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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
TOPICAL REPORT NO. 25

YUKON RIVER DRAINAGE BASIN
DAM SITE INVESTIGATION

SITE NO. 20

GERC DAM SITE
(MAP AND PRELIMINARY REPORT)

BY

E. B. OWEN



OTTAWA
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GERC DAM SITE

General Description

Gerc dam site is located on Pelly River about one half mile upstream from Braden's Canyon site which is described in Topical Report No. 26, site No. 21. Gerc site is an alternative to Braden's Canyon site. At the site the River is flowing in a southwesterly direction between high outcrops of metamorphic rocks similar to those exposed at the Braden's Canyon site. These rocks belong to the Yukon Group and have been described by Bostock¹ as Precambrian or Later.

It is assumed the elevation of the crest of the proposed dam would be 1,645 feet above sea level which is the same as that for the dam at the Braden's Canyon site. The elevation of the water surface of Pelly River at the Gerc site is usually slightly less than 1,462 feet.

The left abutment at the Gerc site is located in an extension of the rock ridge which forms the left abutment at Braden's Canyon site. The ridges forming the right abutments of the two sites, however, are not continuous but are separated by a wide terrace of sandy gravel overlain with a few feet of fine, silty sand. The chief difference between the two right abutment areas is the presence of a narrow draw behind the power dam abutment at Braden's Canyon which will necessitate the construction of an earth-fill saddle dam to contain the water in the reservoir.

The thickness of the overburden underlying the River at Gerc site is not known. It is probably shallow and of comparable thickness to that at Braden's Canyon site. Test borings should be put down along the proposed dam axis to investigate the quality and permeability of the material overlying bedrock and to determine the elevation of bedrock surface.

¹ Bostock, H.S.; "Carmacks District, Yukon"; Geol. Surv., Canada, Memoir 189, 1936

The two upper terraces located immediately north of Braden's Canyon site have approximate elevations of 1,530 and 1,705 feet above sea level. They do not extend upstream into the area mapped at Gerc site. Above Gerc site, however, they occur along the right side of Pelly River for a considerable distance. About a mile upstream from the site the elevations of the two terraces are 1,585 and 1,829 feet.

Unconsolidated Deposits

Three types of unconsolidated deposits have been identified in the area adjacent to the proposed dam site. They are as follows:

1. Recent Alluvium: This is a deposit of the present Pelly River and occurs only in a limited area along the left edge of the River. It consists of a dense, fine-grained, silty sand with numerous boulders up to 10 inches in diameter. It is a small deposit and not considered important.

2. Alluvium (fine-grained, silty sand): This material consists of a dense, graded, silty sand with very few pebbles. The deposit is believed to be thin and to directly overlie bedrock. Gravel was not observed in test pits put down into this material to depths up to 4 feet. The alluvium is an unimportant deposit occurring only on the left side of the River.

3. Talus: This material occurs only in the left abutment area. It consists of broken fragments of bedrock ranging in size from sand to large rock fragments 8 feet in diameter. It is covered with vegetation in many places. The thickness of the talus is believed to be less than 10 feet.

Bedrock

General Description

Two different rock types, gneiss and limestone, have been identified in the area about the Gerc dam site. Similar rocks occur at adjacent Braden's Canyon site and consequently the descriptions of bedrock contained in the reports

for the two sites are much the same. Exposures of quartzite and conglomerate are lacking at Gerc site.

1. Gneiss: Gneiss constitutes most of the rock exposed at Gerc site. It is a dark grey, fine- to medium-grained rock composed of quartz, feldspar, biotite and hornblende. In most exposures it appears massive. Banding is present but is not as apparent as at Braden's Canyon site. Schistosity is rare.

2. Limestone: Limestone interbedded with the gneiss occurs in both abutment areas. It is a light grey to white, crystalline rock occurring in beds and lenses varying in thickness from 6 inches to 20 feet. The beds in the right abutment strike downstream toward the limestone exposures in the right abutment at Braden's Canyon site and doubtless represent an extension of these beds. The dips of the bedding at the two sites are similar varying from 50 to 71 degrees north (i.e. into the right abutment).

