No. 5

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
TOPICAL REPORT NO. 37

PACIFIC COASTAL DRAINAGE
DAM SITE INVESTIGATION

SITE NO. 31

KATHLEEN LAKE DAM SITE

(MAP AND PRELIMINARY REPORT)

BY
E. B. OWEN

OTTAWA
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Contents

Illustrations

Kathleen Lake Dam Site

General Description

Kathleen Lake dam site is located on Kathleen River between the bridge at mile 142.9 on the Haines Road and Kathleen Lake which is drained by the River. The distance between the bridge and Lake is about one-half mile.

The purpose of the dam is to provide storage of high water flows of Kathleen River for later release to a proposed power dam at Kathleen River Canyon some 13 miles downstream. Kathleen Canyon site is described in Topical Report No. 38, site No. 30.

In the site area Kathleen River is a shallow, rapid-flowing stream with an average width of about 110 feet. The water is relatively clear and its temperature at the time of this investigation (June 6, 1961) was 43 degrees Fahrenheit.

Overburden at the site consists of glacio-fluvial gravel overlain by fine, yellow, clayey silt. There is a possibility till underlies the gravel. Bedrock is not exposed. The general geology of the area has been described by Kindle[1]. There is no lack of overburden suitable for construction purposes in the area about the site. Representative samples from several silt and gravel exposures in the vicinity of the site were taken and forwarded to the Soils Laboratory of the Water Resources Branch in Vancouver for grain size analyses. The resultant curves are included at the end of this report.

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[1] Kindle, E.D.: "Dezadeash Map-Area, Yukon Territory"; Geol. Surv., Can., Mem. 268, 1953.

Unconsolidated Deposits

Three types of unconsolidated deposits were identified in the area mapped at Kathleen Lake dam site. These are as follows:

1. Recent Alluvium: This material has been deposited by the present River. It consists of silt, sand and gravel with boulders up to 12 inches in diameter. It occurs directly beneath the River and as fairly extensive flood plain deposits along both sides of the River between the bridge and Kathleen Lake. It is not an important deposit and has little use as a construction material.

2. Glacio-Lacustrine (clayey silt): This material occurs on ground surface throughout most of the site area. It consists of a fine, clayey silt with a medium dry strength indicating the presence of a relatively large proportion of clay. According to Kindle the silt was deposited by glacial Lake Champagne which extended over a large area north of Kathleen Lake. In the site area the thickness of the silt deposit varies from 6 inches to 7 feet. The contact between the silt and the underlying glacio-fluvial gravel is usually well defined.

3. Glacio-fluvial (sand and gravel): This material varies from a medium-grained sand to a silty, sandy gravel with boulders up to 10 inches or more in diameter. In the map-area it underlies both the Recent alluvium and the glacio-lacustrine clayey silt. The density and permeability of the sandy gravel varies with the silt content. In places where there is an appreciable amount of silt the gravel is relatively dense and the permeability is low. In other places where the silt content is negligible the material is loose and the permeability high. The gravel is believed to overlie a dense, silty, sandy till. This material was encountered in several test pits underlying about 3 feet of gravel. It is nowhere exposed

on ground surface.

Bedrock

Bedrock is not exposed in the site area. The nearest rock outcrops occur on the steep slopes of a mountain some 2 miles west of the site. Bedrock here consists largely of sedimentary rocks described by Kindle as belonging to the Dezadeash Group. There is no evidence presently available to indicate these rocks underlie the site area. It is suggested test borings be put down to determine the quality of bedrock and to investigate the possible occurrence of a large fault[1] (Shakwak fault) in bedrock directly beneath the site.

Engineering Considerations

Depth of Overburden

There is no indication on ground surface concerning the depth of overburden in the site area. The possible presence of major faulting in the underlying bedrock suggests the thickness of overburden may be considerable. Ice moving northwest along Shakwak Trench could readily erode broken rock in the fault zones.

Test borings should be put down to investigate the quality and permeability of the overburden and to determine the elevation of bedrock surface. If seismic work is done using the equipment presently owned by the Water Resources Branch it is suggested, for best results, the lines be located parallel to Haines Road.

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[1] Kindle, E.D.: "Yukon Territory"; Geol. Surv., Canada, Dezadeash Map 1019A, 1952.

Abutments and Foundations

It is believed the thickness of overburden is too great to excavate to bedrock for the type of dam required at Kathleen Lake site. Consequently the dam will probably be founded on glacio-fluvial gravel or till if the test borings indicate this material underlies the gravel at sufficiently shallow depths. The till and the more dense, silty phases of the gravel should both provide excellent foundations and abutments for the dam. In some test pits put down immediately upstream from the Haines-Fairbanks oil pipe line, the gravel encountered was extremely dense and till-like in appearance. The contact between the two materials is usually not sharp and will probably not be observed in any excavation made at the site.

Construction Materials

Aggregate

There are unlimited quantities of natural aggregate within economical haulage distances of the site. Representative samples from several easily accessible sand and gravel deposits were taken and forwarded to the Soils Laboratory of the Water Resources Branch in Vancouver. The resultant curves are included at the end of this report.

Impervious Material

It is believed the clayey silt, which covers much of ground surface about the proposed site, and the till, would both provide satisfactory material for the impervious core of an earth-fill dam. The silt is the more accessible of the two materials. However, the thickness of this deposit varies and some test pitting will be required to locate sufficient material.

Pervious Material

Material suitable for the pervious shells of an earth-fill dam can be obtained from the gravel deposits described under the aggregate heading.

Riprap and Rock Fill

Material suitable as riprap does not occur in the site area. The nearest bedrock exposure from which satisfactory riprap could be obtained are readily accessible outcrops of granodiorite located about 2 miles east of mile post 141 on Haines Road.

Ground Water

At the time of the investigation the ground-water table was fairly high throughout the site area. Many small ponds occur and water was encountered within 2 feet of ground surface in several test pits. Accurate information concerning the water table can only be obtained by installing ground-water observation holes and measuring them periodically.

Frozen Ground

Frozen ground was encountered in several of the shallow test pits put down southeast of the River. It usually occurred in the clayey silt beneath an insulating layer of moss and decayed vegetation and varied in depths from 12 to 14 inches beneath ground surface (June 4, 1961). Localities where frozen ground was encountered in the site area are indicated on the accompanying geological map.

Proposed Location of Dam

A proposed location for the centre line of the dam has been indicated on the accompanying geological map by a line of proposed bore holes crossing Kathleen River about 500 feet upstream from the pipe line. The left abutment consists of a bluff somewhat greater than 35 feet in height while a smaller bluff, 10 feet in height, constitutes the right abutment. To increase storage in Kathleen Lake a dyke could be constructed from the right abutment to the higher ground southeast of the River. Overburden here consists of a thin layer of clayey silt overlying dense, silty, sandy gravel. It is similar to that in the abutments and should provide suitable foundation material for a dyke. The material beneath the River probably consists of dense gravel or till overlain by a thin deposit of alluvium. The River at the proposed site is about 150 feet in width.

Further Investigations

It is suggested several test borings be put down along the proposed centre line of the dam and adjoining dyke to investigate the quality and permeability of the overburden and to determine the elevation of bedrock surface. The locations of the borings are indicated on the accompanying geological map.

