by oversize, fragmented bedrock. A view of the ridge material, northwest of the abandoned airstrip, is viewed on the following page..

PHOTO 18: Beach ridge material - coarse and angular.

Source 5 has a probable recoverable volume in excess of 400,000 m^3 of common grade material that covers an extensive lateral area, however, material thickness varies considerably and is often shallow and discontinuous.

4.3.2 Source 6 / Beach Ridges - South

This source is another very large, non-specific site area located south and west of the community airport. The area includes a number of linear, parallel , raised marine beach ridges within an area 1500 meters long and 800 meters wide.. In general, this source covers a large area of the island bounded by the reservoir road to the west, the community airstrip to the north, and Turton Bay to the east. The ridges become discontinuous and shallow to the south eventually merging into a poorly drained lake basin area. The existing airstrip and the entire land area defined by the present airport boundaries are actually part of the large areal extent of Source 6 that continues north towards the settlement and east towards Turton Bay.

Access to this source is via the airport and/or reservoir road and then along almost any of the raised ridges. The source area is seen below; the view is looking directly north towards the community airstrip.

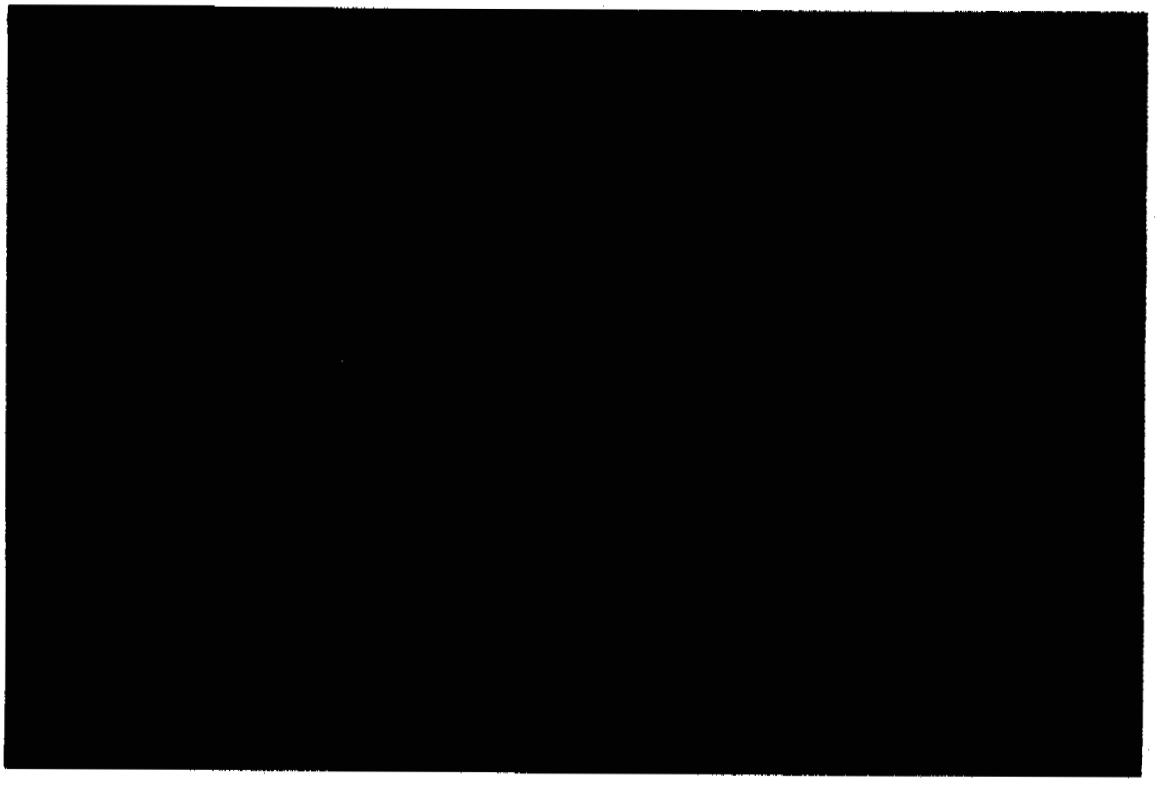

PHOTO 19: Typical cobble/gravel ridge of Source 6

The deposit is formed of gently undulating beach ridges that have been re-worked by eolian and marine processes creating a large plain of very coarse, fragmented, beach material. The ridges obtain a maximum height about 2.0 meters above the surrounding coastal plain, terracing has occurred along the eastern slopes facing Turton Bay. In general, the thickness of the unconsolidated cobbles and gravel ridges is about 1.5 meters. The material is well drained with the active layer below the exposed gravel ridges; ice lensing was not observed within the unconsolidated debris along the ridge slopes.