Bedrock Structures

The attitudes, i.e. the strikes and dips of the gneissic banding and schistosity and of the limestone beds, at Gerc site are approximately the same as those at Braden's Canyon site. However, because the course of Pelly River is different the strata at Gerc site intersect the proposed centre line at a different angle to that at the other site. At Gerc the strata are almost parallel to the River and consequently intersect the proposed centre line at angles from 80 to 85 degrees. The dips are all toward the right abutment.

Minor jointing is common with one prominent set parallel to the centre line and another intersecting the centre line at 45 degrees. Dips are steeply upstream. As at Braden's Canyon site there are no visible structures in bedrock at Gerc site that indicate it would not make a satisfactory dam site.

Quality of Bedrock

The gneiss which constitutes most of the rock exposed at the site is massive and durable. It should make satisfactory abutment and foundation material and should not present any problem during construction. A few small, solution cavities were observed in the limestone exposed in the right abutment area indicating this rock is soluble.

Engineering Considerations

Depth of Overburden

Except for the material underlying the River and small quantities in the left abutment area little overburden occurs within the area mapped about Gerc site. The geological history of the area suggests a relatively small amount of overburden beneath the present River, however, test borings should be put down along the proposed centre line of the dam to accurately contour bedrock surface. This will not be an easy task as the velocity of Pelly River where it passes between the two abutments is considerable.

Abutments and Foundations

The gneiss exposed at the site should make suitable foundation and abutment material. If the construction plan proposed for Braden's Canyon site is adopted at Gerc site the presence of considerable soluble limestone in the right abutment may cause difficulty in driving the diversion tunnels. Considerable ground water may be encountered.

The limestone exposed on the left abutment slope dips beneath the River and as the strike of the limestone beds is almost parallel to the River these rocks could become aquifers carrying considerable water beneath the dam.

Construction Materials

Aggregate

There are several potential sources of natural aggregate for the Gerc

site. All these deposits are readily accessible. They include:

1. The two upper terraces north of the River between Gerc site and Braden's Canyon site.
2. The continuations of the same two terraces which extend upstream from Gerc site along the right side of Pelly River.
3. The terraces which flank the wide valley about one mile north of the two sites through which, as has been suggested, Pelly River formerly flowed when it was at a higher elevation.

The material constituting the terraces consists of glacio-fluvial, sandy gravel. A program of test pitting and sampling will be necessary to accurately determine the quantity and quality of material available. In some places the deposits are believed to be shallow with bedrock not far below ground surface.

Artificial aggregate might be obtained by crushing bedrock occurring at the site. This, however, would be a relatively expensive method and should only be considered as a last resort.

Impervious Material

There is a shortage of impervious material in the site area. The most suitable material is located in the upper part of the bluff which occurs along the right bank of Pelly River about one mile upstream from the site. The material consists of a compact, fine-grained, silty sand interbedded with a dense, silty, sandy till. Grain size curves and permeabilities for the material are included at the end of this report. Six samples were taken of the sandy alluvium which occurs in the north part of Braden's Canyon map-area. Grain size analyses curves for this material are included in the report on the Braden's Canyon dam site (topical report No. 26, site No. 21). The results indicate this material will probably not prove satisfactory for the impervious core of an earth-fill dam.

Pervious Material

Material for the pervious shells of an earth-fill dam can be obtained from the gravel deposits described under the "aggregate" heading.

Riprap and Rock Fill

The specific gravity and durability of gneiss is higher than that of most rocks. Consequently, excellent riprap and rock fill should be obtained from bedrock exposed in the two abutment slopes providing the rock can be blasted into sufficiently large fragments. The talus which covers much of the left abutment slope would not be a source of suitable riprap or rock fill.