Chemical Analyses of Kathleen River Water

Two samples of Kathleen River water were taken during the 1961 field season. One was taken at the Haines Road bridge and the other immediately downstream from Kathleen River Canyon. The samples were analysed for their mineral content by the Industrial Waters Section, Mines Branch, Department of Mines and Technical Surveys, Ottawa. The results of the analyses are included on the following page.

Chemical Analyses of Kathleen River Water
(parts per million)

Location	Date	River Discharge	pH	SiO_2	Ca	Mg	Na	K	Fe	Co_3	HCO_3	So_4	Cl	F	Turbidity	Total Hardness as $CaCo_3$
At Haines Road Bridge	June 7, 1961	medium	7.9	4.3	31.0	7.0	2.4	0.5	Tr.	0.0	105	23.8	0.7	0.10	-	106
At Kathleen River Canyon; 13 miles down stream from bridge	June 6, 1961	medium	8.0	4.4	28.7	5.4	2.3	0.5	0.02	0.0	97.5	19.1	0.3	0.09	-	93.9

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. The permeabilities of samples Nos. 1, 2 and 4 were computed in the field using a Soiltest Permeameter, Model K-620.

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 the individual percentages of the coarse and fine fraction retained on each screen or sieve size.

Three samples (Nos. 1,2 and 4) were analysed as potential impervious material; the remainder as potential aggregate.

Description of Potential Aggregate for the following Grain Size Curves

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
3	Sample taken 4 feet beneath silt sample No. 1.	Sandy gravel; minor silt; very few boulders over 8 inches in diameter; little weathering; numerous rounded pebbles of fine-grained volcanic rocks; boulders are chiefly granitic.	5 feet of clayey silt	5 + feet	Unlimited	Covered with varying thicknesses of clayey silt
5	Cut on north side of Haines Road 800 feet west of mile 146; 4 feet below ground surface; 25 feet above Road surface	Sandy gravel; clean; upper 3 feet badly weathered; fairly well graded; numerous pebbles; very few boulders. Pebble Lithology Igneous (granite,etc) 30% Sedimentary (greywacke,etc) 60% Metamorphic (gneiss, etc) 5% Weathered shale 5%	None	29 + feet	Unlimited	Clean glacio-fluvial material; several eskers in vicinity formed of similar material
6	Cut on north side of Haines Road; 15 feet below sample No. 5	Fine-grained, sandy gravel; no weathering; few pebbles over 2 inches; well graded. Pebble Lithology Igneous - 20% Sedimentary - 65% Metamorphic - 5%	Sample No. 5	29 + feet	Unlimited	Clean glacio-fluvial material; much of it is too fine-grained to be used as coarse aggregate

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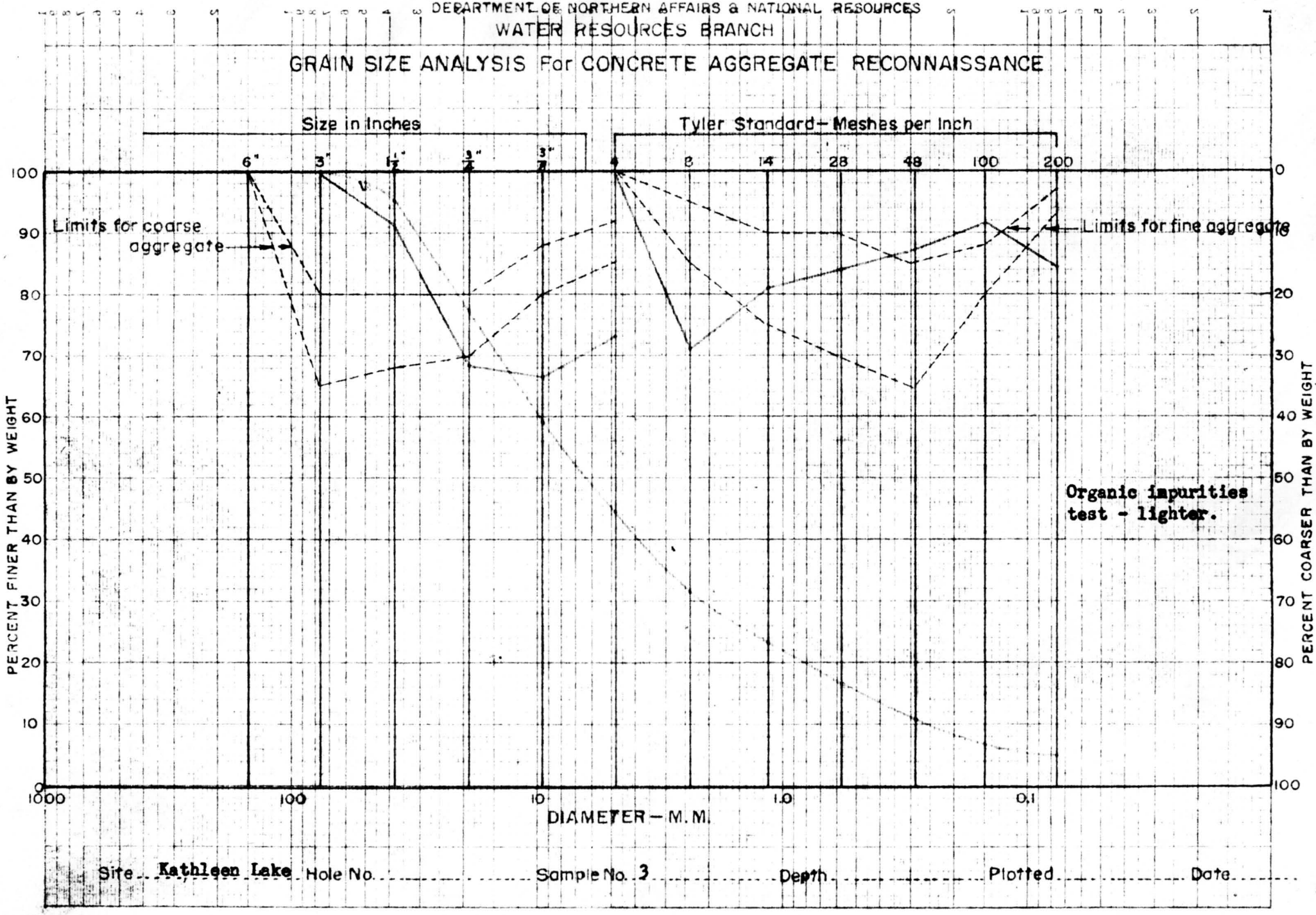
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Site Kathleen Lake Hole No. Sample No. 3 Depth Plotted Date

