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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 8

YUKON RIVER DRAINAGE BASIN
DAM SITE INVESTIGATION

SITE NO. 2

NORTH WEST POWER INDUSTRIES DAM SITE

(MAP AND PRELIMINARY REPORT)

BY

E. B. OWEN

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NORTHWEST POWER INDUSTRIES DAM SITE

General Description

The proposed Northwest Power Industries site is an alternative to the Swift River site. It is located on Teslin River about 37 miles downstream from Johnson's Crossing and approximately 14 miles below the Swift River site. This preliminary report contains a description of the materials occurring at or nearby the site. It also compares the two sites from the standpoint of engineering geology. Preliminary construction plans were not available for the Northwest Power Industries site.

The borders of the wide Teslin River Valley are not well defined in the area adjacent to the site. Extending west from the left side of the present river there is a flat terrace, two hundred feet in width, covered with alluvium. Immediately beyond, a 120-foot bluff rises abruptly to the first of several terraces which altogether extend back 2,500 feet from the river. West of the terraces are several drift-covered ridges with bedrock exposed along their upper parts. The trend of the ridges is about 312 degrees which is probably the direction of the last ice movement in the area.

On the right side of the river a bluff, 310 feet in height, rises from the water's edge to a level terrace which extends back some 1,500 feet from the river. East of the terrace a wide, shallow depression occurs in the ground surface. The trend of the depression is approximately parallel to the river at the proposed site. The average surface elevation is somewhat lower than that of the adjacent terrace. The depression intersects the river at a bend about one and a half miles upstream from the proposed dam site. It might possibly be a former channel when the river was at a higher elevation. Elevations along the depression increase gradually from 2,210 feet above sea level at the river to 2,380 at a point 4,500 feet east of the site. It is not thought this depression would provide an escape route for water impounded behind a dam similar in size to that proposed for the Swift River site.

Unconsolidated Deposits

Four main types of soils occur in the vicinity of the proposed dam site. These are as follows:

1. Recent alluvium: This material occurs along the edges of the present river. It consists of a fine-grained, dense, grey, silty sand. It is also exposed in several shot holes for seismic line no. 1.

2. Post-Lacustrine Alluvium: This material consists of a loose, uniform, medium-grained sand. It is a shallow deposit occurring in many places only as a thin veneer overlying the extensive glacio-fluvial gravels west of the river. Many holes were dug into this material to a maximum depth of four feet. The material was thought to have been deposited early in the history of Teslin River subsequent to draining of the temporary lake in which the silty sand deposits were formed.

3. Glacio-Lacustrine: This material makes up the mass of the overburden in the bluff on the right hand side of the river opposite the proposed site. It consists of a silty, very fine- to fine-grained sand presumably of lacustrine origin. A layer of fine gravel was indicated just below the top of the bluff by digging into the slope-forming material to a depth of two to three feet. The dip of the beds in the silty sand deposit vary from horizontal to slightly upstream. There is no indication in the face of the bluff as to the type of material underlying the silty sand. This information could only be obtained by test borings. It can be reasonably assumed, however, that the lacustrine material overlies glacio-fluvial sand and gravel similar to that occurring on the left side of the river.

4. Glacio-fluvial: This material constitutes the bulk of the overburden for about one-half mile west of the river. It consists of a loose, graded, sandy gravel with boulders up to 18 inches in diameter. Most cobbles and boulders are well rounded. The material is well exposed to depths of three feet in the shot holes for seismic lines no. 2 and 3 and also in the last two downstream shot holes for seismic line no. 1. Rough stratification was noted in a 25-foot face of sandy

gravel along a small creek which empties into Teslin River about 3 miles below the proposed site.

Deposits of clay or till were not observed in the vicinity of the site.

Bedrock

General Description

Bedrock outcrops are scarce in the vicinity of the proposed dam site. With the exception of four small outcrops of massive, medium-grained greywacke occurring on the left side of the river about 300 feet upstream from the proposed centre line bedrock is not exposed for several thousand feet on either side of the present river. The presence of greywacke in the site area is probably the result of the high durability of this rock. Most of the rock exposed on the tops of the ridges east and west of the site area consists of greywacke with small amounts of argillaceous sandstone or conglomerate. The greywacke outcrops near the river suggest the presence of small rock ridges buried in the glacio-fluvial material. The strike of the outcrops is the same as the drift-covered ridges occurring west of the site area.

Engineering Considerations

Thickness of Overburden

The thickness of the overburden throughout most of the site area is unknown. The only exceptions are a few small areas adjoin~~ed to~~ing the rock outcrops west of the river where it is believed to be less than ten feet in thickness. Test borings would be required to determine the thickness of overburden in the area. Such borings should be designed to take regular samples of the soil, to conduct permeability tests and to penetrate at least 15 feet of bedrock.

The scarcity of rock outcrops in the area suggests overburden is too deep to permit excavation to bedrock for the main dam structure crossing the river. It is thought an earth-fill dam similar in design to that proposed at Swift River should be considered for this site and the diversion and intake channels and intake and stilling sections would be constructed on the left side of the river.

Overburden beneath the present river probably consists of alluvial sand and fine gravel overlying glacio-fluvial sands and gravels with the possibility till may exist between the glacio-fluvial material and underlying bedrock. The high permeability of the sands and gravels would necessitate a cut-off trench to the underlying till or bedrock being incorporated into the design of the dam to prevent seepage and possible piping. Also if it were planned to construct the main dam in the dry between an upstream and downstream cofferdam precautions would have to be taken to prevent seepage beneath the cofferdams through these same permeable materials.