Ground Water

Little is known regarding the ground-water table in the vicinity of the proposed dam site. It is believed to be low throughout the area adjacent to the site. This would increase the danger of subsurface leakage especially through the former drainage channel one mile north of the site.

Accurate information regarding the water table can only be obtained by an expensive test-boring program involving the installation of many ground-water observation holes.

Frozen Ground

Evidence of permafrost was not observed within the area mapped about the proposed dam site.

Comparison between Gerc and Braden's

Canyon Dam Sites

The following comparisons are based entirely upon a preliminary geological examination of the two sites and an investigation into possible sources of construction materials in the immediate areas about the sites.

1. Quality of Bedrock: Bedrock is the same at both sites. The most

common rock is a massive, durable gneiss with a relatively high specific gravity. The gneiss should make satisfactory foundation and abutment material. At both sites a crystalline limestone is interbedded with the gneiss in beds varying in thickness from 6 to 30 inches. The limestone is believed to be soluble although solution cavities are seldom visible. The lack of evidence of solution is probably due to the absence of percolating ground water in the steep abutments.

At the Gerc site the limestone beds exposed on the left abutment slope definitely dip beneath the River. Considerable limestone is exposed on both right abutment slopes and it is believed these beds will be encountered in the diversion tunnels if they are located in the right abutments.

2. Bedrock Structures: The attitudes of the gneissic banding, schistosity and interbedded limestone are about the same at the two sites. However, due to a bend in the River, the direction of the River channel is not the same. Consequently the strata at Gerc site are almost parallel to the River whereas at Braden's Canyon site they intersect the River at about 30 degrees. At both sites the dip of the strata is toward the right abutment.

Minor ~~jointing~~^{jointing} is common. ~~Grouting~~^{Grouting} may be necessary in some parts of bedrock to prevent leakage caused by jointing. There is no evidence of faulting at either site.

3. Thickness of Overburden: There is no evidence to indicate the thickness of overburden beneath Pelly River at either site. However, the geological history of the area suggests a relatively small amount of overburden beneath the River at both sites.

4. Aggregate: Sufficient quantities of aggregate are probably available within reasonable haulage distances for both sites. It is suggested, however, that these deposits be thoroughly investigated as the quantity and quality of the material is unknown. It is possible the gravel on the two upper

terraces in the Braden's Canyon map-area are shallow deposits laid down directly upon bedrock.

5. Impervious Material: There is a lack of impervious material at both sites. A silty, sandy till is exposed in a steep bluff on the right side of Pelly River one mile above Gerc site. This was the only material observed which could be used in the core of an earth-fill dam.

6. Riprap and Rock Fill: Suitable riprap and rock fill can be obtained from bedrock exposed at both sites.

7. Permafrost: Permafrost does not occur at either site.

8. Ground Water: The ground-water table is believed to be low at both sites. It is possible leakage of reservoir water will occur through the former drainage channel of Pelly River one mile north of the sites.

The results of the investigation indicate that, geologically, there is little difference between Gerc and Braden's Canyon dam sites. Consequently any decision regarding the choice of sites will have to be based on other criteria such as the necessity of constructing a saddle dam at the Braden's Canyon site to contain the water in the reservoir.

Further Investigations

As a result of this preliminary geological investigation it is suggested test borings are required in the following localities at Gerc dam site:

1. Along the centre line where it crosses the River to ascertain (a) the quality and permeability of overburden, (b) the elevation of bedrock surface, (c) the presence of soluble limestone beds in bedrock beneath the River.

2. In the two abutment areas to determine the quality and permeability of bedrock.

Chemical Analyses of Pelly River Water

During the 1960 field season two samples were taken of Pelly River water from the centre of the River at Pelly Crossing. The samples were analysed for their mineral content by the Industrial Waters Section, Mines Branch, Department of Mines and Technical Surveys, Ottawa. The results of the analyses are included on the following page. The results indicate the water in Pelly River is medium hard but not highly mineralized. Its turbidity, which is an indication of the quantity of suspended matter present, is low.

