No. 2

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

113

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 113

YUKON RIVER DRAINAGE BASIN
DAM SITE INVESTIGATION

SITE No. 18

DETOUR DAM SITE

(MAP AND PRELIMINARY REPORT)

BY

E. B. OWEN

OTTAWA

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Detour Dam Site

General Description

Detour dam site is located on Pelly River in Yukon Territory about 139 miles from the mouth of the Pelly and 107 miles downstream from the community of Ross River. The proposed dam site is included on National Topographic Series sheet No. 105L (Glenlyon), scale 1:250,000, and on Royal Canadian Air Force photograph A12789-210. Except in periods of extremely low water the site can be reached by shallow draft boats from Ross River or from the community of Pelly Crossing located about 106 miles downstream on the Whitehorse-Dawson road. Beaver aircraft can be easily landed on Pelly River at the site.

The purpose of the Detour Project is to provide storage of high water flows of Pelly River for later release to a proposed power project at Granite Canyon some 81 miles downstream.

Upstream from Detour dam site Pelly River flows in a general northwest direction along a broad valley which follows the northeast side of Pelly Mountains. The valley, known as Tintina Trench[1], is a distinct topographic feature which continues as a trench-like depression for several hundred miles across the southern part of Yukon Territory.

The dam site area is located in the centre of a large S-shaped bend in Pelly River. The present channel was probably cut in post-Pleistocene times. The original channel now plugged at its upstream end by glacial debris consisting of about 150 feet of dense till overlaid by glacio-fluvial sand and

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[1] Bostock, H.S.: Physiography of the Canadian Cordellera with special reference to the area north of the fifty-fifth parallel; Geol. Surv. Can., Mem. 247, 1948, p. 60.

gravel was apparently through Detour Lakes situated about 5 miles west of the site. Locally this is known as "The Detour".

The diverted portion of Pelly River is about 16 miles long. All the material exposed along the sides of this section of the river consists of loose, interbedded sand and gravel with the exception of small quantities of till which underlie the gravel in the last two miles. Bedrock is exposed only as a few small rocky islands in the river. The bluff along the left side of the river at the downstream end of "The Detour" consists of permeable materials ranging from fine-grained to coarse-grained gravel. Numerous ground-water seeps occur along the base of this bluff.

Along the right side of the river at the site a 200-foot bluff rises abruptly from the edge of the river to a gravel-covered terrace which extends back about two miles to an extensive "kame-and-kettle" area of potential aggregate. The topography along the left side of the river is less steep; being broken by an irregular, sand and gravel-covered terrace which parallels the river and by low bedrock outcrops.

Unconsolidated Deposits

The following unconsolidated materials are exposed at Detour dam site:

(1) Recent alluvium (silt, sand, gravel): This material is exposed on the flood plain of Pelly River which extends along both sides of the river up to elevation 1,915. It consists of silt, sand and gravel, the latter containing boulders up to 24 inches in diameter. The alluvium is not an

important deposit and has little use as a construction material. The large boulders scattered through the material may prevent the driving of steel sheet piling during coffer-dam construction.

(2) Alluvium (sand): This material occurs along the left side of Pelly River between its present flood plain and elevation 1,934. It is believed to have been deposited by Pelly River during some former time when the river flowed at a higher elevation. The alluvium occurs as a thin deposit of fine- to medium-grained sand ranging up to 36 inches in thickness. The small quantities available limit its use as a construction material.

(3) Talus: Talus is material produced by the mechanical disintegration of bedrock. At Detour dam site it occurs as a thin accumulation of angular, weathered, rock fragments located along the edges of the bedrock outcrops in the upper part of the left abutment area. The longer dimension of the rock fragments seldom exceeds 12 inches. They have usually broken off along joints or planes of schistosity and are usually small because of the close spacing of the jointing. The size and shape of the rock fragments in the talus suggests suitable rock fill may be obtained from bedrock exposed at Detour dam site but riprap may have to be obtained from a bedrock source outside the area.

(4) Most of the right abutment slope is covered with debris resulting from soil creep. This material consists of a mixture of till, gravel and sand all of which are exposed in the upper part of the abutment. In places masses of till up to 25 feet in diameter have slid as much as 75 feet down

slope. There is no evidence of recent, large-scale sliding in the site area. However, several slides have occurred within the last few years along the right side of the river downstream from the site.

(5) Glacio-fluvial (silt, sand, gravel): This material consists chiefly of loose, coarse-grained, bouldery gravel. It is exposed along the top of the right (south) abutment in thicknesses varying from 12 to 18 feet. Here it can be seen to directly overlie till. The gravel immediately above the till was frequently damp but in no place was there evidence of flowing water.

The gravel extends over most of the site area north of the river. In places it is concealed by 2 to 3 feet of fine- to medium-grained, silty sand but is exposed on the steep slopes leading up to the terraces. The upper 18 inches is usually weathered to a deep orange-brown colour. Satisfactory aggregate could probably be obtained by processing the fresh gravel. The pit-run material would be useful as base coarse material in road construction.

(6) Till: The till is a dense, blue-grey, silty, sandy material containing an assortment of angular pebbles and cobbles up to 6 inches in diameter. It is exposed on both sides of the river in the dam site area; along the upper part of the right abutment and on the steep slope leading up to the lower terrace which parallels the left side of the river. Soil samples Nos. 1 and 3 described at the end of this report were taken from till exposures on the right and left sides of the river respectively.

It was not possible to estimate the extent of the till throughout the dam site area. It probably underlies the upper part of the slide debris covering the right abutment as well as much of the sand and gravel exposed on the left abutment. The till is believed to directly overlie bedrock. Its thickness is unknown. About 70 vertical feet is exposed in the upper part of the right abutment but this should not be considered as the true thickness of the deposit as bedrock may exist behind the till at a much more shallow depth.

The till appears to be impervious and should provide satisfactory abutment material. However, it is possible lenses of silty clay and sand and gravel are present. These materials could lower the shear strength of the till mass and also cause leakage of reservoir water.

Suitable material for a rolled earth dam may possibly be obtained from the till deposits. The absence of large boulders is favourable from the viewpoint of compaction. There are undoubtedly sufficient quantities of till available in or near the dam site area to satisfy the requirements of an earth dam. Till is not exposed along Pelly River for about 12 miles downstream from the site but bluffs up to 150 feet in height occur a short distance upstream in the reservoir area.

Bedrock

General Description

Bedrock in the dam site area consists of fine-grained, greenish-black, andesitic rocks which in places are coarse-grained and dioritic in

appearance. According to Campbell and Wheeler[1] the coarser-grained phases may occur in the centres of thicker flows. All bedrock exposures at the dam site are located in the left abutment area with the exception of one small outcrop on the right side of the river near the upstream end. The upper part of the right abutment consists almost entirely of bedrock with a long ridge of rock extending diagonally across the abutment from this part to bedrock outcrops at the river. Zones of light-coloured, sericite schist, a few inches to 2 feet in width, occur in the finer-grained rock. These are not common but their presence would lower the competency of the rock mass.

Bedrock at the site is situated at the southeast end of an elongated, northwest-trending rock ridge which separates Detour Lakes from that part of Pelly River immediately downstream from the site. Following glaciation when its course through "The Detour" was blocked by glacial debris the river was compelled to turn northeast and flow around the ridge until it could resume its former course some 16 miles downstream.

Scattered veins of white, barren quartz, up to 16 inches in width, intersect the andesitic rocks in the dam site area. The larger of these have been indicated on the accompanying geological map.

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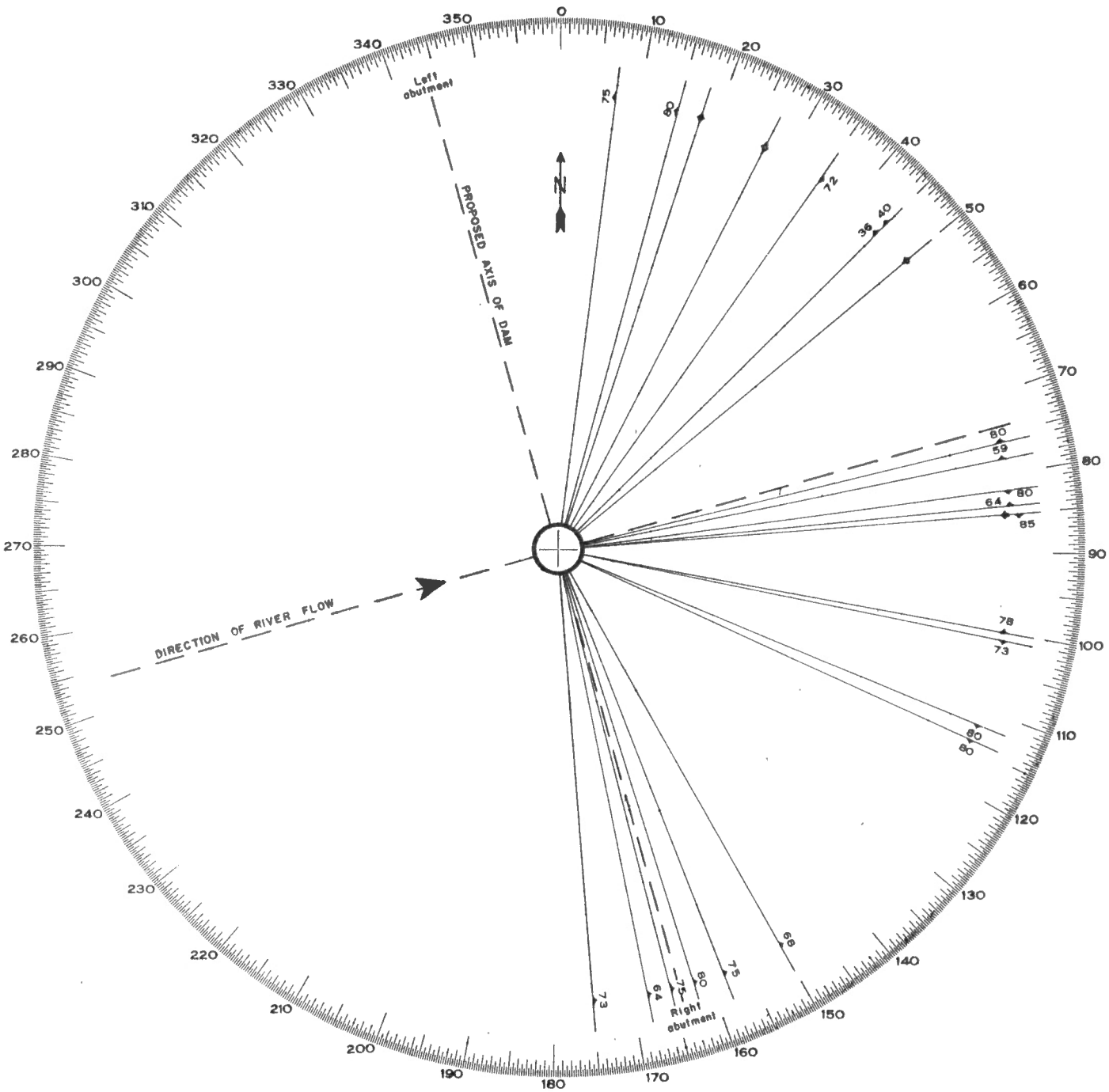
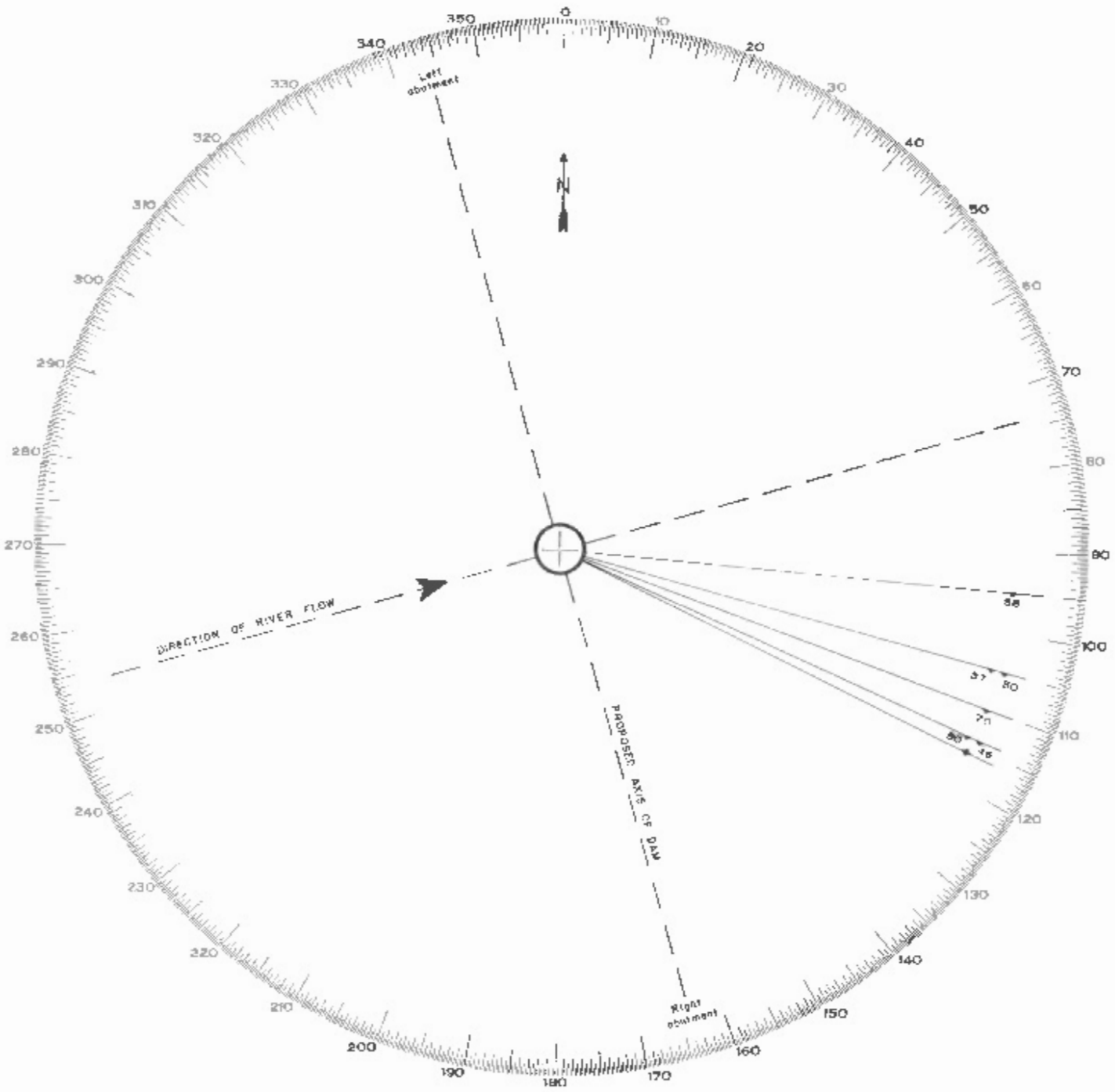
[1]Campbell, R.G. and Wheeler, J.O.: Glenlyon Map-area; Geol. Surv. Canada; Map 25-1960 with descriptive notes.



