CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 10

YUKON RIVER DRAINAGE BASIN
DAM SITE INVESTIGATION

SITE NO. 4

BIG SALMON DAM SITE

(MAP AND PRELIMINARY REPORT)

BY

E. B. OWEN

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BIG SALMON DAM SITE

General Description

The Big Salmon dam site is located on the Yukon River about 17 miles below the mouth of Big Salmon River and 47 miles downstream from the proposed site at Hootalinqua. At the Big Salmon site the river is flowing in a westerly direction along the south side of a high, westward trending, rock ridge which rises abruptly from the river (approximate elevation 1,825) to an elevation in excess of 3,500 feet above sea level. The right abutment of the dam is located in the lower part of this ridge.

The left abutment consists of an uneven terrace which rises abruptly 35 to 45 feet from the edge of the river and extends south some 3,500 feet to the base of a high, rock hill. The surface elevation of the terrace gradually rises from 1,870 feet above sea level at the river to 2,180 feet at the west edge of the area mapped. The presence of numerous large potholes is the reason for the roughness of the terrace surface. The mass of material constituting the terrace consists of glacio-fluvial sandy gravel covered with a thin veneer of sandy alluvium. A similar terrace with approximately the same elevation occurs on the right side of the river about one-half mile downstream. The glacio-fluvial material mapped on the right side of the river is a shallow deposit of sand and gravel overlying both bedrock and talus.

At the site the river is flowing over a shallow depression in bedrock surface probably formed prior to the last glaciation. The presence of the depression is indicated by the relatively large depths to bedrock computed along seismic lines no. 2 and 5. These lines cross the centre line and are parallel and close to the river. The great thickness of overburden indicated by seismic line no. 1, located some 2,000 feet upstream from the centre line suggests the depression is following

the bend in the river and will probably underlie the river farther upstream.

Unconsolidated Deposits

Three types of soils have been identified at the proposed Big Salmon dam site. These are as follows:

1. Post-Lacustrine Alluvium (fine to coarse sand): This material consists of a loose, uniform, fine- to coarse-grained sand with a few scattered pebbles up to two inches in diameter. It is a shallow, extensive deposit thought to have been formed during an early and higher stage in the history of Yukon River. The material was doubtless derived in part from the underlying glacio-fluvial sand and gravel. The deposit is not sufficiently thick to warrant consideration as a source of aggregate or fill.

2. Post-Lacustrine Alluvium (fine sand, clayey in part): This material consists of a very fine, medium dense sand which in some parts has a high clay content. It occurs as an irregular deposit, usually in the lower, more swampy ground, on the terrace south of the site. It frequently occurs as a thin veneer overlying glacio-fluvial, sandy gravel. The quantity of clayey material available is too small to meet the requirements for impervious material for the main earth dam.

3. Glacio-fluvial: This material consists of a loose, graded, sandy gravel with boulders up to 24 inches in diameter. The silt content is low. Most cobbles and boulders are well rounded. The overburden constituting the terrace on the south side of the river consists almost entirely of this material. In most instances it is covered with a thin veneer of alluvium, but is well exposed in the shot holes for seismic line no. 3 and along the base of the rock bluff south of the terrace. A 30-foot section of the material is exposed along the left bank of the river for a distance of about one-half mile. On the right side a thin deposit of glacio-fluvial sand

and gravel overlies both bedrock and talus.

Bedrock

General Description

Many dam site settings in glacial terrains are deeply filled valleys with one rock abutment and the other abutment formed by pervious sand and gravel terraces or morainic deposits. The Big Salmon dam site is no exception to the above precept.

Bedrock is exposed only in the right abutment area. It consists of a fine-grained, purplish, greenish and greyish andesite containing abundant small phenocrysts of feldspar and smaller quantities of hornblende and pyroxene. A small fraction of the volcanic rock is made up of agglomerate with a matrix similar to that of the andesite. The agglomerate contains large, semi-rounded fragments usually of a somewhat lighter colour than the matrix. A dyke, 5 to 15 feet wide and 500 feet long, was encountered on the right abutment about 800 feet upstream from the proposed centre line. The dyke is an iron-bearing, siliceous intrusion. It is yellow to pink on a fresh surface, but weathers to a reddish-brown colour.

The high, rock hills, 3,500 feet south of the river, which form the left side of Yukon River Valley at this point, consist chiefly of conglomerate with some agglomerate west (downstream) from the extension of the proposed centre line. The rock exposed on these hills is a potential source of riprap and rock fill.

Quality of Bedrock

Bedrock exposed on the right abutment is a massive, durable rock. Weathering is superficial and very little loose rock would have to be removed before dyke material or concrete could be placed against it. The presence of a few small vesicules would not seriously effect the durability or permeability of the rock.

Bedrock Structures

The volcanic rocks exposed on the right abutment have few structural weaknesses. Jointing is the only structure which could adversely affect the dam. One strong joint set intersects the centre line at approximately 30 degrees and dips fairly steeply downstream. The jointing appears to be tight, however, and little leakage should result from it. A few, minor faults and shear zones were noted on bedrock surface. They are almost parallel to the centre line and dip steeply downstream. The faults are firmly recemented with a green, epidote-rich material and should not present any leakage problem. The possibility of a dam failure resulting from the downstream dip of the joint and shear planes is remote.

