CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 16

YUKON RIVER DRAINAGE BASIN
DAM SITE INVESTIGATION

SITE NO. 10

FORT SELKIRK SADDLE DAM SITE

(MAP AND PRELIMINARY REPORT)

BY

E. B. OWEN

OTTAWA
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FORT SELKIRK SADDLE DAM SITE

General Description

The Fort Selkirk Saddle dam site is located in a small valley about two and a half miles southwest of the proposed site of the main power dam on Yukon River. At the site the valley is approximately parallel to the present channel of the river. It is separated from the river by a high ridge of granitic and volcanic rocks, the northeast side of which forms the left abutment of the main dam. The valley leaves the larger Yukon River Valley about four miles upstream from the saddle dam site and rejoins it again about three miles downstream. The presence of the valley suggests a potential area of leakage for water impounded behind the main dam.

The topography of the valley is level compared to that of the draw valleys at Five Finger rapids and Wolverine. The area is swampy in part with a small pond located near the centre of the valley about 500 feet northwest of the proposed centre line.

Numerous shallow test pits put down in the site area to maximum depths of four feet encountered chiefly fine-grained, silty sand with scattered lenses of clay and gravel.

Granitic rocks outcrop only in the right abutment area although numerous bedrock exposures occur at higher elevations along both sides of the valley. The unusual amount of weathering associated with the bedrock at the right abutment suggests it was not subjected to ice erosion during the last glaciation, which, according to Bostock, was moving in a direction slightly south of west in this area. It is possible the rock was protected from the ice by the high, rock ridge immediately to the east.

Evidences of solifluction occur on the north-facing slope which constitutes the left abutment but no frozen ground was encountered in test pits put down to a maximum depth of 4 feet.

It is possible immediately following the last glaciation and also the extrusion of the Selkirk lavas, which filled the former channels of Yukon and Pelly Rivers, the valley acted as a spillway for part or all of the water from these two rivers. Hence its relatively flat floor and the alluvial deposits of clay, silt and fine sand which cover much of it. The great mass of overburden filling the valley, however, is probably glacio-fluvial material.

The lowest elevation across the saddle dam site is 1,510 feet above sea level or approximately 112 feet above the present level of Yukon River (August 25, 1959). As the Fort Selkirk site is an alternative site to that at Wolverine it can be assumed that to utilize the entire hydrostatic head of the river the elevation of the normal full pool behind any dam constructed at Fort Selkirk would be the same as for Wolverine, i.e. 1,635 feet above sea level. This would necessitate the construction at the saddle site of an earth-fill dam, some 140 feet in height,to contain the water in the reservoir. The chief requirements at the saddle site would be for impervious material for the core of the dam and for pervious materials, rock fill and riprap for the main mass of the dam.

Glacial History

In the Fort Selkirk area there is evidence glaciation occurred before, during and following the extrusion of the Selkirk lavas. A till-like material occurs near the right abutment of the main power dam immediately overlying Mount Nansen volcanic rocks and underlying some 60 feet of silt, sand and

gravel. These unconsolidated materials are overlaid by a considerable thickness of Selkirk lavas on the surface of which glacial striae have been found. [1]

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[1]Bostock, H.S.: Carmacks District, Yukon, Geol. Surv., Canada, Mem. 189, p. 47 (1936).

A recent radio-carbon age determination of fragments of charred wood from a silt bed about three feet below the lavas gave an age of 38,000 plus years. The silt was too badly "cooked" for a determination of the pollen grain content.

It is thought the Selkirk lavas underlying the wide, flat terrace on the north side of Yukon River opposite Fort Selkirk blocked the former channels of Pelly and Yukon Rivers forcing the water into new courses. The former junction of the two rivers probably lies buried beneath the lavas about one mile northeast of the main power site. The presence of these buried channels should be investigated as they represent potential leakage areas around the right abutment of the power dam.

Unconsolidated Deposits

Three types of soils have been identified in the area about the proposed saddle dam. These are as follows:

1. Alluvium (fine-grained, silty sand): This is a fine-grained, compact material occurring beneath the swampy area on the right half of the valley floor and extending up into the outcrop area on the right side of the valley. On the slope it contains small quantities of clay and coarse-grained sand both derived from weathering of the granitic bedrock.

2. Alluvium (silt and fine-grained, silty sand, with clay): This is chiefly a fine-grained, firm, silty sand which covers most of ground surface

in the area mapped. The clay occurs as narrow, irregular lenses in the sand. The material covers most of the valley floor and extends to the bottom of the slope on the left side of the valley. It constitutes the only source of impervious material encountered in the area. Test borings should be put down in the valley floor northwest (downstream) from the centre line of the proposed dam to determine the quality and extent of the material. The thickness of the deposit is unknown.

