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No. 2

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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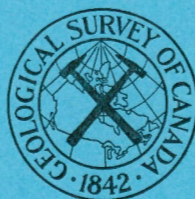
GEOLOGICAL SURVEY OF CANADA  
TOPICAL REPORT NO. 18

YUKON RIVER DRAINAGE BASIN  
DAM SITE INVESTIGATION

SITE NO. 11

**SELWYN DAM SITE**  
(MAP AND PRELIMINARY REPORT)

BY  
E. B. OWEN



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OTTAWA  
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## Contents

	Page
General description. . . . .	1
Unconsolidated deposits. . . . .	2
Bedrock. . . . .	2
General description. . . . .	2
Bedrock structures . . . . .	3
Quality of bedrock . . . . .	3
Engineering considerations . . . . .	4
Depth of overburden. . . . .	4
Construction materials . . . . .	4
Aggregate. . . . .	4
Impervious material. . . . .	5
Pervious material. . . . .	5
Riprap and rock fill . . . . .	5
Frozen ground. . . . .	5
Ground water . . . . .	5
Further investigations . . . . .	6
Chemical analyses of Yukon River Water . . . . .	6
Grain size analyses curves . . . . .	9
Description of potential aggregate . . . . .	10
Description of potential impervious material . . . . .	11

## Illustrations

Map of part of Yukon River drainage basin showing the location of the proposed dam sites. . . . .	12
Map showing the geology of Selwyn dam site . . . . .	(In pocket)

Selwyn Dam Site  
General Description

Selwyn dam site is located on Yukon River about one mile upstream from its junction with Selwyn River. It is about 31 miles below the community of Fort Selkirk. At the site the River is flowing in a westerly direction between ridges of metamorphic rocks which have been described as Precambrian and Later<sup>1</sup>.

On the left side of the River at the site, a steep, rock bluff, partially covered with talus, ascends from the River's edge to an elevation in excess of 2,500 feet. Considerable bedrock is exposed on this bluff which would form the left abutment of the proposed dam.

On the right side a level terrace with an average elevation of about 1,340 feet extends north from the River for a distance of 1,100 feet to the toe of a steep, rock bluff which would constitute the right abutment of the proposed dam. The terrace is covered with fine-grained alluvium, chiefly silty sand, which was frozen at depths from 6 to 30 inches throughout the area mapped.

There is no evidence at present to indicate the existence of a former course of Yukon River in the area and consequently it is believed the River was flowing in its present channel prior to the last glaciation. Selwyn site was not covered by ice during the last glaciation<sup>2</sup>. The limit of glaciation is about 30 miles upstream near the community of Fort Selkirk. As the ice sheet disintegrated large quantities of melt water probably flowed down Yukon River past Selwyn site. As a result, a relatively great thickness of glacio-fluvial sand and gravel is presumed to exist beneath the River at the site.

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<sup>1</sup> Yukon Territory; Geol. Surv., Canada, Map 1048A, 1957.

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<sup>2</sup> Bostock, H.S.; "Carmacks District, Yukon"; Geol. Surv., Canada, Memoir 189, Canada, 1936, p. 10.

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There is a lack of construction materials in the dam site area.

Gravel terraces, which frequently are potential sources of natural aggregate and pervious material, are non-existent and occurrences of impervious material were not observed. Bedrock exposed at the site is chiefly a durable gneiss which should provide excellent riprap and rock fill.

#### Unconsolidated Deposits

Three types of unconsolidated deposits have been identified in the area about the proposed Selwyn dam site. These are as follows:

1. Recent Alluvium: This material varies from a fine-grained, compact, silty sand to masses of cobbles and boulders up to 10 inches in diameter. It is a deposit of the present River and occurs extensively along the right side. It is believed to be a shallow deposit and relatively unimportant.

2. Alluvium (silty sand): This is a dense, silty sand which overlies the wide terrace immediately north of the River. It is covered almost entirely with 6 to 12 inches of moss and decayed vegetation. The material was frozen from 6 to 30 inches below ground surface in all test pits put down into it with the exception of the pits located within 500 feet of the River. The locations where frozen material was encountered have been indicated on the accompanying geological map. There is no information available concerning the thickness of the deposit or the quality of the underlying material.

3. Talus: Considerable talus material exists on both abutment slopes. It consists of rock fragments varying in size from sand to boulders several feet in diameter. Much of the talus is covered with vegetation.

#### Bedrock

##### General Description

Two rock types have been identified in the area about the proposed dam site. They are as follows:

1. Gneiss: This a massive, fine- to medium-grained, grey rock which

constitutes almost all of bedrock exposed at the site. The principal minerals of the gneiss are quartz and biotite with minor quantities of feldspar. Some banding is evident. Schistosity is rare. Irregular quartz veins, up to 2 inches in diameter, are abundant throughout the gneiss.