Engineering Considerations

Depth of Overburden

Except for the data obtained from the six seismic lines and the bedrock exposures in the right abutment area scant information is available concerning the thickness of overburden in the vicinity of the site. It is thought the range of 21 to 51 feet, obtained from seismic lines no. 3, 4 and 5, is a fair approximation of the depths to bedrock beneath the wide terrace south of the site. The thicknesses of overburden indicated by seismic lines no. 1, 2 and 5 implies the presence of a depression in bedrock surface below the present river channel. The elevation of bedrock surface evidently decreases rapidly below the base of the rock bluff forming the right abutment and probably continues downward to the depression. It is improbable a similar depression in bedrock surface occurs beneath the terrace extending south from the river.

Additional seismic investigations accompanied by test borings would be required to accurately contour bedrock surface in the site area. Test borings put

down along the proposed centre line should be designed to take regular samples of the soil, to conduct permeability tests, to measure the depth of the water table below ground surface and to penetrate 15 feet of bedrock.

Little is known concerning the type or thickness of overburden beneath the river. The main mass of material probably consists of permeable, glacio-fluvial sand and gravel similar to that exposed along the left bank of the river at the site. The glacio-fluvial material may overlie bedrock although there is a possibility till may occur directly over the rock. There is no indication on ground surface of the presence of till.

The great thickness of permeable overburden beneath the river would prevent excavation to bedrock for the main dam. Consequently a cut-off trench would necessarily have to be incorporated into the design of the dam to control seepage through the underlying sands and gravels and prevent piping. A similar seepage problem would arise during construction of the upstream and downstream cofferdams inside of which the main earth dam would be constructed.

Numerous large boulders occur in the glacio-fluvial gravel exposed on surface at the site. The presence of similar size boulders in the material beneath the river would hinder the driving of a steel sheet pile cut-off wall along the cofferdams.

Abutments and Foundations

The volcanic rocks forming the right abutment are satisfactory. They are massive, relatively impermeable and superficially weathered. They should also make suitable foundations for the spillway section and power-house and intake sections all located on the terrace south of the river. The sandy gravel underlying the river should make an excellent foundation for the earth dam. The chief problems here result from the high permeability of the material.

Construction Materials

Aggregate

The extensive deposits of sandy gravel underlying the terrace south of the river are a potential source of natural aggregate. The quantity is unlimited. A program of test pitting and sampling would be required to develop the deposit and to determine the quality of the material. It will probably be necessary to screen and reblend it to obtain a satisfactory aggregate. The silt content is very low. A large quantity of sandy gravel will be excavated during construction of the diversion channel, the spillway section and the power-house and intake sections. This material could be stockpiled for future use.

Impervious Material

Sufficient material suitable for the impervious core of the proposed earth dam was not found in the vicinity of the site. The deposits of alluvial, clayey sand on the terrace south of the river are small.

Pervious Material

Material for the pervious shells of the dam can be obtained from the extensive deposits of glacio-fluvial, sandy gravel underlying the terrace south of the river.

Riprap

Satisfactory riprap and rock fill can be obtained from the volcanic rock exposed along the right side of the river. The durability and specific gravity of these rocks are relatively high and the joint planes are sufficiently apart that large rock fragments should be obtained by blasting. The larger rock fragments in the talus located higher up on the rock ridge would also make satisfactory riprap.

Ground Water

Information concerning the ground-water table in the vicinity of the proposed site is incomplete. The water level in two small sloughs on the terrace, some 2,500 feet southwest of the site, probably indicates the elevation of the water table in that area. The water level in each slough is close to 1,850 feet in elevation which is about 25 feet above the level of the water in the river.

The proximity of the water table to ground surface lessens the danger of leakage south of the left abutment following construction of the dam, but increases the difficulty of maintaining a dry excavation during construction of the power-house and the spillway and power intake dams. Bedrock occurring at the site is not of the soluble type and there should be no leakage problem in the right abutment or beneath any bedrock foundation. Accurate information concerning the ground-water table can be obtained only by an expensive drilling program involving the installation of many ground-water observation holes.

Further Investigations

It should be remembered the present geological investigation of the proposed dam site at Big Salmon is a preliminary one designed to furnish the engineers with as much information as possible before money is spent on an expensive subsurface investigation. More test borings will be required at the Big Salmon site before designs of the various structures can be finalized. The following borings are suggested as part of any proposed subsurface program:

Location	Approximate Elevation	Depth	Remarks
1. North abutment, on centre line, 30 feet north of river	1,840	15 feet into bedrock	Soil samples taken every 5 feet or where there is a change in material, permeability tests conducted, ground-water table noted
2. South abutment, on centre line, 40 feet south of river	1,850	15 feet below grade of diversion channel	" " " " " " "
3. Spillway dam, on centre line of diversion tunnel	1,890	" " " " " "	" " " " " " "
4. Non-Overflow dam	1,870	" " " " " "	" " " " " " "
5. Power Intake dam	1,865	15 feet below grade of power intake dam	" " " " " " "
6. Power Intake dam	1,865	15 feet below grade of power intake dam	" " " " " " "
7. Non-Overflow dam	1,910	" " " " " "	" " " " " " "
8. Parking Area	1,980	15 feet into bedrock	" " " " " " "