JOINT ROSETTE

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



SCHISTOSITY ROSETTE

The above illustration presents diagrammatically the direction and dip of the schistosity in bedrock exposed at Detour dam site

Bedrock Structures

Jointing and schistosity are the structures which affect the competency of bedrock exposed at Detour dam site. Faulting was not observed in spite of the fact that Tintina Trench in which the site is located is the locus of a major zone of faulting[1]. The jointing is irregular with considerable variance in its attitudes. There are, however, two fairly prominent sets roughly at right angles to one another. One set intersects the river at angles varying from 70 to 90 degrees and dips steeply downstream. The other closely parallels the river and dips steeply into both abutments.

The strike of the schistose zones which varies from 5 to 20 degrees north of west closely parallels the trend of Tintina Trench. The dips range from 37 to 80 degrees east, i.e. toward the right abutment.

Quality of Bedrock

Bedrock at Detour dam site is believed competent and should provide satisfactory abutment and foundation material for the proposed earth-fill dam and other structures. Jointing is the chief bedrock structure present which may affect the competency of the rock mass. Open fractures, 3 to 6 inches wide and up to 25 feet long, occur along the jointing in some places on bedrock surface. The permeability of the rock mass would be increased if these extended to any depth and grouting would be necessary. Bedrock is not of the soluble type and solution channels or cavities should not exist in it. Weathering is negligible.

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[1] Campbell, R.G.: Glenlyon Map-area; Geol. Surv. Canada; preliminary map 54-12 with descriptive notes.

Engineering Considerations

Depth of Overburden

The results of seismic lines Nos. 1 and 2 located on the left abutment indicate the thickness of the overburden in this area varies from 36 to 47 feet. These figures are believed accurate. The sides of the bedrock ridge which cuts diagonally across the abutment are probably steep and consequently there will not be a gradational decrease in the thickness of overburden near the outcrop but rather an abrupt one close to the exposed rock. The thickness of overburden at the downstream end of seismic line No. 1 which is close to the proposed centre line has been calculated as about 47 feet. Overburden here consists of 6 or more feet of sand overlying gravel which in turn overlies till. The till rests directly upon bedrock.

There is no indication as to the thickness of overburden on the right abutment. The results of seismic line No. 3 situated along the toe of the slope indicate bedrock exists from 9 to 14 feet beneath ground surface. The depth of 9 feet is about 400 feet downstream from a bedrock outcrop. The extent to which bedrock surface rises in the abutment can only be accurately determined by test borings. The thickness of overburden on the terrace above the abutment is probably much greater than that along the toe.

The present channel of Pelly River at the site has been cut in fairly recent times. Consequently bedrock surface should not be far beneath the water. This is confirmed by several small bedrock islands in the river and by rock outcrops along its sides which project out into the river. Other bedrock islands occur in the river a short distance downstream from the site.

The river is in the process of degradation in its relatively new channel and consequently it is doubtful if a buried stream channel exists either beneath the river or the abutments. The northwest trend of the elongated bedrock ridges in the areas adjacent to the site, which corresponds to the direction of movement of the ice during the last glaciation, intersects the river at about 60 degrees. Smaller bedrock ridges concealed at the site would doubtless strike in the same general direction.

Abutments and Foundations

The left abutment and main part of the dam will be built on bedrock. Further investigation will be necessary to determine if the right abutment material will consist of till or bedrock. There was no evidence in the field which indicated the depth at which bedrock underlies the till exposed in this area. More information is required to determine the ability of the till to provide satisfactory abutment material. Along the centre line of the proposed dam in the right abutment area the till is exposed in a steep bluff, some 60 feet in height. However, a short distance downstream from the site area numerous slides have occurred in the till which suggest the material is not always stable. Some of the slides may have resulted from undercutting by the river and others from variations in the water content, the mineralogy or the grain size distribution of the constituent particles. If it is at all possible stripping to sound rock is recommended for the right abutment.

Some difficulty may be encountered with the jointing if bedrock is used as abutment material in the right abutment. The joint set parallel

to the river dips steeply into the abutment. This may cause the entire abutment slab to be unstable when excavated especially if undercut even slightly. The presence of jointing parallel to the river could decrease the resistance of the rock to shearing stresses set up by an arch dam. The rock may be sufficiently strong as far as pressure is concerned but may yield easily under shear. The downstream dip of a second joint set which intersects the river close to right angles may appreciably reduce the resistance of the bedrock foundation to sliding. Grouting will be necessary both to create a seepage barrier and to consolidate the rock in the abutments and foundations of the proposed dam.

Proposed Location of the Dam

From the viewpoint of both geology and topography the dam should be located close to the centre of the area included on the accompanying geological map with its axes running in a north-south direction and intersecting the river close to right angles. The diversion tunnels and spillway would be located at the north end and would be excavated in bedrock. The dam would be an earth-fill type of conventional design. It would be founded on bedrock and rise from the lowest elevation of 1,900 feet to its crest at elevation 2,105; an overall height of 205 feet. The reservoir would extend upstream in Tintina Trench for a distance of about 50 miles[1].

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[1] Ellis, A.L.: Power Resources of the Yukon River Basin in Canada, Interim Rept. No. 2, Water Resources Branch, Dept. of Northern Affairs and National Resources, 1959.

Aggregate

Satisfactory aggregate can probably be obtained from the gravel exposed in both abutments. The weathered upper part could be removed by scraping and the fresh material processed to produce the proper sized material. Test pitting and/or test borings will be necessary to determine the quality and quantity of gravel available in the site area. Minor quantities of groundwater may be encountered in the gravel at its contact with the underlying till. The sandy silt (sample No. 2) which overlies the gravel in parts of the left abutment consists of about 50 per cent silt-size particles, 10 per cent clay and 40 per cent fine-grained sand. The deposit is thin and it is doubtful if sufficient quantities are present to be useful as a construction material.

Large quantities of glacio-fluvial sand and gravel occur in the form of long, narrow, sinuous ridges (eskers) in the upstream (southeast) end of "The Detour". Similar materials occur to the southeast on the opposite side of the river. Here several square miles of ground surface is covered with a profusion of mounds and ridges separated by circular depressions frequently containing small ponds or lakes. This has been sometimes described as "kame-and kettle" topography. Most of the exposed material consists of fine- to medium-grained sand. However, it is believed more coarse-grained materials would be found if the areas were thoroughly investigated.

Sample No. 4 was taken half way up the bluff at the downstream end of "The Detour" about 16 river miles from the site. The material consists of clean, sandy gravel containing few pebbles greater than one and a half inches in diameter. Similar gravel is exposed in a bluff along the right side of Pelly River about 3 miles upstream. The quantity of gravel in this area is unlimited. However, because of the much smaller haulage distance, it is suggested the glacio-fluvial deposits at the upstream end of "The Detour" be investigated first.

Satisfactory coarse aggregate could be obtained by crushing bedrock exposed at the site. This would be a relatively expensive process and should be considered only after all attempts at locating a source of natural aggregate have failed.

Impervious Material

Two samples (Nos. 1 and 3) were taken of the till exposed in the abutments at Detour dam site to determine if it could be used as core or embankment material in an earth dam. The results of the laboratory analyses of the samples, which were about 2,000 feet apart, were quite similar. This suggests the till may be homogenous throughout the site. The analyses indicate the till is a borderline case as far as its use in earth dams is concerned. The lack of clay-size particles would decrease its ability to compress when compacted and saturated and lower its workability as a construction material.

It is suggested other till exposures along Pelly River be examined to determine if more satisfactory material is available.

Pervious Material

Pervious materials required for construction of an earth dam may be obtained from the deposits of sand and gravel described in the section in aggregate. There are unlimited quantities available within a few miles of the site.

Riprap and Rock Fill

Excellent rock fill can be obtained from the andesitic bedrock exposed at the dam site. Suitable riprap may not be as readily available as the rock has a tendancy to break into small fragments. The specific gravity of the rock is in the 2.6 - 2.7 range. It is only slightly weathered.

The breaking characteristics of a rock material exposed in an outcrop can frequently be determined by an examination of the talus associated with it. At Detour dam site talus only occurs in the upstream part of the left abutment. The rock fragments are angular and roughly squared in one plane. The longest dimension is seldom greater than 12 inches. The size and shape of the fragments show the influence of the joint pattern formed by the two most prominent joint sets which intersect one another close to right angles and are frequently closely spaced.

The quantity of bedrock available for riprap and rock fill is unlimited. The bedrock ridge, the southeast tip of which forms the left abutment of the dam, extends several miles northwest of the site. Numerous exposures of similar rock occur about 2 miles southeast of the right abutment and are readily accessible from the site.

Groundwater

The only indication of groundwater at Detour dam site is in the right abutment. Here the surface of the gravel where it is in contact with the underlying till is sometimes moist. However, in no place was there sufficient groundwater present to form a spring. At the time of the investigation ground surface in the left abutment area was completely dry. Groundwater was not encountered in test pits dug as deep as 8 feet nor did it occur immediately above the frost line in the few pits where frozen ground was encountered.

Frozen Soil

In the dam site area frozen soil was encountered in the upstream part of the left abutment along the toe of a talus slope. The material consisted of fine-grained, sandy silt overlaid by about 8 inches of moss and black organic material. Two samples (Nos. 6 and 7) were taken of the material and sent to the soils laboratory of the Water Resources Branch in Vancouver for a determination of their water content. The results are included on the following pages.

Nine samples of frozen soil were taken in the reservoir area upstream from the site. Seven of the samples were from fine-grained material and two from till. The method of sampling was to drive BX casing or a 2-inch O.D. split tube into the frozen material with a ten pound sledge hammer. The method is effective providing there are no rock fragments over about one and half inches in diameter present in the material.