Chemical Analyses of Pelly River Water
(parts per million)

| Location | Date | River Discharge | pH | SiO ₂ | Ca | Mg | Na | K | Fe | CO ₃ | HCO ₃ | SO ₄ | Cl | F | Turbidity | Total Hardness as CaCO ₃ |
|------------------------------------|----------------|-----------------|-----|------------------|------|-----|-----|-----|------|-----------------|------------------|-----------------|-----|-----|-----------|-------------------------------------|
| At Pelly Crossing; centre of River | June 18, 1960 | High | 8.0 | 5.9 | 24.5 | 7.3 | 1.3 | 0.7 | 0.71 | 0.0 | 85.0 | 23.7 | 0.9 | - | 11 | 91.0 |
| At Pelly Crossing; centre of River | Sept. 11, 1960 | Medium Low | 7.9 | 7.4 | 31.3 | 9.6 | 1.5 | 0.6 | 0.22 | 0.0 | 105 | 33.9 | 0.3 | 0.0 | 14 | 117 |

Grain Size Analyses Curves

The grain size analyses curves included in this report, were prepared in the Soils Laboratory of the Water Resources Branch in Vancouver. The permeabilities were computed in the field using a Soiltest Permeameter, model K-620. The results indicate the till is a potential source of impervious material. The deposit, however, should be investigated much more thoroughly before a final decision is reached. The samples taken for analyses were only from the till. The presence of several silty, sand layers in the till may raise the permeability to a point where the material would not be satisfactory.

Description of the Potential Impervious Material for the following Grain Size Analyses Curves

| Sample Number | Location | Field Description of Material | Field Description of Overburden | Thickness of Deposit | Areal Extent (estimated) | Permeability* (cm./sec.) |
|---------------|--|-------------------------------|---------------------------------|----------------------|----------------------------------|--------------------------|
| 7 | 10 feet below top of steep bluff; right side of Yukon River, one mile above site | Dense, silty, sandy till | None | 50 feet | 1,000 feet wide, 1,000 feet long | 10^{-5} |
| 8 | 10 feet below sample No. 7 | " | " | " | " | 10^{-6} |