2. Fine-grained, black intrusive: Two dykes of this rock, both about 3 feet in width, intrude the gneiss exposed in the toe of the right abutment slope. They are about 50 feet apart. One dyke strikes south 25 degrees west and dips 50 degrees west and the other strikes south 5 degrees east and is vertical. The dyke rock appears to be durable with a high specific gravity. It should provide excellent riprap and rock fill. The quantity of rock available, however, is probably small.

#### Bedrock Structures

The strike of the gneissosity is in a general westerly direction, i.e. approximately parallel to the River. The dip is steeply north toward the right abutment. Minor jointing is common with the most prominent set striking at about 35 degrees to the River. The dip is vertical. The presence of considerable jointing indicates the rock may tend to break into relatively small fragments when blasted. Grouting may be necessary to consolidate the rock in the two abutments. There is no visible evidence of major faulting in the area about the proposed dam site.

#### Quality of Bedrock

The gneiss which is exposed at the site should provide satisfactory foundations and abutments. It is a massive, durable rock. Weathering is not extensive and little loose rock will have to be removed to obtain a fresh, solid face against which concrete or dyke material could be placed.

## Engineering Considerations

### Depth of Overburden

The geological history of the area suggests the depth of overburden beneath the River is greater than at the Fort Selkirk, Wolverine and Braden's Canyon sites further upstream. The results obtained from the one seismic line located on the right bank of the River is the only information available regarding the thickness of overburden in the site area. Here the depths to bedrock surface have been computed to be 95 to 120 feet, i.e. the elevation of bedrock surface varies between 1,210 and 1,225 feet. It is believed these depths are accurate but that the elevation of bedrock surface will be lower a few hundred feet south of the seismic line beneath the present River.

Test borings should be put down into the overburden beneath the River to investigate its quality and permeability. It is believed the permeability of the material is relatively great. As indicated on the accompanying geological map the line of borings should be continued to include the level terrace which extends from the edge of the River 1,100 feet north to the rock bluff forming the right abutment.

### Construction Materials

#### Aggregate

Deposits of natural aggregate do not occur within the area mapped at the proposed site. The nearest deposit of gravel occurs in a terrace on the left side of the River about 5.4 miles above the site. The material consists of a sandy gravel with numerous boulders up to 14 inches in diameter. Many of the boulders consist of porous lavas of the Selkirk series. The deposit appears to be extensive but a program of test pitting and sampling should be conducted to determine the quantity and quality available. Grain size analyses curves for this gravel and for the material from 3 other potential



aggregate deposits are included at the end of this report. Artificial aggregate might be obtained by crushing the gneissic rock outcropping in the abutment areas. This, however, would be a relatively expensive method and should only be considered as a last resort.

#### Impervious Material.

The nearest deposit of impervious material is in the Fort Selkirk draw area which is described in Topical Report No. 16, site No. 10.

#### Pervious Material

The nearest deposits of pervious material are believed to be those described under the "aggregate" heading in this report.

#### Riprap and Rock Fill

The gneissic bedrock exposed at both sides of the River at the site should provide suitable riprap and rock fill. The considerable visible jointing may result in a large percentage of the blasted rock breaking into fragments too small to be useful. The talus slopes would not be a source of material suitable as riprap or rock fill.

#### Frozen Ground

Frozen ground was encountered beneath 6 to 12 inches of moss and decayed vegetation throughout the terrace immediately north of the River. The material consisted of silty sand. It was frozen at depths from 6 to 30 inches below ground surface (June 28, 1960).

#### Ground Water

Little is known regarding the ground-water table in the vicinity of the proposed site. Accurate information concerning the water table can only be obtained by installing many ground-water observation holes. The presence of frozen ground beneath the terrace on the right side could make this an expensive task.

### Further Investigations

The following test boring program is suggested as a result of this preliminary geological investigation. All borings should be located along a line crossing the River as indicated on the accompanying geological map. Soil samples should be taken at 5-foot intervals or where there is a change in material, permeability tests should be conducted and bedrock penetrated to a minimum depth of 15 feet.