PLAN No. 100 – 13

M-6

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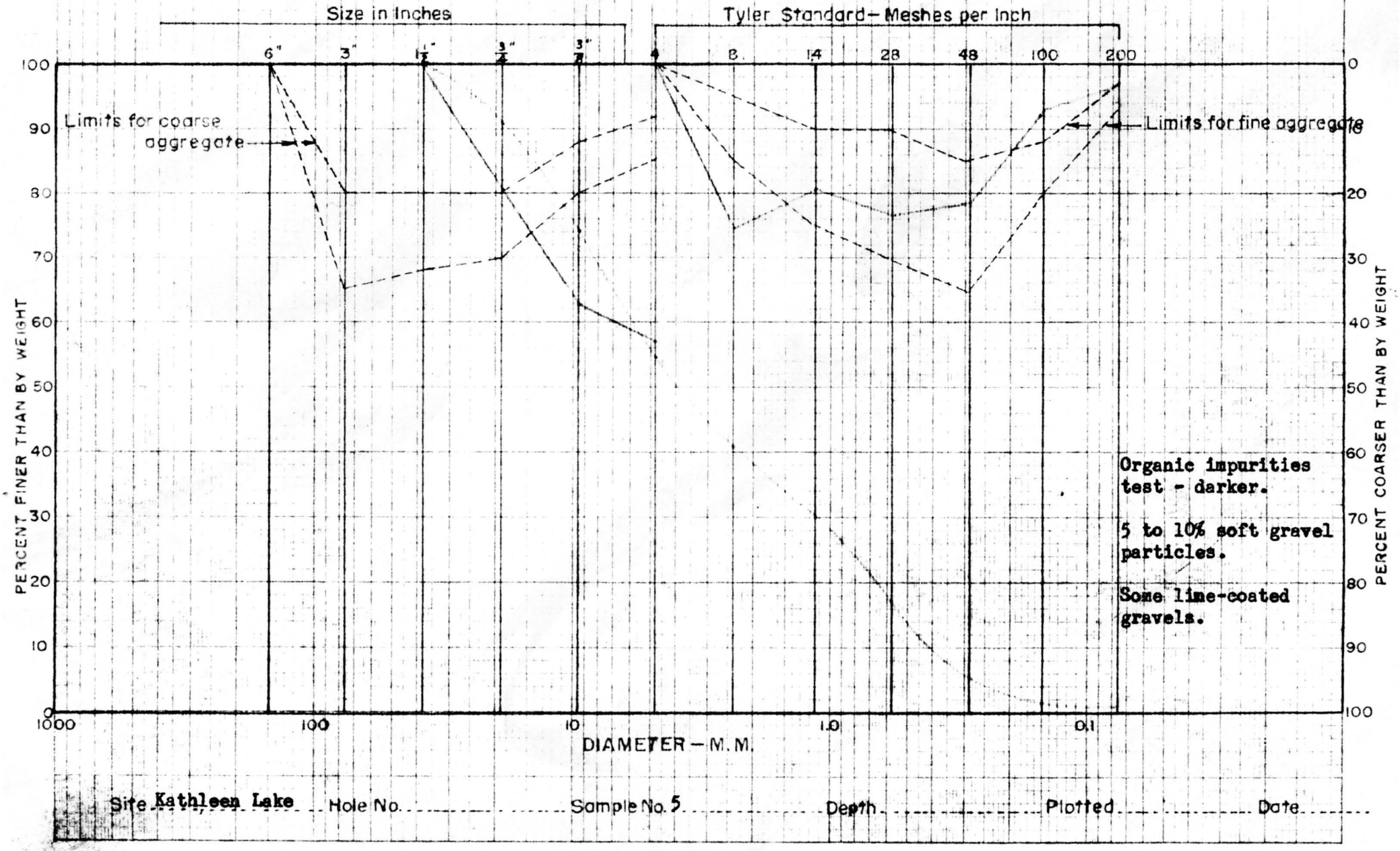
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Site Kathleen Lake Hole No. Sample No. 5 Depth Plotted Date

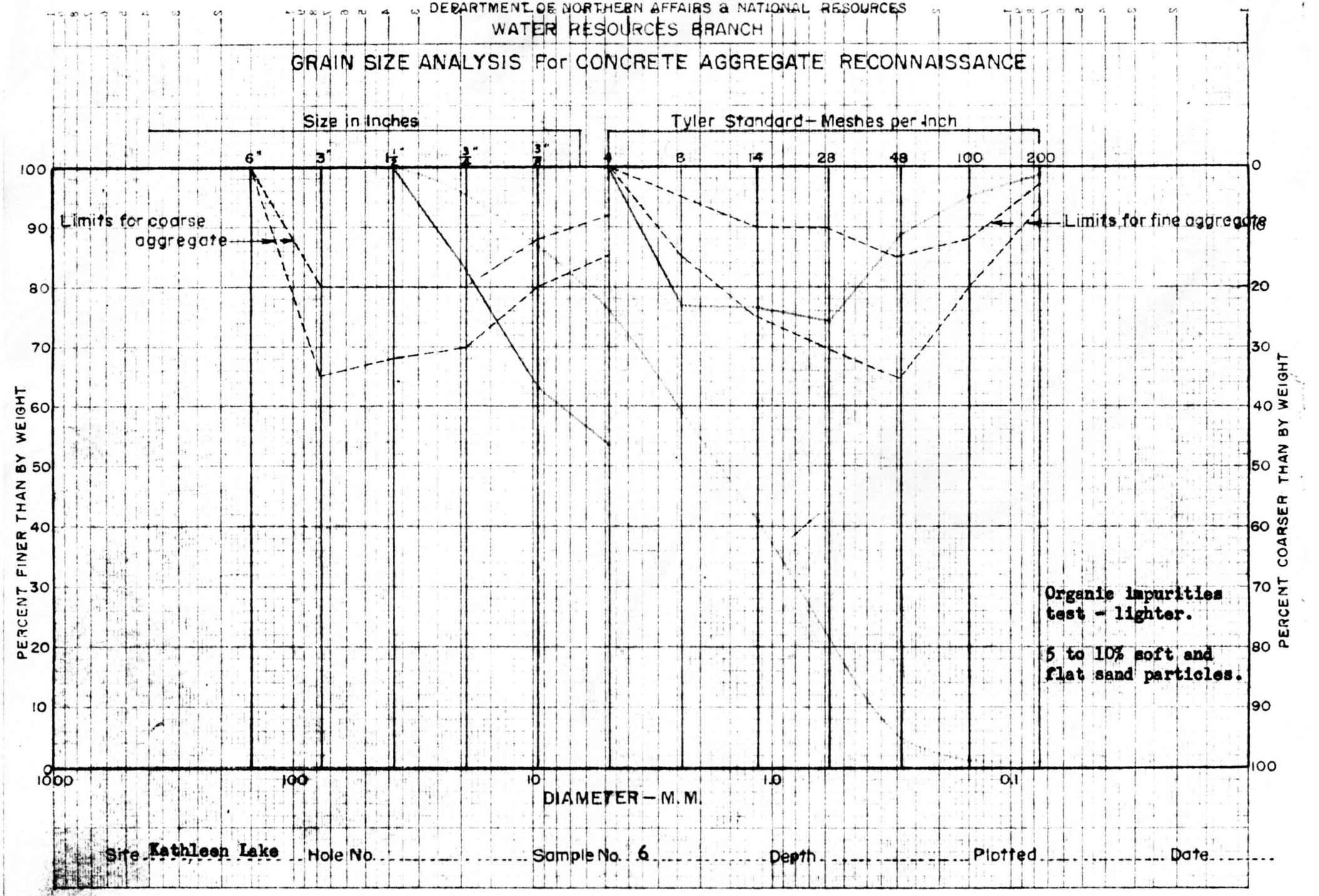
PLAN No. 100 – 13

M-6

DEPARTMENT OF NORTHERN AFFAIRS & NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Site Kathleen Lake Hole No. Sample No. 6 Depth Plotted Date

