No. 2

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
TOPICAL REPORT NO. 100

YUKON RIVER DRAINAGE BASIN
DAM SITE INVESTIGATION

SITE No. 24

INDEPENDENCE DAM SITE

(MAP AND PRELIMINARY REPORT)

BY
E. B. OWEN

OTTAWA
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INDEPENDENCE DAM SITE

General Description

Independence dam site is located in the valley of Stewart River, Yukon Territory about 68 miles upstream from its confluence with Yukon River. The site is one of three proposed for Stewart River in the scheme to develop the power potential of the Yukon River drainage basin. Porcupine dam site is situated about 35 miles downstream and Fraser Falls site is about 122 miles upstream. These sites have been described in Topical Reports Nos. 99 and 98 respectively.

The most direct route to reach Independence site is from abandoned McQueston airport situated on the right side of the river about 12 miles upstream. The airport is about a mile south of the Dawson - Whitehorse highway to which it is connected by a fairly good road. Stewart River is easily ascended by shallow draft boats from its mouth as far upstream as Fraser Falls. Formerly streamboats navigated the river in summer as far as Mayo Landing.

The centre line of the proposed dam is indicated on the accompanying geological map. It will be mainly an earth-fill structure with a crest elevation of 1,655 feet. The earth-fill will occupy the left portion of the site whereas the right part in which the spillway and powerhouse will be located will be a concrete gravity structure. The maximum water-surface elevation of Stewart River at the dam site is about 1,370 feet. The normal pool elevation of the reservoir which will extend to Fraser Falls is 1,640.

Geology of the site area

The geology of the region has been described by Bostock[1]. Bedrock in the area adjacent to the site consists of metamorphosed

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[1] Bostock, H.S.: McQueston, Yukon Territory, map 1143A, Geol. Surv. Can., 1964.

Proterozoic rocks intruded mainly by Mesozoic granite and granodiorite and to a lesser extent by ultrabasic rocks such as gabbro and peridotite. The right abutment of the dam is located in an outcrop of granitic rock.

About 9 miles upstream from the site Stewart River which had been flowing in a general northwest direction along a broad valley known as Tintina Trench swings to the southwest. It continues to flow in this direction as it passes through the site. Tintina Trench is a distinct topographic feature which continues as a straight trench-like depression across much of southern Yukon. It does not form a master drainage channel but is occupied at intervals by parts of Pelly River, several small creeks and by Klondike and Yukon Rivers. Stewart River joins the Trench near the community of Stewart Crossing and follows it in a meandering fashion for about 36 miles until it breaks through to the southwest a few miles below McQueston airport.

During the Pleistocene ice age at least 3 ice sheets, all moving generally in a westerly direction, occupied parts of Stewart River valley. It is believed only the earliest of these reached the dam site area, the others terminating farther upstream. Till deposited by this older ice is exposed along the sides of the valley and is often visible in cut banks along the smaller creeks tributary to the Stewart where these streams have eroded valleys in the walls of the main valley. It occurs in the left abutments of both Independence and Porcupine sites and as elongated west-trending ridges west of Independence site. The till is a dense, grey material containing an abundance of black, chert pebbles. Most granitic rocks in it are highly weathered suggesting the material is older than the fresh till occurring at Fraser Falls site some 70 miles east. The till at Fraser Falls may have been deposited by a later west-moving ice sheet which advanced to a point in Stewart River valley a few miles downstream from Mayo Landing. From the construction viewpoint there is little difference between the tills at the various sites. The descriptions and grain size analyses curves for

the till included in this report could be used for Porcupine site further downstream.

According to Bostock[1] that part of Stewart River valley between Tintina Trench and the valley of Yukon River was once filled with glacio-fluvial gravel deposited by melt water from the wasting ice-sheets. At this stage the drainage route for the water was through Australia Creek and Indian River. Subsequently the river excavated the gravel down to the present valley floor. High gravel terraces along the sides of the valley are all that remains of the fill. The gravel is badly weathered and would have to be processed before being used as aggregate. Analyses of 2 samples of the gravel taken at the site indicate it is a poorly graded material with a low silt-clay content. The floor of the valley is covered with alluvial silt, sand and gravel deposited by the river when it flowed at a slightly higher elevation before it had cut down to its present channel and as flood plain deposits.

Engineering geology of the dam site

The setting at Independence site is common among the many dam sites which have been examined in the glaciated parts of Yukon Territory. It consists of a deeply filled valley with bedrock exposed in the lower parts of the abutments which rise steeply from the valley floor. Various types of glacial deposits overlie bedrock. Some of these are pervious and could introduce problems of leakage.

Bedrock consists of massive, medium- to coarse-grained, grey granite. It is exposed almost continuously close to the river along the base of the right abutment slope but only as small irregular outcrops on the left side. In places the rock is highly weathered. Five feet of brown residual soil consisting of quartz, weathered feldspar and biotite was encountered in a test pit put down at the downstream end of one outcrop

[1] Bostock, H.S.: Ogilvie, Yukon Territory, map 711A, Geol. Surv. Can., 1942.