Description of Frozen Soil

Pit No.	Location	Sample No.	Depth (in inches)	Description	Moisture Content	Visible Ice	Log of test pit (in inches)	Temperatures
1	1,000 feet upstream from Detour site; on low terrace along left side of Pelly River; 150 feet north of river.	1	14 - 19	Silt: fine-grained, sandy, alluvial; indistinctly stratified.	78.4%	None	0- 6 = Moss 6-14 = Organic material at 14= Frost line 14-40= Silt	Air = 68°F., Frozen ground at 40 inches = 31.5°F. (June 30, 1965)
		2	19 - 24		66.2%	"		
		3	24 - 27		112.3%	"		
		4	27 - 32.5		-			
		5	32.5 - 40		174.8%			
2	Left abutment Detour dam site; at toe of talus slope; 230 feet north of station R.3.	6	38 - 44	Silt: fine-grained, sandy.	11.4%	None	0- 8 = Moss 8-14 = Volcanic ash 14-20= Organic material 20-51= Silt	Air = 72°F., Frozen ground at 51 inches = 32°F. (July 2, 1965)
		7	44 - 51		12.8%	"		
3	2 miles upstream from Detour dam site; at upstream end of "The Detour"; 60 feet north of river and 29 feet above river.	8	52 - 60	Silt: fine-grained, sandy.	12.5%	"	0- 4 = Moss 4-16 = Volcanic ash 16-20= Organic material 20-60= Silt at 52= Frost line	

Description of Frozen Soil

Pit No.	Location	Sample No.	Depth (in inches)	Description	Group Symbol*	Moisture Content	Visible Ice	Log of test pit (in inches)	Temperatures
4	2 miles upstream from Detour dam site; at upstream end of "The Detour"; 500 feet north of river and 29 feet above river.	9	49 - 53	Silt: fine-grained, sandy; non-plastic	ML	14.7%	10% clear ice particles less than 1/16 inch	0- 3 = Organic material 3-12 = Volcanic ash 12-53= Silt at 49= Frost line	
5	2 miles upstream from Detour dam site; right side of river opposite "The Detour"; 100 feet south of river; 20 feet above river.	10 11	18 - 28 28 - 32	Till: clayey silty, minor sand; pebbles to $\frac{3}{4}$ inch; low plastic	ML-CL	38.5% 40.1%	10% clear ice particles less than 1/8 inch	0- 8 = Moss 8-16 = Organic material 16-32= Till at 18= Frost line *Unified Soil Classification System	L.L.-24.1 P.L.-17.1 P.I.- 7.0

Frozen Soil Classification Chart

Sample Number	% passing #4	% passing #200	% Co	% F	% G	% S	D10	D30	D60	Cu	Cc	LL	PL	PI	Group Symbol*
1	100	87.0	13.0	87.0	0.0	13.0	.0057	.013	.030			non-	plastic		ML
2	100	89.0	11.0	89.0	0.0	11.0	.0038	.011	.030			"	"		"
3	100	95.0	5.0	95.0	0.0	5.0	.0037	.010	.022			"	"		"
4	100	89.0	11.0	89.0	0.0	11.0	.0047	.010	.021			"	"		"
5	100	100.0	0.0	100.0	0.0	0.0	-	.0078	.014			"	"		"
6	100	58.0	42.0	58.0	0.0	42.0	.0037	.015	.078			"	"		"
7	100	66.0	34.0	66.0	0.0	34.0	-	.015	.065			"	"		"
8	100	75.0	25.0	75.0	0.0	25.0	.0054	.027	.054			"	"		"
9	100	71.0	29.0	71.0	0.0	29.0	.0094	.034	.061			"	"		"
10	88.0	59.5	40.5	59.5	12.0	28.5	-	-	-			24.1	17.1	7.0	ML-CL
11	96.0	68.0	32.0	68.0	4.0	28.0	-	.0060	.035			Sli.-	plastic		ML

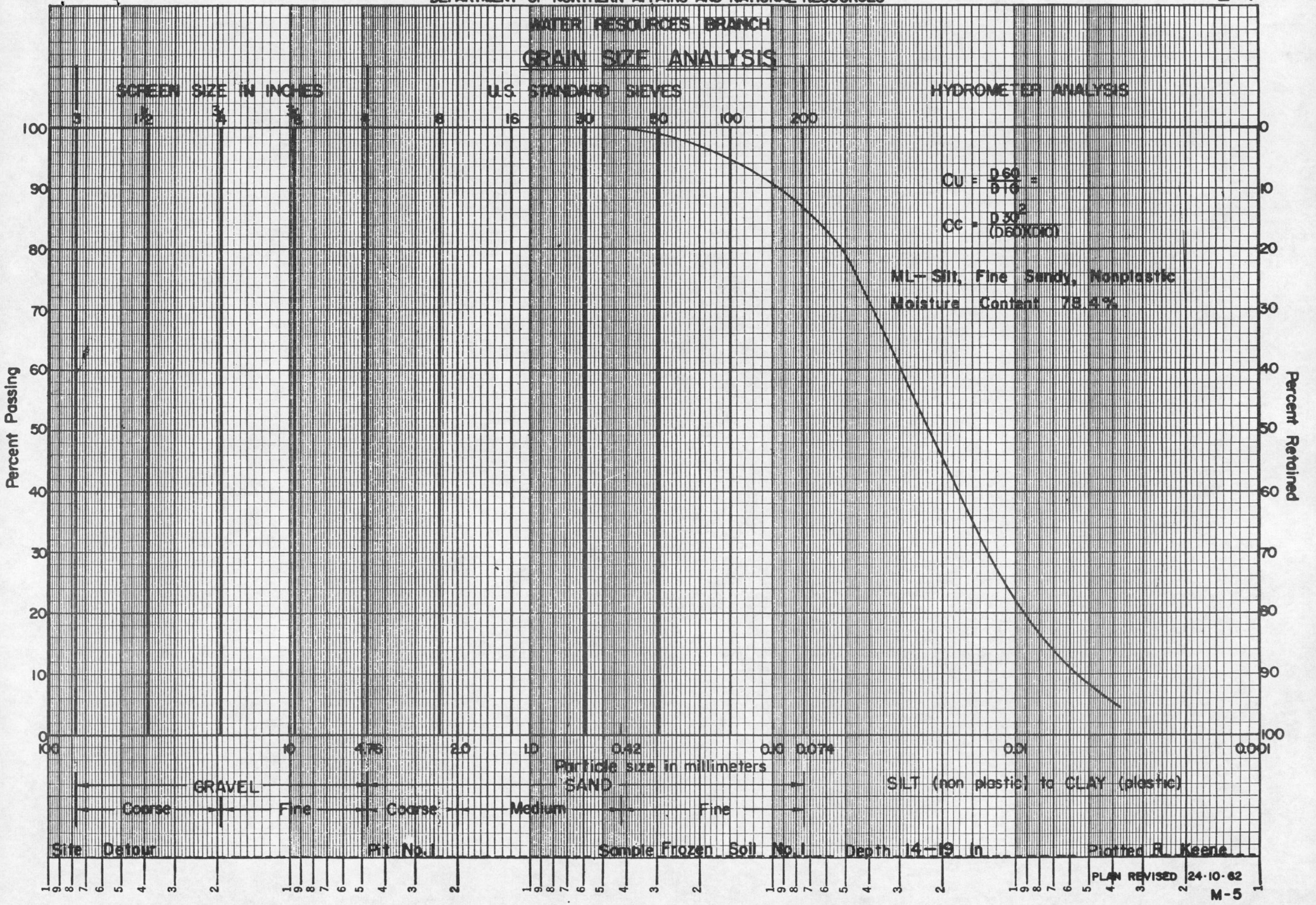
*Unified Soil Classification System

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

L-7

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Detour Pit No.1 Sample Frozen Soil No.1 Depth 14—19 in Plotted R. Keene

PLAN REVISED 24-10-62

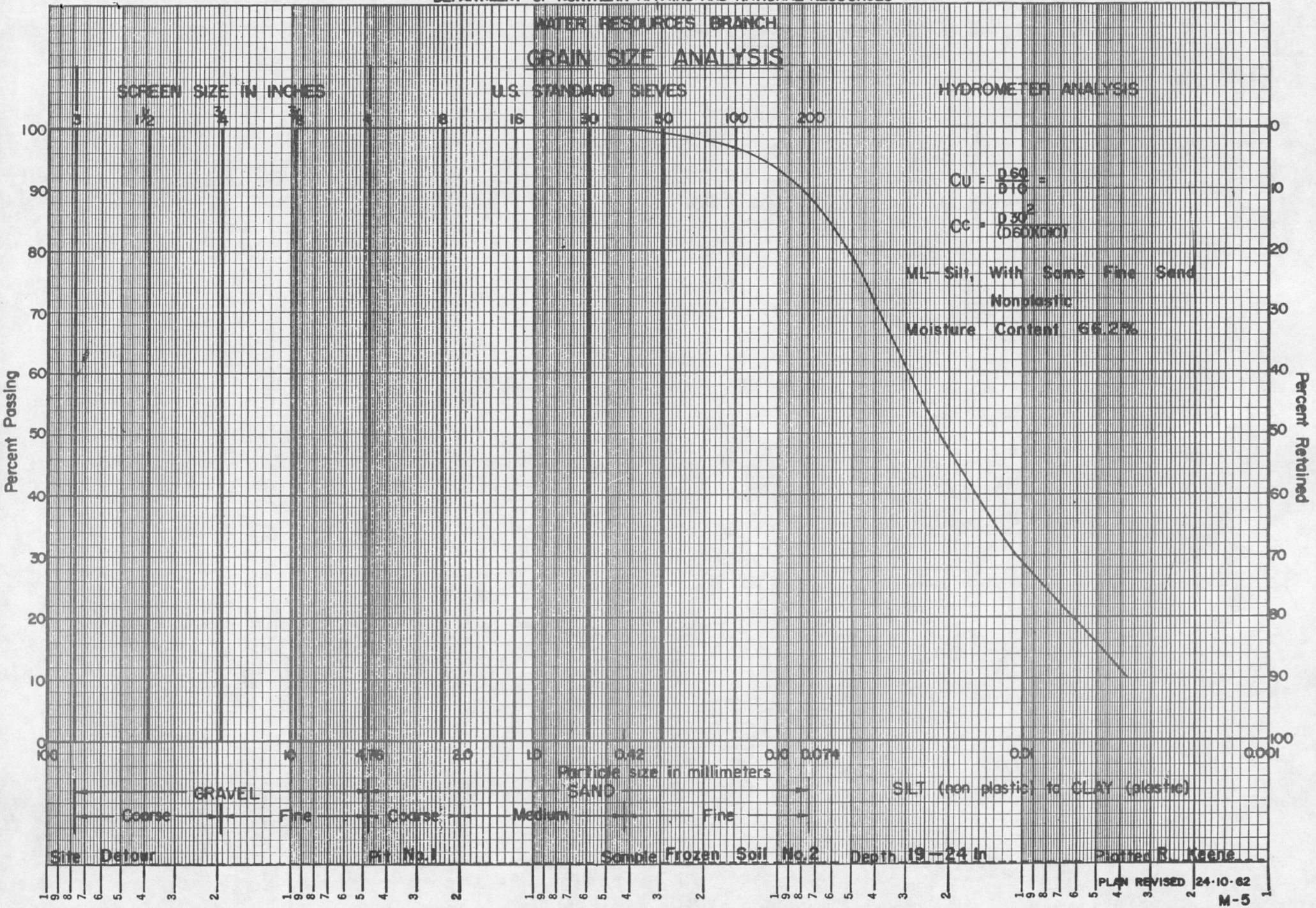
M-5

K&E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Detour Pit No. 1 Sample Frozen Soil No. 2 Depth 19—24 in. Plotted R. Keene