The material consists of 90 % cobbles to gravel, 8 % sand, and 2 % 'fines'. A large percentage of the material is in the cobble size range with an average length between 76 mm - 144 mm. Oversize is about 5 %. Material is soft and friable.

The ridge material of Source 6 is viewed below; note the coarse, angular, fragmented nature of the deposit.

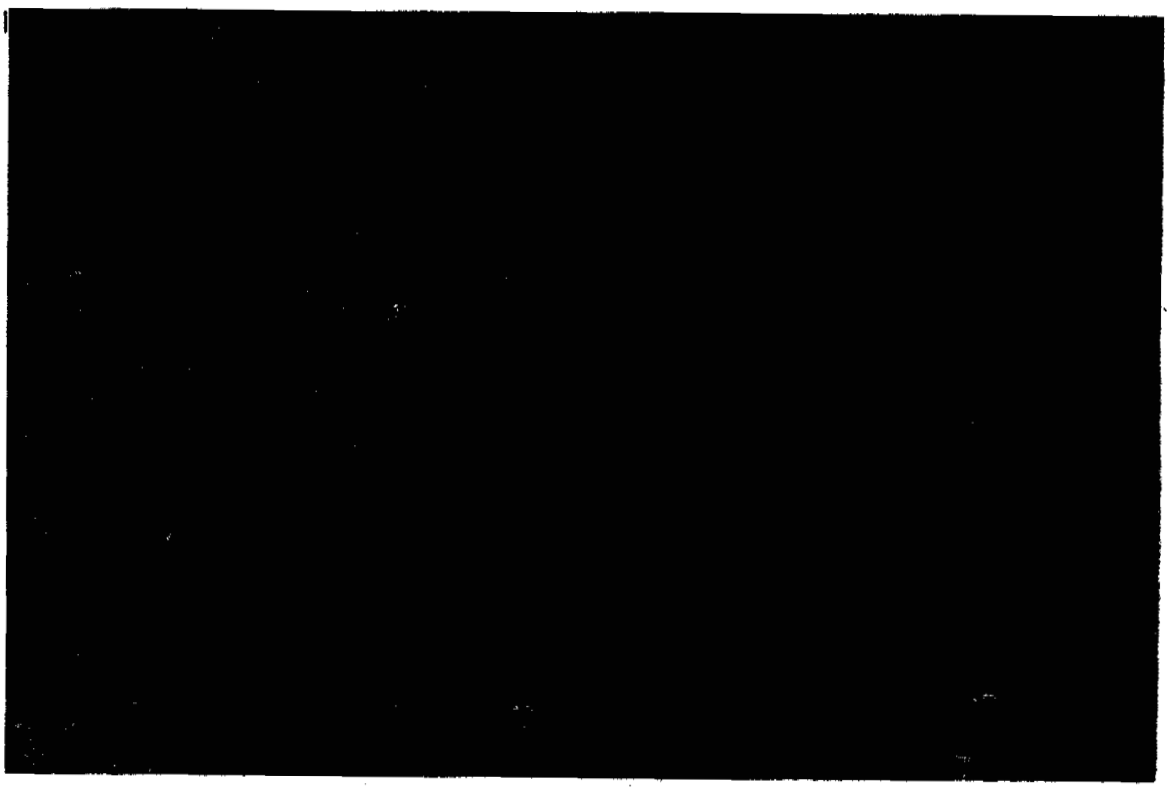

PHOTO 20: Broken and fragemented dolostone.

Source 6 has a probable recoverable volume in excess of 1,000,000 m^3 of common grade material suitable as general fill or as 'pitrun' for a crushing operation.

4.3.3 Source 7 / West Subdivision

Source 7 is formed of gently sloping beach terraces that lead down from the airport road to the shores of Turton Bay. The source area lies adjacent to the western boundary of the community and continues westward toward the POL site, however, after about 700 meters the deposit becomes shallow and discontinuous with bedrock at or near the surface. The deposit is shallow with an average depth between 0.8 m and 1.0 m.; the depth increases upslope towards the airport road.