PLAN No. 100 – 13

M-6

Description of Potential Aggregate for the following Grain Size Curves

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
7	In face of borrow pit on north-east side of Haines Road at mile 139.5; 4 feet below ground surface; 10 feet above pit floor	Well graded, sandy gravel; no boulders; no silt; stratified; loose; no weathering. Pebble Lithology Igneous (weathered granite) - 40% Sedimentary (arkose, greywacke, slate) - 54% Metamorphic (gneiss, etc) - 5% Black chert - 1%	3 feet of silt; 1 foot of brown, weathered gravel	10 + feet	Unlimited	Glacio-fluvial material used for Haines Road maintenance
8	Cut on east side of Haines Road at mile 101.6; 15 feet below ground surface; 15 feet above Road	Well graded, sandy gravel; considerable coarse-grained sand; very little silt; no weathering. Pebble Lithology Igneous (granite,etc) -75% Sedimentary (arkose, argillite) -20% Metamorphic (schist, etc) - 5%	6 inches of silt	30 + feet	Unlimited	Glacio-fluvial material used for Haines Road maintenance

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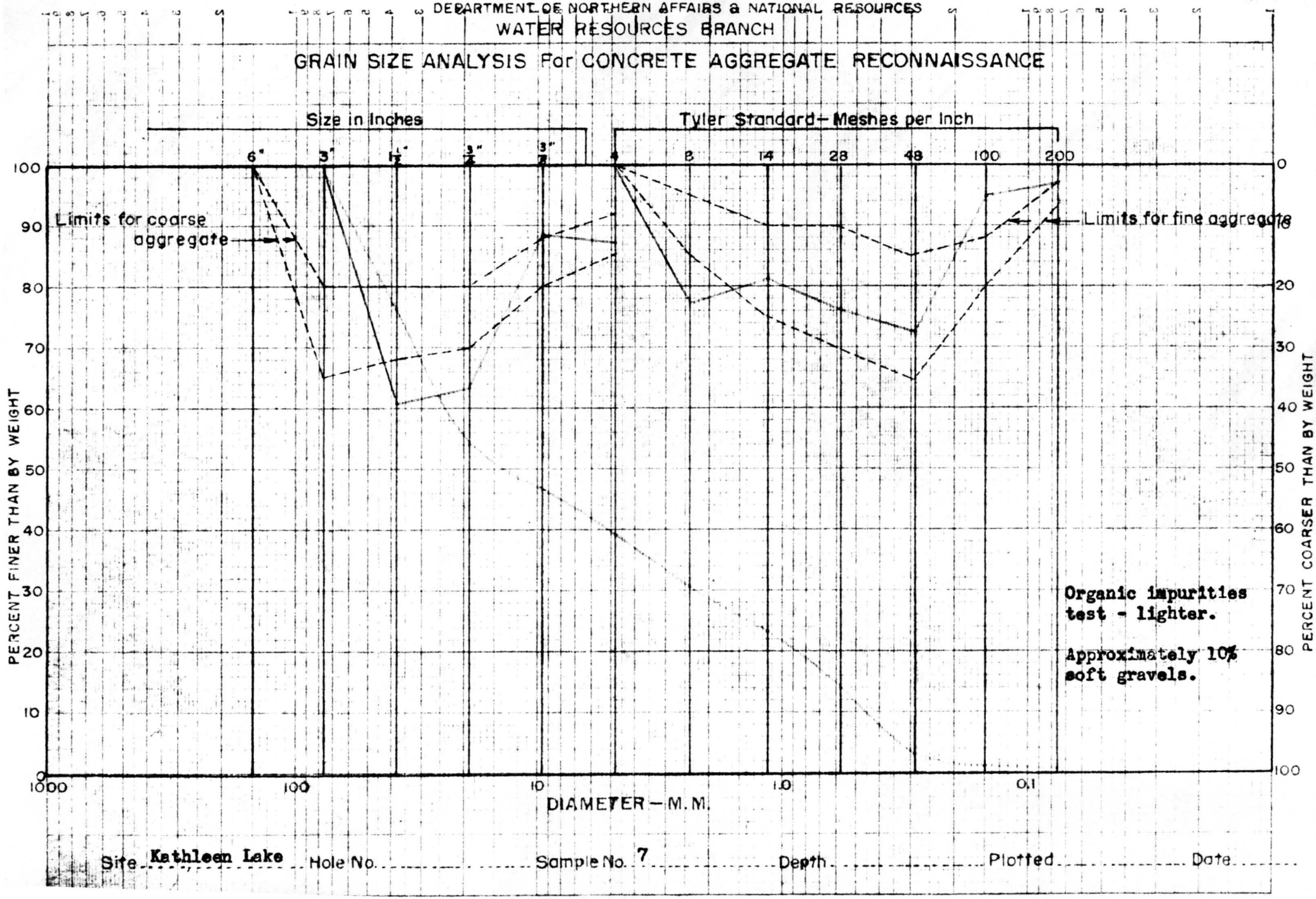
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Site Kathleen Lake Hole No. ..... Sample No. 7 ..... Depth ..... Plotted ..... Date .....

PLAN No. 100 – 13

K&E SEMI-LOGARITHMIC 359-81G
KEUFFEL & ESSER CO.
5 CYCLES X 70 DIVISIONS

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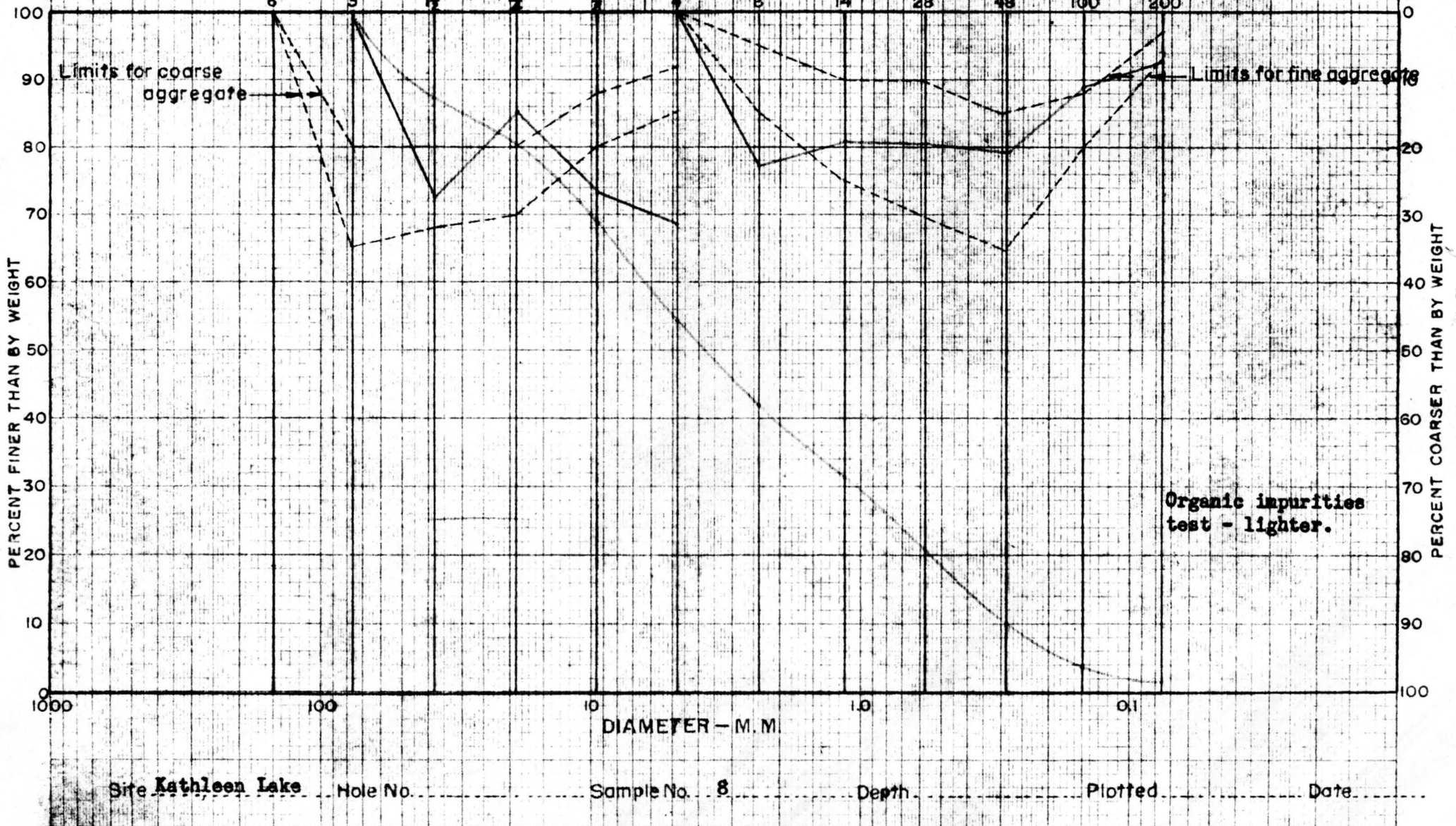
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Site Kathleen Lake Hole No. Sample No. 8 Depth Plotted Date