PLAN REVISED 24-10-62

M-5

K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

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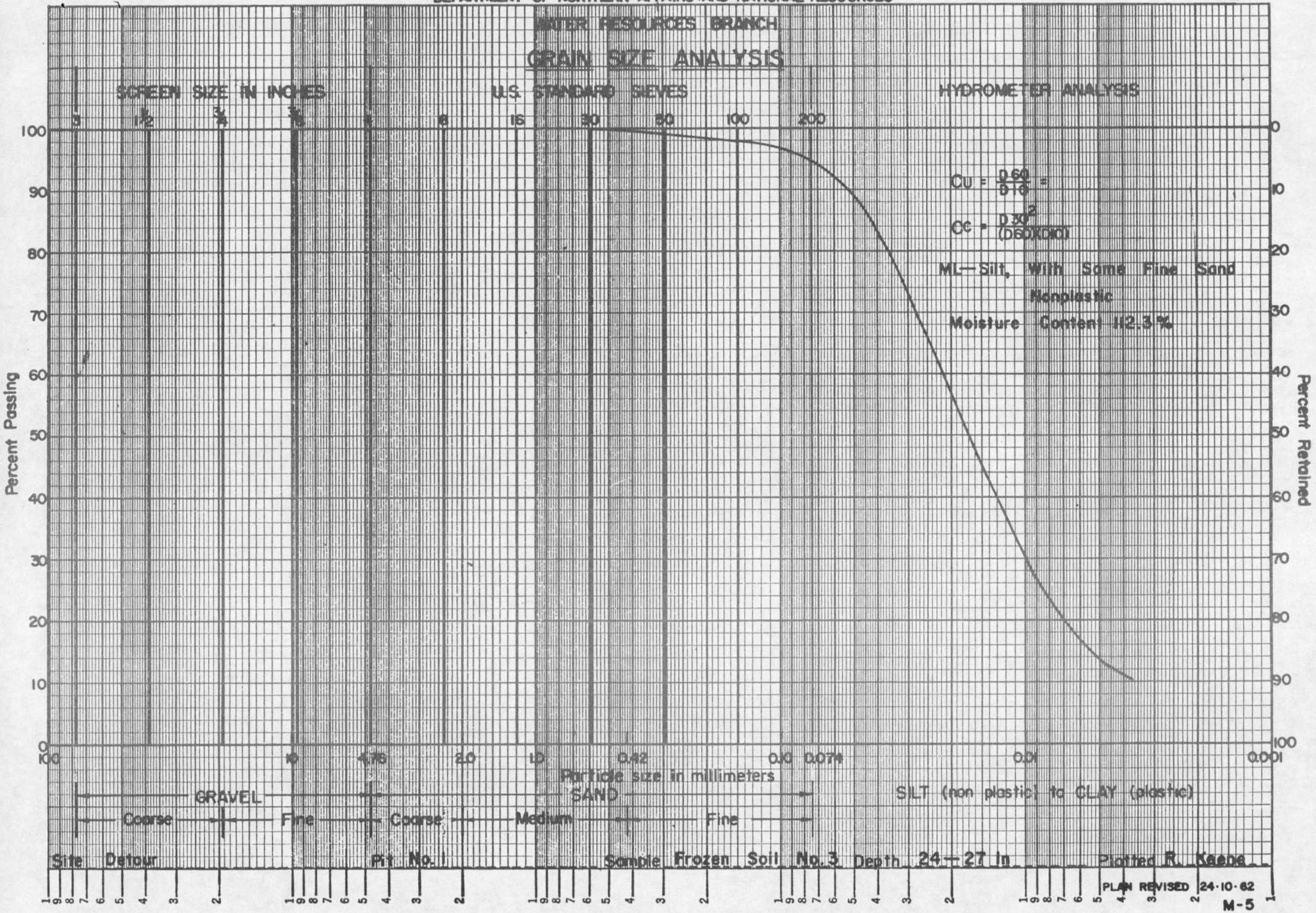
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Detour Pit No. 1 Sample Frozen Soil No. 3 Depth 24—27 in. Plotted R. Keebe

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M-5

359-91G SEMI-LOGARITHMIC KEUFFEL & ESSER CO. MADE IN U.S.A. 5 CYCLES X 70 DIVISIONS

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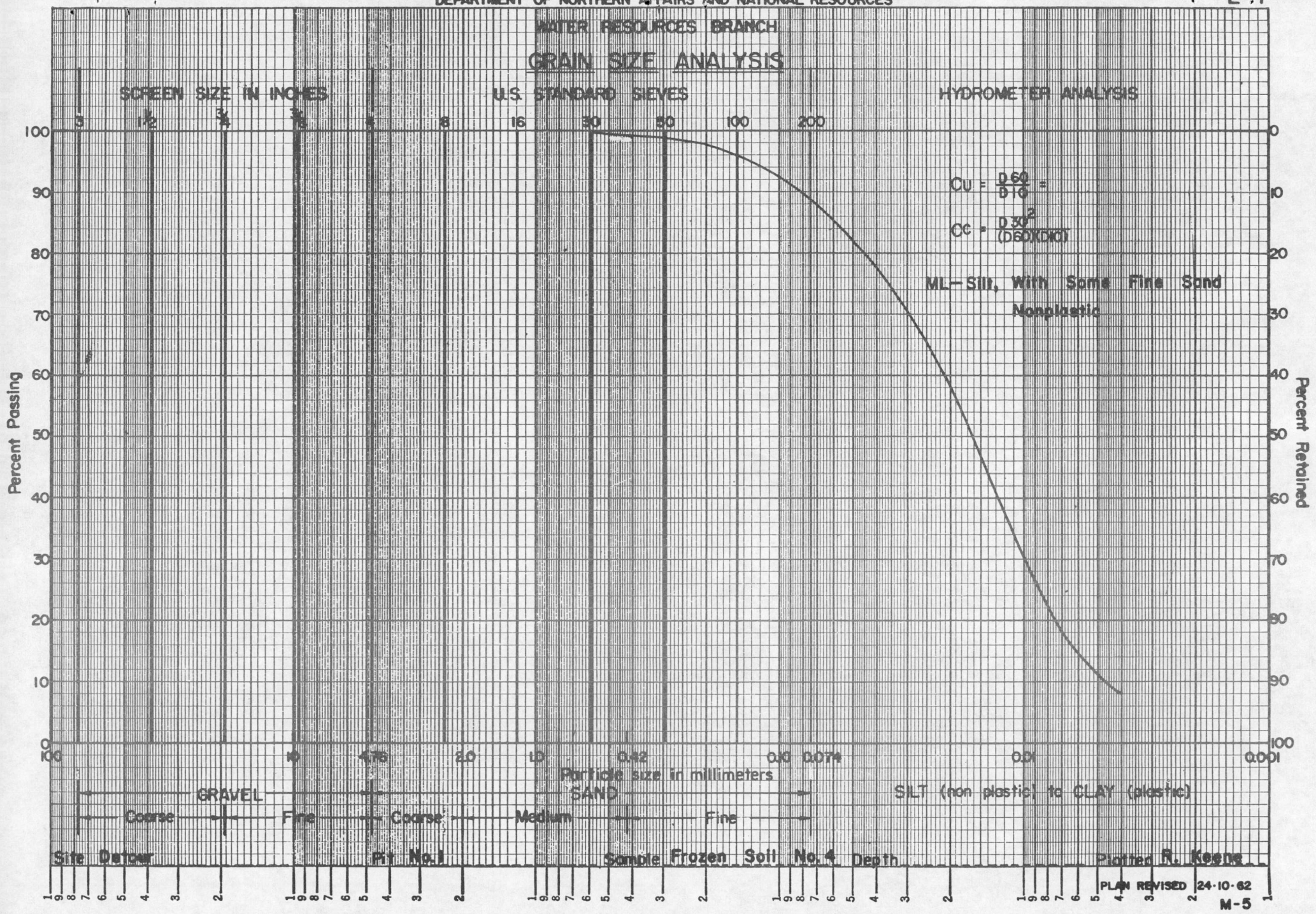
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Dewar Pit No.1 Sample Frozen Soil No.4 Depth Plotted R. Keene

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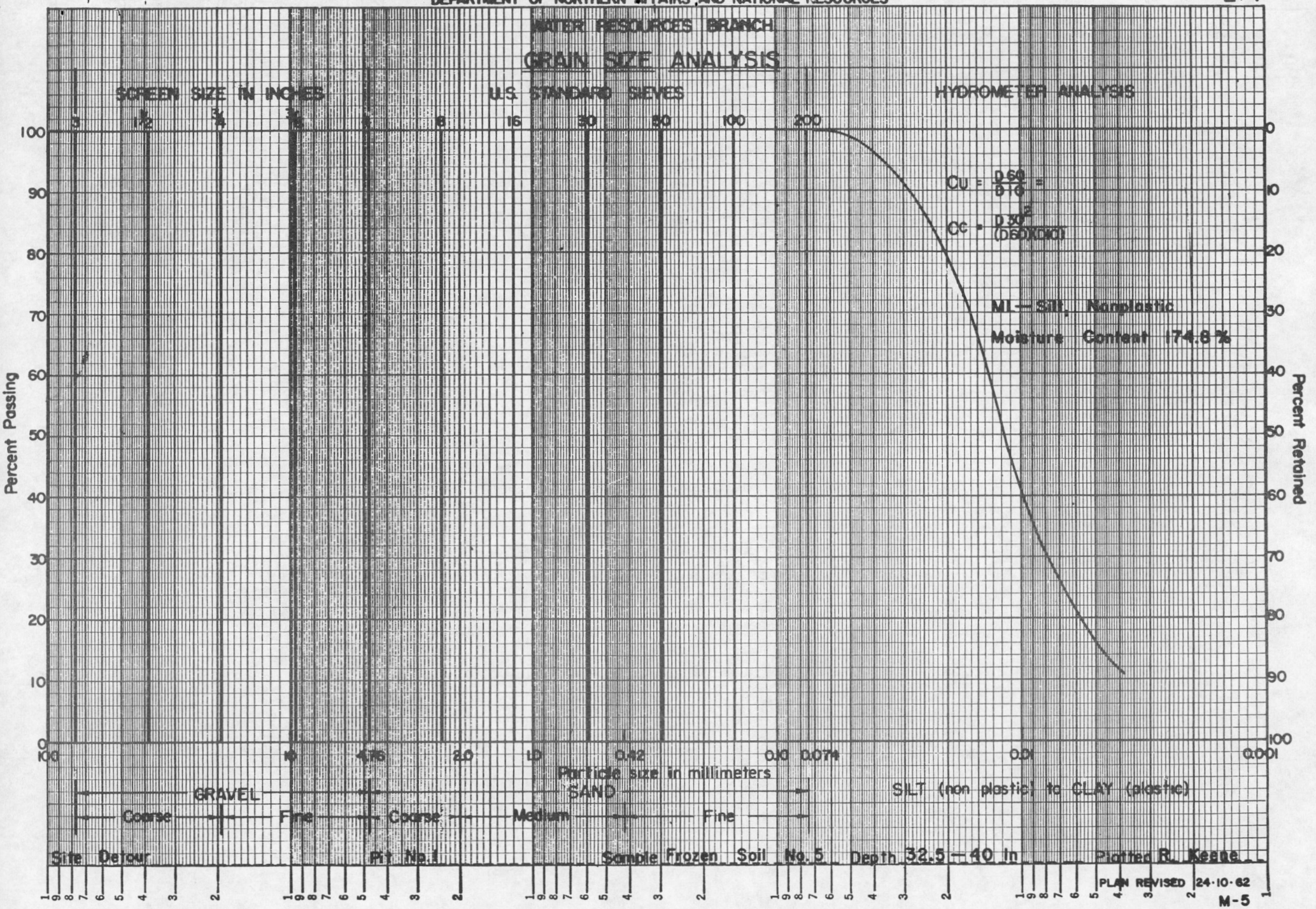
L-7

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Detour Pit No. 1 Sample Frozen Soil No. 5 Depth 32.5 — 40 in. Plotted R. Keene