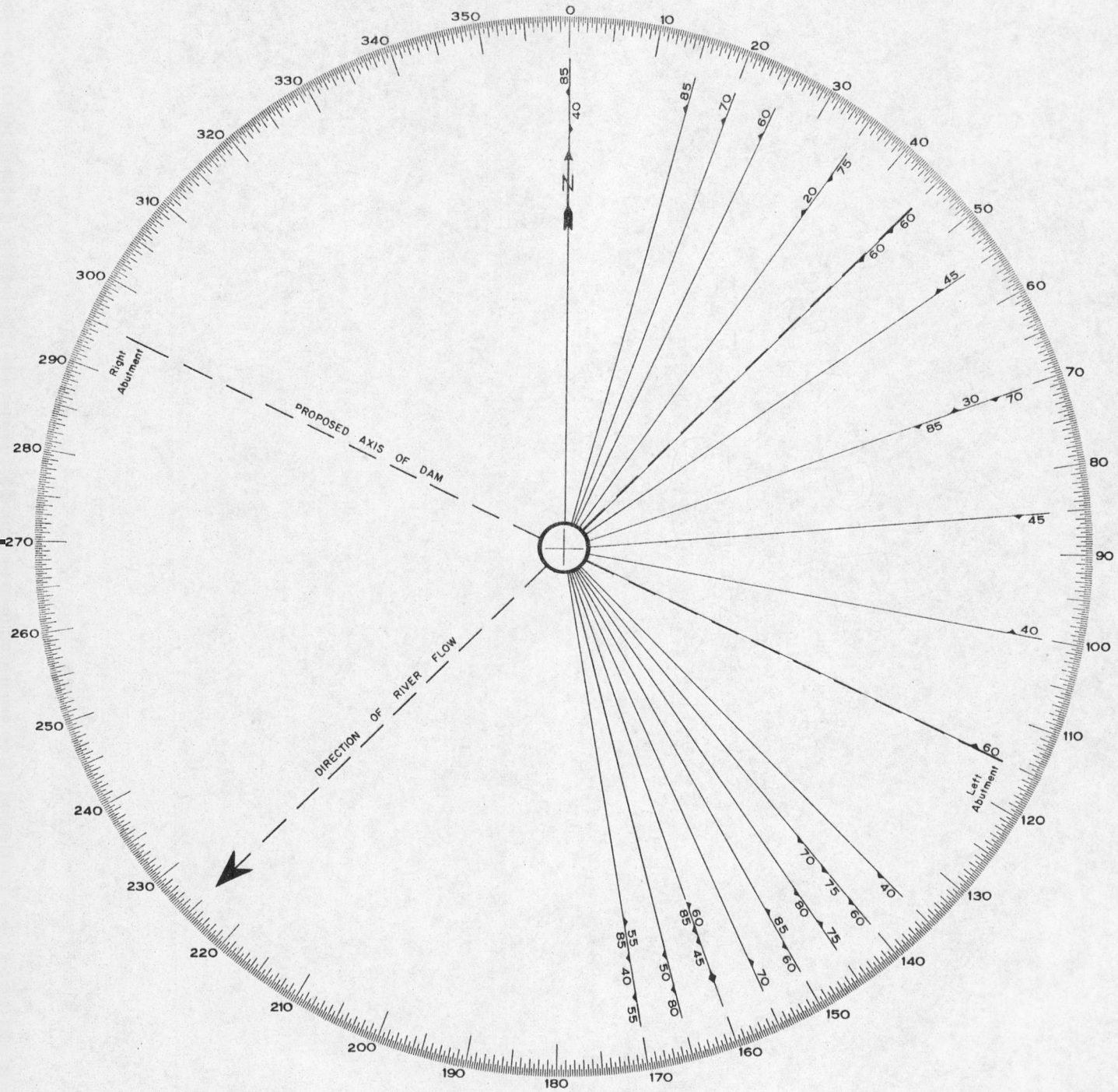
on the left abutment slope. The fresh granite is a sound, competent rock and should provide satisfactory abutment and foundation material. Jointing is the only structure which might effect its competency. Two fairly prominent joint sets are present, one is parallel to the river and the other at about 60 degrees. The spacing varies from a few inches to several feet. The jointing is commonly tight but some grouting will be necessary to prevent leakage beneath the dam. On bedrock surface some of the fractures are open as much as 3 inches. The attitudes on the accompanying joint rosette are representative of the jointing at the site.

Five different types of unconsolidated material were identified at the dam site. Recent alluvium consisting of silt and fine-grained sand covers the narrow flood plain bordering the river. The alluvium beneath the river is more coarse containing boulders up to 18 inches in diameter. Steel sheet piling could be driven through any of the visible alluvium but test borings should be put down to determine if larger boulders exist at depth.