The deposit comprises an area approximately 700 meters long and 300 meters wide adjacent to the western edge of the community. The community is expanding in this direction, Phase 4 of the West Subdivision Final Plan, to commence during the 1994/95 fiscal year, will be located adjacent to and will partially cover the source area.

Source 7 is seen below ; the view is looking northwest towards the western boundary of the community; note the bedrock escarpment in the background.

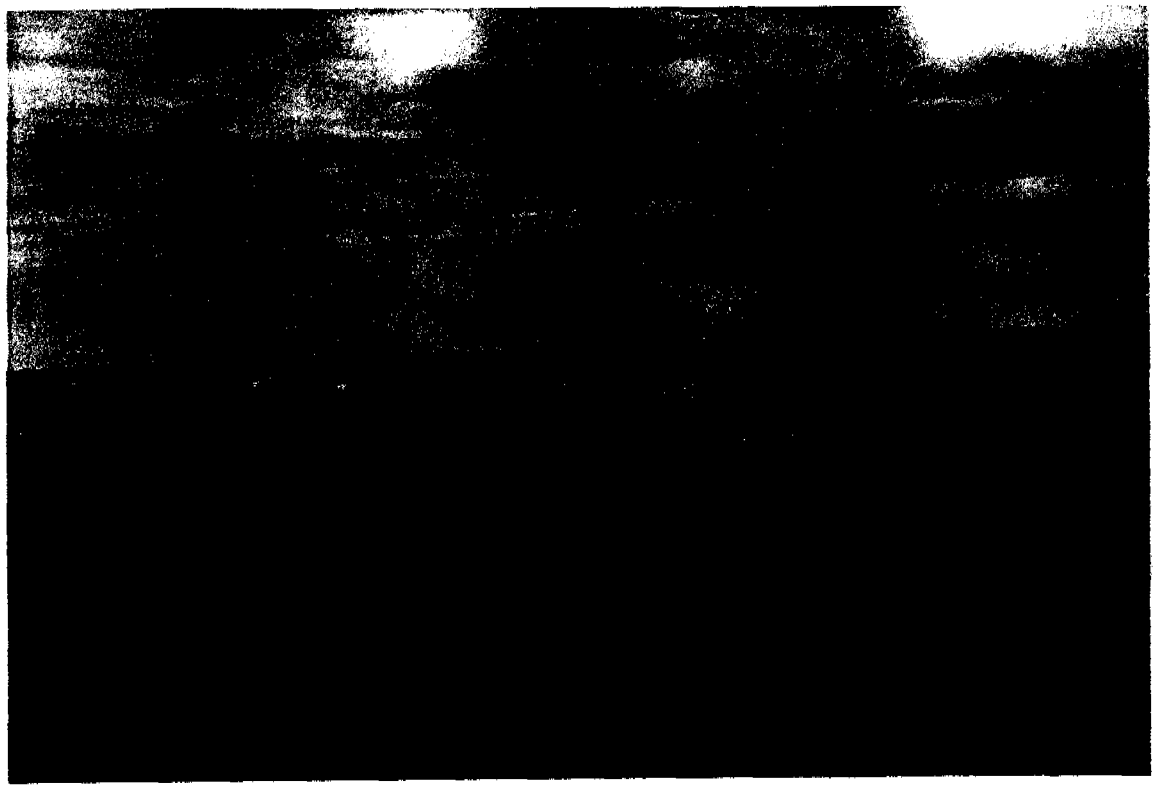

PHOTO 21: Source 7 - forefront of photograph.

A number of test pits were observed throughout the source area. The water table was near or at the surface and frozen ground was encountered 0.9 meters below the gound surface. The surface has a thin cover of peat and organic clays and silts and the active layer was wet and poorly drained. The ground slopes gently towards Turton Bay but drainage is poor and ponding prevalent.

On average, the material consists of 57 % gravel, 40 % very coarse sand, and 3 % 'fines' and is poorly graded.

Source 7 is situated in an area of core expansion and contains a probable recoverable volume in excess of 165,000 m^3 of common grade material ; however, extraction depth is shallow and the material is wet and highly permeable.

4.3.4 Source 8 / Northwest Peninsula

This source is located approximately 4.2 Km southwest of the community. The deposit covers a peninsula of land situated towards the far southwest corner of the island. Access is by the water reservoir road and then by a narrow trail that lead to this part of the island. The peninsula and surrounding terrain is partly used as a recreation area by the community. The source area is seen below; the view is looking southwest from Source 3.