PLAN REVISED 24-10-62

M-5

SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

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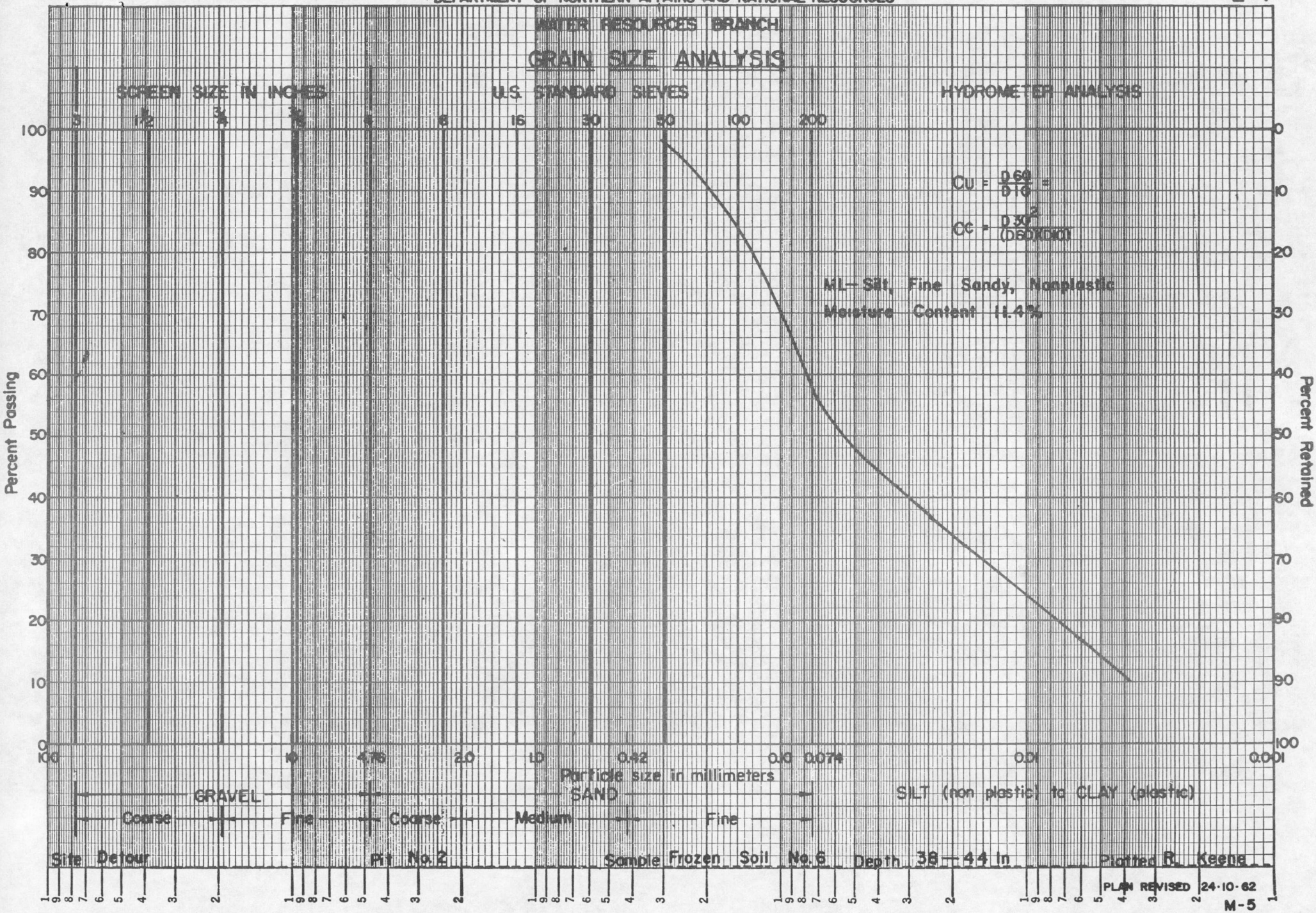
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Detour Pit No. 2 Sample Frozen Soil No. 6 Depth 38 — 44 in. Plotted R. Keene

PLAN REVISED 24-10-62

M-5

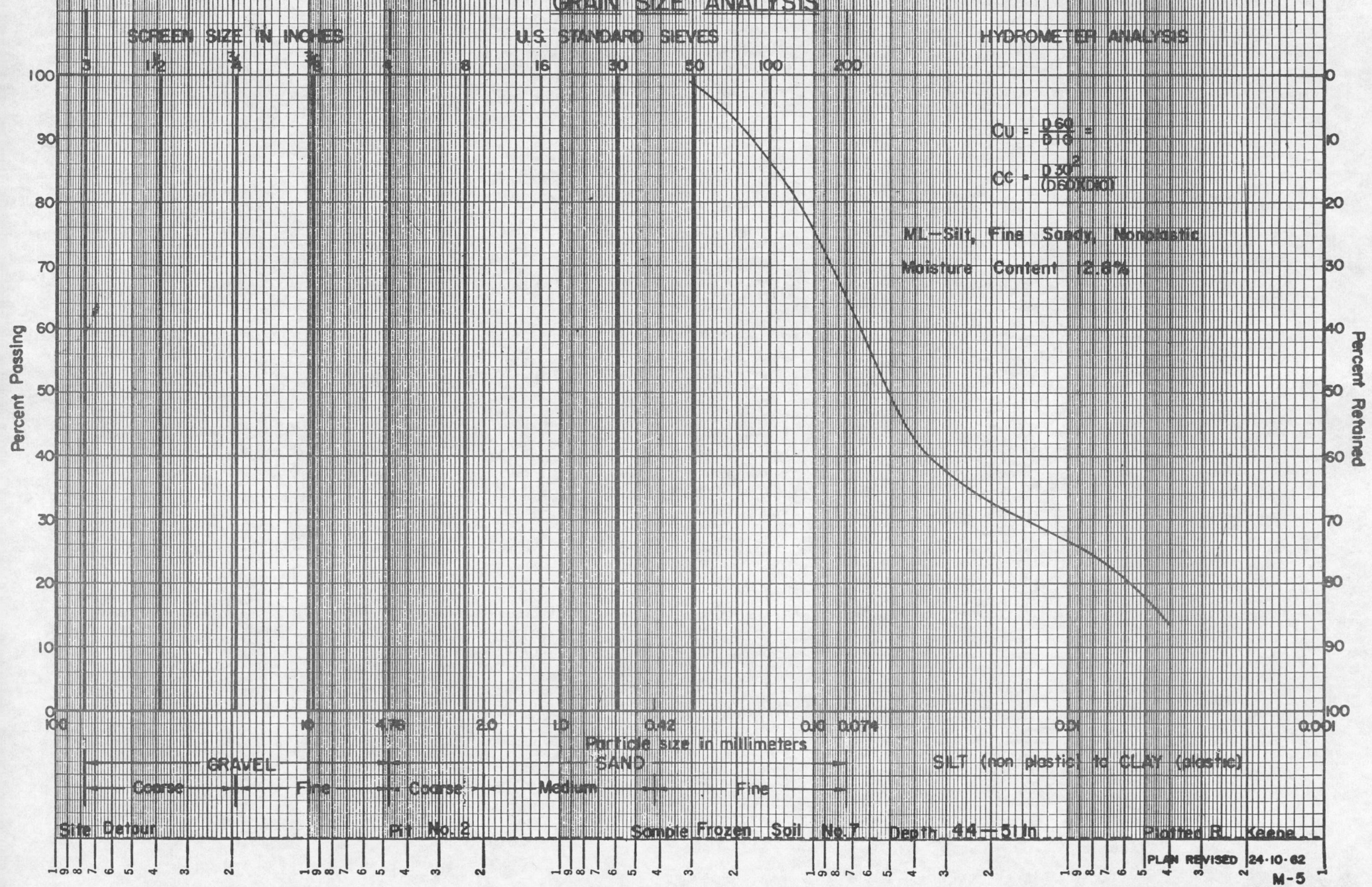
K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

L-7

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Detour Pit No. 2 Sample Frozen Soil No. 7 Depth 4'4" — 5'1" Plotted R. Keene

PLAN REVISED 24-10-62

M-5

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS

Site Detour Pit No. 3 Sample Frozen Soil No. 8 Depth 52—60 in. Plotted R. Keene

PLAN REVISED 24-10-62

M-5

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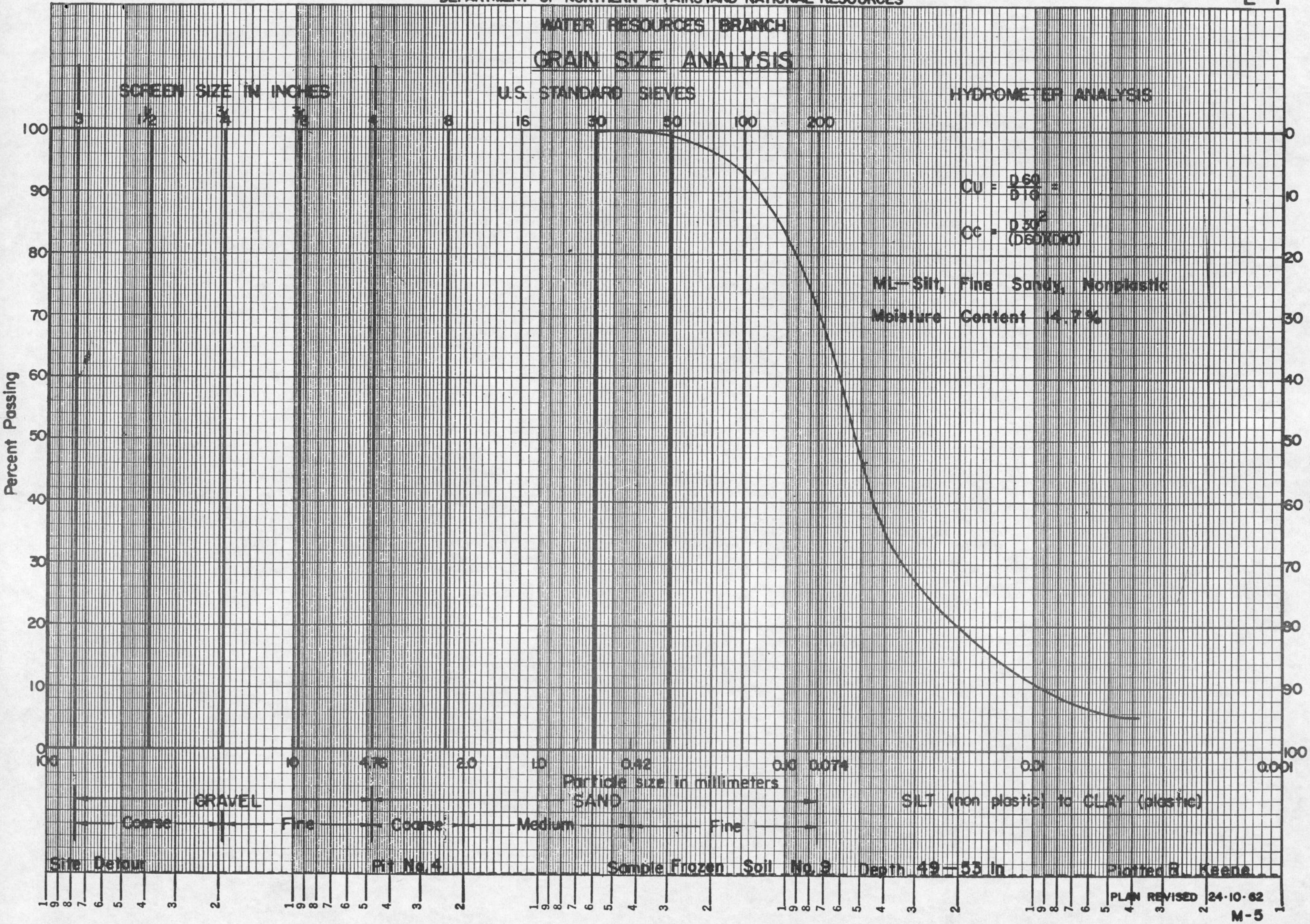
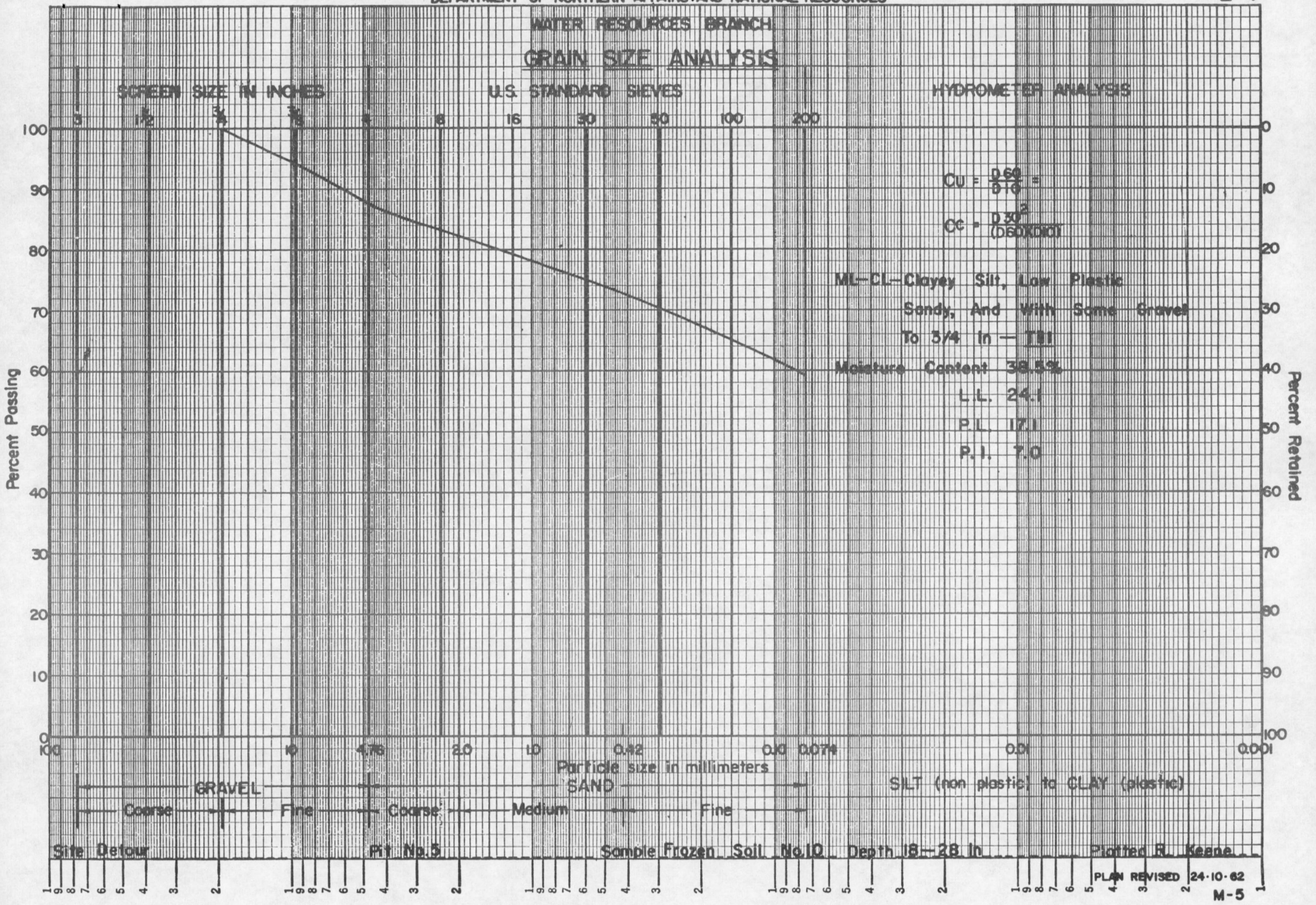
L-7



DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Detour Pit No.5 Sample Frozen Soil No.10 Depth 18—28 in Plotted R. Keene

PLAN REVISED 24-10-62

M-5

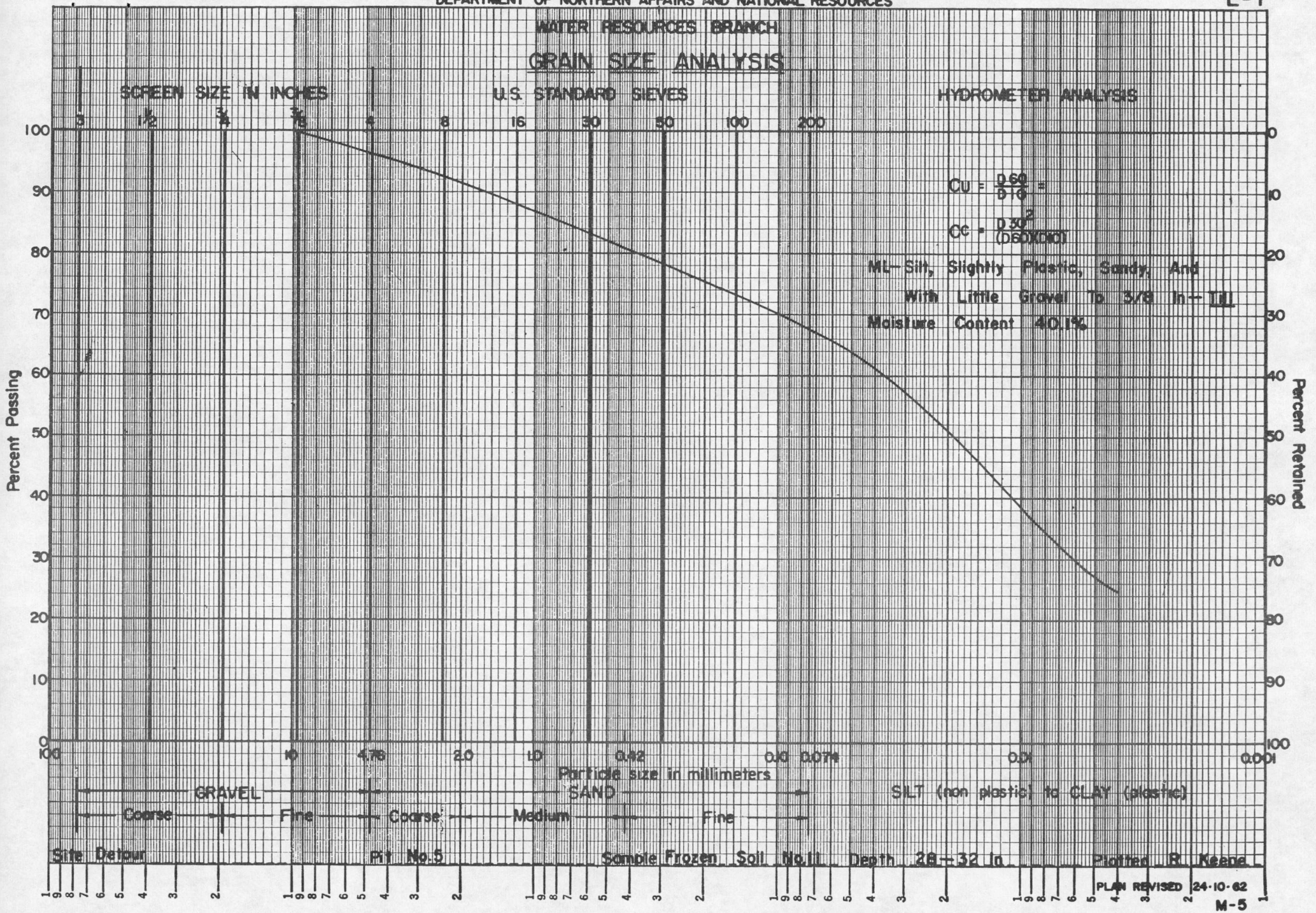
K&E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

L-7

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



Site Detour Pit No.5 Sample Frozen Soil No.11 Depth 28-32 in. Plotted R. Keene

PLAN REVISED 24-10-62

M-5

K&E SEMI-LOGARITHMIC 359-91G
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Chemical Analysis of Pelly River Water

One sample of Pelly River water was taken at Detour dam site. The chemical analysis of the sample was made by the Industrial Waters Section, Mines Branch, Department of Mines and Technical Surveys, Ottawa. The results are included on the following page.

The chemical analyses indicate the mineral content of Pelly River water at Detour dam site is similar to that at Hoole Canyon some 127 miles upstream. Bicarbonate salts of calcium and magnesium constitute the chief mineralization. There are no salts present in sufficient quantity to be harmful to the concrete or other parts of the dam structures which would be exposed to the water. At the time the sample was taken at Detour site Pelly River was in a low water stage. This is the reason why the reported value of the turbidity was much lower than that at Hoole Canyon. Any reported value for turbidity should be considered only as indicative. Flash floods may cause a rapid increase in the sediment load. A proper sediment study, therefore, requires regular sampling, often in the case of flash flooding at hourly intervals.

Many small streams enter Pelly River between Detour dam site and Hoole Canyon. Most of these have their source in Pelly Mountains and flow in a northerly direction across Tintina Trench to the river. The absence of any change in the mineral content of Pelly River water between Hoole Canyon and the site suggests the mineralization of these streams is similar to that of the river.

Chemical Analysis of Pelly River Water at Detour dam site
(Parts per million)

Location	Date	River Discharge	PH	SiO_2	Ca	Mg	Na	K	Fe	CO_3	HCO_3	SO_4	Cl	F	NO_3	Turbidity	Hardness as $CaCO_3$
Pelly River near centre of dam site area; center of river, 12 inches below water surface	July 7, 1965	Low; Temp. 58°F., July 12, 1965	7.5	5.3	30.5	7.7	1.5	0.8	0.7	0	98.1	28.4	0.3	0.17	0	0	108

Grain Size Analyses Curves

Four soil samples, each weighing about 35 pounds, of potential construction materials were taken at different localities adjacent to the site and sent to the Soils Laboratory of the Water Resources Branch in Vancouver for testing. The grain size analyses curves included in this report were prepared in Vancouver. Three of the samples were taken in the site area and the other about 16 miles downstream along Pelly River. Descriptions of the samples are included on the accompanying pages.

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	Bluff at down-stream end of left abutment; 80 feet above river; 3 feet beneath ground surface	Till: silty, sandy, minor gravel; very little clay, grey-brown; dense; no weathering	About 10 feet of coarse-grained, dirty gravel	80-plus feet	Extends along entire left abutment	Borderline material for an earth dam, Group symbol= SM. (Unified Soil Classification System)
2	Bluff at centre of right abutment; close to proposed centre line; 135 feet above river; 3 feet beneath ground surface	" " "	About 20 feet of coarse-grained, dirty gravel	"	"	"
3	Terrace on left abutment; from farthest down-stream shot hole on seismic line No. 2; 10 feet beneath ground surface	Silt; fine-grained, non-plastic; no pebbles; highly weathered in upper 12 inches; fresh material is grey; no visible stratification	None	2-10-plus feet	Covers about 20% of left abutment area	Usually on terraces or shallow slopes Group Symbol = ML. (Unified Soil Classification System)

Potential Impervious Soil Classification Chart

Sample Number	% passing #4	% passing #200	%CO	%F	%G	%S	D10	D30	D60	Cu	Cc	LL	PL	PI	Group Symbol*
1	73.5	40.0	60.0	40.0	26.5	33.5	.0095	.024	6.8	716	.009	non-	plastic		SM
2	100.0	57.0	43.0	57.0	0.0	43.0	-	0.29	.08	-	-	"	"		ML
3	72.0	34.0	66.0	34.0	28.0	38.0	.014	.037	1.0	71	0.09	"	"		SM

*Unified Soil Classification System

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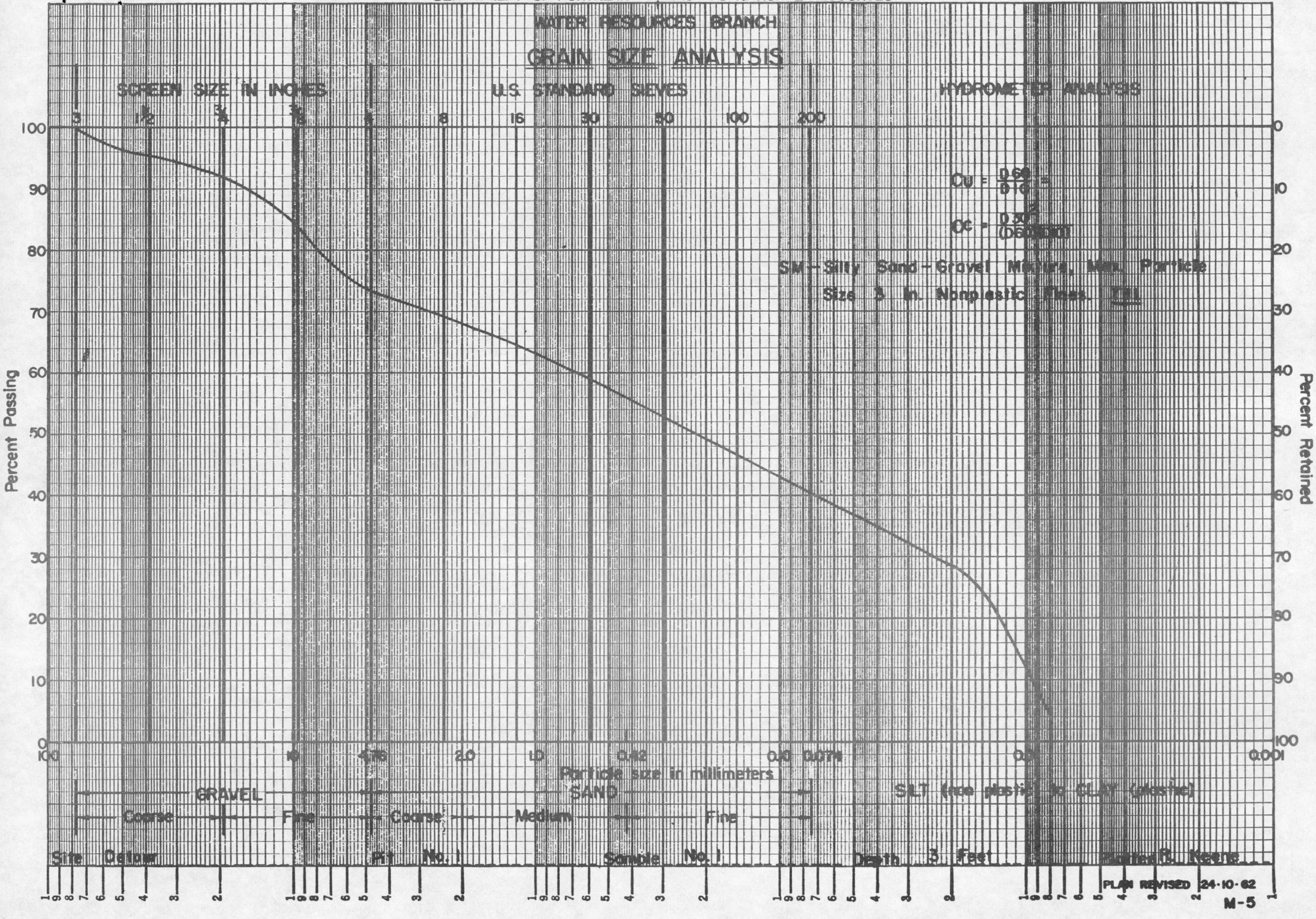
L-7