Alluvium consisting of silty sand covers most of the valley floor between the abutments. It extends up to approximate elevation 1,385. This material is believed to have been deposited by Stewart River when the river was flowing at a higher elevation before it settled into its present channel. The thickness of the silty sand varies from 10 to 15 feet. Its permeability as computed in the field is 3.87 feet per day (recompacted material).

The areas adjacent to the outcrops west of the river are covered with talus mixed with gravel and silt. The rock fragments in the talus consist of angular, weathered fragments of grey granite seldom greater than 14 inches in diameter. Small areas of similar talus also occur along the toe of the right abutment slope.

Coarse-grained, brown, weathered gravel covers the right abutment slope above the bedrock exposures. The slope is continuous upward with no visible terraces. Similar gravel occurs above the rock



JOINT ROSETTE

The above illustration presents diagrammatically the direction and dip of jointing in bedrock exposed at Independence site

outcrops on the left abutment. Here several small discontinuous terraces occur. These consist of a steep bluff, 10 to 40 feet in height, above which is a fairly level, gravel-covered area which, in turn, extends back to the toe of another bluff. Large boulders of quartzite and weathered granite ranging up to 6 feet in diameter occur on the terraces. The gravel probably overlies bedrock.

A grey, silty till containing numerous black chert pebbles covers the upper part of the left abutment slope. Two samples of this material were sent to the soils laboratory of the Water Resources Branch in Vancouver for analyses. The resultant grain size curves are included at the end of this report.

Data from 2 seismic lines indicate the thickness of overburden beneath the large island in the river at the dam site varies from 56 to 78 feet. These figures are probably correct and could be extended to include the unconsolidated material beneath the main channel of the river west of the island. Bedrock surface probably slopes steeply upward from beneath the river to the outcrops on the abutments. The thickness of the talus is nowhere believed to be greater than 10 feet. The gravel deposits on the abutments probably increase in thickness up slope. The results of seismic line No. 1 indicate the thickness of the till covering the upper part of the left abutment is about 4 feet. This figure is believed low. Test pits put down in this area encountered the frost line at 24 to 36 inches but there was no evidence that bedrock was near.

Construction Materials

The weathered gravel at the dam site could probably be processed to produce satisfactory aggregate. The material contains a high percentage of black shale fragments and partly disintegrated granitic rocks which would be harmful to concrete. Similar gravel is exposed in terraces along Stewart

River valley downstream from the site and also for several miles upstream. The quantity available should be large although some of the terraces have only a thin deposit of gravel which overlies bedrock. Satisfactory artificial aggregate can probably be obtained by crushing bedrock at the site.

The till in the left abutment could be used for embankment or core material in the earth-fill section of the dam. There are unlimited quantities of this material available within a few miles of the site.

Suitable riprap and rock fill could be obtained from bedrock at the site. The specific gravity of the rock is relatively high and the soundness is believed satisfactory. The size and shape of the rock fragments in the talus, which is a good indication of how the rock will break when quarried, is acceptable.

Conclusions

The following conclusions have been made as a result of this preliminary geological investigation of Independence dam site:

1. Bedrock at the dam site consists of massive, medium- to coarse-grained, grey granite. It should provide satisfactory foundation and abutment material. Suitable riprap and rock fill could be obtained from this rock and it can also be crushed to produce aggregate.

2. The till at the site could be used as embankment or core material for an earth dam.

3. There is no information regarding groundwater conditions at the site. Springs or seeps were not observed in either abutment nor is there any indication they have occurred in the past. The swamp conditions on the alluvium-covered terrace along the toe of the right abutment near its upstream end are due to poor surface drainage of water derived from precipitation and the melting of the underlying frozen ground.

4. The frost line was encountered within 30 inches of ground surface in many parts of the left abutment. On the island it occurred within 30 feet of the edge of the river.

5. More information is required concerning subsurface conditions at the site. Test borings should be put down to determine the thickness and quality of the overburden and the elevations of bedrock surface. The results of seismic line No. 1 on the left abutment should be checked as overburden here is believed to be thicker than calculated. The presence of large boulders in the overburden beneath the river should be investigated as these could prevent the driving of steel sheet piling for the proposed copperdams. In all the borings soil samples should be taken and permeability tests conducted.

6. Bicarbonate salts of calcium and magnesium constitute the chief mineralization of Stewart River water. The results of chemical analyses of several samples of the water are included in the report on Fraser Falls dam site (Topical Report No. 98).