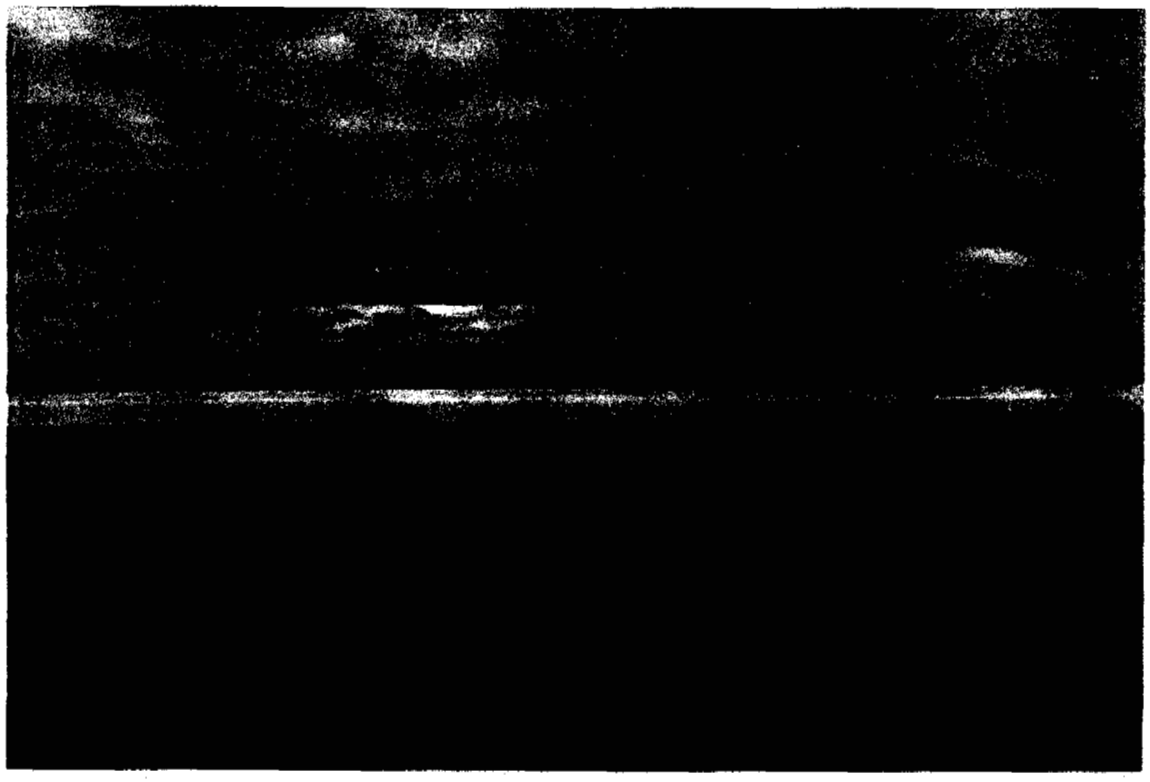

PHOTO 22: Source 8 - frozen gravel deposit.

The deposit is a modern storm beach with an irregular shape, about 200 meters long and 50 meters wide, is relatively flat with an average depth of 1. 5 meters above the surrounding, poorly drained terrain. However, only about 0.5 meters is unconsolidated , the remaining material is perennially frozen.

The deposit is well drained and consists of over 90 % cobbles and gravel; the material is angular and flat with few 'fines'. No sample was obtained as the material was frozen at a depth of 0.4 meters below the gravel surface and penetration was difficult through the unconsolidated layer of cobbles. The deposit rises above the low-lying coastal plain as viewed below.