<u>Boring Number</u>	<u>Location</u>
1	Left abutment, 200 feet south of River
2	Left bank of River
3	In River, 345 feet north of left bank
4	In River, 350 feet south of right bank
5	Right bank of River
6	400 feet north of River
7	800 feet north of River
8	1,200 feet north of River
9	1,600 feet north of River

### Chemical Analyses of Yukon River Water

During the 1960 field season a sample of Yukon River water was taken about 5 miles below the mouth of Pelly River (26 miles above Selwyn dam site). The sample was analysed for its mineral content by the Industrial Waters Section, Mines Branch, Department of Mines and Technical Surveys, Ottawa. The results of the analysis are included on the following page. For comparison an analysis made of Yukon River water at Selwyn by the United States Geological Survey is included. The results indicate the water of Yukon River near Selwyn is medium hard but not highly mineralized. The reported value of the turbidity should be considered only as indicative. Flash floods may cause a very rapid increase in the sediment load. A proper sediment study, therefore,

requires regular sampling, often in the case of flash flooding, at hourly intervals.



Chemical Analyses of Yukon River Water  
(parts per million)

Location	Date	River Discharge	pH	SiO <sub>2</sub>	Ca	Mg	Na	K	Fe	CO <sub>3</sub>	HCO <sub>3</sub>	SO <sub>4</sub>	Cl	F	Turbidity	Total Hardness as CaCO <sub>3</sub>
Five miles below Pelly River; centre of River	June 23, 1960	High	7.7	6.4	22.8	6.5	1.3	0.8	1.1	0.07	81.3	18.5	0.0	-	15	83.5
Near Selwyn*	July 7, 1915	Medium	-	11	18	4.5	-	-	.02	.0	71	9.6	Tr	-	-	-

\* Dole, R. B., and Chambers, A. A.; "Chemical Character of some Surface Waters in Alaska"; U. S. Geol. Surv., W. S. P. 418-420, 1917, p. 12.

### 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. Each grain size sheet for potential aggregate shows the following information:

(a) Limits of fine and coarse aggregate based upon a 6-inch maximum size.

(b) A cumulative grain size curve for each sample.

(c) Curves showing individual percentages of the coarse and fine fraction retained on each screen or sieve size. For these purposes the sample is divided at the No. 4 sieve into coarse and fine fractions.

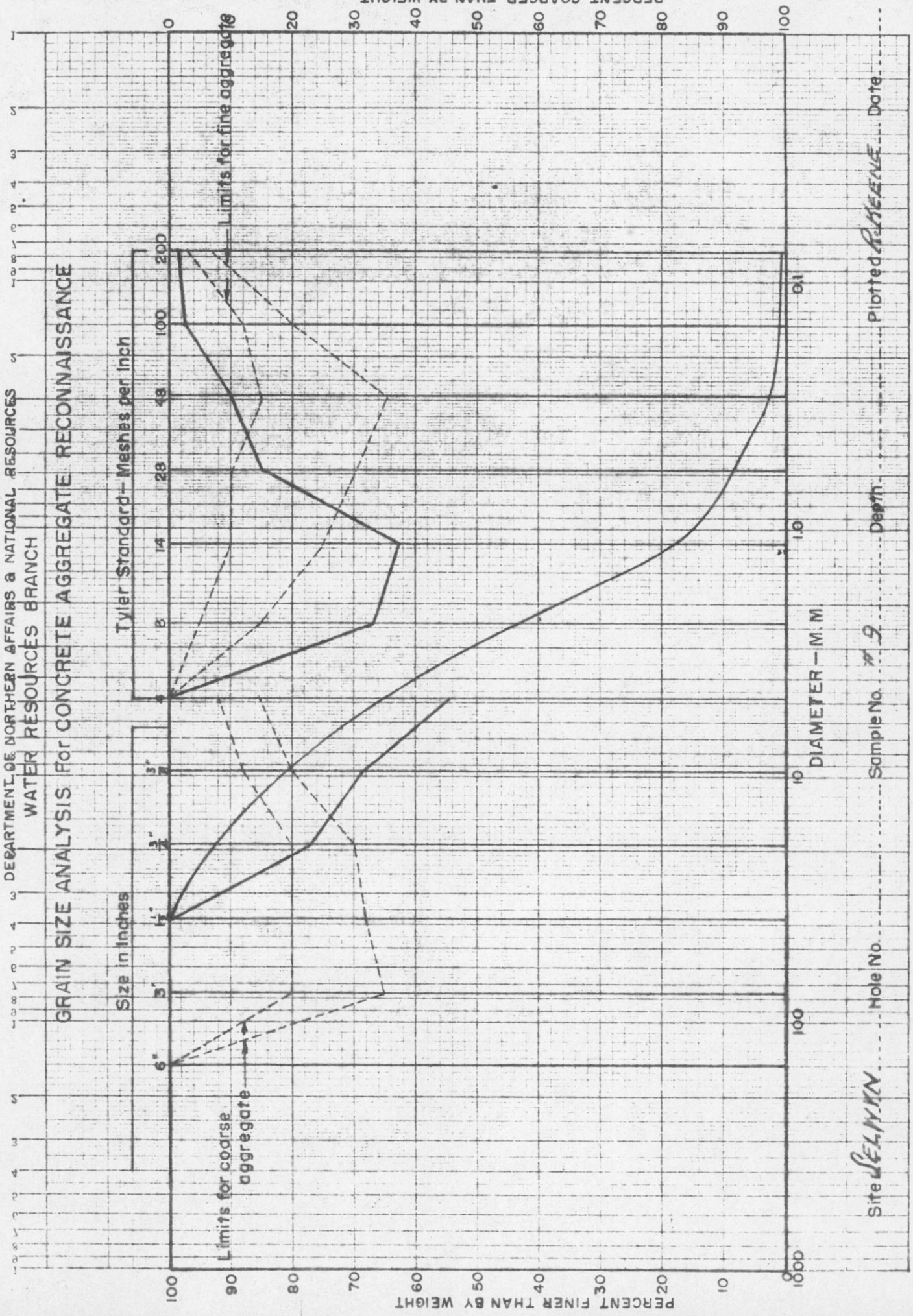
One sample (No. 10) was analysed as potential impervious material; the remainder as potential aggregate.