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

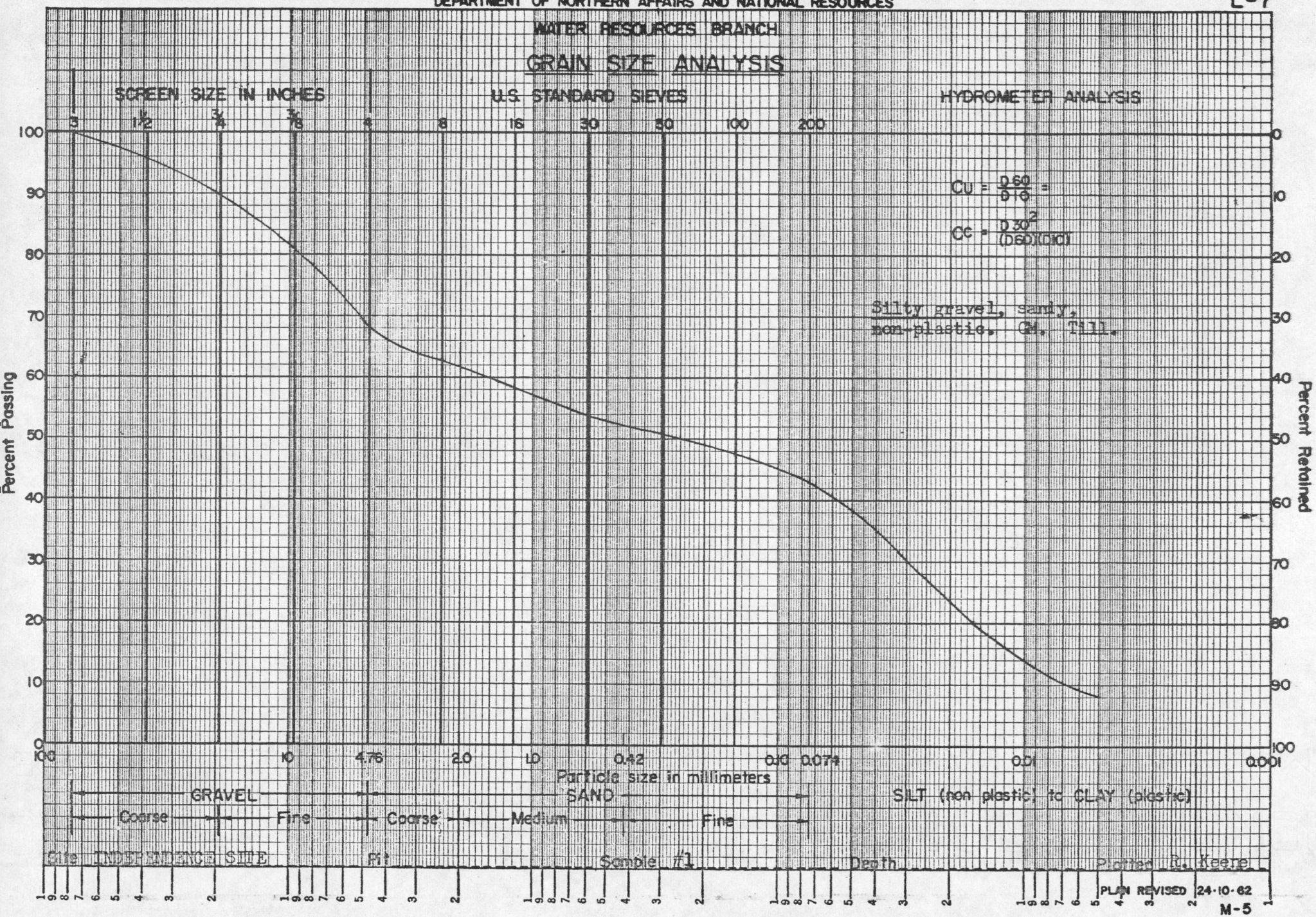
Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
1	Station E-30; 3 feet beneath ground surface; left abutment area	Till: grey, silty, sandy; angular boulders to 12 inches chiefly schist, white quartz and weathered granite with many small, black chert pebbles	None	3+ feet	very large	Frost line at 42 inches
2	Station E-29; 30 inches beneath ground surface; left abutment area	Till: grey, silty, sandy, medium dense; angular pebbles and cobbles to 8 inches of schist, white quartz and weathered granite, about 25% of pebbles are black chert.	None	30+ inches	very large	Frost line at 36 inches