PLAN No. 100 – 13

M-6

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
10	Borrow pit on east side of Haines Road at mile 106.4	Well graded, sandy gravel; very little silt; stratified; very little weathering; rounded cobbles up to 5 inches in diameter. Cobble Lithology Igneous (granite, andesite, basalt) - 65% Sedimentary (greywacke, arkose) - 25% Shale - 5% Metamorphic (gneiss) - 5%	4 feet of clayey silt	10 feet	Limited supply	A 10-foot bed of excellent material interbedded with clayey silt; not easy to excavate
13	Borrow pit on east side of Haines Road at mile 142.2; 10 feet below ground surface	Sandy gravel; minor silt; fairly dense; a few granitic boulders up to 14 inches in diameter. Pebble and Cobble Lithology Igneous (granodiorite, granite, diorite)-50% Sedimentary (greywacke, arkose) -45% Metamorphic (gneiss) - 5%	4 feet of clayey silt	10 + feet	Unlimited Supply	Used for road maintenance

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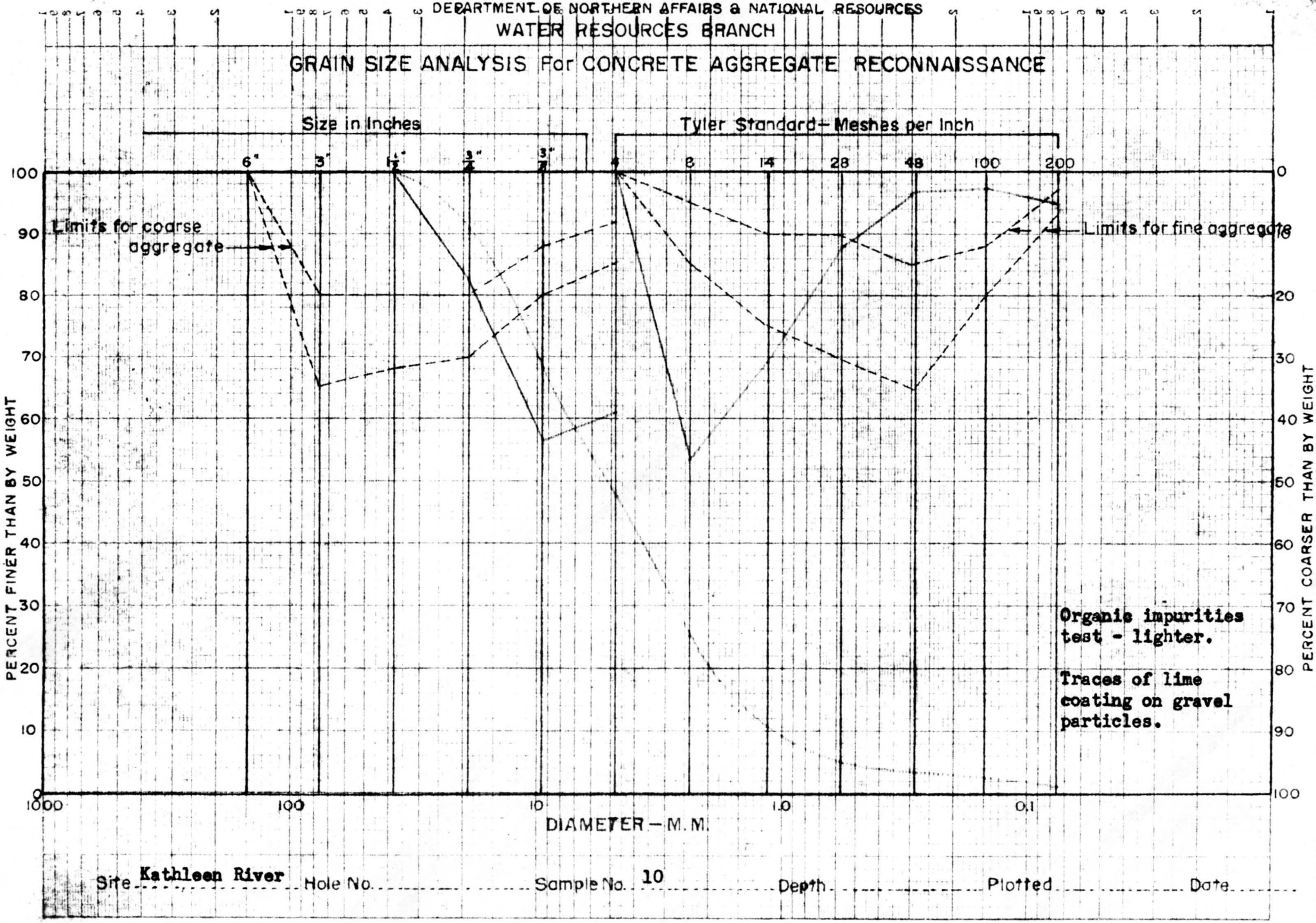
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Site Kathleen River Hole No. Sample No. 10 Depth Plotted Date