Description of Potential Aggregate for the following Grain Size Analyses Curves

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (estimated)	Accessibility
9	Left side of Yukon River; 5.4 miles above site; on side of terrace 25 feet above River	Sandy gravel with boulders up to 14 inches; numerous porous, Selkirk lava cobbles and boulders	3 feet of silty sand	50 feet	300 feet wide, $\frac{1}{4}$ mile long	By Yukon River; this is the nearest gravel terrace to site.
11	Right side of Yukon River; 15 miles above site; 20 feet above River	A 15-foot bed of fine sand with minor silt interbedded with gravel as in sample No. 9	5 feet of silty sand overlying 30 feet of sandy gravel	15 feet		By Yukon River
12	Right side of Yukon River; 16 miles above site; 10 feet below top of a terrace 300 feet south of River	Sandy gravel with cobbles up to 5 inches	3 feet of silty sand	50 feet	600 feet wide, $\frac{1}{2}$ mile long	By Yukon River
14	Right side of Yukon River; 6.5 miles below site; 25 feet above River	Sandy gravel with numerous rounded to semi-rounded boulders up to 12 inches; boulders chiefly granite and other hard intrusives	2 feet of silty sand	60 feet	$\frac{1}{2}$ mile wide, $1\frac{1}{2}$ miles long	By Yukon River