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

L-7

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



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M-5

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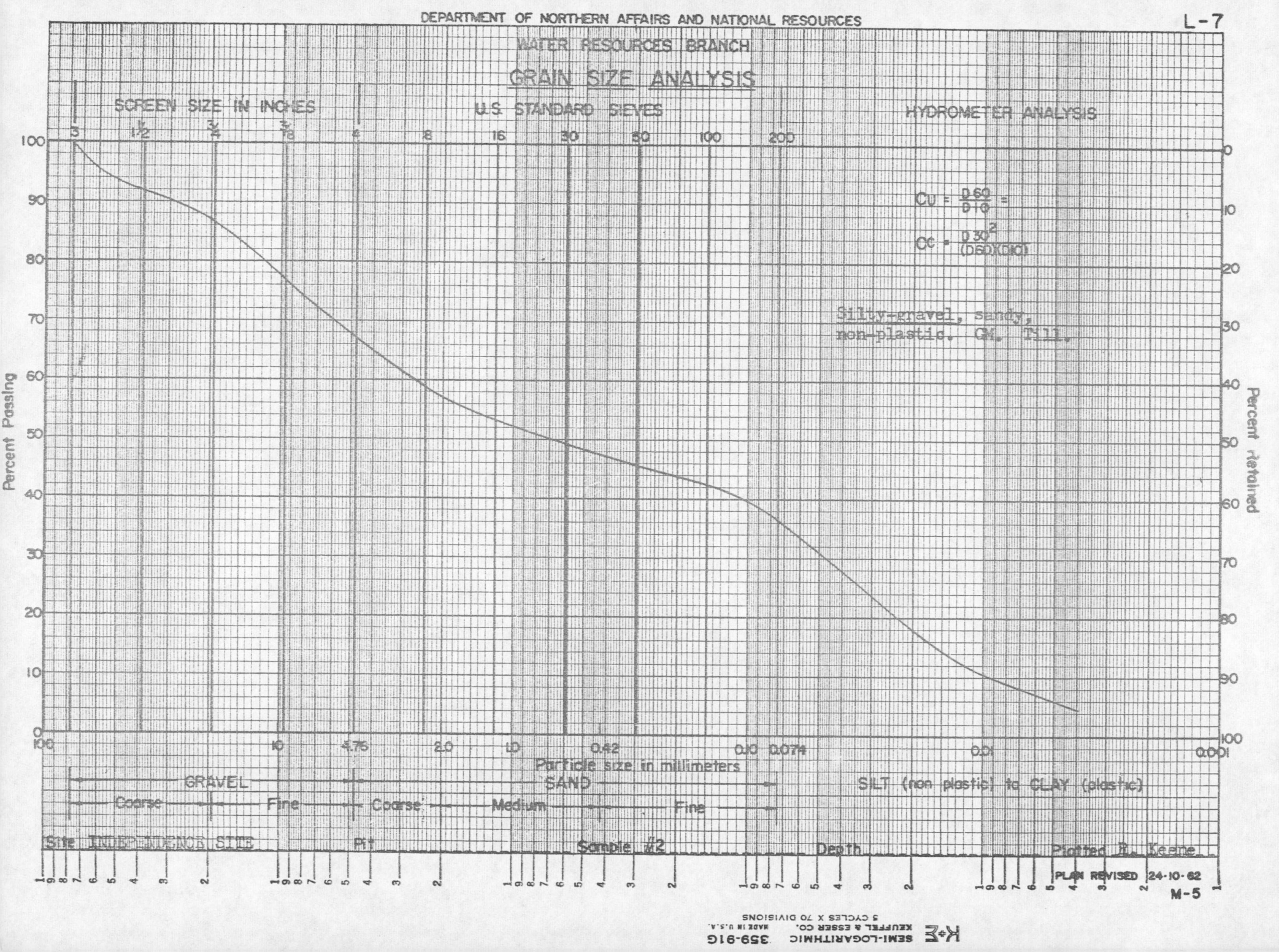
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



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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)	Remarks
3	On terrace along left side of Stewart River 1/2 mile upstream from site; 50 feet above river; 3 feet beneath ground surface	Gravel: brown, sandy, no silt, poor grading; loose, cobbles to 6 inches; considerable weathering.	None	Unknown	Large	No frost line noted, may be dry frozen
4	At station T-5 on right abutment; 34 inches beneath ground surface	Gravel: brown, sandy, no silt, poor grading; cobbles to 5 inches; considerable weathering	None	Unknown	Large	No frost line noted, may be dry frozen.
5	On terrace along left side of Stewart River 14 miles upstream from site; 75 feet above river; 24 inches beneath ground surface	Gravel: grey, sandy, no silt, poor grading; loose; minor weathering; cobbles to 6 inches consisting of chert, quartzite, granite, diorite, gneiss, schist and minor shale	None	35+ feet	Large; extends 2 miles along left side of river	Unlimited supply; less weathered then gravel at dam site.