* Permeabilities computed in the field using a Soiltest permeameter, model K-620

DEPARTMENT OF NORTHERN AFFAIRS & NATIONAL RESOURCES
 WATER RESOURCES BRANCH
 GRAIN SIZE ANALYSIS

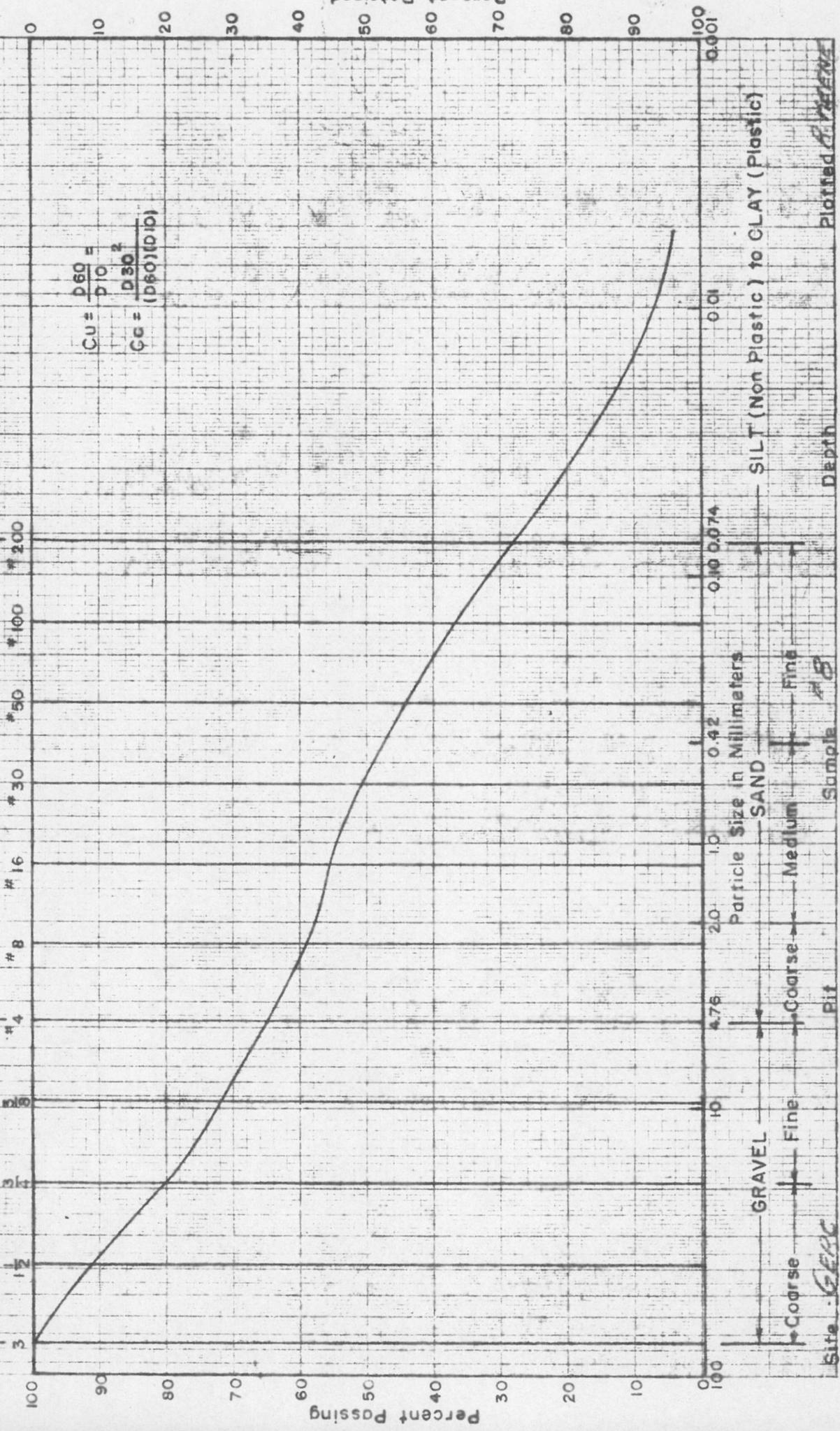
HYDROMETER ANALYSIS

$$CU = \frac{D_{60}}{D_{10}} =$$

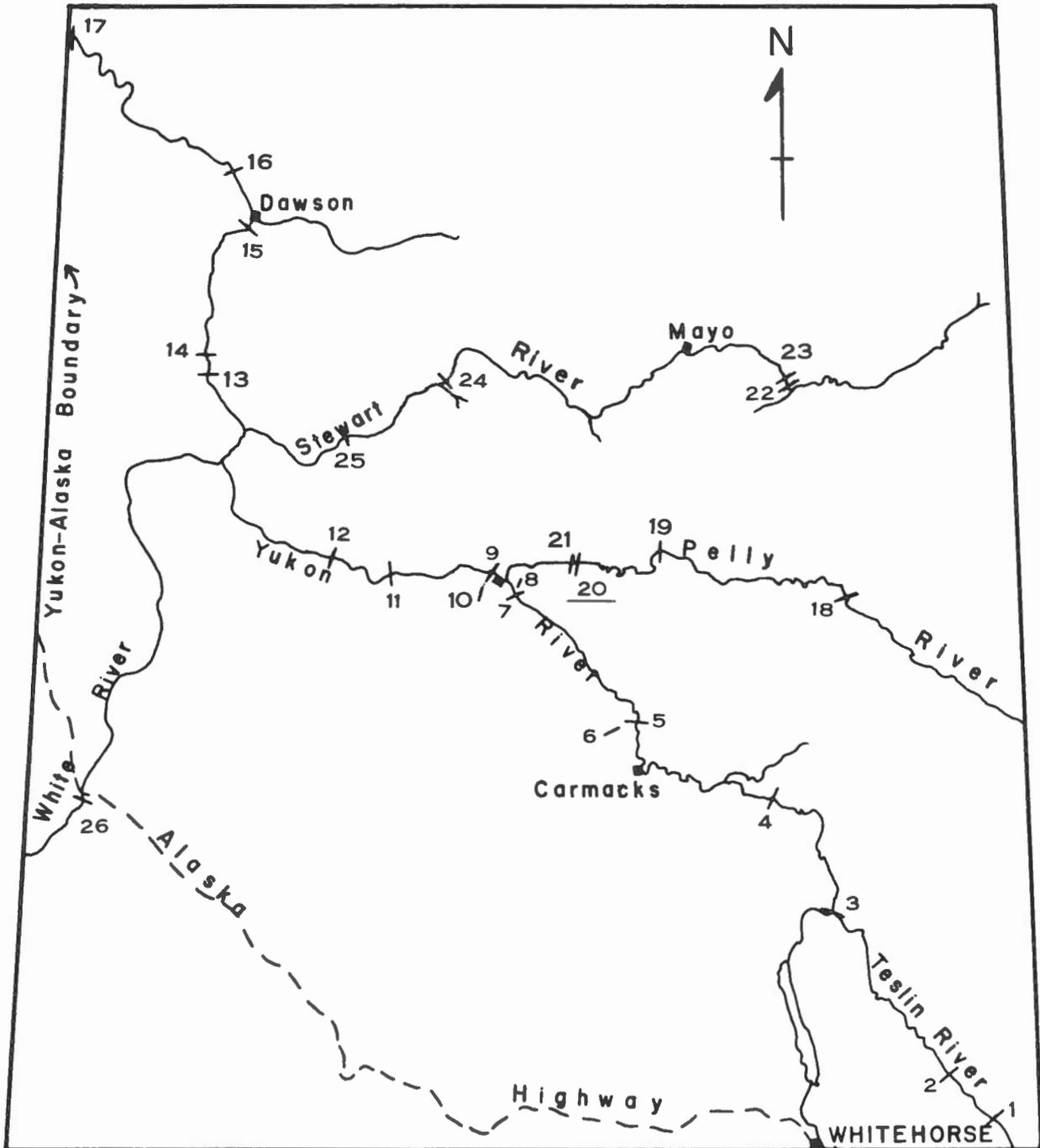
$$GC = \frac{D_{30}^2}{(D_{60})(D_{10})}$$

U.S. STANDARD SIEVES

SCREEN SIZES IN INCHES



Site: *GEPC* Pit: *8* Sample: *8* Depth: *Plotted 6/2/58*



LOCATION OF PROPOSED DAM SITES
YUKON RIVER DRAINAGE BASIN

Scale: 1 inch = 40 miles

| Site No. | Name | Site No. | Name | Site No. | Name |
|----------|--------------------|----------|-------------------|----------|------------------|
| 1 | Swift River | 10 | Fort Selkirk Draw | 19 | Granite Canyon |
| 2 | Northwest Power | 11 | Selwyn | 20 | <u>Gerc</u> |
| 3 | Hootalinqua | 12 | Britannia | 21 | Bradens Canyon |
| 4 | Big Salmon | 13 | Ogilvie no.1 | 22 | Five Mile Rapids |
| 5 | Five Finger Rapids | 14 | Ogilvie no.2 | 23 | Fraser Falls |
| 6 | Five Finger Draw | 15 | Upper Dawson | 24 | Independence |
| 7 | Wolverine | 16 | Lower Dawson | 25 | Porcupine |
| 8 | Wolverine Draw | 17 | Boundary | 26 | Lower Canyon |
| 9 | Fort Selkirk | 18 | Detour | | |