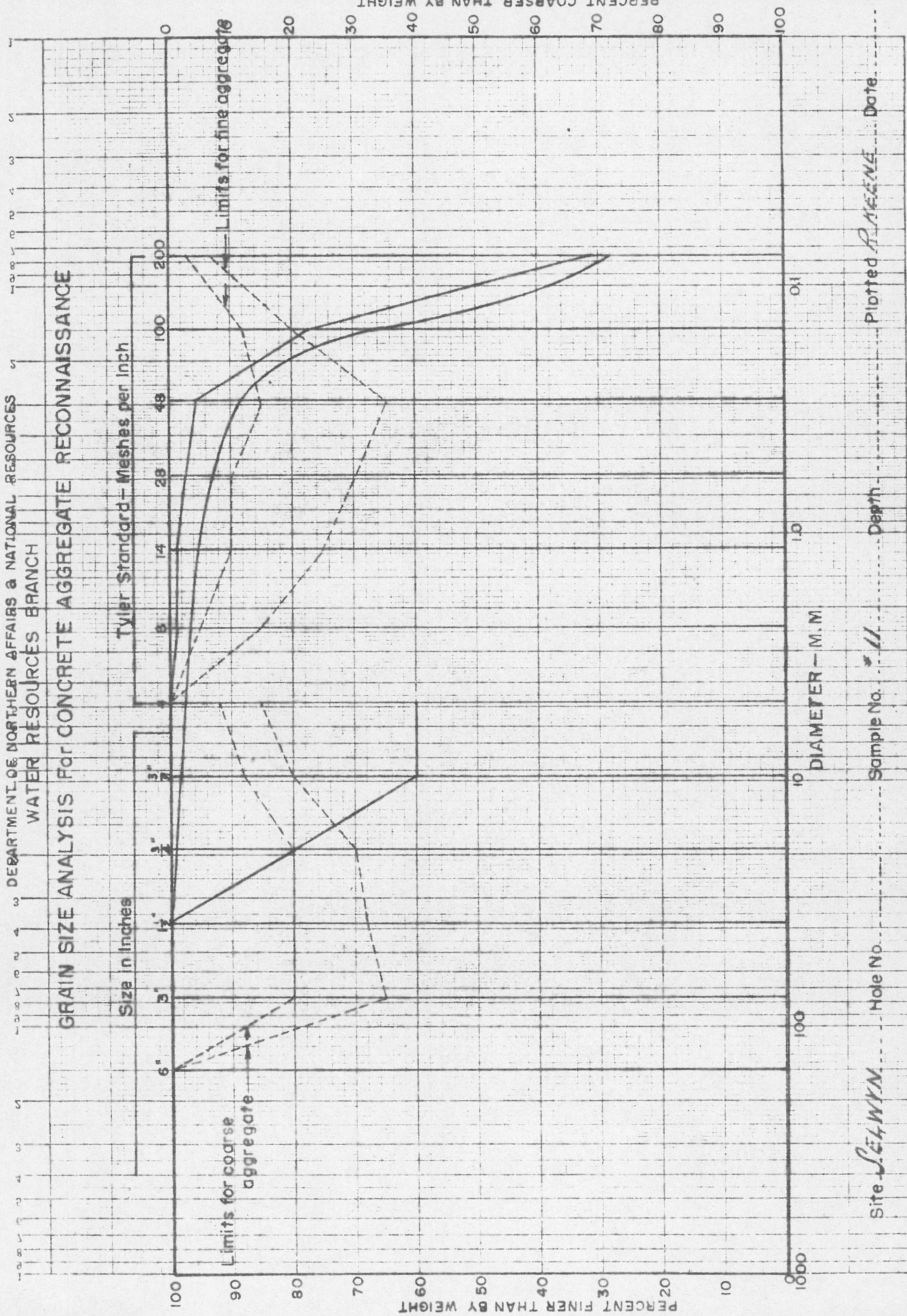
GRAIN SIZE ANALYSIS FOR CONCRETE AGGREGATE RECONNAISSANCE



Site SELWYN Hole No. 109 Depth            Plotted            Date

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GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE

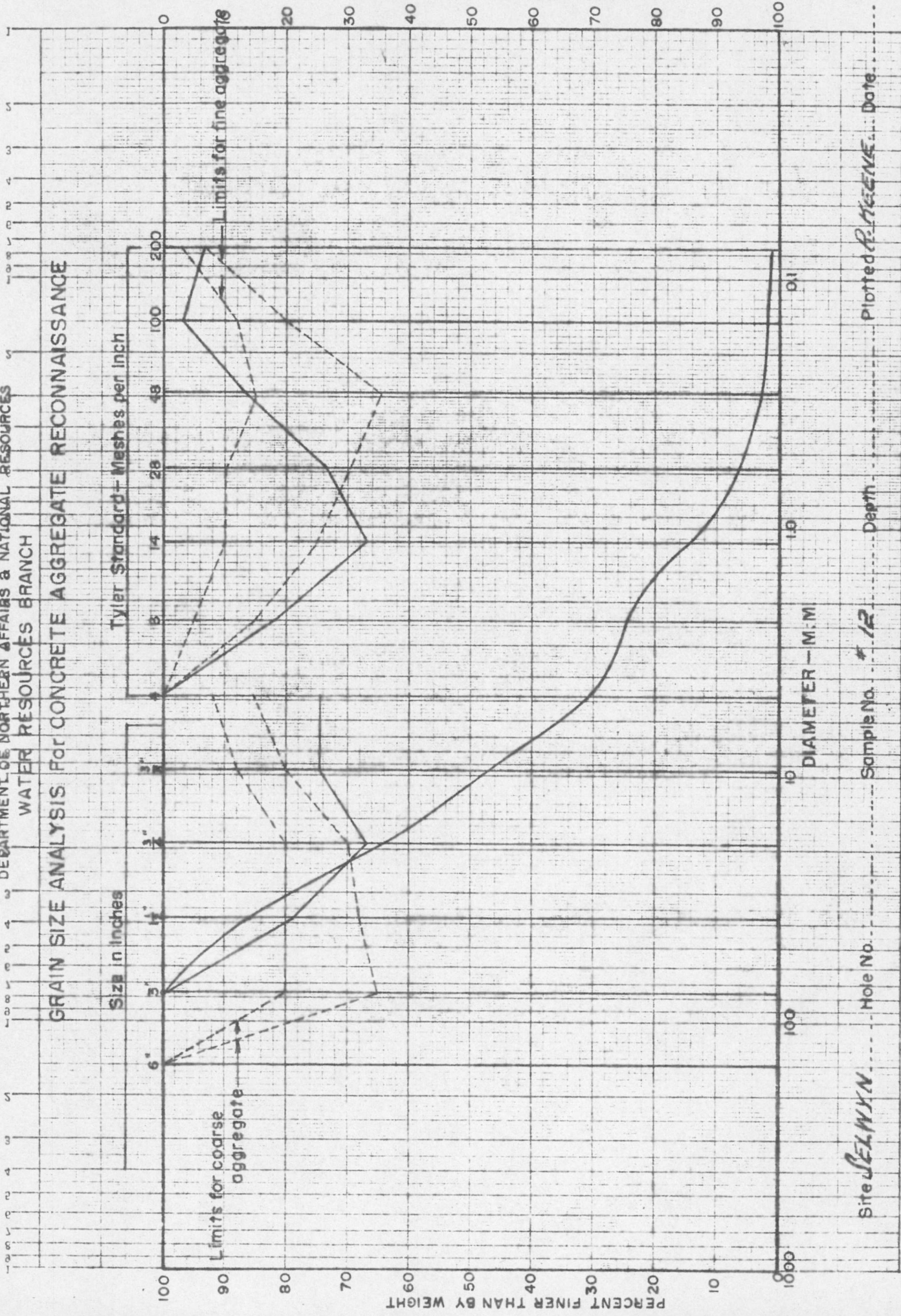


Site *S.E.4 WYN.* Hole No. *11* Depth *Plotted* *A. W. E. N. E.* Date *.....*



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WATER RESOURCES BRANCH

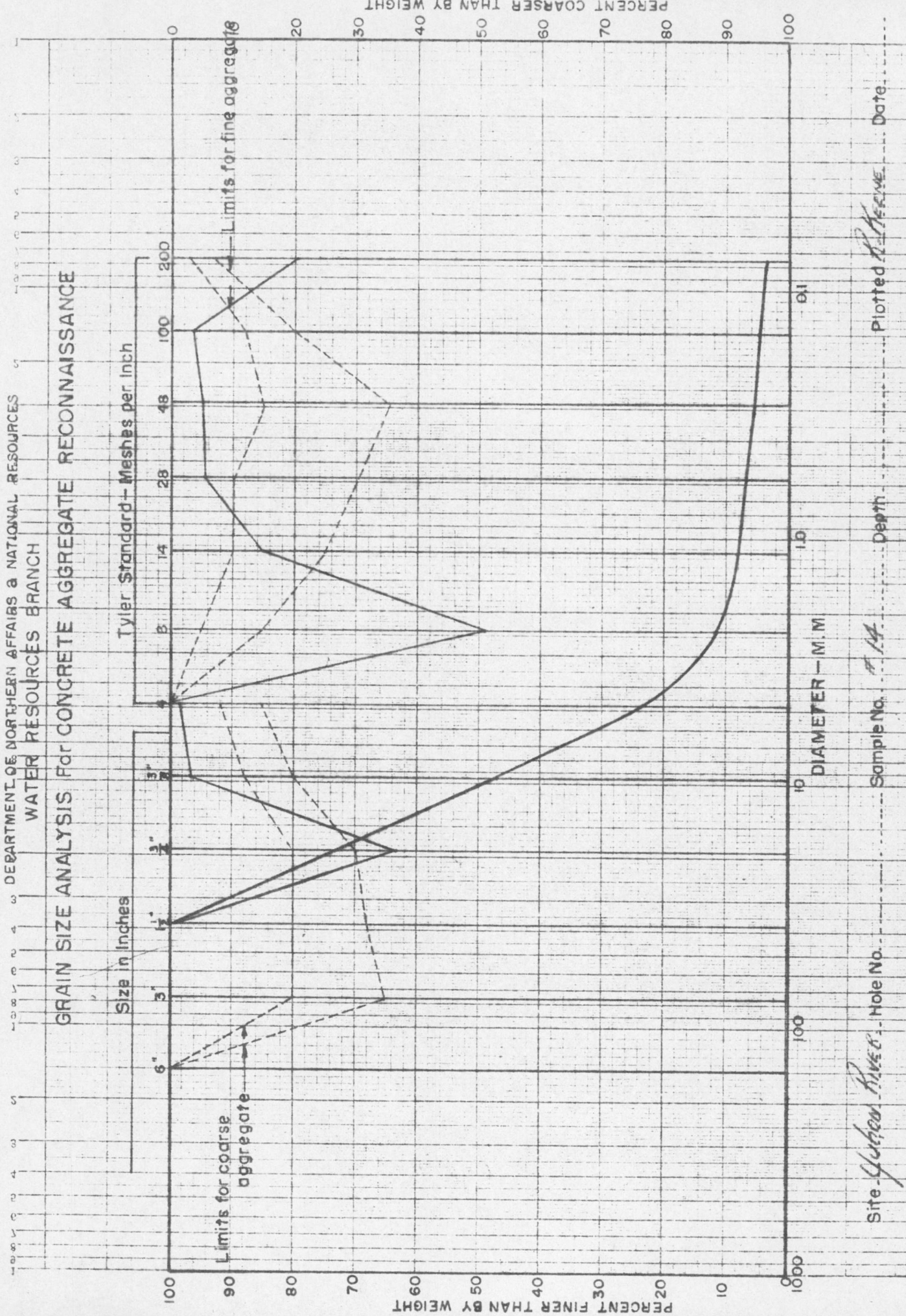
GRAIN SIZE ANALYSIS FOR CONCRETE AGGREGATE RECONNAISSANCE



Site *SALWYN* Hole No. *12* Sample No. *12* Depth *12* Plotted *R. McENE* Date *.....*