K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

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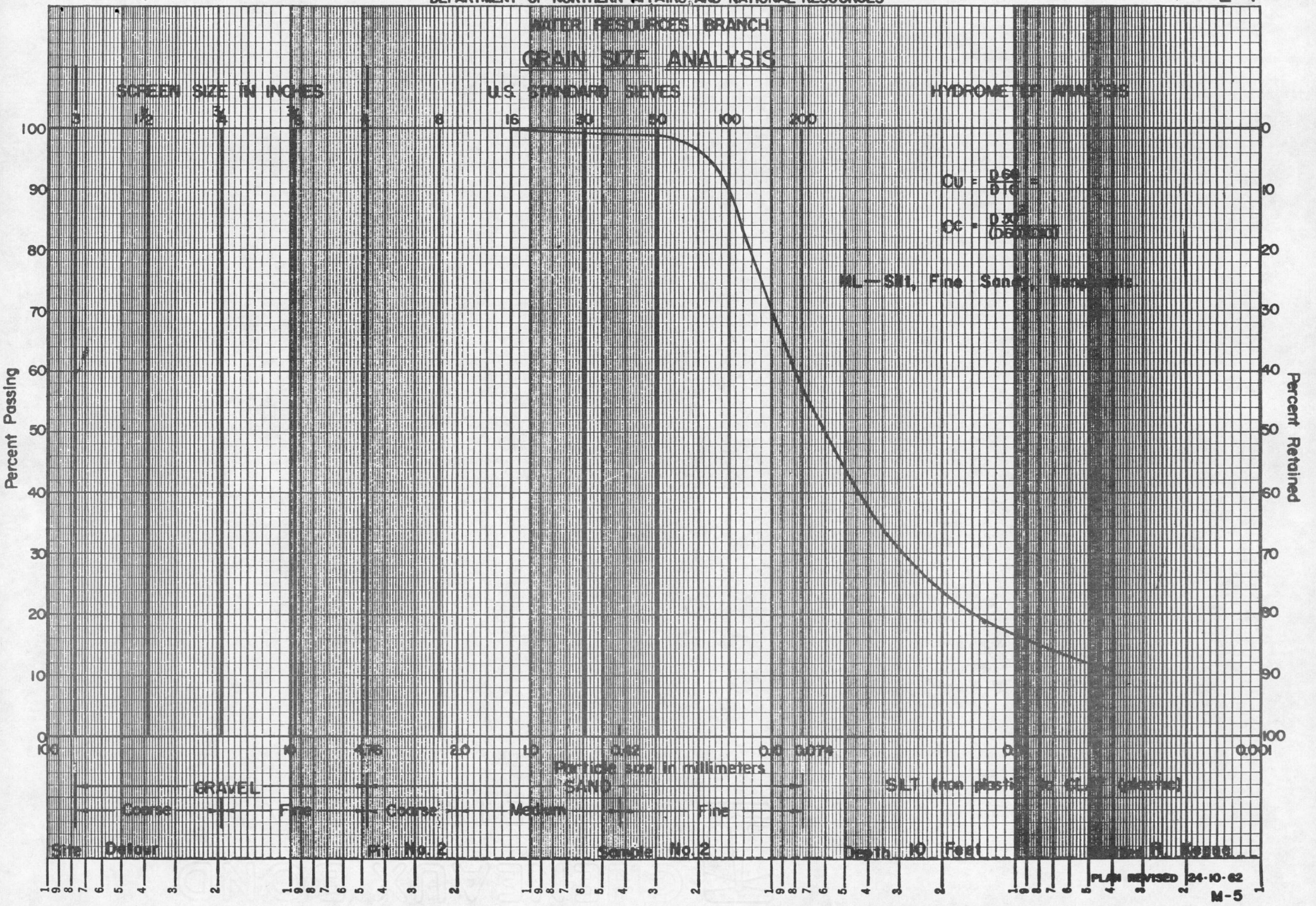
L-7

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



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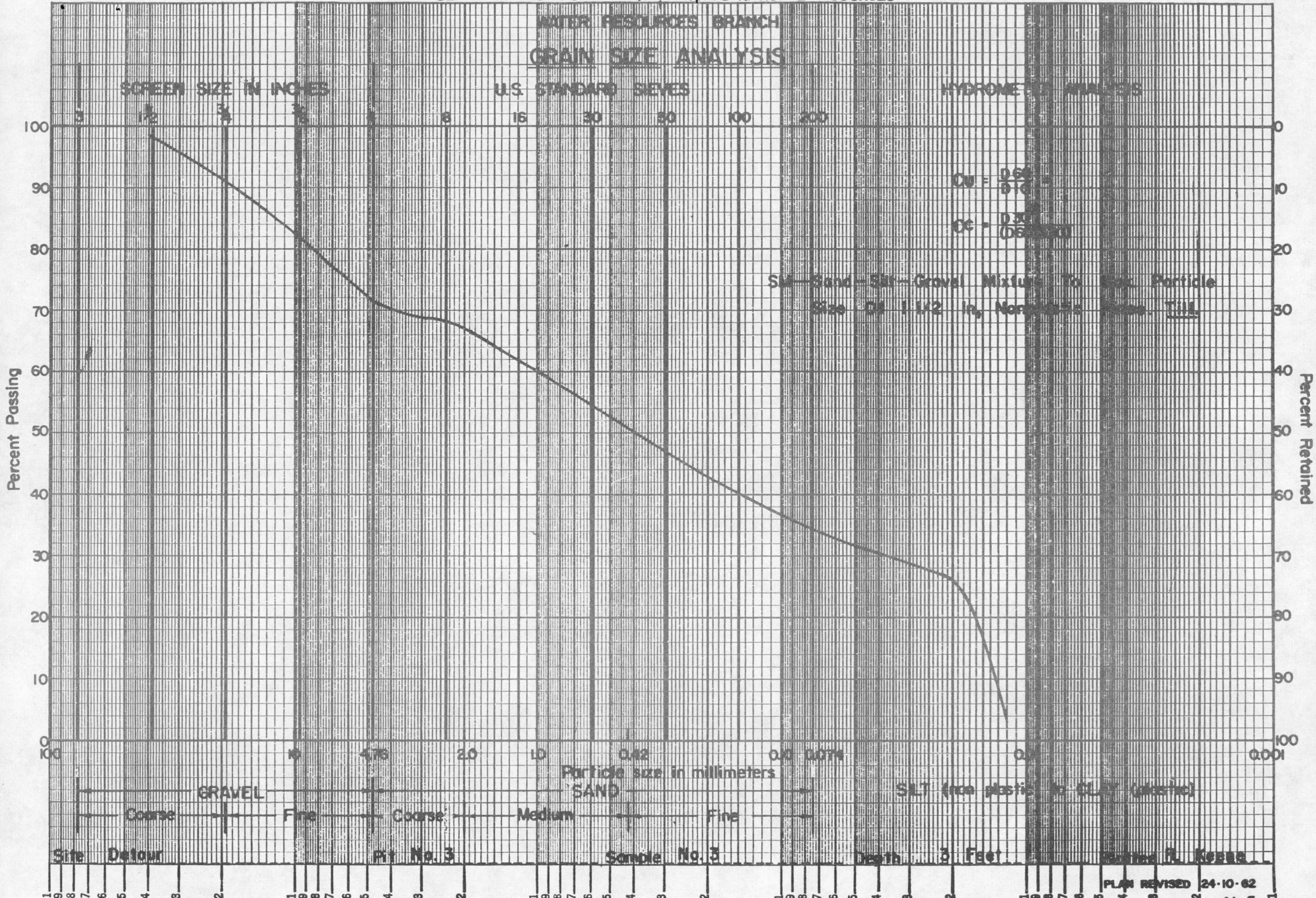

K+E SEMI-LOGARITHMIC 359-91G
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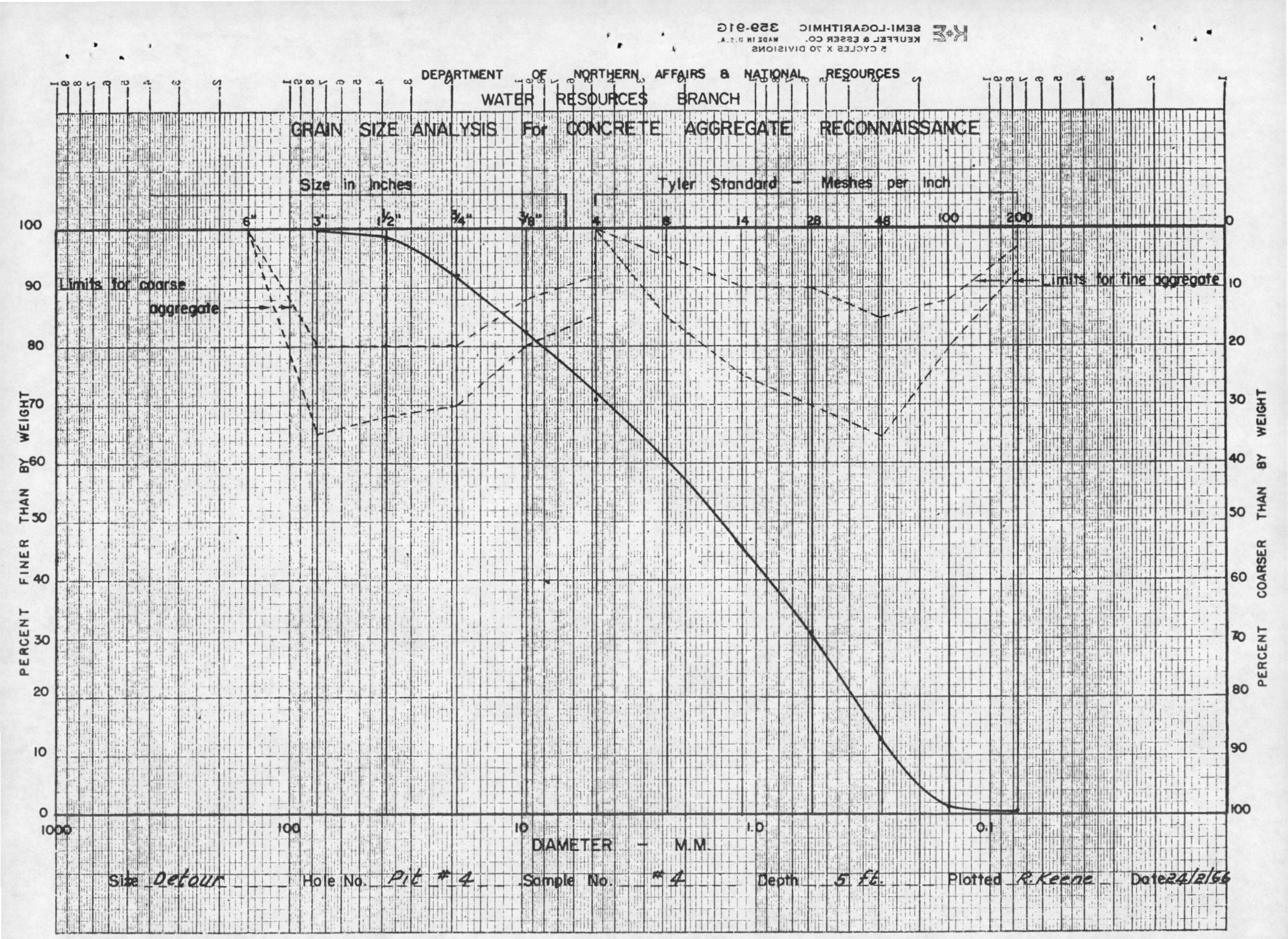
5 CYCLES X 70 DIVISIONS