3. Alluvium (fine-grained, silty sand, with gravel): This material covers the left side of the valley extending from the bottom of the slope upward beyond the limit of the area mapped. It consists of a fine-grained, silty sand containing narrow lenses of fine, sandy gravel. Numerous solifluction terraces occur on the slope which faces approximately north. Frozen ground was not encountered in several test pits put down on the slope to depths up to four feet.

Bedrock

General Description:

Bedrock is exposed only in the right abutment area. It consists of a medium-grained, grey, slightly gneissic granite with little quartz. The rock exposures are highly weathered. The one prominent joint system strikes parallel to the draw valley and dips steeply to the southeast.

Engineering Considerations

Depth of Overburden

A considerable thickness of overburden probably fills the draw valley. This is indicated by the fact bedrock was not reported from seismic line no. 3 located near the valley centre. The low elevation of bedrock surface beneath the valley suggests drainage took place through the valley for a considerable length of time prior to the last glaciation with the result a large quantity of

bedrock was eroded away. The valley was subsequently filled with glacial materials. There is no indication on ground surface to suggest the thickness of overburden throughout the valley except in the right abutment area where several small granite outcrops occur. Test borings should be put down in the floor of the valley to accurately determine the elevations of bedrock surface.

Abutments and Foundations.

The granitic rocks exposed on the right side of the site area should form a satisfactory abutment. However, the rock is extensively weathered and considerable loose, disintegrated rock will have to be stripped before solid, fresh rock is exposed. The silty sand covering the slope forming the left abutment should be investigated regarding the presence of permafrost. The shear strength of this material would be very low when thawed. Also the shear strength of the clayey, silty sand covering the valley floor upon which the earth dam will be constructed should be investigated.

Permeability of the Overburden.

The fine-grained, silty sand covering the valley floor is relatively impermeable. This is especially true where clay is associated with it. The material is thought to be alluvial in origin and to be only a few feet in thickness. It is underlain by glacio-fluvial sand and gravel which constitutes the main mass of overburden filling the valley. The permeability of the glacio-fluvial material is probably high and its presence could result in considerable leakage through the valley. Till may exist between the sand and gravel and bedrock. This would be a till similar to that exposed on the right side of Yukon River downstream from the proposed site of the power dam and directly overlying Mount Nansen volcanic rocks. The sand and gravel would be similar to that exposed on ground surface at Fort Selkirk.

Construction Materials

Aggregate

The nearest source of natural aggregate underlies the community of Fort Selkirk and the adjacent airport where it is exposed along the river bank and in several small excavations. The material is a loose, well graded gravel with cobbles up to eight inches in diameter. Many weathered pebbles and cobbles occur in the upper two feet but below this the material is fresh with little deleterious material. The proportion of rock types in the gravel size-material is as follows:

(1) Intrusive Igneous (granite, etc.) = 50 per cent.
(2) Extrusive Igneous (andesite, etc.) = 40 per cent.
(3) Sedimentary (sandstone, etc.) = 10 per cent.

Chert comprises from 3 to 5 per cent of the material.

Concrete in which this aggregate was used may be seen in the foundations of two partly completed buildings at Fort Selkirk.

Impervious Material.

The fine-grained, clayey, silty sand which overlies much of the bottom of the draw valley at the site is a potential source of impervious material. Test borings would be necessary here to determine the thickness and lateral extent of the material. The necessity of maintaining an impervious blanket upstream from the site prevents material from being taken from that area. Hence the material would have to be excavated from some locality downstream from the site.

Pervious Material.

Material for the pervious shell of the saddle dam can be readily obtained from the extensive deposits of gravel underlying the area about the community of Fort Selkirk.

Riprap

Satisfactory riprap can be obtained from the granitic rocks outcropping along the right slope of the draw valley downstream from the site. Several feet of soft, weathered rock may have to be removed before solid, fresh rock suitable for riprap or rock fill is exposed. The considerable weathering associated with these rocks is not an indication of low durability but rather the lack of glaciation. The lack of jointing suggests large rock fragments can be obtained.

Ground Water

The ground-water table is thought to be high throughout the area. The elevation of the water surface in a small pond a few hundred feet downstream from the centre line probably indicates the water table. Ground water was encountered at a depth of one and a half feet near the downstream end of seismic line no. 3.