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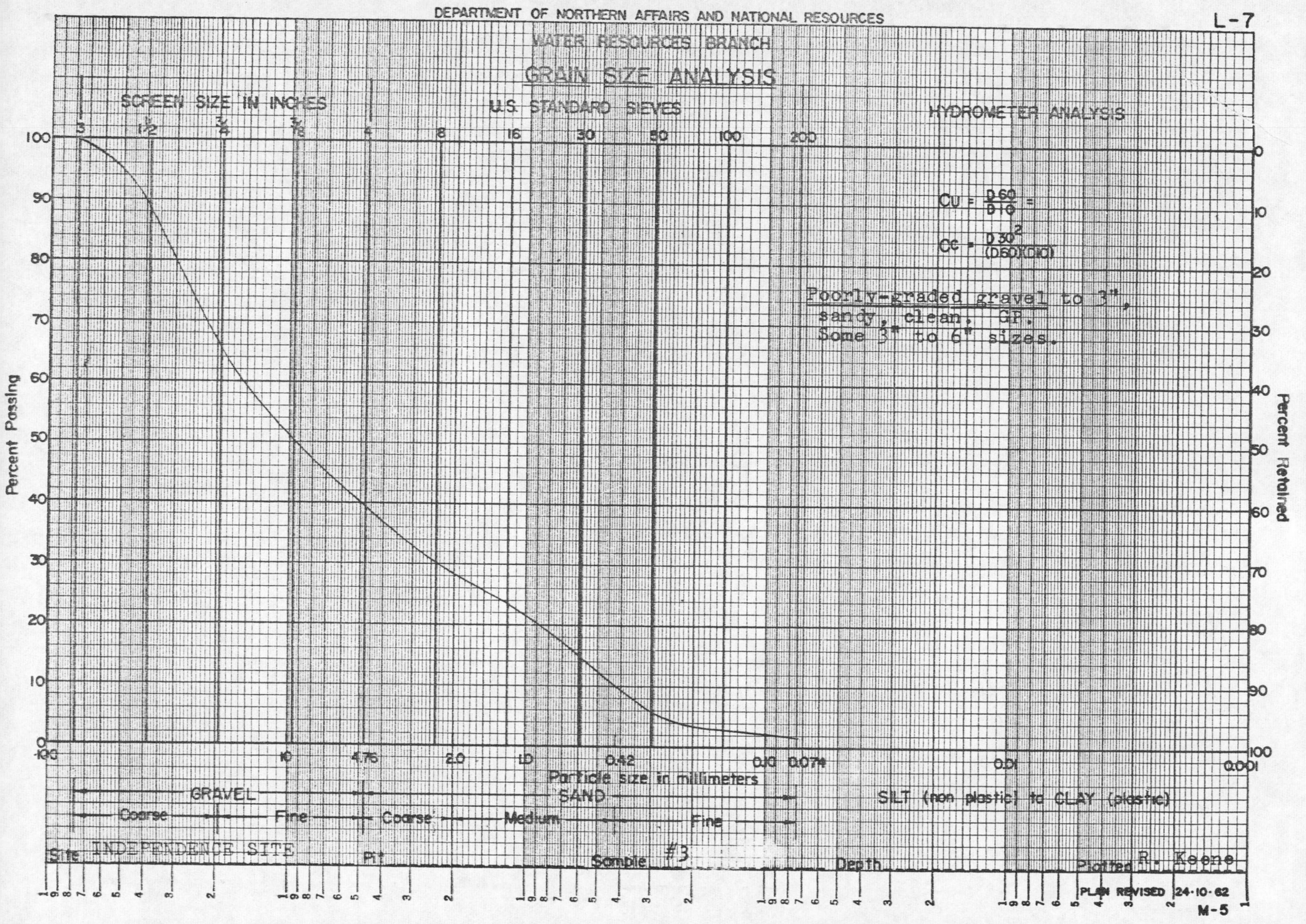
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site INDEPENDENCE SITE Pit Sample #3 Depth Plotted R. Keene

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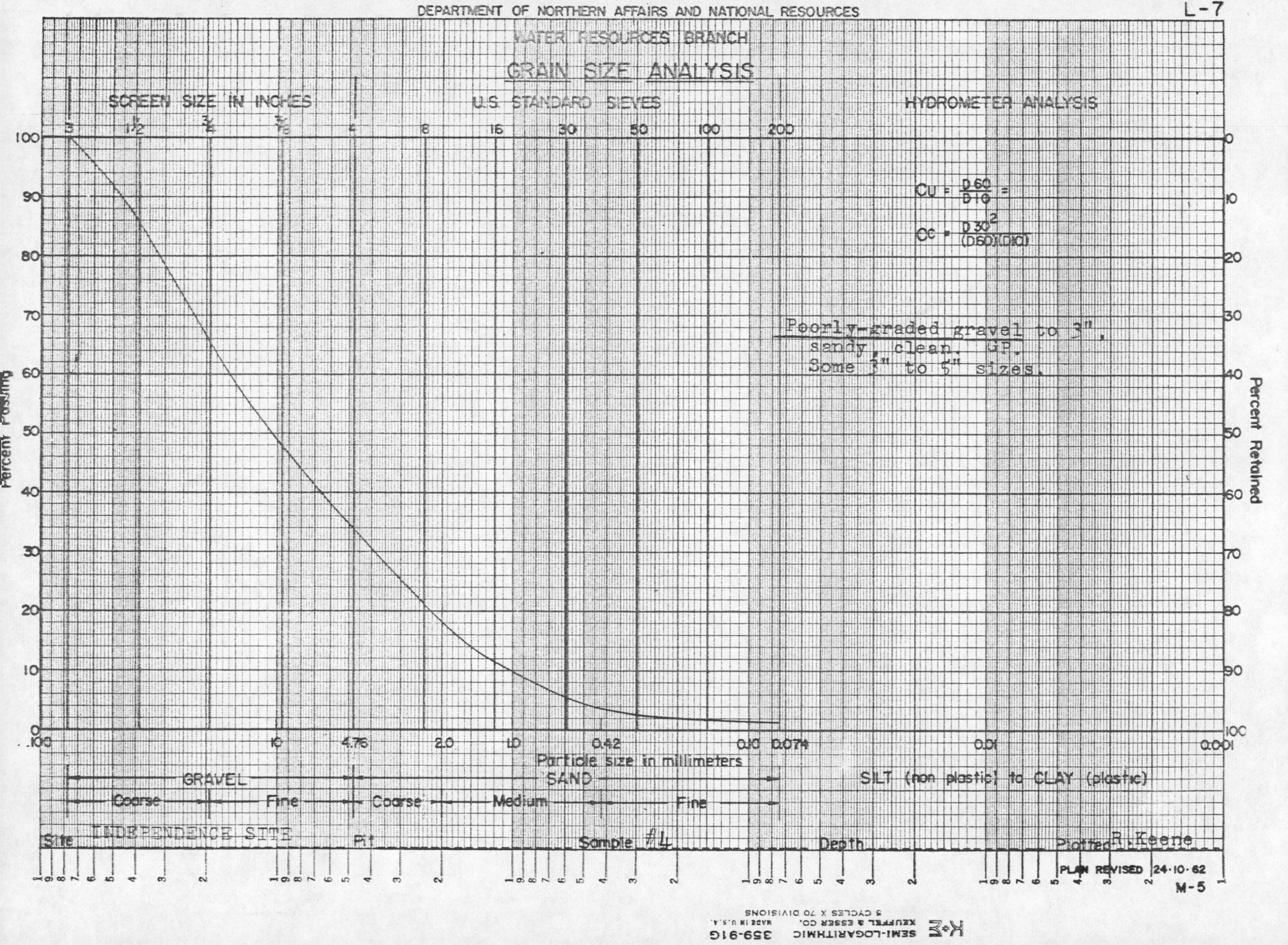
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site INDEPENDENCE SITE Pit Sample #4 Depth Plotted R. Keene