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
4	Bluff along left side of Pelly River, at downstream end of "The Detour" and 12 river miles downstream from site; 80 feet above river; 5 feet beneath ground surface	Gravel: sandy, clean, few pebbles over one and a half inches; max. size of boulders is 6 inches; no visible stratification; no weathering	0 - 10" = silt 10"- 18" = volcanic ash 18"- 25' = coarse-grained dirty, gravel 25'- 80'-plus = gravel as in sample	55-plus feet	Exposed for 500 feet along bluff	Bluff is 150 feet high; bottom part covered with slide debris; several small springs along toe of bluff


DEPARTMENT OF NORTHERN AFFAIRS & NATIONAL RESOURCES
WATER RESOURCES BRANCH
GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE
Size in Inches
Tyler Standard - Meshes per Inch
6"
3"
1½"
¾"
⅜"
4
8
14
28
48
100
200
Limits for coarse aggregate
Limits for fine aggregate
PERCENT FINER THAN BY WEIGHT
PERCENT COARSER THAN BY WEIGHT
0
10
20
30
40
50
60
70
80
90
100
1000
100
10
1.0
0.1
DIAMETER - M.M.
Size Detour
Hole No. Pit #4
Sample No. #4
Depth 5 Ft.
Plotted R. Keene
Date 24/2/66

Conclusions - Further Investigations

It should be remembered this report is based upon a preliminary geological investigation designed to furnish the engineer with general geological information regarding the proposed dam site. The data compiled are only sufficiently precise to permit office studies and obtain general cost estimates.

It is believed an earth dam could be successfully designed and constructed at Detour site. Bedrock should provide satisfactory abutment and foundation material although grouting may be necessary to consolidate it in places. As in most dam sites in glaciated areas there are numerous problems which must be solved. One result of glaciation was the disrupting of the drainage system of Pelly River. The former channel through "The Detour" was filled with glacial debris and the river diverted into its present course. The setting at Detour site is common in glaciated areas. It consists of a rock abutment on one side with glacial deposits forming the other. Bedrock surface beneath the river is probably close. The diversion tunnels, spillway and other dam structures would be located on the side where bedrock foundations are available.

The possibility bedrock can be used as abutment material in the right abutment is one problem at Detour dam site. Another is the ability of the till to act as abutment material. The possibility of reservoir leakage through "The Detour" should be investigated. The till part of the plug of glacial materials at the upstream end of "The Detour" is impervious. However, the presence of permeable materials beneath the till should be considered. The springs along the base of the bluff at the downstream end of "The Detour" indicate some subsurface drainage is taking place but its extent is not known.

The feasibility of using the overburden and bedrock near the site as sources of construction materials should be investigated. Satisfactory coarse-grained aggregate and rock fill can probably be obtained from bedrock and large rock fragments suitable for riprap may be obtained by selective quarrying of the coarser-grained, dioritic rock. Some prospecting will be necessary to locate natural aggregates which would meet most concrete specifications and for impervious material suitable for the core of an earth dam.

Test borings will be required to accurately contour bedrock surface beneath the river and in the abutment areas. Continuous samples should be taken of the overburden and permeability tests conducted. The borings should penetrate at least 35 feet into solid rock. Some of the rock borings should dip about 60 degrees north and west in order to intersect the more prominent jointing at a favourable angle. A line of borings should be put down to bedrock across the upstream end of "The Detour". Soil samples and permeability tests are important here.

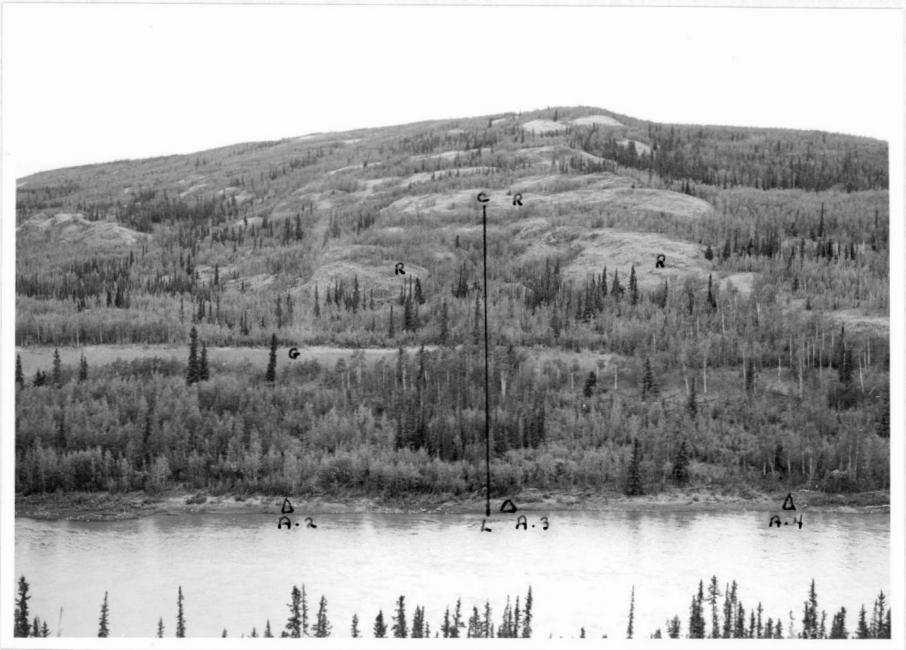


Plate 1

Left abutment of Detour dam site looking along proposed centre line from right abutment; G. - gravel terrace, R. - bedrock outcrop, C.L. - centre line of abutment, Δ - survey station.

G.S.C. 1-4-65

Plate 2

Looking downstream through Detour dam site from the left side of Pelly River; G. – gravel, T. – till, S. – slide debris, R. – bedrock outcrop, C.L. – centre line of abutment.

G.S.C. 1-8-65

Plate 3

Potential aggregate at the upstream end of "The Detour" about one mile from the dam site; exposed material varies from fine-grained sand to fine-grained gravel; E. - esker (?), K. - kettle.

G.S.C. 1-6-65

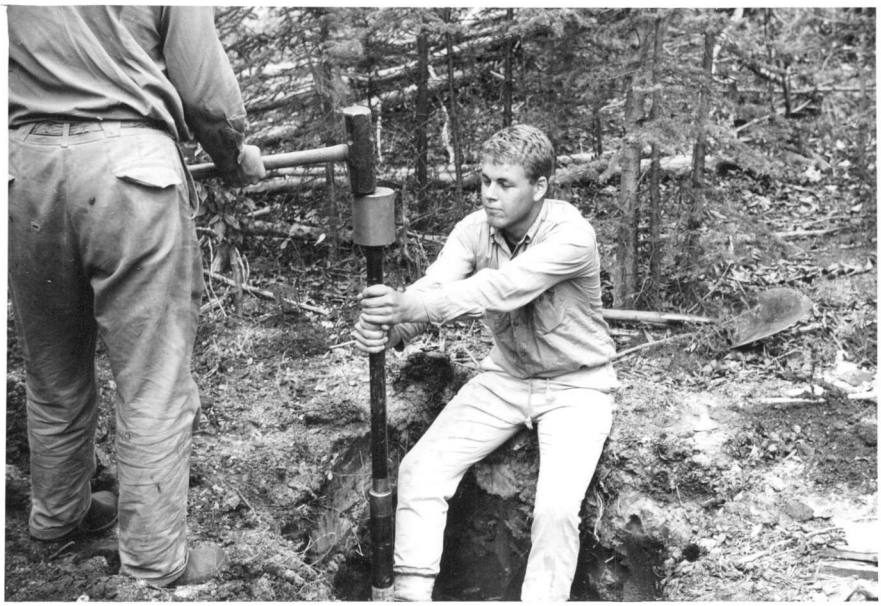
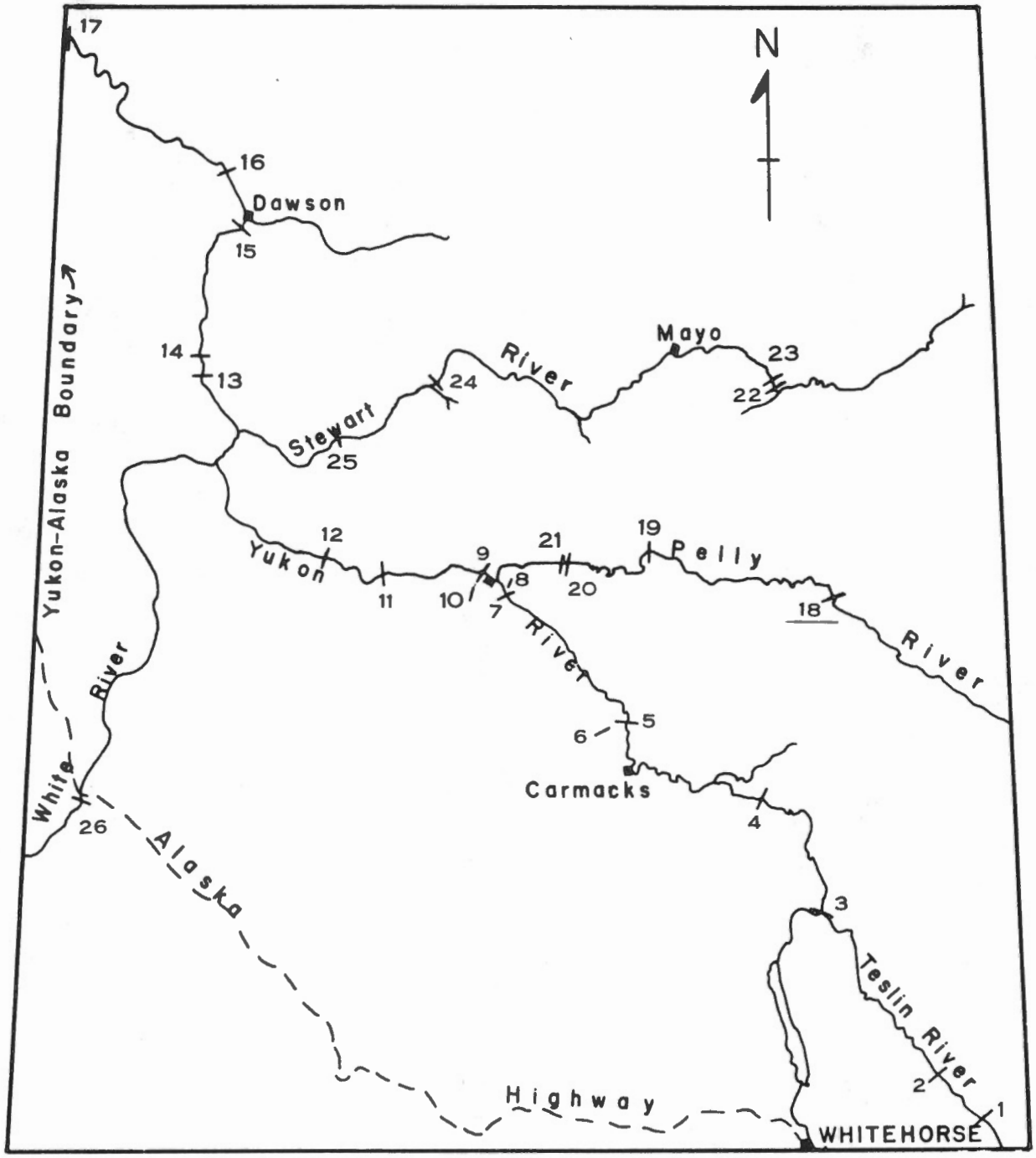


Plate 4

Taking a drive sample of frozen soil at Detour dam site.

G.S.C. 2-3-65



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		