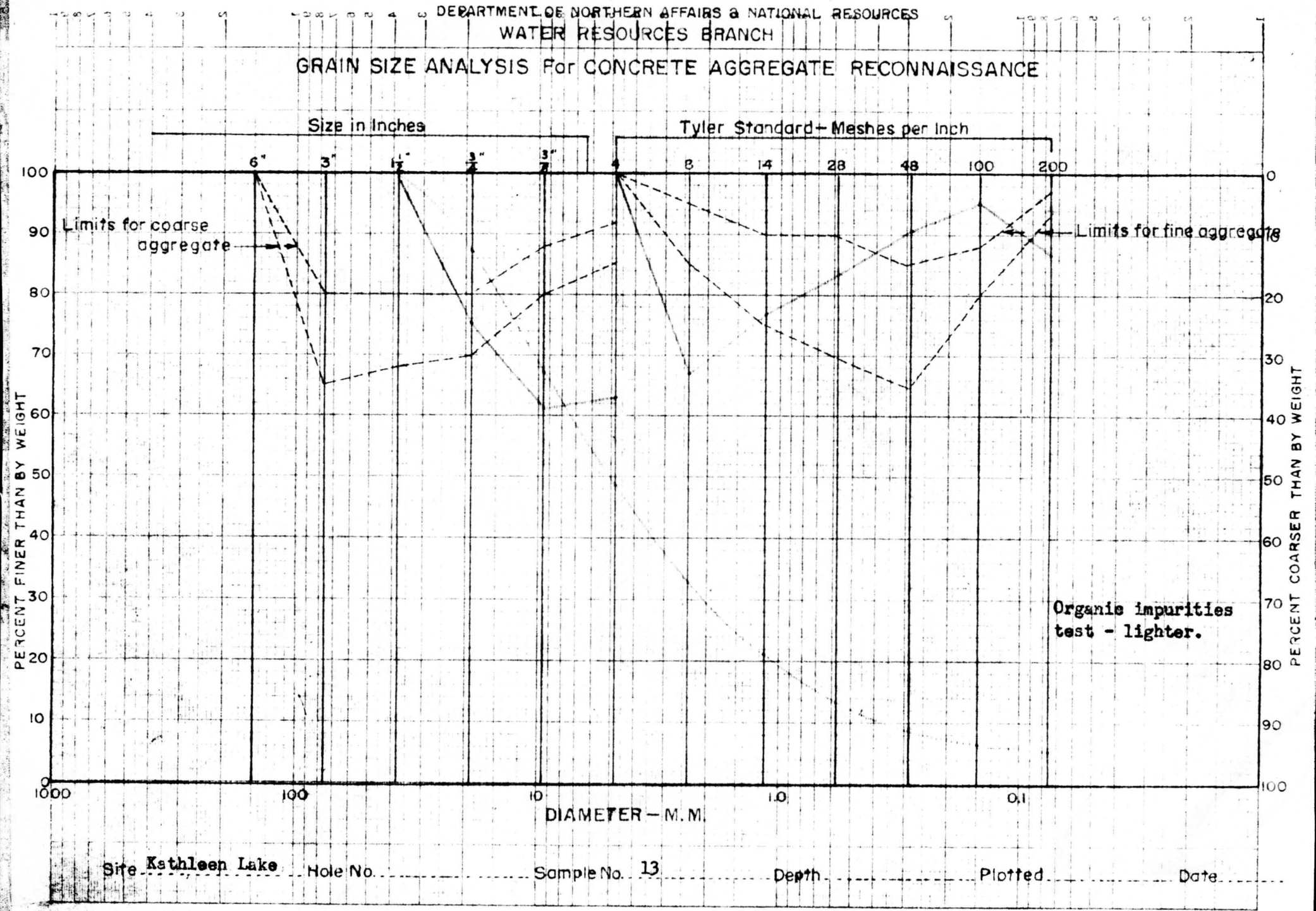
PLAN No. 100 – 13

19-6

DEPARTMENT OF NORTHERN AFFAIRS & NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Site Kathleen Lake Hole No. Sample No. 13 Depth Plotted Date

PLAN No 100 – 13

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)	Permeability* (cm. per sec)
1	Cut on west side of Haines Road 650 feet south of Kathleen River bridge; 3 feet below ground surface	Yellowish, clayey silt; thinly-bedded up to 2 inches; overlies glacio-fluvial, sandy gravel	none	5 feet	Unlimited	10^{-5}
2	On centre line of Haines-Fairbanks oil pipe line; 1,300 feet north of north side of Kathleen River; 3 feet below ground surface	Silty sand; friable; grades downward into medium-grained sand.	none	4 feet	Unlimited	10^{-4}
4	1,200 feet northwest of bridge and 200 feet northeast of Haines Road; 30 inches below ground surface	Sand; fine-grained; loose; a few pebbles up to 1 inch; minor silt	18 inches of silty, sand gravel.	2 + feet	Not known	10^{-4}

* Permeability computed in the field using a Soiltest Permeameter, Model K-620

SEMI-LOGARITHMIC 359-916
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

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GRAIN SIZE ANALYSIS

SCREEN SIZES IN INCHES | U.S. STANDARD SIEVES | HYDROMETER ANALYSIS

3 | 1½ | ¾ | ⅜ | 4 | 8 | 16 | 30 | 50 | 100 | 200

Percent Passing: 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 0

Percent Retained: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

$$Cu = \frac{D60}{D10} =$$

$$Cc = \frac{D30^2}{(D60)(D10)}$$

Liquid limit 39.2
Plastic limit 23.7

Classification CL

100 | 10 | 4.76 | 2.0 | 1.0 | 0.42 | 0.10 | 0.074 | 0.01 | 0.001

Particle Size in Millimeters

GRAVEL — Coarse | Fine

SAND — Coarse | Medium | Fine

SILT (Non Plastic) to CLAY (Plastic)

Site Kathleen Lake Pit Sample #1 Depth Plotted

PLAN

DEPARTMENT OF NORTHERN AFFAIRS & NATIONAL RESOURCES

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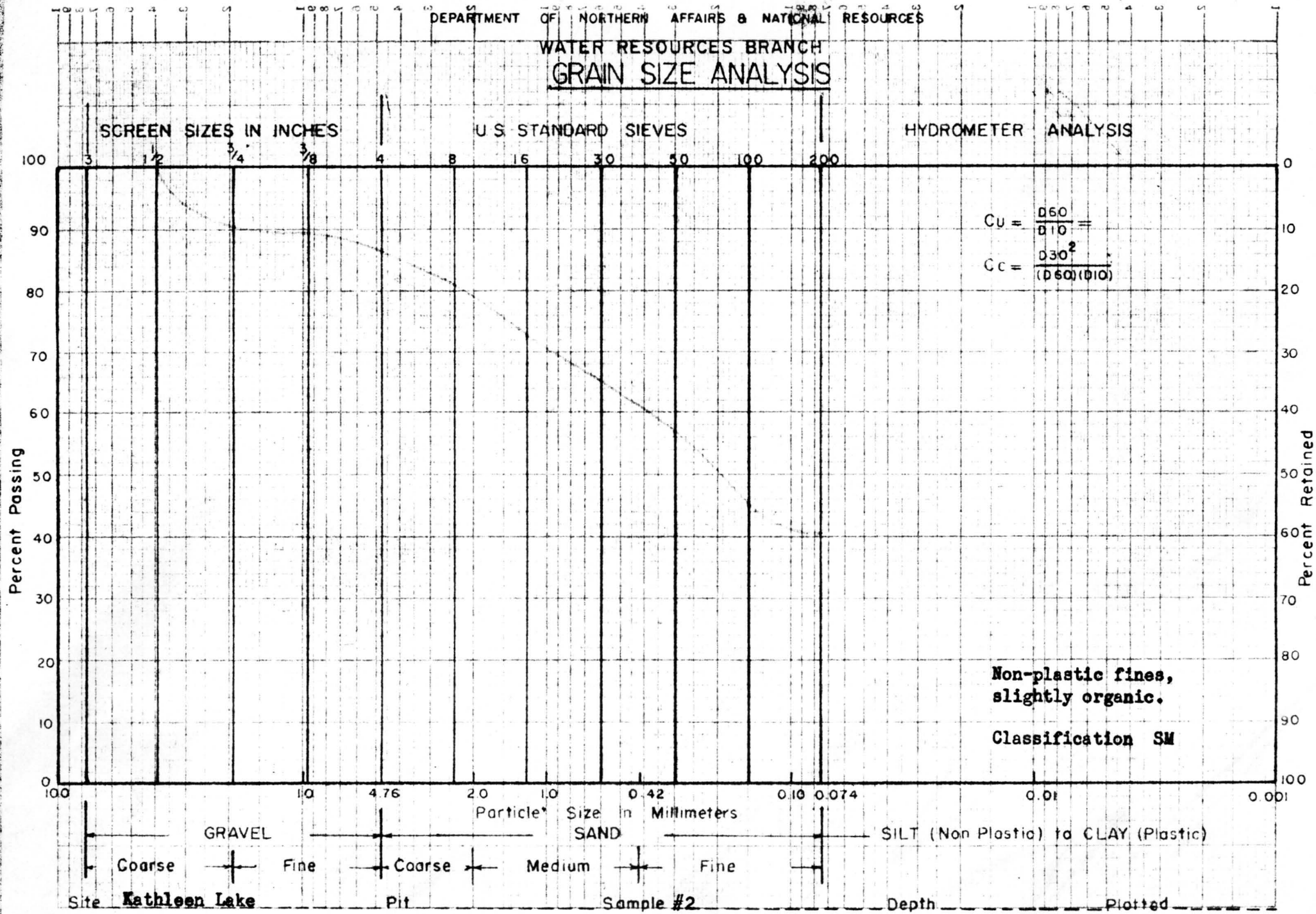
GRAIN SIZE ANALYSIS