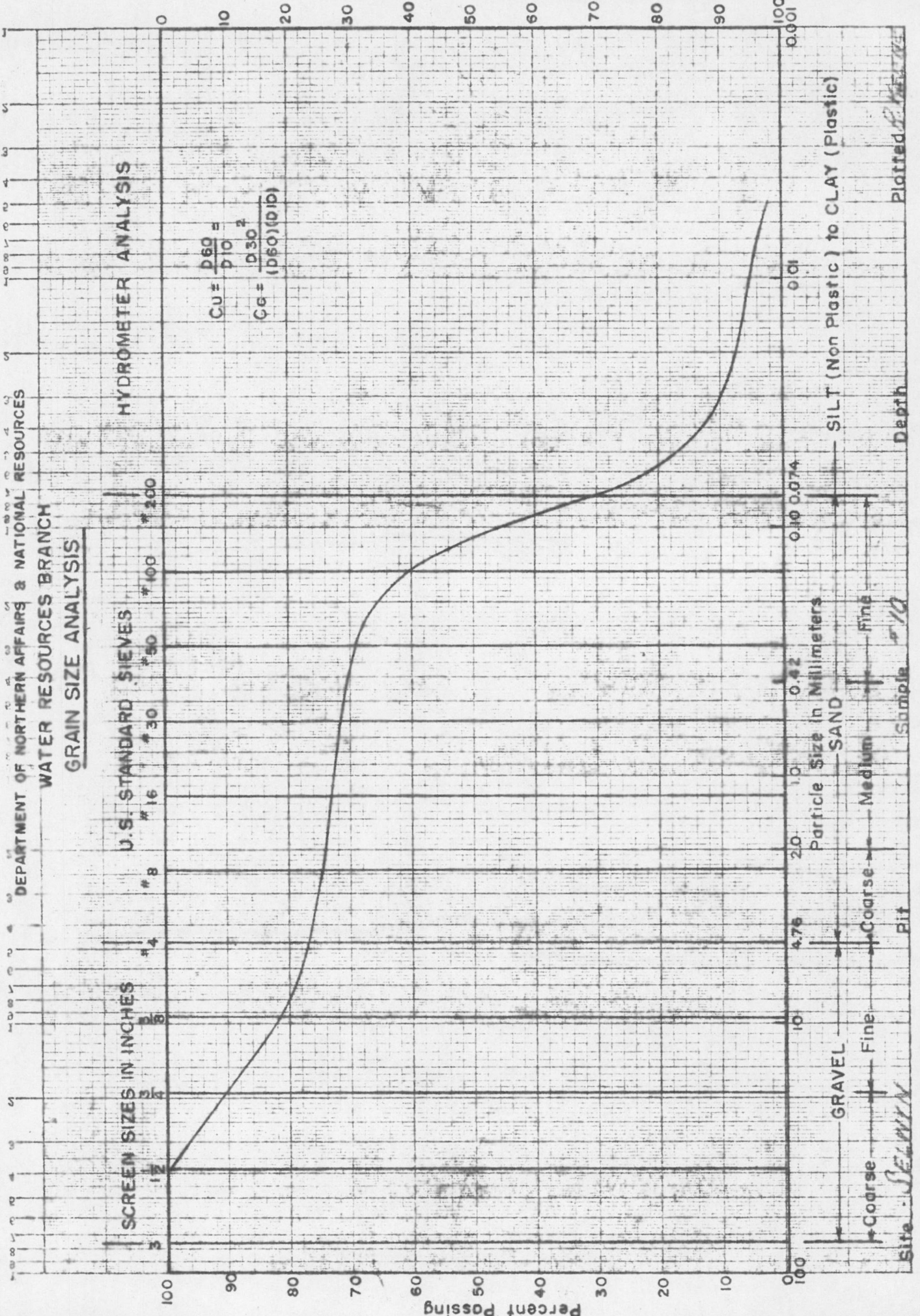
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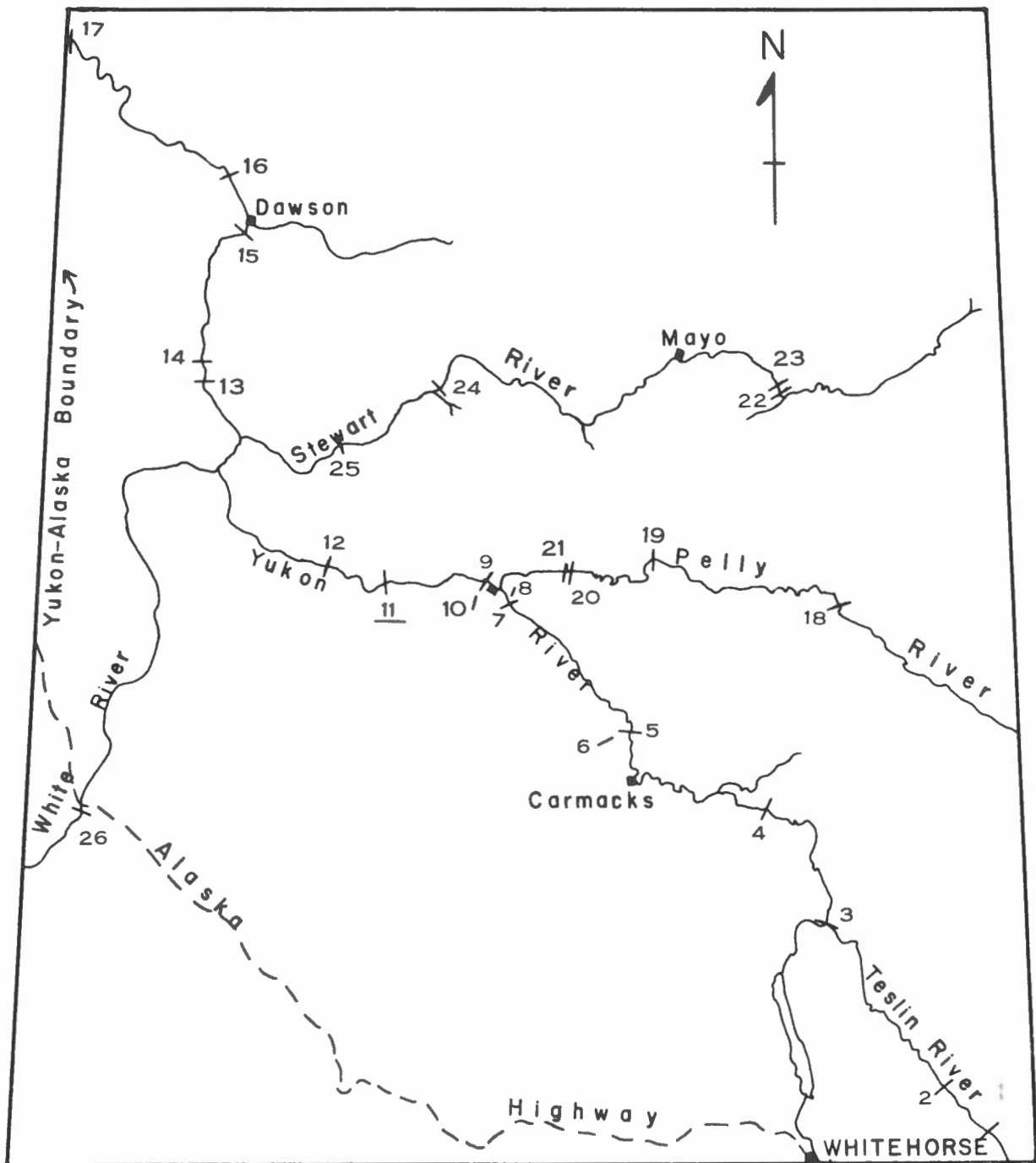


Site - Gudon River Hole No. 14 Sample No. 14 Depth          Plotted          Date

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

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (estimated)	Accessibility
10	Right side of Yukon River; 13 miles above site; 10 feet above River	Till-like, solifluction material; a soft, silty, sandy gravel; pebbles up to 3 inches; on sides and at base of large rock bluff	None	20 feet maximum	Not large	By Yukon River





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	<u>Selwyn</u>	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		