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WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS

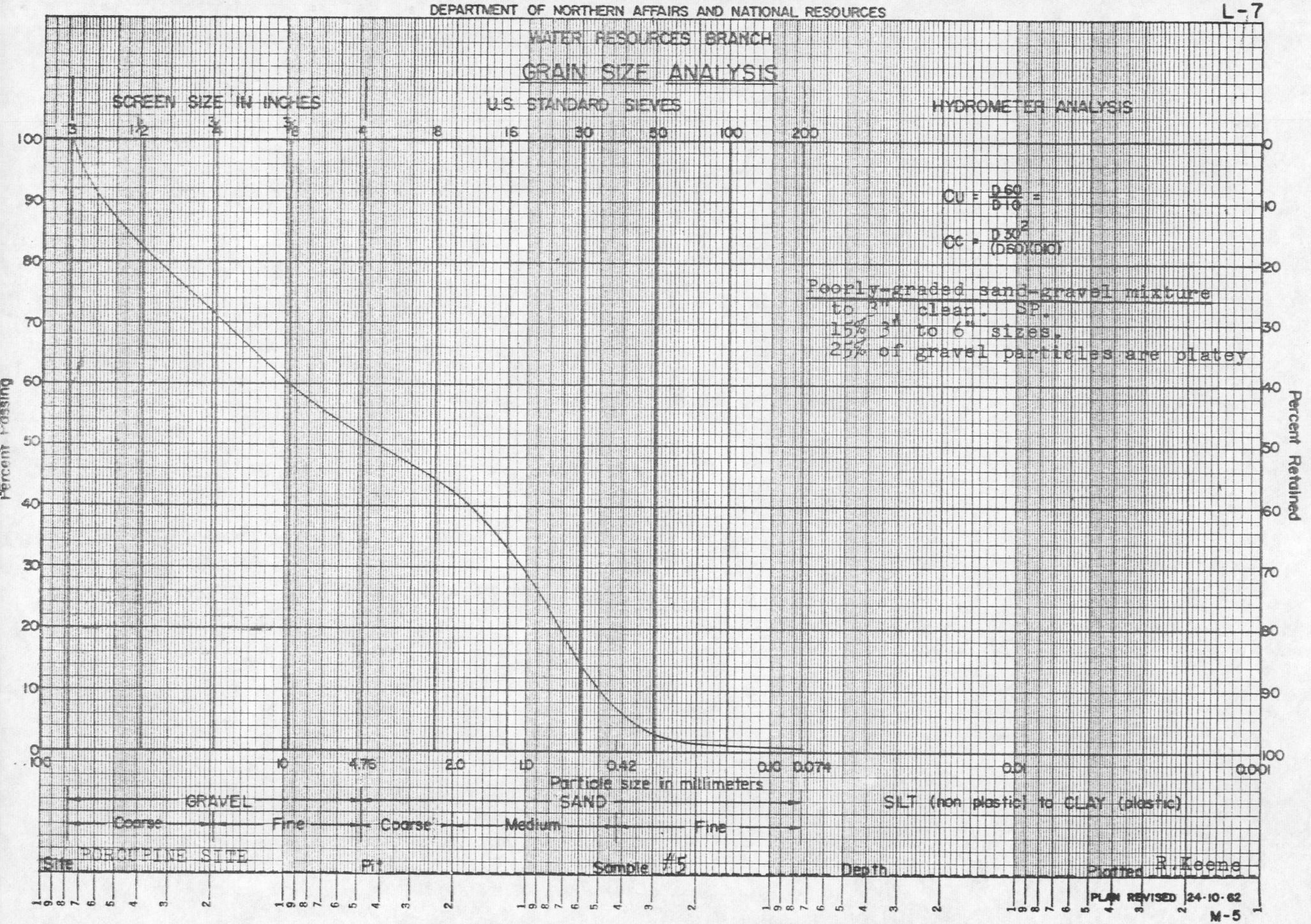

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Plate 1

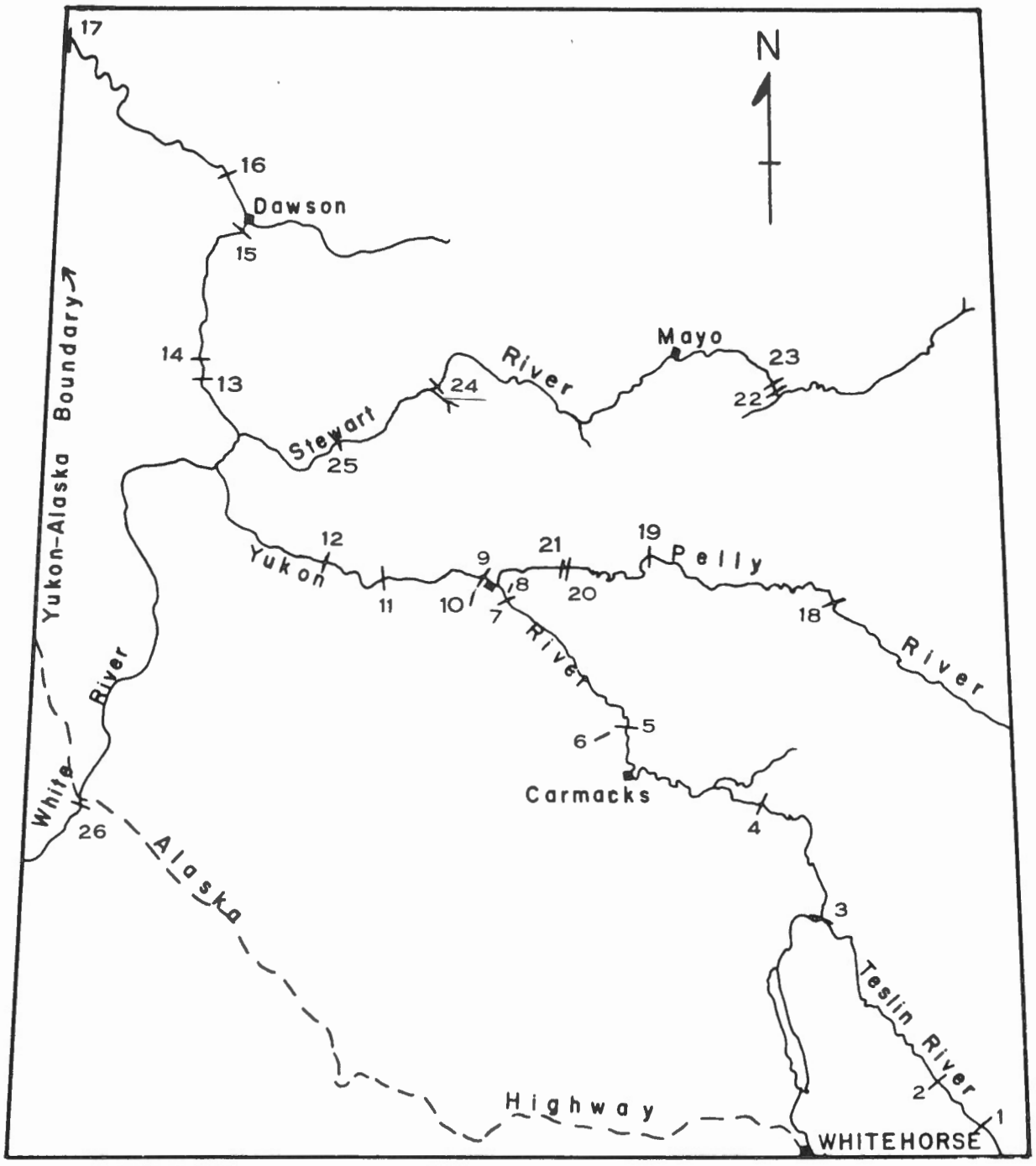
Right abutment, Independence dam site, the black line indicates the approximate location of the centre line, the rock bluff in the foreground is about 60 feet high.

G.S.C. 1-4-63

Plate 2

View of left abutment area from right abutment, approximate location of proposed centre line indicated by black line.

G.S.C. 1-5-63



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		