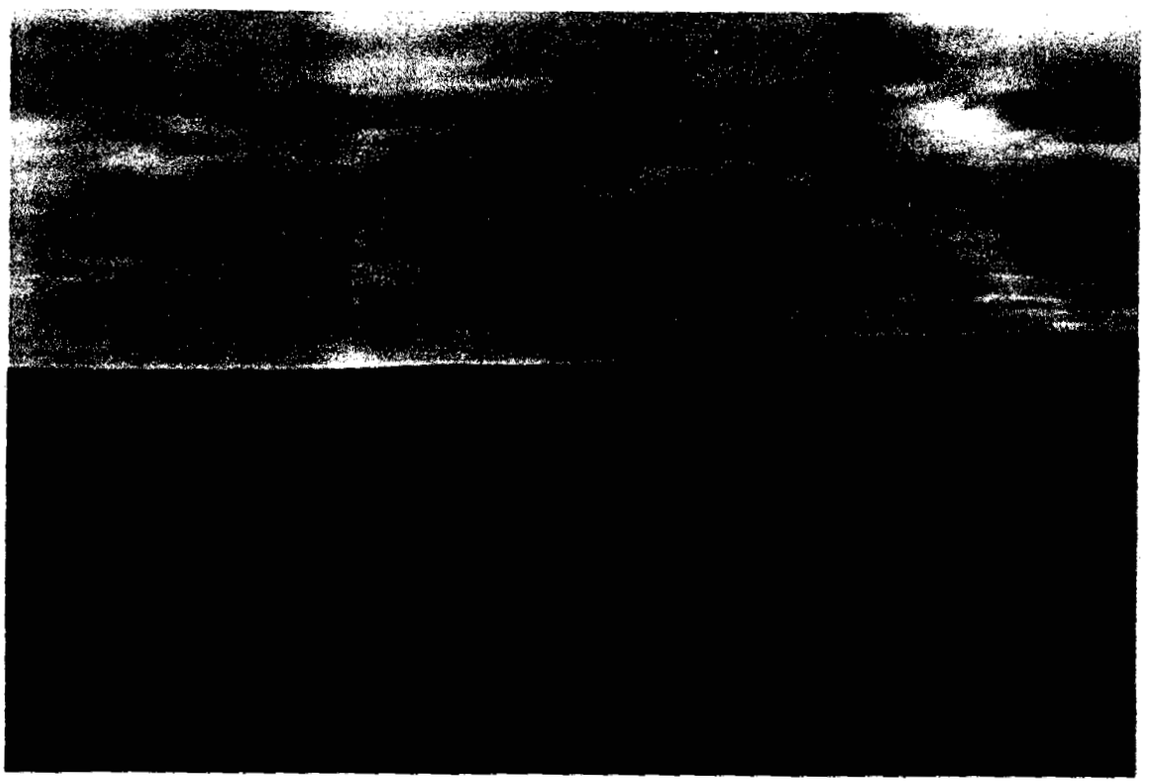

PHOTO 23: Source 8 rises above surrounding terrain.

Source 8 has a probable recoverable volume in excess of 8,000 m^3 of common grade material, however, most of the material is perennially frozen below 0.5 meters.

4.3.5 Rock Quarry

There are no suitable sites for a rock quarry operation within the study area. Screening or crushing of 'pit-run' are better alternatives. The escarpment situated northwest of the community does provide a suitable vertical face for a drill and blast operation but the bedrock is soft, highly fractured, blocky, and badly weathered with a poor drillability coefficient. The rock breaks down into long flat fragments. A view of the badly weathered and jointed bedrock of the escarpment is seen on the following page,