Site Kathleen Lake Pit Sample #2 Depth Plotted

PLAN

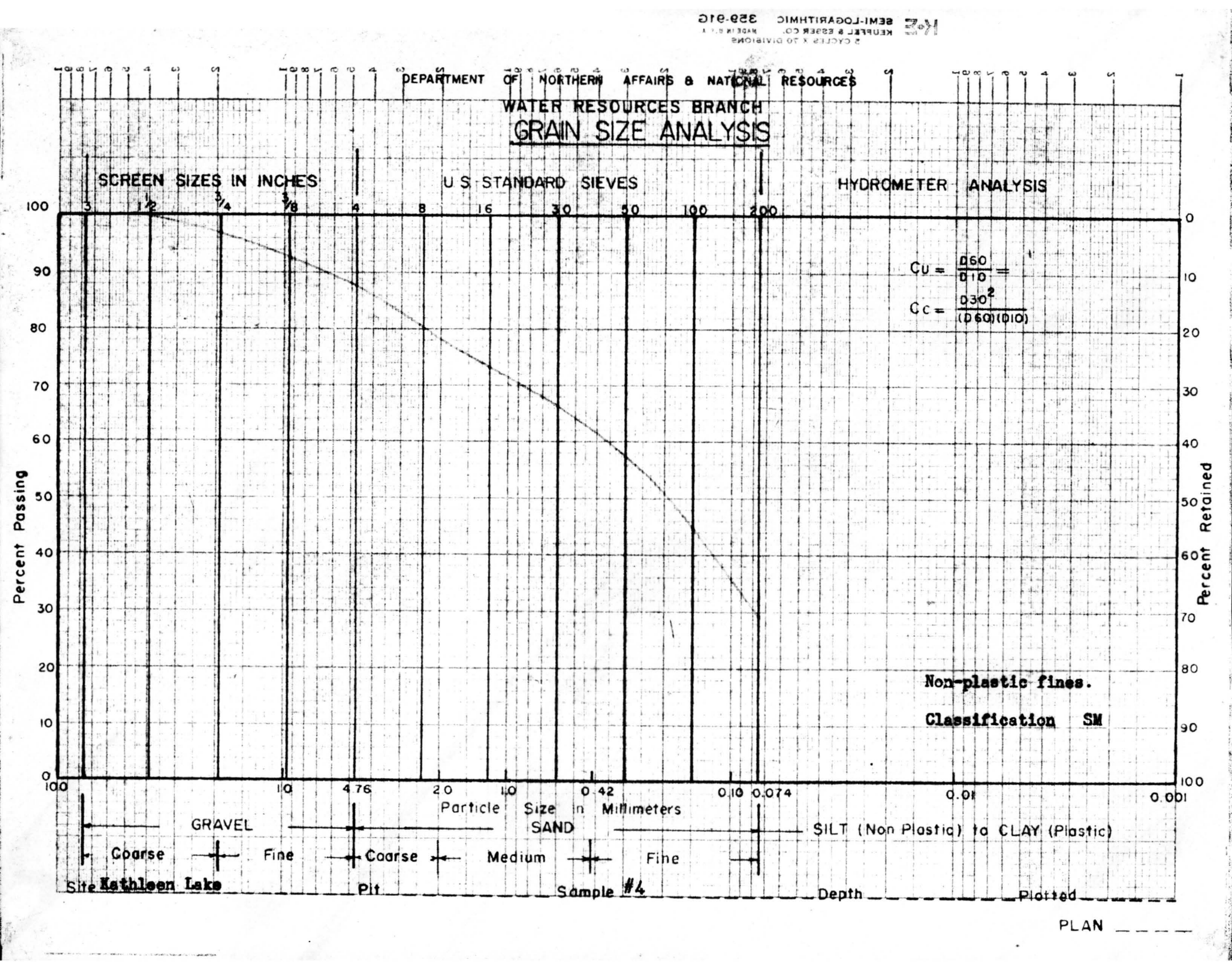
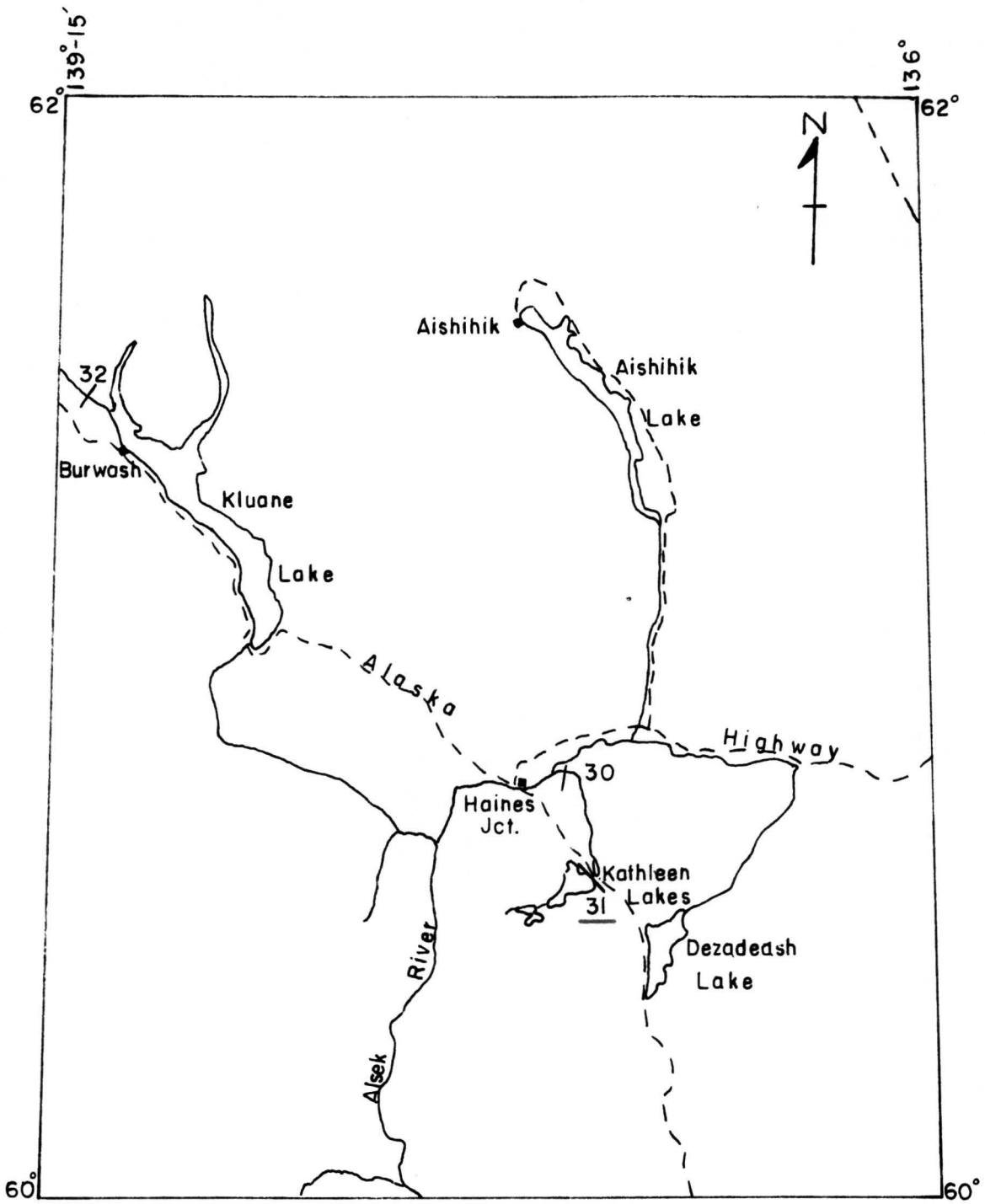