Further Investigations

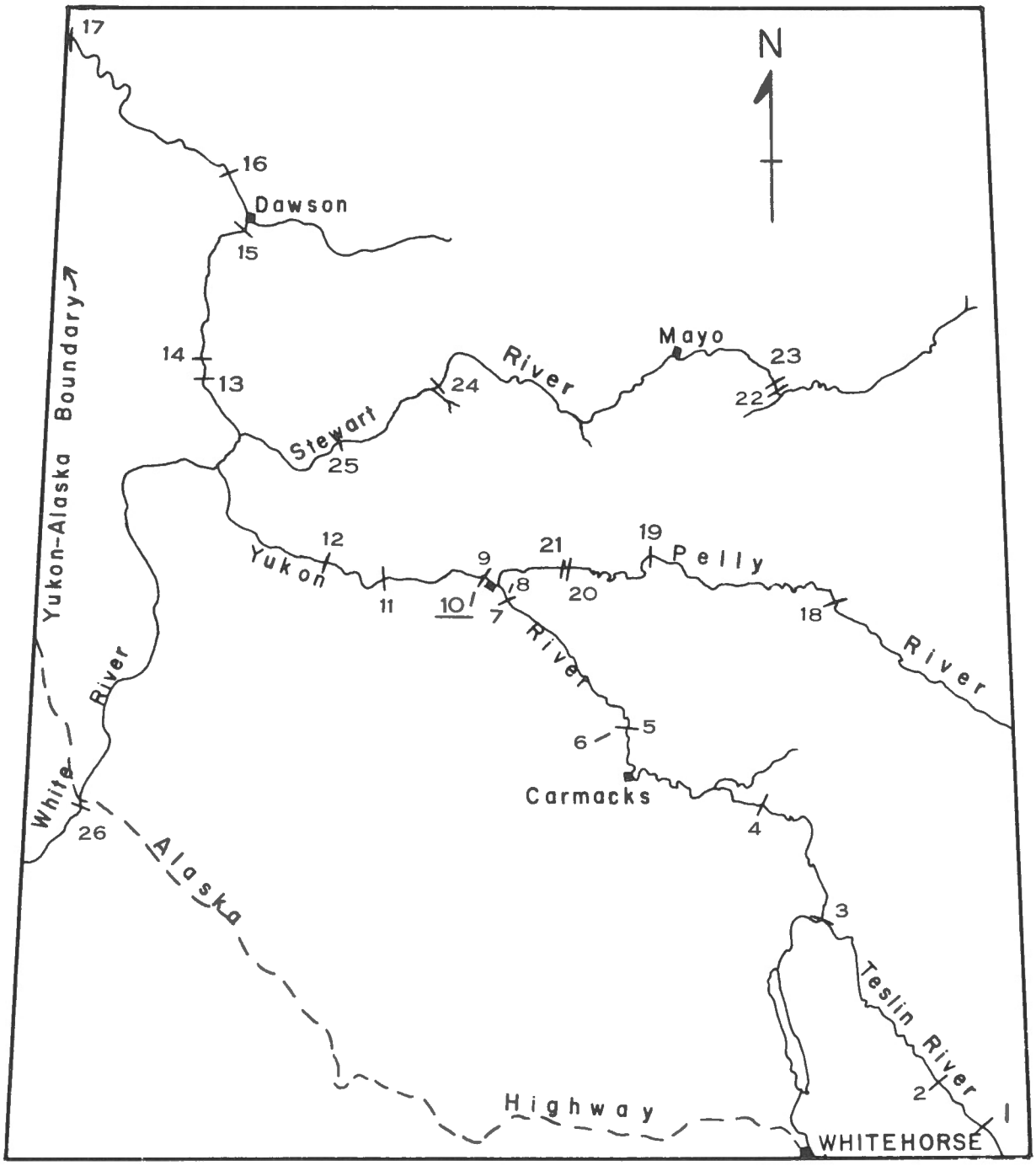
It should be remembered the present geological investigation of the proposed saddle dam site at Fort Selkirk is a preliminary one designed to furnish the engineers with as much information as possible before any money is spent on an expensive subsurface investigation. If it is decided more information is required at this site it is suggested test borings be put down in the following localities as part of the program:

1. Along the centre line of the proposed site to determine the quality and permeability of the material and the elevation of bedrock surface.

2. On the floor of the draw valley downstream from the proposed site to determine the quantity of impervious material available. If possible these borings should be arranged in a grid pattern.

3. In the left abutment area to determine the presence and extent of permafrost.

4. In the right abutment area to determine the extent of weathering in the granite bedrock.



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	Gerc
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		