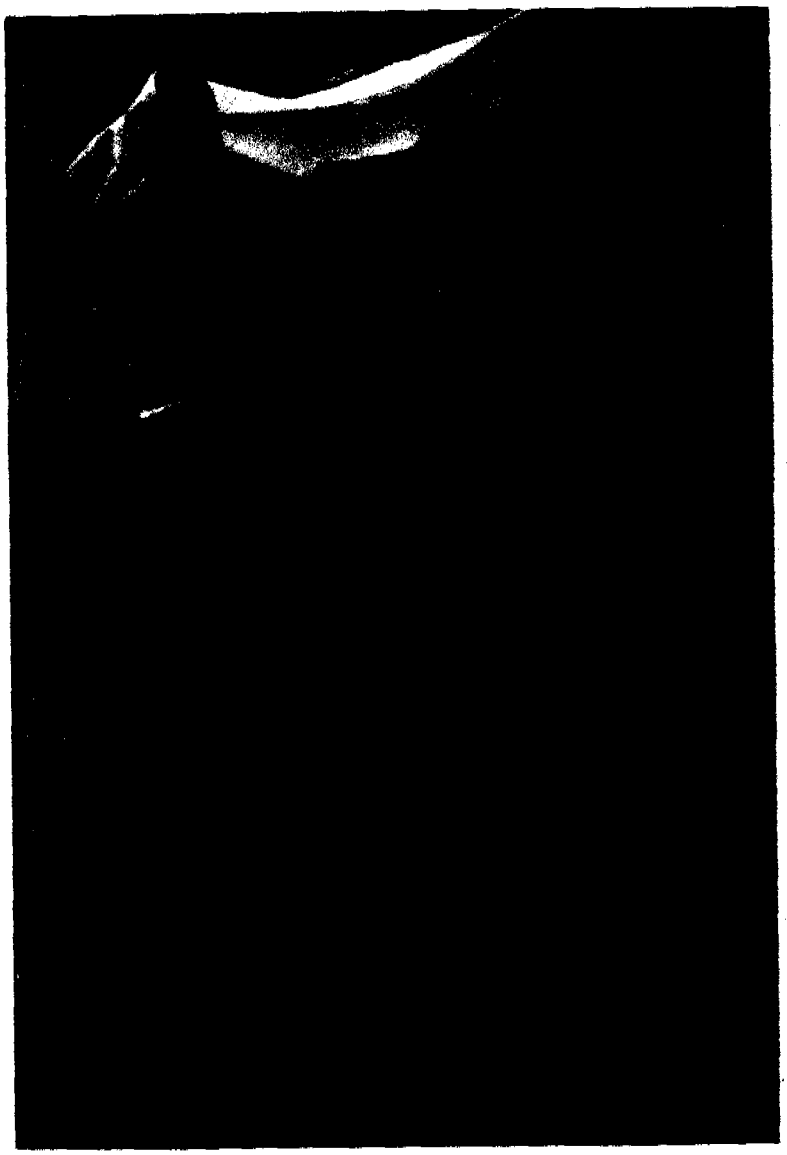

PHOTO 24: Weathered bedrock.

Rock samples were obtained for material testing. When crushed to 25 mm, the material consisted of 78 % gravel, 16 % sand, and 6 % 'fines'. The crushed material did not meet the gradation specifications for a select grade. Also,the abrasion loss was over 90 % and therefore continual replacement would be necessary if crushed material was used for surfacing.

Although crushing of the 'pit-run' is a viable option, a 'blend' source would still be necessary to improve gradation as the beach ridge material is primarily comprised of limestone and dolomite, similar to the bedrock of the escarpment.

6.2 TABLE 2: COMPARISON OF GRANULAR RESOURCE SOURCES

Source	Distance from Community	Access	Material Type and Quality	Quantity Cubic Meters	Cost/cu./m Load, haul place, & compact.	Environmental Impact
1	1.0 Km	Excellent	Silty Gravel Common Grade	10,000 Fair	$16.50	Moderate Erosion controal and adequate drainage
2	0.5 Km	Excellent	Sandy Gravel to Gravelly Sand All Grades	7,000 + Good to Excellent	$16.50	Minimal
3	3.2 Km	Fair	Cobbles and Gravels Common Grade	3,000 Good	$17.00	Minimal
4	3.5 Km	Good	Rip Rap Boulders Gravels Common Grade	5,000 Poor to Good	$17.00	Moderate Stockpiles should be used and surronding area restored
5	2.0 Km	Excellent	Cobbles to Sandy Gravels All Grades	400,000 Good to Excellent	$16.50 to $17.00	Minimal Adequate drainage shoould be provided and proper pit design
6	2.5 Km	Excellent	Cobbles and Gravels Common Grade	1,000,000 Fair to Good	$17.00	Minimal Ensure Proper Pit boundaries
7	0.5 Km	Excellent	Gravel and Sand Common Grade	165,000 Poor to Fair	$16.50	Minimal
8	4.2 Km	Poor	Cobbles to Sandy Gravels All Grades	8,000 Not Recommended	$20.00	Severe

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 self-sufficient in all grades of granular material and thus granular production projects normally initiated by the Granular Program, Department of Government Services and Public Works, are not recommended for implementation at this time.
- to enhance the ability of the community to process select material, the Granular Program initiate the mobilization of a 90B Screen-All to the community should one become available.

Resource Management

- the Municipal Council direct, by resolution, that the resources discussed in this study be utilized only for the purposes as described in Section 6 of this report.
- the Municipal Council direct, by resolution, that further development of potential sources be deferred until existing sources are depleted or for at least a two year period until 1995/96
- the Municipal Council approve, by resolution, the establishment of a reserve, quarry license and land use permit on the entire Source 6 and that this site remain the primary source of embankment class material for community infrastructure projects and insure that all environmental and operational guidelines for the proper, cost-effective, and timely development of this source are in place

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.