DEPARTMENT OF NORTHERN AFFAIRS & NATIONAL RESOURCES
WATER RESOURCES BRANCH
GRAIN SIZE ANALYSIS
SCREEN SIZES IN INCHES
U S STANDARD SIEVES
HYDROMETER ANALYSIS
3
1 1/2
3/4
3/8
4
8
16
30
50
100
200
Cu = D60 / D10 =
Cc = D30² / (D60)(D10)
Percent Passing
Percent Retained
100
90
80
70
60
50
40
30
20
10
0
Non-plastic fines.
Classification SM
100
4.76
2.0
1.0
0.42
0.10
0.074
0.01
0.001
Particle Size in Millimeters
GRAVEL
SAND
SILT (Non Plastic) to CLAY (Plastic)
Coarse
Fine
Coarse
Medium
Fine
Site Kathleen Lake
Pit
Sample #4
Depth
Plotted
PLAN

Plate I

Kathleen River looking upstream from Haines Road bridge. Haines-Fairbanks oil pipe line crosses River in centre of photograph.

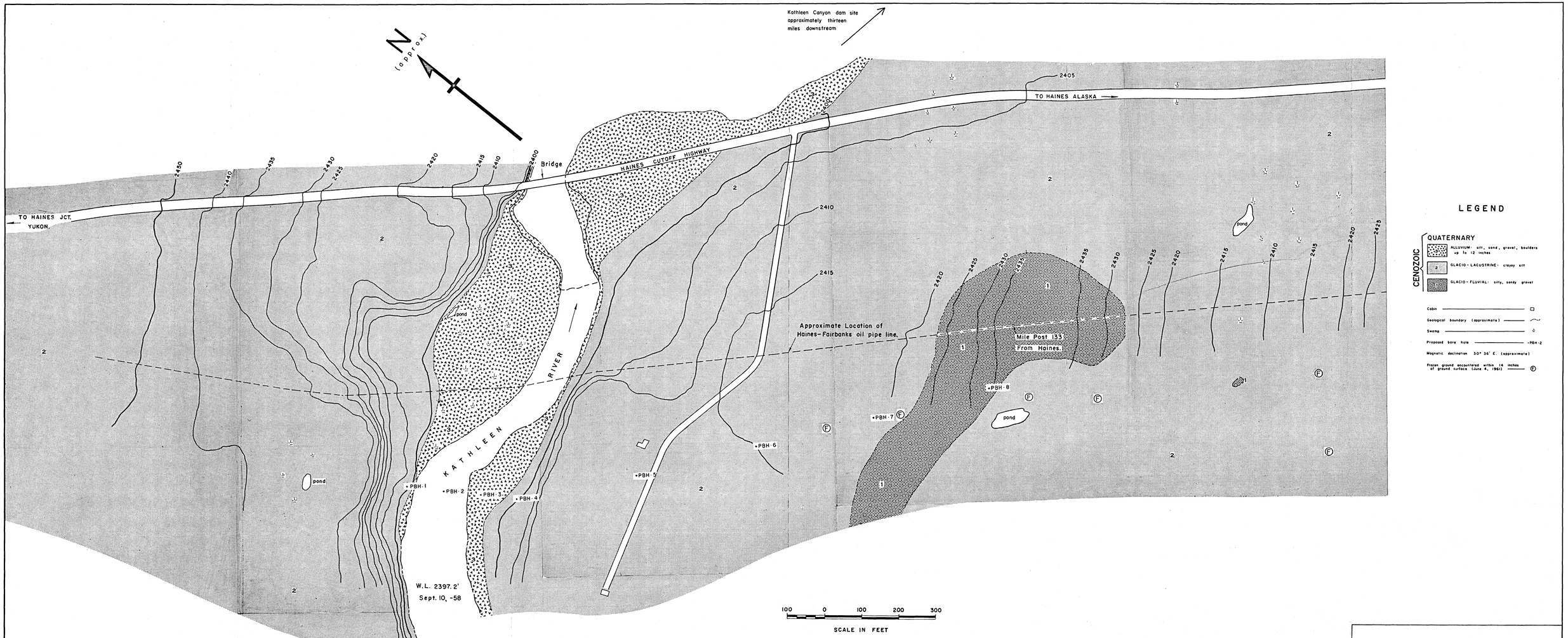
G.S.C. 1-7-61



LOCATION OF PROPOSED DAM SITES
YUKON RIVER DRAINAGE BASIN
AND PACIFIC COAST DRAINAGE
Scale: 1 inch = 20 miles

Site No.	Name
30 —	Kathleen Canyon
31 —	Kathleen Lake
32 —	Kluane Canyon

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS



LEGEND

CENOZOIC — QUATERNARY

- ALLUVIUM - silt, sand, gravel, boulders up to 12 inches
- 2 — GLACIO-LACUSTRINE - clayey silt
- 1 — GLACIO-FLUVIAL - silty, sandy gravel

Cabin
Geological boundary (approximate)
Swamp
Proposed bore hole — •PBH-2
Magnetic declination 30° 36' E. (approximate)
Frozen ground encountered within 14 inches of ground surface (June 4, 1961) — (F)

PACIFIC COAST DRAINAGE
SITE NO. 31

KATHLEEN LAKE DAM SITE

TO ACCOMPANY TOPICAL REPORT NO. 37
GEOLOGY BY E.B. OWEN, 1961