Foundations and Abutments

Considerable more subsurface information is required at the Northwest Power Industries site before a decision can be reached regarding the suitability of the foundation and abutment material. Very little bedrock is exposed at the site and it is thought the greater part of the material forming the foundations and abutments will be overburden. The bedrock exposures on the left bank could indicate a low rock ridge trending through the abutment area. The elevation of the top of this ridge would not exceed 2,230 feet. As the elevation of the river is about 2,185 it is unlikely bedrock would constitute the entire abutment. The right abutment consists of very fine-to fine-grained, silty sand.

If a construction plan similar to that proposed for the Swift River site is decided upon the excavation for the diversion and intake channel will be partly in massive greywacke and the remainder in permeable sand and gravel.

Construction Materials

Aggregate

A potential source of natural aggregate is the loose, graded sand and gravel exposed on the terraces immediately west of the left abutment. This material would have to be screened and reblended to obtain a satisfactory aggregate. The quantity of material available is unlimited. Samples to determine the quality could be obtained by a program of test pitting.

A second potential source of natural aggregate is located east of the river about a mile from the right abutment. Here a small creek flows through a deep, narrow gully and empties into Teslin River Valley. The bluffs on each side of the creek consist chiefly of gravel and cobbles with some sand. A road could easily be constructed to this deposit from the site area.

Aggregate could also be obtained by crushing the greywacke exposed on the west side of the river.

Impervious Material

The glacio-lacustrine, silty sand deposits occurring on the right side of the river at the site constitute the only materials in the area which might be used as impervious material in the main dam. The clay content is negligible but due to its grading the material can probably be compacted to a fair degree.

Pervious Material

Material for the pervious shell of the earth dam can be readily obtained from the extensive deposits of sand and gravel exposed on the terraces immediately west of the river.

Riprap

The greywacke outcropping on the west side of the river would be an excellent source of riprap. It is a massive, durable rock and if excavated for the diversion and intake channels should yield rock fragments sufficiently large to be used as riprap.

Ground Water

Little is known regarding the ground-water table in the area about the dam site. It is thought to be low throughout the area mapped. This would increase the danger of leakage, especially through the permeable sands and gravels ~~at~~ in the left abutment, following construction of the dam. Accurate information regarding the water table can only be obtained by an expensive drilling program involving the installation of many observation holes.

Further Investigations

A comprehensive drilling program for this site is not recommended until the alternative Swift River site has been thoroughly investigated. If the results of the subsurface investigation program at the Swift River site are not satisfactory, then the Northwest Power Industries site should be extensively investigated. To commence the program test borings should be put down along the proposed centre line of the dam and at each abutment. Soil samples should be taken at regular intervals or whenever there is a change in material, permeability tests should be conducted and at least fifteen feet of bedrock should be penetrated in each hole. Ground-water levels should also be noted.

Comparison of Swift River and Northwest Power Industries Sites

The results of this preliminary survey indicate the Swift River site is a better site than the Northwest Power Industries site. This conclusion is based

upon the following observations:

1. Left Abutment

   The bedrock exposed on the left abutment at the Swift River site will make a much more satisfactory abutment than the permeable sands and gravels constituting the left abutment at the Northwest Power Industries site.

2. Right Abutment

   The silty material constituting the right abutment at the Swift River site is less permeable than the silty sand at the Northwest Power Industries site. It is also a potential source of material for the impervious core of the earth-fill dam.

3. Earth-Fill Dam

   There is no information regarding the quantity and quality of the overburden beneath the present river at either site. Test borings should be put down along the centre line at each site to obtain this information. It is believed, however, the thickness of overburden under both sites is too great to consider founding the earth dam on bedrock. It is also thought the greater part of the material underlying the river at both sites is permeable sand and gravel. Consequently a dam constructed at either site would be of an earth-fill design with considerable emphasis on the control of seepage though the underlying sand and gravel upon which the structures would probably be founded.

4. Aggregate

   The sandy gravel exposed on the terrace immediately west of the Northwest Power Industries site should make satisfactory natural aggregate. At the Swift River site the nearest deposits of aggregate

are along the sides of Swift River about three miles downstream. These latter deposits are easily accessible.

5. Impervious Material:

There is a lack of impervious material at both sites. It is thought, however, the glacio-lacustrine silts exposed on the right abutment at the Swift River site are a potential source of impervious material. Similar material was used during the recent construction of the dam at Whitehorse Rapids on the Yukon River.

6. Pervious Material

There are large quantities of materials available at both sites for the transition zones and pervious shells of the earth dams.

7. Riprap

The greywacke exposed at the Northwest Power Industries site should make excellent riprap. Durability tests should be made in the argillaceous sandstone exposed at the Swift River site before it is accepted as satisfactory riprap material.

8. Ground Water

Little is known regarding the ground-water table in the areas about either site. There will probably be a much greater water problem at the Northwest Power Industries site during construction of the diversion and intake channel and forebay than at the Swift River site. The reason for this is the higher permeability of the sand and gravel at the Northwest Power Industries site. At the Swift River site much of the material to be excavated will be relatively impermeable bedrock.